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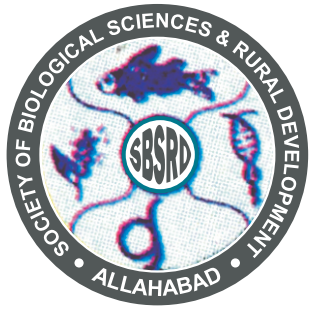
New Approaches in Agricultural Environmental and Nutritional Technology

Vol. 1



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PREFACE

Nutrition is the science of foods , the nutrients and other substances therein, their action, interaction and balance in relationship to health and disease ,the processes by which the organism ingests, digests, absorbs, transports and utilize nutrients and disposes of their end products. In addition, it is concerned with social, economic, cultural and psychological implications of food and eating. Nutrition science is the area of knowledge regarding the role of food in the maintenance of health. Nutrients are the constituents in food that must be supplied to the body in suitable amounts. These include carbohydrates, fats, proteins, minerals, vitamins and water. Chemical substances obtained from food and used in the body to provide energy, structural materials and regulating agents to support growth, maintenance and repair of the body's tissues, nutrients may also reduce the risks of some degenerative disease. Nutritional status in the condition of health of the individual an inflounced by the utilization of nutrients. It can be determined only by the correlation of information obtained through a careful medical & dietary history, athorough physical examination & appropriate laboratory investigation.

India has 2nd largest population in the world after china. So we need largest amount of basic needs to our population. The development of our country is based on the development of ndustrial and agricultural production. The figures in the discipline of nuclear and radiation technology have revolutionized the developments in the field. our unplanned activities for gaining immediate more profit, are creating environmental pollution in different disciplines. All living organisms including man have been exposed to certain types of toxic substances since time immemorial. advances in science & technology have provided mankind with capabilities and know how to produce synthetic chemicals, some of which are highly toxic. Toxic chemicals invariable find their way into the body tissues directly or indirectly through complex food chain & some of these are quite stable or have unusually long half life. further, certain chemicals are neighter fully metabolized nor quickly detoxicated & therefore, create serious problems of residue accumulation increasing use of these chemicals are changing the metabolism activates of human beings. They are creating pollution everywhere in the country. Therefore it is an urgent need to check up the unwanted use of these chemicals and to find out a feasible technology which is environmentally save, socially acceptable, economically viable and poses no risk to agro- ecosystem.

Farming system is more or less stable arrangement of farming activities managed by the household. Farming system that are ecologically compatible should not only involve crop production but are also depend upon integration with other enterprises like animal husbandry, horticulture, vegetable production, piggeries, fisheries, apiculture, goatery, poultry, sericulture and agro-forestry. The concept of farming system includes components like soil, water, crops, livestock, labours and other resources available with the farmers' families. The best strategy for economic viability within agriculture system for production of milk and their products, fodders, fuel eggs, fisheries etc. The enterprise flexibilities can be achieved through reduced input cost and increased diversification of activities providing more and more employment opportunities.

The development of a country is based on the development of industrial and agricultural production. Our unplanned activities for gaining immediate more profit, are creating environmental pollution in different discipline. All living organisms including man have been exposed to certain type of toxic substances since time immemorial. Advances in Science and Technology have provided man kind with capacities and know-how to produce synthetic chemicals, some of which are highly toxic. Their precise effect on the life processes still remain inadequately known. Toxic chemicals invariably find their way into the body tissue directly or indirectly throw complex food chain and some of these are quite stable or have usually long half life. Further certain toxic chemicals are neither fully metabolized nor quickly detoxicated and therefore, create serious problems of residue accumulation. Increasing use of these chemicals are changing in metabolism activities of human beings. They are creating pollution every where in the country. Therefore it is very necessary to check the unwanted use of these chemicals and to find out a feasible technology which is environmentally save.

The editors pay their sincere thanks to almighty God for his grace without which this book would not have come into existence. We wish to thank and appreciate all the contributors who contribute in this book and made it an outstanding effort which is expected to play some role in enhancing the Technological Innovation in agriculture and rural development through the world. This book contains 44 chapters in different fields of Technological Innovation in agriculture sustainable agriculture and rural development. The main aim of this book is to provide a comprehensive and critical review of the work done in different fields of agriculture, Technological Innovation in rural development. We hope this publication will provide a valuable source of information and will lead to make further advancement in different fields of Agriculture, Environment and Nutritional Security.

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CONTRIBUTION OF PATH BREAKING WOMEN SCIENTISTS IN RESEARCH AND EDUCATION

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S&T sector has shown sustained growth over the years despite great challenges and has created a new platform for women in research, teaching and education. It paved the way for women to gain entry in to the magical world of science. This has been the reason for India's fast growth in the sector of S&T with motivation of brilliant minds by sharpening their skills. A glorious success of Indian women scientists could make to inspire the young girl students to pursue higher education in the disciplines of science, engineering, life sciences and biotechnology.

It has been experienced that women of this country are very bright, brilliant and sincere in their work. They constitute 50% of the human resources of India making it very advanced country by utilizing their talent pool and human resource in solving socio-economic problems with their techno-economic empowerment. Good scientific and technological leads achieved in health, food and nutritional security, environment, sanitation, the potential sectors for development for women with appropriate S&T measures. It has been a privilege to mention that the active presence of women in Science based activities had enabled S&T contribution in a more holistic and objective manner. The contribution of some of the women scientists in India who have given great support to boost the scientific research in life sciences, physical sciences and biotechnology inspired the young women to take science discipline as their career in large numbers.

The Ministry of Science & Technology is greatly recognizing the efforts of women scientists every year on the occasion of International women year with a focused theme 'Women Leadership in Science & Technology' and providing impetus to budding scientists to take challenges in their career in academics, research, entrepreneurship development and gender issues in science. The quest of scientific knowledge in discovery driven research is rare that greatly contributed by women scientists.

It is unforgettable to remember the contribution by some of the path making women scientists' viz. Dr. Indira Nath and Dr. Sunita Saxena who have contributed in Human Health and Medical Sciences, Dr. Chandrima Saha in Immunology, Dr. Chitra Sarkar and Dr. Sashi Wadhwa in Neuropathology and Neurobiology, Dr. Kasturi Dutta in Life Sciences and Biotechnology, Dr. Renu Khanna Chopra in Agriculture Sciences, Dr. Bimla Bati in Plasma physics, Dr. Vibha Tandon in Medical Chemistry and Radiation Biology, Dr. Krishna Mishra in Medical Sciences in drug designing, Dr. Rupamanjari Ghosh in Quantum Physics, Dr. Charu Sita Chakravarti in Quantum Sciences and Computer simulation methods and Dr. Riddhi Saha in mathematical science. These women scientists have continued their efforts with their inter-disciplinary research approach in the area of life sciences and biotechnology.

Dr. Manju Sharma is always remembered for the development of S&T and biotechnology research in India. She has been the role model for focusing India's presence in the global research arena. The establishment of large numbers of institutes in biotechnology research has given impetus in life sciences and biotechnology by focusing major emphasis on human resource development, infrastructure creation at the educational and research institutes, promotion of biotechnology in the states and certainly on biotechnology policy initiatives and implementation protocol.

Madam Marie Curie could be an idol for any scientist. She made a great discovery with her devotion

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in science leading to pioneering research on radioactivity. She was the first woman to win a Nobel Prize, the first person and only woman to win twice, the only person to win a Nobel Prize in two different sciences, and was part of the Curie family legacy of five Nobel Prizes. She was also the first woman to become a professor at the University of Paris, and in 1995 became the first woman to be entombed on her own merits in the Panthéon in Paris.

American environmental microbiologist Rita Rossi Colwell, Scientific Administrator, Founder and Chair of CosmosID, a bioinformatics company and the 11th Director of the National Science Foundation. She was the first female director of the foundation supporting that developments in public and Government on global infectious diseases and health. She has developed an international network that has brought attention to the emergence of new infectious diseases in drinking/bathing water, the issues pertaining to the developing world.

Government agencies have identified large numbers of schemes for women benefitting them in higher education and witnessing their entry in different science disciplines, including engineering, arts and humanities apart from their involvement in extension activities from lab to field and in every sphere of S&T. Educated women are working as bio-scientist in R&D labs and pharmaceutical companies. Awareness activities through training and counseling programmes for teachers and trainers are widely disseminated by state S&T councils through qualified women folk. However, their adequate representation at different levels is yet to reach at optimal level. Opportunities are created in research and education through research grants and fellowships available for women scientist/ researchers both at institutional and non-institutional levels in R&D to address their societal issues.

The Department of Science & Technology supports scholarship scheme for women scientists and technologists in India, who have breaks in their career due to social responsibilities and are interested to return to the field of science and work. The Department of Biotechnology also supports a scheme Biotechnology Career Advancement and Re-orientation (Bio-CARe), to enhance the participation of Women Scientists in Biotechnology Research. These schemes and programmes are supporting to meritorious students across the country with special encouragement to girls and physically challenged with science scholarship programme to young women to pursue careers in scientific studies.

The Department of Biotechnology further promoting partnership innovation research to product development through a non-profit section 25 company BIRAC, working with i3 (ignite, innovate and incubate) concept nurturing and mentoring innovations supports women scientists and the entrepreneurs through development of products at various stages from pre-discovery to commercialization. The women scientists are nurtured with innovative ideas through ignition grant programme and strategic partnership with aligned organizations like Bill and Melinda Gates Foundation. Successful women entrepreneurs are taking high tech biotechnology as commercial ventures for potential development as recombinant therapeutics, molecular diagnostics, vaccines, contract research etc.

On the occasion of International Women's Day, Department of Biotechnology had organized a two-day national seminar on Women Leadership in Science & Technology: Opportunities & Challenges at INSA, New Delhi on 9th-10th March, 2017. During the seminar, discussions were held on opportunities and challenges for professionally qualified women scientists and their contribution to the landscape of insights in the area. The seminar was dedicated to the efforts of the spirit of excellence demonstrated by women in science, technology and biotechnology. It was also for exploring the challenges in academics in changing environment for research and management and for creation of opportunities for start-ups and entrepreneurship development.

In the field of entrepreneurship, not only for S&T but also the general opportunities for women and technology were debated to encourage that the percentage for women entrepreneurs in India needs encouragement. The gender aspects in science policy need for gender conscious, especially for S&T programmes for improving livelihood of tribal women to mobilize them in science and gendering in larger context for inclusive growth. Science and Media Advocacy rises in science communication as flexible career

opportunities for women to engage them with civil societies in S&T. At grassroots level the issues were discussed for the improvement of quality of lives of women through S&T with SHG approach.

The National Seminar on Women Leadership in S&T created opportunities for women scientists to project their challenges through S&T programmes with the integration and networking of resources and talents with the support of science based policy.

Women leaders are debating on S&T policy issues for the promotion of science, education and research

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ENVIRONMENT AND HUMAN HEALTH

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Environment has been one of the most important factors in human life. It is one of the most important triggers in the increasing awareness of the need for better environmental management. The changes in our environment induced by human activities in nearly every sphere of life have an influence on our health patterns.

Environmental health, as defined by WHO, comprises those aspects of human health including the quality of life, that are determined by physical, chemical, biological, social and psychosocial factors in the environment. It also refers to the theory and practice of assessing, correcting, controlling and preventing those factors in the environment that adversely affect the health of present and future generations.

Climate change related impacts on human health could lead to displacement of a large number of people, creating environmental refugees and lead to further health issues. Change in environment may affect the distribution of vector species (eg. mosquitoes) which in turn, will increase the spread of diseases such as malaria and filariasis, to new areas which lack a strong public health infrastructure. The seasonal transmission and distribution of many diseases that are transmitted by mosquitoes (dengue, yellow fever) and by ticks (Lyme disease, tick borne encephalitis) may spread due to climate change. Climate affects their distribution and abundance through its effects on host plants and animals.

The environment affects health in a variety of ways. Climate and weather affect human health. Public health depends on sufficient amounts of good quality food, safe drinking water, and adequate shelter. Natural disasters such as storms, hurricanes and floods still kill many people every year. Unprecedented rainfall triggers epidemics of malaria and water- borne diseases.

The atmosphere is an insulating blanket around the earth. It is source of essential gases and maintains a difference of day and night temperature. Unfortunately the concentration level of different gases show variations due to pollution. There are also added a number of harmful gases into the atmosphere which adversely effect the air quality and make it unfit for living organisms. The atmosphere is said to be polluted if the concentration of any constituent increases or decreases drastically to cause harmful effects on human health or his environment. The addition of foreign materials into the atmosphere may also cause pollution.

Air pollution is clearly a great danger to man and it can lead to disastrous incidence. High-density city traffic leads to an increase in respiratory diseases like asthma. But not many are however aware of this fact that the air we breathe is contaminated with dust and gases in harmful proportions. Solid and liquid aerosols suspended in the atmosphere are referred to as suspended particulate matter (SPM). They arise from grinding erosion, spraying etc. Aerosols are the chemicals which are referred into the air with force in the form of mist or vapours. Aerosols cause serious environmental pollution in recent years. The aeroplane emission is an important source of aerosols in upper atmospheric layer. Although smoke is popularly used to denote mixtures of particulate matter, fumes, gases, and mists. Dust is referred to solid dispersion aerosol and mist to liquid aerosol. The aerosols contain fluorocarbons. Fluorocarbons deplete the ozone layer in the stratosphere and thus permit more harmful ultraviolet radiations to reach the earth surface.

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Ozone layer act as preventive covering against ultra violet light. From the emission of supersonic aeroplanes nitrogen and sulphur oxides are released which also cause thinning of ozone layer. Carbon tetrachloride (CCl_4) is also known to destroy some of the stratospheric ozone. Atmospheric particles can scatter and absorb sunlight thus reduce the visibility. Reduced visibility is undesirable and is also dangerous for aircraft and motors. In general cities receive about 15-20% less solar radiation than rural areas and the reduction of sunlight can become as high as one- third in summer and two -third in winter. The reduction in sunlight is due to fuel combustion for industrial and house heating purposes. The effect of particulate matter include corrosion of metals, erosion and soiling of buildings, sculpture and painted surfaces and soiling of clothing, damage of electric equipments etc.

The assumption that the only indicator of human progress is economic growth is not true. We expect urbanization and industrialization to bring in prosperity, but on the downside it leads to diseases related to overcrowding and poor quality drinking water, resulting to an increase in water borne diseases like infective diarrhea and air borne bacterial diseases like tuberculosis. Agricultural pesticides that enhanced food supplies during green revolution have affected both farm worker and all of us who consume the product. Modern medicines promised to solve many health problems, especially associated with infectious diseases through antibiotics, but bacteria have found ways to develop resistant strains, frequently even changing their behavior in the process, making it necessary to keep on creating newer antibiotics. Many drugs have been found to have serious side effects. Some times the cure is as damaging as the disease process itself.

Human physiology can adapt to changes in weather, within certain limits. However, short term fluctuations in weather lead to serious health issues. Heat waves cause heat related illness and death (eg, heat stroke). The elderly and persons with existing heart or respiratory diseases are more vulnerable. The heat wave in India in 1998 was associated with many deaths.

Environmental problems created by development are due neither to the need for economic development, nor to the technology that produces pollution, but rather to a lack of awareness of the consequences of unlimited and unrestricted anti-environmental behaviour. Thus development has created several long-term health problems while better health care has led to longer life spans, coupled with lowered infant mortality, it has also led to an unprecedented growth in our population which has negative implications on environmental quality. A better health status of society will bring about a better way of life only if it is coupled with stabilizing population growth. Environmental education is the best programme to deal with the environmental problems by creating awareness of the problems, developing new attitude towards the problem.

The understanding of environmental concerns and issues related to human health has exploded during the last few years due to the sudden growth of information technology. The internet with its thousands of websites has made it very simple to get the appropriate environmental information for any study or environmental management planning. This not only assists scientists and students but is powerful tool to help increase public awareness about environmental issues. The relationship between the environment and health has been established due to growing utilization of computer technology.

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ENVIRONMENTAL DISEASES

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An environmental illness can occur when we are exposed to toxins or substances in the environment. Environmental diseases are a direct result from the environment. This includes diseases caused by substance abuse, exposure to toxic chemicals, and physical factors in the environment, like UV radiation from the sun, as well as genetic predisposition. Meanwhile pollution-related diseases are attributed to exposure to toxins in the air, water, and soil. Therefore all pollution-related disease are environmental diseases but not all environmental diseases are pollution-related diseases. Exposures to environmental pollution remain a major source of health risk throughout the world though risks are generally higher in developing countries where poverty, lack of investment in modern technology and weak environmental legislation combine to cause high pollution levels.

Illnesses and conditions caused by factors in the environment are collectively called environmental diseases. Pesticides, chemicals, radiation, air pollution, and water pollution, are some of the manmade hazards that are believed to contribute to human illnesses.

In epidemiology environmental diseases are due to environmental factors like genetic factors and infection. Stress, physical and mental abuse, diet, exposure to toxins, pathogens, radiation, and chemicals found in almost all personal care products and household cleaners are possible causes of a large segment of non-hereditary diseases.

There are different types of environmental diseases[1].

Lifestyle disease

- such as cardiovascular disease, diseases caused by substance abuse such as alcoholism, and smoking-related disease
- Disease caused by physical factors in the environment, such as skin cancer caused by excessive exposure to ultraviolet radiation in sunlight

1. DISEASES CAUSED BY POLLUTION IN THE AIR

- **Asthma attacks**are due to inhaling various poisonous gases and constant suffocation owing to polluted air
- **Weakening of lung function** is due to constant inhaling of contaminated air
- **Pulmonary cancer** is because of inhaling various carcinogenic stuff through polluted air
- **Mesothelioma** is another type of lung cancer because of inhaling asbestos particles suspended in the air
- **Pneumonia** is an infection of lungs because of breathing inside bacteria flying in wind pressure and moves into the respiratory system of a person who inhales polluted air
- **Bronchitis** is the inflammation and swelling of the air passages between nose to lungs and throat to lungs

- **Emphysema** is a state of lungs with tiny air sacs
- **Leukemia** is exposure to benzene vapors causes this disease which is a type of blood cancer
- **Birth defects and immune system defects**occurs due to constant breathing in polluted air
- **Cardiovascular problems** is due to bad air quality and lot of poisonous gases and particulate matter suspended in the air cause heart diseases and stroke
- **Neurobehavioral disorders** is result of inhaling polluted air that directly affect your neuro system
- **Liver and other types of cancer** is due to suspended carcinogenic (cancer causing) matter in the air and all types of cancer related to respiratory system
- **Premature death** is due to outcome of constant inhaling of polluted air
- **Autism** is tendency to live in isolation[2]

2. DISEASES CAUSED BY POLLUTION IN THE WATER

- **Typhoid** is an infectious diseases caused by intake of water with harmful bacteria and mixing of various water pollutants
- **Giardiasis**[3]is an intestinal diseases caused by microscopic parasite present in polluted water
- **Amoebiasis** is a type of gastro disease gives risediarrhoea
- **Ascariasis** is intestinal infection due to intake ofascaris's eggs with polluted water
- **Hookworm** is another form of parasitic infection of intestines
- **Gastroenteritis** is an inflammation of gastro intestines
- **Diarrhea** means complete disorder of your digestive system and inflammation in your stomach because of drinking water pollution
- **Encephalitis** isacute inflammation of brain because of viral infection
- **Stomach cramps and aches** arises due to presence of various harmful bacteria in polluted water
- **Vomiting** results due to misbalance of digestive system
- **Hepatitis** is an inflammation of liver as a result of viral infection; it is of A, B and C types
- **Respiratory infections** is due to flow of polluted water into the respiratory system while bathing and cleaning nose
- **Liver damage and even cancer**is due to presence of chlorinated solvents in the polluted water
- **Kidney damage** is due to presence of various harmful chemicals present in the polluted water
- **Neurological problems** includes weakening of nervous system owing to presence of DDT and other pesticides in water that mix into it with agriculture run-off
- **Weak sexual power** is due to presence of various chemicals in drinking water including endocrine disruptors
- **Thyroid system disorders** arises because of various harmful chemicals in polluted water
- **Malaria** it is a mosquito borne infectious disease caused by persistent water pollutants
- **Rashes on skin** presents on sensitive parts of body because of direct contact of various harmful chemicals present in polluted water
- **Ear aches**is result of direct contact of polluted water in sensitive parts of ear
- **Pink eyes** is present as a result of passage of polluted water on eye surface

3. DISEASES CAUSED BY POLLUTION IN THE SOIL

- **Cancer** it is result of direct exposure of body to polluted soil that has a lot of harmful chemicals including benzene, chromium, pesticide, week killing chemicals etc.
- **Brain and Nerve Damage** as a result of exposure to soil that is lead-contaminated

- **Kidney and Liver Disease** it is also an outcome of polluted soil that has various infectious chemicals

4. HEALTH EFFECTS OF POLLUTION OF NOISE

- **Efficiency decrease of people** living in noisy environment is the major effect of noise pollution
- **Lack of concentration**people affected by noise polluted fail to concentrate
- **Fatigue** it is due to persistent noise make them tired sooner than normal beings
- **Abortion** is due to the shocks on pregnant woman owing to noise
- **Blood Pressure** it is caused because of mental disturbance of a person living in noisy environment for a long time
- **Temporary or permanent deafness** it is the most lethal effect of noise pollution and may appear in older age mostly
- **Anxiety** it is due to person in constant noise exposure does not have strong nerves and get worried on smaller problems

5. Diseases caused exposure to toxic **or** irritant **chemicals in the environment such as** toxic metals**[4]**

The dye industry has experienced rapid growth in the world economy with the development of bright and inexpensive textile colors. However in the early 20th century researchers in the scientific community have confirmed that exposure to benzidine and beta-naphthylamine two dye intermediates leads to bladder cancer. Dye workers who were routinely exposed to benzidine have 14 times the probability of developing bladder cancer that unexposed workers have and those exposed to beta-naphthylamine have 87 times the probability of developing bladder cancer. Wastewater discharged by dyeing plantsif not properly treated can contain large amounts of hazardous chemicals. The development of the petrochemical industry made possible the wide use of plastic products in our daily lives. However later the scientific community in Europe had confirmed that vinyl chloride a major petrochemical used in the production of plastic materials was a potent carcinogen. It causes a rare type of cancer [5]angiosarcoma of the liver as well as more common liver cancers and cancers of the kidneys, brain, lungs, digestive organs, and respiratory system. Asbestos has been widely used in industry over the past century. Nowadays more than 3000 products contain asbestos including brake linings, hair dryers, insulation, textiles, cement, and pipes. The inhalation of asbestos fibers is extremely hazardous. It causes asbestosis a fatal disease characterized by the progressive scarring of lung tissue resulting in shortness of breath also causes lung cancer and mesothelioma a rare form of cancer in the pleural or peritoneal membrane. The inhaled asbestos fibers can migrate throughout the body results cancers of the gastrointestinal tract, larynx, and kidney have also been detected in asbestos workers, their family members and residents living in the neighborhood of asbestos plants[6-7]. Industries causes air pollution, water pollution, soil erosion, diseases related to soil degradation and injuries to mankind.

Table1. Selected major "environmental disease" outbreaks

Location and year	Environmental hazard	Type of disease	Number affected
London, UK 1952	Severe air -pollution with sulphur dioxide and suspended particulate matter (SPM)	Increase in heart and lung disease manifestations	3,000 deaths, many others ill
Toyama, Japan 1950s	Cadmium in rice	Kidney and bone disease (“Itai-itai disease”)	200 with se vere disease, many more with slight effects

South-east Turkey 1955 - 61	Hexachlorobenzene in seed grains	Porphyria; neurological disease	3,000
Minamata, Japan 1956	Methylmercury in fish	Neurological disease ("Minimata disease")	200 with severe disease, 2,000 suspected
USA cities 1960s-70s	Lead in paint	Anaemia, behavioural and mental effects	Many thousands
Fukuoka, Japan 1968	Polychlorinated biphenyls (PCBs) in food oil	Skin disease, general weakness	Several thousands
Iraq 1972	Methylmercury in seed grains	Neurological disease	500 deaths, 6,500 hospitalized
Madrid, Spain 1981	Aniline or other toxin in food oil	Various symptoms	340 deaths, 20,000 cases
Bhopal, India 1985	Methylisocyanate	Acute lung disease	2,000 deaths, 200,000 poisoned
California, USA 1985	Carbamate pesticide in watermelons	Gastrointestinal, skeletal, muscle, autonomic and central nervous system effects (Carbamate illness)	1,376 reported cases of illness resulting from consumption, 17 severely ill
Chernobyl, USSR 1986	Iodine-134, Caesium - 134 and -137 from a reactor explosion	Radiation illness (including increases in cancer and thyroid diseases in children)	300 injured, 28 died within 3 months, more than 600 cases of thyroid cancer
Goiánia, Brazil 1987	Caesium-137 fro m an abandoned cancer therapy machine	Radiation illness (follow - up of in utero exposures continuing)	Some 240 people were contaminated and 2 died
Peru 1991	Cholera epidemic	Cholera	139 deaths, many thousand ill

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AIR POLLUTION CONTROL WITH WET SCRUBBERS

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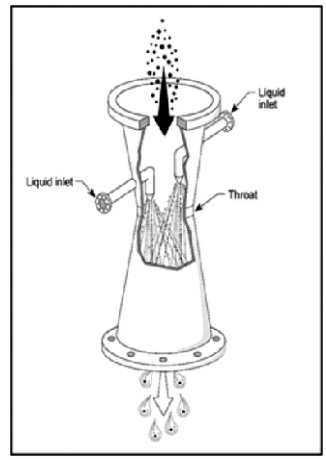
Scrubbers are air pollution control devices that use liquid to remove particulate matter or gases from an industrial exhaust or flue gas stream. This atomized liquid (typically water) entrains particles and pollutant gases in order to effectively wash them out of the gas flow. In comparison to other air pollution control devices, scrubbers are very multidisciplinary, with the ability to remove solids, mists, and gases simultaneously while also providing cooling. They are also capable of handling explosive and flammable gases safely. However, scrubbers suffer from high levels of corrosion and produce slurry waste streams which are less convenient for recycling and disposal.

Typical wet scrubber systems consist of a scrubbing vessel, ductwork and fan system, mist eliminator, pumping (and possible recycle system), spent scrubbing liquid treatment and an exhaust stack. Modern controls are used to monitor the system and make any necessary adjustments.

Wet scrubbers are common in many industrial applications including pollutant reduction at petroleum refineries, chemical processes, acid manufacturing plants, and steel making.



Scrubber Design and Operation

Scrubbers are devices that use a liquid (often water) to capture and remove pollutants. Through a nozzle or orifice a scrubbing liquid is atomized and dispersed into the gas stream. The droplets entrain and capture dust particles through agglomeration, adherence, or encapsulation. This effectively increases the size and mass of the particles, making them easier to collect in a subsequent filter or separation process. The scrubbing liquid simultaneously absorbs and neutralizes gaseous pollutants. Suspended liquid is typically recovered in mist collectors and recycled through the system.

Many air scrubbers, wet scrubbers, and gas scrubbers are available with pre-filters or final filters to further reduced emissions. Pre-filters are installed upstream of the scrubber intended to catch larger particles. While the scrubber itself would be able to remove these larger particulates as well, their removal allows the

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scrubber to be designed to focus more keenly and effectively on smaller particulates. A final filter is often installed downstream of the scrubber, and is intended to catch fine particles that were not removed during the scrubbing process.

A key parameter in the design of scrubbers is the liquid-to-gas ratio (L/G). It is commonly expressed in gallons per minute (gpm) of liquid divided by actual cubic feet per minute (acfm) of gas. This ratio is determined by the solubility of the gas pollutants, the abundance of pollutants and particulate matter in the gas stream, and the mass transfer characteristics of the tower. Increasing (L/G) increases the collection efficiency of the system, so finding the optimum ratio is important for balancing performance with operating costs.

In wet scrubbing processes, liquid or solid particles are removed from a gas stream by transferring them to a liquid. The liquid most commonly used is water. A wet scrubber's particulate collection efficiency is directly related to the amount of energy expended in contacting the gas stream with the scrubber liquid. Most wet scrubbing systems operate with particulate collection efficiencies over 95 percent. Wet scrubbers can also be used to remove acid gas; however, this section addresses only wet scrubbers for control of particulate matter.

There are three energy usage levels for wet scrubbers. A low energy wet scrubber utilizes pressure drops less than 5 inches of water column and are capable of efficiently removing particles greater than about 5-10 micrometers in diameter. A medium energy scrubber has a pressure drop from 5 to 25 inches of water column and is capable of removing micrometer-sized particles, but is not very efficient on sub-micrometer particles. A high energy scrubber expends the most energy and has a pressure drop of 25 to over 100 inches of water column, which is necessary to remove sub-micrometer particles.

Types of Scrubber

- Chemical Scrubbers / Gas Scrubbers
- Particulate Scrubbers / Venturi Scrubbers
- Ammonia Scrubbers
- Chlorine Scrubbers
- Particulate / Dust Scrubbers
- Sulfuric Acid Scrubbers

A spray tower scrubber is a low energy scrubber and is the simplest wet scrubber used for particulate control. It consists of an open vessel with one or more sets of spray nozzles to distribute the scrubbing liquid. Typically, the gas stream enters at the bottom and passes upward through the sprays. The particles are collected when they impact the droplets. This is referred to as counter-current operation. Spray towers can also be operated in a cross-current arrangement. In cross-current scrubbers, the gas flow is horizontal and the liquid sprays flow downward. Cross-current spray towers are not usually as efficient as counter-current units.

The most common high energy wet scrubber is the venturi, although it can also be operated as a medium energy scrubber. In a fixed-throat venturi, the gas stream enters a converging section where it is accelerated toward the throat section. In the throat section, the high-velocity gas stream strikes liquid streams that are injected at right angles to the gas flow, shattering the liquid into small drops. The particles are collected when they impact the slower moving drops. Following the throat section, the gas stream passes through a diverging section that reduces the velocity.

All wet scrubber designs incorporate mist eliminators or entrainment separators to remove entrained droplets. The process of contacting the gas and liquid streams results in entrained droplets, which contain the contaminants or particulate matter. The most common mist eliminators are chevrons, mesh pads, and cyclones. Chevrons are simply zig-zag baffles that cause the gas stream to turn several times as it passes through the mist eliminator. The liquid droplets are collected on the blades of the chevron and drain back into the scrubber. Mesh pads are made from interlaced fibers that serve as the collection area. A cyclone is typically used for the small droplets generated in a venturi scrubber. The gas stream exiting the venturi enters the bottom of a vertical cylinder tangentially. The droplets are removed by centrifugal force as the gas stream

spirals upward to the outlet.

Wet scrubbing systems are susceptible to several operating problems. The most common of these include inadequate liquid flow, liquid re-entrainment, poor gas-liquid contact, corrosion, and plugged nozzles, beds, or mist eliminators.

Dry Scrubbers

Wet scrubbers are the most common and well-known types of scrubbers. However, recently the term 'scrubber' has also been used to describe air pollution devices which inject a dry sorbent or spray into a gas stream. This effectively eliminates the problematic liquid waste stream, capturing instead a dry solid. Applications for dry scrubbers include the removal of acid and odorous gases from boilers, incinerators, and wastewater treatment plant operations.

Dry sorbent injectors inject an alkaline material into a gas stream to react with acid gases. The reaction produces solid salts which are removed in the system's particulate control device. Efficiencies for these devices are limited, but can be improved by increasing the humidity or using wet scrubbing in addition to dry injection.

Dry spray absorbers are packed towers where the gases are contacted with atomized alkaline slurry. Acid gases form solid salts which can then be removed in the system's particulate control device. Spray dryers can achieve acid gas removal efficiencies above 80%.

Selection tip: One of the key design considerations for packed tower scrubbers is the selection of packing material. The packing's surface area, material, shape, weight, and cost are all important factors for finding a chemically compatible packing that gives maximum gas-liquid contact and low gas-phase pressure drop.

Monitoring Information

The primary indicators of wet scrubber performance are pressure differential, liquid flow rate, and scrubber liquid outlet concentration. The less significant indicators of gaseous pollutant control efficiency for wet scrubbers are gas flow rate, neutralizing chemical feed rate, and scrubber outlet gas temperature. Parameters to monitor as an alternative to scrubber liquid outlet concentration include scrubber liquid pH, scrubber liquid specific gravity, and scrubber makeup/blow down rates. For systems that control gaseous streams with low particulate matter loadings, there is no advantage to monitoring the scrubbing liquid solids content. In this way the scrubbers is so useful for control of air pollution.

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VERMICULTURE BIOTECHNOLOGY FOR SUSTAINABLE AGRICULTURE

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Vermiculture is an ecotechnology which harnesses the self-designed and self-regulated ecosystem. Here, the earthworms play a key role in the soil ecology by acting as a natural aerobic bio-reactor as well as a bio-manager. They farm aerobic bacteria, the versatile and most productive bioprocessing agents, which use crop residues (dead roots, shoots, etc.) to fix atmospheric nitrogen, solubilize the fixed soil phosphorus, make potassium, calcium, magnesium, sulfur and essential micronutrients available, produce vitamins, antibiotics and plant growth hormones. Their metabolites in turn are absorbed by the plant roots as growth factors.

Earthworms also cull the anaerobic bacteria, pathogens, fungi, protozoa, etc. and graze on sensecent bacterial colonis, thus keeping them young and productive. In the soil as biomedium, earthworms process the soil along with the organic matter (valuable substrate) by grinding into micron-size particles thus increasing the speific surface area. These ground particles, however, are agglomerated by the earthworms into 2-3 mm granules which maintain the voidage. This soil phenomenon enables a high surface area for nutrient absorption and a high enough voidage for air and water circulation. This product having a mechanical strength @ 1 ton/m^2 and specific surface area of 600 m^2/g is called vermicastings which is an effective biofertilizer.

Properties of Vermicastings :

- It has a neutral pH & contains balanced plant nutrients in available form.
- Improve structural stability of soil.
- Absorbs moisture from air.
- Enhances water retaining capacity.
- Improves infiltration properties of soil.
- Contains plant nutrients and beneficial soil micro-organisms.
- Prevents leaching of nutrients to ground water.
- Improves soil structure and productivity.
- Increase immunity against pest attack.
- Provides balaned nutrition for plants.
- Contains earthworm cocoons.

Ecological Classification:

The present discussion about the earthworms, which has been used in the technology, pertains to K-selected organisms. These, unlike r-selected organisms (redworms, etc.), maintain a steady biomass in the soil at the carrying capacity controlled by the available food, moisture, etc. They often construct permanent burrows in the soil, thereby tilling the soil upto 3m. They also take in rock and soil particles for carrying out process such as grinding and mixing with humus. They increase porosity, aeration and infiltration by filling the soil to a depth of 3m as discussed earlier. **Species of Earthworms cultivated in vermiculture***Tropical speciesTemperate speciesEndrilus eugeniaeElsnia fetikdaPerionyx excavatus Eleshia andreiPolypheretima elongataLumbricus rubellus*

Pest Management & Role of Weeds:

Healthy soil has a balanced population of beneficial soil microflora and burrowing earthworms. This eliminates soil pathogens through competition and antibiosis. Vermicastings provide a balanced nutrition to plants, thus giving them resistance to pests, thereby eliminating the use of both pesticides and chemical fertilizers. Weeds, too, change according to the soil deficiencies and they help control these deficiencies by bringing up the trace elements from the lower depth of the soil. Hence, weed growth should be promoted and weeds are they recycled by feeding them to the earthworms.

A. Harnessing vermiculture biotechnology for sustainable agriculture -

Farmers in diverse agroclimatic conditions in India, who are using vermicastings (biofertilizer) instead of chemical fertilizers, have realized the practice of sustainable agriculture without a significant loss of yield, by witnesing soil improvement, as indicated by measurements of soil pH, nutrients availability, electric conductivity and water holding capacity. Moreover, the produce is of better nutritional qualities, without pesticide residues and with better keeping qualities - enhancing exportability.

B. Method of application :

(a) For horticultural crops (Pomegranate, chickoo, mango, banana etc.)

1. Divide 1 ton equally over number of trees (main plantation & intercrop) per acre.
2. Apply vermicastings diretly below tree or under drip only.

(b) For ridge and furrow crops (tomato, brinjal, capsicum, chilly etc.)

1. Spread vermicastings only in furrows after transplanting the seedling from nursery beds.
2. Apply cowdung and mulch only in furrows.
3. Furrows may be used again after end of first crop.
4. New seedlings may be transplanted before old ones are removed.
5. Old plants may be used as mulch.

(c) For seasonal crops (Jawar, Bajra, wheat, rice, ground nut etc.)

1. Mix 1 ton vermicastings with equal volume of cowdung.
2. Broadcast and harrow or sow with seed drill to a depth of 50 mm only.
3. Cover ground with mulch.

Worms hatch out from the cocoons associated with vermicastings, within a month. They start processing the dung and organic mulch and produce vermicastings, making the system almost a zero-external- input-sustainable agriculture.

C. Conclusion

Vermiculture biotechnology can be fruitfully utilised to gain several benefits:

To Farmers:

- Less reliance on purchased inputs, realizing in considerably low cost of production.
- Enhancement of soil productivity.
- More yield with lesser irrigation.
- No tension of losing the crop to pest-attack.
- Produce with better taste, luster, keeping qualities without toxic residues, fetching a higher price.

To Industries:

- Cost effective pollution abatement technology.

To Environment:

- Wastes create no pollution, as they become valuable raw materials for the soil biotechnological process.
- More groundwater recharge and lesser depletion of ground water.
- Reduced soil salinization, lesser soil erosion.

- No polluting chemicals need to be produced and used.

To National Economy:

- Lesser imports of agrochemicals, saving valuable foreign exchange.
- Saving on subsides
- Boost to rural economy
- More export of agricultural produce with lower pesticide residues
- Less expenditure on water supply and pollution control
- Lesser wasteland formation

D. Case Studies

Some case-studies of successful farmers who have used vermiculture technology in their farms are as under: -**Case - 1**

For the first year (for plantation crop) the vermiculture plot yielded the same profit as the chemical plot (plot where chemical fertilizer was used). The net profit for the second year (i.e. first ratoon) was nearly three times that of the chemical plot. Moreover, the net profit for second ratoon was maintained for vermiculture plot whereas the chemical plot did not have second ratoon.

Even the soil analysis results showed marked improvements in the soil productivity for vermiculture plot within a year as compared to chemical plots => 37% more N: 66% more phosphates: 50% less electrical conductivity. 46% less chlorides.

Case 2:

Vegetables were planted on saline soil and irrigation was done by saline ground water. With the application of this technology, there was a drastic improvement in soil structure. pH improved from 8.2 to 7.3 within a year, salt crustation on the surface disappeared and water holding ability also increased. Produce was of better quality fetching 30% extra price. The net profit from the vermiculture plot in 2 years was 50% more than that from the chemical plot in 3 years.

Storage :

Vrmicastings (seed culture) can be stored upto one year & transported without spoilage.

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ECO – FRIENDLY WEED MANAGEMENT APPROACHES IN DIRECT SEEDED RICE (DSR) - A REVIEW

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Direct Seeded Rice (DSR) is the technology which is water, labour and energy efficient along with eco-friendly characteristics and can be a potential alternative to conventional puddled transplanted rice (CT-TPR). Weeds are the major biological constraint in direct seeded rice (DSR) due to the concurrent emergence of competitive weeds, in the absence of water to suppress weeds at the time of seedling emergence is difficult. Strategies on weed management in direct seeded rice depend on critical period of weed control, weed flora and method to be adopted. Ecological / Eco-friendly weed management differs from traditional weed management in several ways. Eco-friendly weed management approaches is to integrate the options and tools, rather than on specific control practices which are available to make the crops and cropping system unfavorable for weeds and to minimize the impact of any weed that survive. Maintaining appropriate crop rotation with legume and non-legume crops, and growing of cover crop helps to suppress weeds by smothering and allelopathic effects. Growing competitive cultivars, modifying in sowing and planting techniques, changing sowing and planting time, mulching with organic residues, green and brown manuring and the adoption of reduced or zero tillage makes an inappropriate environment for weed seed germinations and their growth. It also stores a higher amount of organic matter by reducing the mineralization rates and subsequently decreases energy consumption and carbon oxide emission. Herbicide use has been a valuable asset for modern agriculture; however, prudent use of chemicals for weed control is essential to fulfilling the goals of sustainable crop production, by reducing detrimental environmental impact, and delaying herbicide resistance development. Further development and testing of alternative weed management practices that can be utilized along with herbicide applications must be pursued in order to make the practice sustainable and successful. The literature regarding the critical period of weed control, weed flora and different eco-friendly approaches for the sustainable management of weeds in direct seeded rice are reviewed in this paper.

1. Introduction:

Rice is cultivated in India in a very wide range of ecosystems from irrigated to shallow lowlands, mid-deep lowlands, deep water to uplands. Transplanting is the major method of rice cultivation in India. However, transplanting is becoming increasingly difficult due to shortage and high cost of labour, scarcity of water, and reduced profit. Puddling and transplanting consumes 30 per cent of the total water requirement of rice. In addition to water scarcity, the farmers are facing the problem of acute labour shortage and hike in wage rate. Transplanting takes 240 to 250 man hr. ha^{-1}, which is 25 per cent of the total labour requirement of the rice crop (Ojha and Kwatra, 2014).Thus, direct-seeding is gaining popularity among farmers of India . Direct-seeding constitutes both wet- and dry-seeding and it does away with the need for seedlings, nursery preparation, uprooting of seedlings and transplanting. The upland rice area is around 5.5 million hectares which accounts or 12.33% of the total rice area of the country. Dry direct Seeded Rice (DSR) is the technology which is water, labour and energy efficient along with eco-friendly characteristics and can be a potential

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alternative to CT-TPR (Kumar and Ladha 2011). Direct seeding is a good alternative to transplanting as it is more economical and labour saving. DSR matures 7 to 10 days earlier than transplanted rice due to absence of transplanting shock (Rana *et al*., 2014). Awan *et al*. (2006) reported that direct seeded rice was almost at par in yield with transplanted crop. Though DSR has several advantages and it could be an effective alternative to traditional transplanting, poor germination, uneven crop stand and high weed infestation are the major constrains in DSR (Farooq *et al*., 2010).

Irrespective of the method of rice establishment, weeds are a major impediment to rice production through their ability to compete for resources and their impact on product quality. Weeds are responsible for heavy rice yield losses, to the extent of complete crop loss under extreme conditions. Out of the losses due to various biotic stresses, weeds are known to account for nearly one third. Weed competition would be less severe under transplanting than those under direct-seeding (Singh et al., 2005; Savary et al., 2005; Rao and Nagamani, 2007; Rao et al., 2007). Uncontrolled weeds reduced the grain yield by 75.8, 70.6 and 62.6% under dry-seeded rice (DSR), wet seeded rice (WSR) and transplanted rice (TPR), respectively (Singh et al., 2005). Experiments showed that yields were comparable across all establishment methods of rice when competition from weeds was removed. Thus, weed control is major prerequisite for improved rice productivity and production using different methods of rice establishment.

Thus weed management would continue to play a key role to meet the growing food demands of increasing population in India. As the weed problems are multi-pronged, a holistic multi-disciplinary Integrated Weed Management approach would be imperative. In this context, Eco–friendly weed management may provide a more sustainable approach to rice production.

The objective of this paper is to provide a summary on Eco – friendly weed management in direct seeded rice in India and suggest areas of future research on Echo –friendly weed management to combat weed menace effectively, economically and ecologically.

2. Weed flora associated with different methods of rice establishment: Several studies were conducted in India on weed flora of rice under different methods of rice establishment and major associated weeds are given in Table 1.

(a) Weed flora in DSR: Common weed flora in DSR includes grasses, sedges and broad leaf weeds (BLW). Weed flora will vary depending on the season as well as climatic and edaphic conditions. Grassy weeds causing major yield losses are *Echinochloa colona*, *Echinochloa crusgalli, Leptochloa chinensis*, *Ischaemum rugosum,* Dactyloctenium aegyptium, Paspalum distichum and Cynodon dactylon. *Echinochloa colona* requires less moisture than *Echinochloa crusgalli* resulting in the predominance of *E. colona* in dry-seeded rice. Sedges causing major yield losses are *Cyperus rotundus, Cyperus iria*, *Cyperus diffor*mis, *Schoenoplectus juncoides*. BLW causing major yield losses are Ammannia robusta*,* Digera arvensis, *Eclipta prostrata*, Euphorbia hirta, *Spheoclea zeylanica, Ludwigia hyssop*ifolia, Trianthema portulacastrum and Phyllanthus niruri. Raj *et al*. (2013b) reported that during *kharif* season BLW predominate (39.3 per cent) followed by sedges (38.9 per cent) and grassy weeds (21.8 per cent) while in *rabi* season sedges predominate (96.8 per cent) followed by BLW (2.7 per cent) and grasses (0.5 per cent).

Changes in crop establishment, from transplanting to direct seeding also resulted in marked changes in the composition of weed flora (Singh *et al*., 2008). *Echinochloa* spp. noticed the most noxious weed in rice fields under transplanted situation, however when the system was changed to direct seeding *Leptochloa chinensis* became more dominant than *Echinochloa* spp. Direct seeding increased the population of annual grasses such as *Echinochloa crusgalli*, *Echinochloa colona* and *Leptochloa chinensis*, perennial sedge *Cyperus rotundus* and BLW such as *Commelina diffusa* and *Caesulia axillaris* (Singh *et al*., 2008). Adoption of direct seeding technology may result in weed flora shifts towards more difficult to control and competitive grasses and sedges (Kumar and Ladha, 2011). Depending on the weed flora as well as critical period of weed competition, we have to intelligently select and adopt different weed management techniques based on the available resources. Significant variation occurs in the dominance of the abundant weed species with crop establishment and weed control methods (Singh et al., 2005). Weedy rice is emerging as a major problem in direct-seeded rice (Rao et al., 2007).

Table: 1. Weeds flora in different methods of rice establishment in India*

Weed Name	TPR	WSR	DSR
Echinochloa colona	1	2	1
Echinochloa crusgalli	2	3	6
C yperus iria	3	1	3
Cyperus difformis	4	4	9
Fimbristylis miliacea	5	8	17
Eclipta alba	6	5	7
Cyperus rotundus	7	8	2
Ammannia baccifera	8	7	+
Ludwigia parviflora	9	6	+
Monochoria vaginalis	10	12	+
Cynodon dactylon	11	15	5
Commelina benghalensis	11	11	4
Marselia quadrifolia	12	10	+
Spaenoclea zeylanica	13	18	-
Paspalum distichum	14	20	+
Panicum repens	15	16	+
Caesulia axillaris	15	+	+
Leptochloa chinensis	16	17	-
Ischaemum rugosum	17	+	13
Digitaria sanguinalis	18	+	8
Phyllanthus niruri	19	+	6
Leersia hexandra	20	+	-
Caesulia axillaris	+	12	+
Fimbristylis dichotama	+	19	-
Eluesine indica	+	+	10
Trianthema portulacastrum	+	+	12
Ageratum conyzoides	+	+	9
Cleome viscosa	+	+	13
Digera arvens	+	+	14
Digitaria sanguinalis	18	+	8
Phyllanthus niruri	19	+	6
Leersia hexandra	20	+	-
Caesulia axillaris	+	12	+
Aeschynomene indica	+	+	17
Setaria glauca	+	+	18

TPR = Transplanted rice., WSR = Wet-seeded rice., DSR = Dry-seeded rice, 1 = Most reported weed; 20= Less reported; + reported , * = Based on a survey of several published research papers in various journals

3. Impact/losses due to weeds:

Weeds were reported to reduce rice yields by 12 to 98%, depending on type and method of rice establishment (Table: 2). Rice yield losses due to uncontrolled weed growth and weed competition were least (12%) in transplanted rice (Singh et al., 2011) and highest in aerobic direct-seeded rice on a furrow-irrigated raised-bed systems (Singh et al., 2008) and in dry-seeded rice sown without tillage (Singh et al., 2011). in DSR it is important to minimize the crop-weed competition during the early stages of the crop before it forms a closed leaf canopy.

Weed control during the critical weed-free period is essential to reduce the weed competition and for effective utilization of available resources for enhanced productivity. In DSR, the critical period of weed competition has been reported to be 14- 41 days after sowing (Chauhan and Johnson, 2011). Azmi *et al*. (2007) reported that critical period for weed control under mixed weed infestation in DSR was from 12 to 60 DAS. The effective control of weeds at initial stages of rice growth (0 to 40 DAS) could help in improving the productivity of DSR (Maity and Mukherjee, 2008). Singh (2008) noticed that a weed free situation for first 60 or 70 DAS produced yield comparable with weed free situation until harvesting. The competition in DSR beyond 15 days after seeding may cause significant reduction in grain yield.

Threshold levels for a few weed species were also worked out. For example: *Cyperus iria* at density of 30 m^{-2} and *Echinochloa crusgalli* density of 20 m^{-2}, is considered the threshold level for transplanted rice, as it causes the minimum loss of 6.57% and 8.74%, respectively, in grain yield, above which control measures are to be undertaken (Singh and Angiras, 2003; 2008).

An on-farm study indicated that the yield loss from weeds in un- weeded plots was highest in the rice-wheat system followed by rice-pea-rice, and was least in the sugarcane system (Singh et al., 2005). Weeds not only cause huge reductions in rice yields but also increase cost of cultivation, reduce input efficiency, interfere with agricultural operations, impair quality, act as alternate hosts for several insect pests, diseases, they affect aesthetic look of the ecosystem as well as native biodiversity, affect human and cattle health.

Table: 2. Estimated yield losses caused by weeds in different methods of rice establishment in India.

Methods of rice establishment	Weeds	% reduction in yield due to weeds	Reference
Transplanted Rice	Season long Competition	12 to 69.5%	Rammohan et al;1999, Singh et al; 2011
Wet-seeded rice	Season long Competition	85%	Singh et al;2011
Upland-direct seeded rice	Season long Competition	93.6%	Ladu, and Singh, 2006*
Upland rice	Uncontrolled weeds	97.2%	Singh et al.,1988*
Dry-seeded rice-zero tillage	Season long Competition	98%	Singh et al;2011
Dry-seeded rice	Pre-, Post-flooding periods & during crop growth	17.4 to 25.8; 10.03 to 48.3 and 34.4 to 72.6%	Moorthy and Saha,2001*

4. Factors influencing weed competition and critical period:

Many factors influence the presence and abundance of weed species or groups of weeds in rice fields. Important factors include: rice seeding method, soil moisture, crop rotation, type and amount of fertilizers applied, time of fertilizer application, rice cultivar, water management; crop management and weed control methods used. These factors influence the weed growth and subsequently the rice productivity and quality. The critical period for weed control is a period in the crop growth cycle during which weeds must be controlled to prevent yield losses (Zimdahl, 1988, 2004). Studies on critical period of crop weed competition revealed that first thirty to seventy days are critical, depending of the type of rice cultivar and the method of rice establishment.

The loss in grain yield of direct-seeded rice caused by unchecked weed growth was greater when N fertilizer was applied and when the conventional practice of ploughing the fields just before sowing was followed (Sharma, 1997). In transplanted rice, *C. iria* competition for the first 30 days caused less than one fourth (12.9%) of the total losses in yield while competition for 40 days resulted in more than half (43.5%) of the total losses due to the weed (Dhammu and Sandhu, 2002). Maximum reduction in rice yield (35.2%) was observed by delaying *C. iria* removal from 30 to 40 DAT, indicating this period as the most critical period of

C. iria competition in transplanted rice.

5. Approaches Involved In Eco-Friendly Weed Management Under- DSR:

The principles that underline ecologically and economically viable weed management system in rice are: (a) adapting the weed management options that suits to the environment of the region, including soil, water, climate and biota present at the site; (b) optimizing the use of biological and chemical/physical resources for effective management of weeds in rice. An important principle underlying long-term weed management is that weed seed banks maintain emergent populations, and therefore, seed banks must be managed at low densities to reduce the potential for a buildup of intractably high weed populations.

Reviews on weed management practices on dry-seeded rice (Rao and Nagamani,2007) in India there is no single weed control method for effectively and economically managing weeds in rice to attain optimal rice productivity and production. Hence, integrated weed management strategy using a combination of several weed control methods is often envisaged. The principles of IWM are that it must be: (i) effective, (ii) economical; (iii) easy to use; (iv) and environmentally safe.

1. Integrated weed management (IWM):

Weed management must aim at reducing the weed population to a level at which weeds occurrence has no effect on farmer's economic and ecological interests. By using different appropriate management practices against weeds, farmers have more options for controlling weeds, thereby reducing the possibility of escapes and weed adaptation to any single weed management tactic. IWM is a science-based decision-making process that coordinates the use of environmental information, weed biology and ecology, and all available technologies to control weeds by the most economical means, while posing the least possible risk to people and the environment (Sanyal, 2008).Effective IWM combines preventive, cultural, mechanical and biological weed control methods in an effective, economical and ecological manner.

1. (A) Non chemical IWM:

Limited number of research studies were reported on non-chemical methods of IWM. In rice seedling nursery rabbing (pre-burning the nursery area) gave 100% weed control (Zagade et al., 1992). In transplanted rice, the reduction in weed growth was observed with, (a) intensive puddling and shallow depth submergence (Reddy and Reddy, 1999)

(b) higher dosage of fertilizer i.e.180 kg N ha^{-1} and plant density of 41 plants m^{-2} (Brar and Walia, 2001).

In rainfed upland rice, better land preparation (2 ploughings at 15 days before sowing and 2 days at sowing), timely sowing (in the last week of June), the application of fertilizer and an additional hand weeding markedly decreases the infestation of all categories of weeds, compared to the traditional farmers' practice, (Singh and Ghosh,1992). In rice-rice cropping system, the least weed growth was recorded with: (a) ploughing the land twice, during off-season followed by twice hand weeding in the crop, (b) raising green manure of *Sesbania aculeata* (c) incorporation of press mud at 10 t ha^{-1} +Azolla inoculation at 1 t ha^{-1} (Gnanavel and Kathiresan, 2002). In rice/wheat cropping system, inclusion of green gram in summer or summer cowpea for fodder or Sesbania for green manuring, resulted in lowest grasses and sedges (Singh et al., 2008).

1. (B) IWM with herbicides as a component:

In rice seedling nurseries, use of effective herbicides such as Pretilachlor plus Safener (Rao and Moody,1988;Balasubramanian and Veerabadran,1998); Cyhaloop bytyl (Jayadeva et al., 2002; Sharma et al, 2004a), Propanil and Quinclorac + Bensulfuron (Rao and Moody, 1988) either alone or in combination with hand weeding results in healthy rice seedlings for transplanting. Several herbicides were found effective in managing weeds in different methods of rice establishment (Table 6). However, only about 17% area out of 42 mha under rice is treated with herbicides, almost entirely in transplanted rice. Herbicides form only 12% of the pesticides used on crops in India (Saksena, 2003; Bhat and Chopra, 2006*).* The rice herbicides such as Butachlor and Anilofos have recorded huge increase in use up to 1650 and 500 MT, respectively. As direct-seeded rice area is increasing in India, there exists a very good scope for their use in future. Research on IWM was carried out to use herbicide as a component of weed management rather than using herbicides alone.

Table: 3. Herbicides reported to be effective in dry-seeded rice in India

Herbicide	Rate (kg/ha)	Time of application (DAS)
Anilofos	0.4	7 DAS
Anilofos + 2,4-D	0.4+0.6	7 fb 25DAS
Anilophos fb Cyhalofop butyl	0.4 fb 0.09	3 DAS fb 35 DAS
Butachlor + Safener	1.5	4 DAS
Butachlor fb 2,4-D	1.25 fb 0.5	Pre fb Post Emergence
Cyhalofop butyl	0.120	15 DAS
Dithiopyr	0.180	3 DAS
Fenoxaprop-p- ethyl	0.07	POE
Fluchloralin	1.5	PRE
Oxadiazon	0.5	PRE
Oxadiazon fb Oxadiazon	0.4 fb 0.4	PRE fb 45 DAS
Oxyflourfen	0.25	3 DAS
Pendimethalin	1.5	3 DAS
Pendimethalin fb 2,4-D	1 fb 0.6	PRE fb POST
Pretilachlor	1	2 DAS
Pretilachlor + Safener	0.3	4 DAS
Pyrazosulfuron	0.015 to 0.030	6 DAS
Pyrazosulfuron ethyl + Molinate	15 to 30 + 1.5	6 DASf b 15 DAS
Quinclorac	0.375	Pre
Thiobencarb fb 2,4-D	1 fb 0.5	Pre fb 20 DAS
Thiobencarb fb Cyhalofop butyl	1 fb 0.09	4 fb 35 DAS

*Pre=Pre emergence application; Post = Post emergence; fb= Followed By * Summarized based on several published papers.

1. B. (a). Crop rotations, cropping systems and herbicides:

Crop rotation is an important component of IWM. The choice and sequencing of crops affects long-term weed population dynamics, and consequently weed management. In traditional farming, rotations comprised of crops with different life cycles were a key component of weed management. Different planting and harvest dates among these crops provide more opportunities for farmers to prevent either plant establishment or seed production by weeds.

In rice/wheat cropping system, sequences involving summer cowpea for fodder or *Sesbania* for green manuring, resulted in significantly lowest population of grasses and sedges (Singh et al., 2008). However, the different cropping sequences failed to affect broadleaf weeds. Rice-lentil + mustard (3: 1) - cowpea, rice-maize + pea (1: 1) - cowpea and rice –potato – green gram gave high yield (Singh et al., 2008). Effective weed control in terms of reduced weed density and dry weight was achieved by Pretilachlor with Safener at 400 g ha^{-1} combined with Sesbania (Daincha) intercropping and Azolla dual cropping in wet-seeded rice (Subramanian and Martin, 2006). The cono-weeder incorporation of Daincha and Azolla resulted in higher weed control during early stages.

In green gram intercropped with rice, pre-emergence application of Pendimethalin 1.0 kg ha^{-1} with hand weeding at 25 DAS significantly reduced the weed biomass and increased the yield of both the crops (ICAR, 2007). In upland direct-seeded rice, an integrated strategy of growing Cowpea or *Dhaincha* as an intercrop and pre-emergence application of Pendimethalin (1.0 kg ha^{-1}) followed by a manual weeding at 20 DAS has been found appropriate for reducing weed competition (ICAR, 2007).

In rice-wheat system, sequential application of Butachlor (rice) and Isoproturon (wheat) and Butachlor fb hand weeding have been found effective against *Echinochloa* sp. and *Fimbristylis* sp. in rice. Continuous use of Butachlor in rice and Isoproturon in wheat has reduced the problem of *Echinochloa colona*

in rice (ICAR, 2007). The effectiveness of crop rotation in weed suppression may be enhanced by crop sequences that create varying patterns of resource competition, allelopathy, soil disturbance, and mechanical damage to certain weed species. Many aspects of crop rotation and intercropping and their effects on weeds are yet to be explored.

1. B. (b) Tillage and herbicides as components of IWM:

Tillage prior to crop establishment serves mainly to prepare a weed free seed bed. It eliminates established and emerged prior to crop seeding and also moves weed seeds near the soil surface vertically, resulting in weed seed burial. It is suggested that an integrated weed management strategy involving summer ploughing, Thiobencarb application and inter-crop cultivation is essential for effective weed control in direct-sown, flood-prone, lowland rice, in order to ensure higher N-use efficiency and crop productivity (Sharma, 1997). In dry-seeded rice stale seedbed preparation was found better than traditional seedbed preparation (Sharma et al., 2004).

1. B. (c) Integration of crop competitiveness with herbicides:

Farmers normally prefer high yielding varieties. Using high yielding crop variety competitive against weeds in combination with other methods of weed control is one of the most economical approach to attain optimal crop yield. Upland rice cultivars Vandana, Kalinga-III and RR-151-3 have shown better weed competitive ability and higher yield potential under sub-optimal weed management condition (ICAR, 2007). Rice cultivar 'Gautam' (high yielder) and cultivar 'Prabhat' (better weed minimizer) + Butachlor at 1.5 kg PE +2,4-D at 0.5 kg ha^{-1} POE recorded highest rice yield with minimum weed dry weight (Singh et al., 2004). Enhanced dry-seeded rice competitiveness against weeds was observed with 100 kg ha^{-1} seed rate + Oxyfluorfen 0.25 kg ha^{-1} (3 DAS) + *halod* (Angiras and Sharma, 1998). The increase in transplanted rice density from 22 to 44 hills m^{-2} + application of Pyrazosulfuron 0.015 kg/ ha was found to be significantly better in controlling *L. chinensis* (Aulakh and Mehra, 2006).P

1. B. (d) Integration of herbicides with mulching:

Covering or mulching the soil surface can reduce weed problems by preventing weed seed germination or by suppressing the growth of emerging seedlings. Mulches can be made from a number of materials: a living plant ground cover, loose particles of organic or inorganic matter spread over soil, and sheets of artificial or natural materials laid on the soil surface. Pre-emergence application of Pendimethalin at 1.0 kg/ ha + farm wastes as mulch (7.5 t/ ha) + one hand weeding at 45 days after sowing (DAS) of direct-seeded rice resulted in effective weed control and higher crop yield (Singh et al., 2001).

(d1) Sesbania co-culture (Brown Manuring):

Growing Sesbania as a green manure either as pre- rice or inter or mixed crop with rice is called brown manuring (sesbania co-culture). Sesbania is sown at 25 kg ha^{-1} together with rice. After 25– 30 days of growth, when Sesbania is 30–40 cm tall, it is killed with 2, 4-D ester at 0.5 kg ha^{-1}. This co-culture technology can reduce the weed population by nearly half without any adverse effect on rice yield (Singh *et al*., 2007). In addition to weed suppression, other benefits of Sesbania co-culture are atmospheric nitrogen fixation and facilitation of crop emergence in areas where soil crust formation is a problem (Gopal *et al*., 2010). The best time of sowing Sesbania for maximum weed suppression is on the day of sowing of rice (Singh *et al*., 2007). Sesbania co-culture was more effective against BLW and sedges and less effective on grasses. So, it is recommended to use Pendimethalin as pre-emergence to overcome the problem of grass weeds in this technique (Kumar and Ladha, 2011). Anita and Mathew (2010) reported that the best time for incorporating Sesbania for maximum weed suppression and grain yield was at 30 DAS for semi- dry rice and the best method for knocking down Sesbania was 2, 4-D spraying @ 1 kg ha^{-1}. Study conducted by ICAR revealed that growing Cowpea or Daincha as an intercrop and pre-emergence application of Pendimethalin @ 1 kg ha^{-1} followed by hand weeding at 20 DAS as an integrated strategy has been found appropriate for reducing the weed competition in upland direct seeded rice (ICAR, 2007).

1. B. (e) Integration of zero tillage with herbicides:

The use of zero tillage would also reduce the costs of seeding. In rice-wheat system, under zero

tillage, the time taken between rice harvest and wheat sowing is considerably shortened and early sowing of wheat after rice results in increased wheat yield (Vincent and Quirke, 2002). Herbicide (Pendimethalin at 1.0 kg/ ha) as pre-emergence supplemented with two hand weeding were needed to reduce weed growth in zero till dry-seeded rice (Singh et al., 2005a). In rained lowland rice, Zero tillage and conventional tillage were similar in weed control efficacy when supplemented with Butachlor or hand weeding (Moorthy et al., 2002). In irrigated dry-seeded rice: (a) zero tillage significantly reduced the total population and dry matter of weeds compared with conventional tillage, but the difference in yield was not significant, (b) Integration of Pendimethalin 1.0 kg/ ha or Pretilachlor 0.75 kg/ ha with 1 hand-weeding at 30 DAS or sequential application of pre-emergence herbicides followed by post-emergence application of 2, 4-D (0.5 kg/ ha) and Fenoxaprop (0.07 kg/ ha), being on a par with each other, proved quite effective against weeds (Mishra and Singh, 2008).

If weed seed production has minimized during the growing season, weed seedling emergence in no-till would decline more across years compared with tilled systems as the surface weed seed pool in no-till is depleted more rapidly by emergence and mortality. Burial of weed seeds in soil by tillage favours persistence across time, thus leading to more weed seedlings in later years. Farmers can get additional benefits from this pattern of weed seedling emergence in no-till systems when combined with crop diversity in their rotations.

1. B. (f) Integration of hand weeding with herbicides:

Hand weeding is being practiced by farmers in India since they initiated agriculture. It is effective on annual weeds. Hand weeding is ineffective against perennial weeds due to their regenerative capability. Raising cost of labor and their non availability lead to the search for alternative methods such as herbicide use either alone or in combination with hand weeding (Singh et al., 2001; Rao and Nagamani, 2007; Rao et al., 2007). Several research publications have proved that integration of herbicides with hand weeding is the most effective and economical method of weed management.

Table: 4. Most economical IWM methods for managing weeds in rice grown under different methods of rice establishment in India.

Methods of Rice Establishment	IWM*	References
TPR	(i) Application of Butachlor 1.0 kg/ ha, Anilofos 0.4 kg/ ha along with closer planting	(i)Gogoi et al;2001
	(ii) Anilophos 0.6 kg ha 1 7 DAT + HW . 27 DAT	(ii) Singh & Kumar,1999
	(iii) Rice + Fish + Poultry Farming system +Oxyfluorfen at 0.25 kg ai/ha	(iii) Anbhazhagan& Kathiresan,2008
DSR	(i) Butachlor @ 1.25 kg /ha as pre-plant surface application +(i) Brown manuring + 2,4-D@ 0.50 kg/ha at 30 DAS	(i) Maity& Mukherjee, 2009
	(ii) Mulching (pine needles (5 t ha-1) or farm wastes (7.5 t /ha) + PE of Pendimethalin at 1.0 kg / ha supplemented with one hand weeding at 45 days after sowing or post-emergence application of 2,4-D at 0.6 kg/ ha	(ii) Singh et al., 2001
	(iii) Stale seed bed preparation + Pendimethalin + One Hand weeding	(iii) Sharma et al;2004
	(iv) Stale seedbed preparation + Criss-Cross sowing + One Hand weeding	(iv) Sharma et al;2004
WSR	Pre-sowing weed control (by conjunctive use of burn down herbicide Paraquat at 0.12 kg or tank mix of Glyphosate and 2,4D Na salt at 0.20 kg + 0.20 kg / ha, followed by subsequent weed submergence to 40 cm depth for 10 days) + sowing on clean seedbed with pre emergence herbicide (Pretilachlor + Safener at 0.4 kg/ ha) + post-emergence 2,4-D Na salt at 0.80 kg / ha	Latif and Wahab, 2007

*DAS = Days after seeding; DAT = Days after transplanting; DAP= Days after planting; HW=Hand weeding; PE = Pre emergence. DSR = Dry-seeded rice; TPR=Transplanted rice; WSR= Wet-seeded rice.

2. Stale seed bed technique: In Stale seed bed technique (SSB) weeds are allowed to germinate by giving a light irrigation or after a rainfall and after that emerged weed seedlings are killed using a non-selective

herbicide like glyphosate or shallow tillage or flooding. This technique not only reduces weed emergence but also reduces the number of weed seeds in the soil seed bank (also referred to as the soil weed seed bank) (Rao *et al*., 2007). The success of stale seedbed depends on several factors: method of seedbed preparation, method of killing emerged weeds, weed species, duration of the stale seedbed (Ferrero, 2003), and environmental conditions (e.g., temperature) during the stale seedbed period. Weed species, especially *Cyperus iria, Cyperus difformis, Fimbristylis miliacea* (L.) Vahl, *Leptochloa chinensis,* and *Eclipta prostrata*, are relatively more susceptible to the stale seed bed technique because of their low seed dormancy and their inability to emerge from a depth greater than 1 cm (Chauhan and Johnson, 2008; Chauhan and Johnson, 2010). Singh (2013) reported that in dry direct seeded condition SSB using glyphosate application 1 kg ha^{-1} was more effective in reducing the weed density and it recorded higher grain yield and B: C ratio than SSB using shallow tillage. Jose *et al*. (2013) reported that SSB was very effective in managing the weedy rice in DSR.

3. Crop rotation: Crop rotation is often considered to be a vital tool of weed management. Weeds respond to crop rotation, which affects weed demography and subsequent population dynamics (Liebman and Gallandt, 1997). Crop rotation helps in breaking the weed seed cycle as well as facilitating the identification of weedy rice, and it leads to better control. Effective control of weedy rice can be obtained by rotating the rice crop with other crops, such as soybean, mungbean, cotton, maize, etc., which allow using other herbicides and cultural practices that cannot be used in rice (Singh *et al*., 2013). Inclusion of forage crop, in crop rotation offers diverse mechanisms to suppress weeds through competition, grazing and mowing (Gill and Holmes, 1997).

4. Seed priming: Seed priming refers to a carefully-controlled moisture addition technique, where seeds are allowed to be hydrated partially to that point where germination-related metabolic activities occur, but seeds do not reach the irreversible point of radicle emergence (Bradford, 1986). Seed priming can improve the traits closely associated with weed competitiveness of rice include early height, growth rate, early crop biomass and early vigor. Various priming techniques employed to improve speed and synchrony of seed germination are pre-soaking, hardening, hormonal priming, hydro priming, halo priming, osmo conditioning, and ascorbate priming (Farooq *et al*., 2009). Juarimi *et al*. (2012) reported that priming treatments increased seedling vigour in aerobic rice variety Aeron 1. Priming treatments also produced the most vigorous seedlings with 50 per cent more vigour index compared to unprimed seeds. Higher and synchronized emergence of primed seeds can ensure vigorous crop stand with rapid canopy development giving rice plants a preliminary advantage over weeds (Anwar *et al*., 2012).

5. Submergence and weed control: Submergence is considered as the best herbicide in direct seeded rice. Every weed species has an optimum soil moisture level, below or above which its growth is hampered, and therefore time, depth and duration of flooding could play an important role in suppressing weeds. Submergence hinders weed germination and suppresses population of most germinated weeds. The timing, duration and depth of flooding are critical in suppressing germination and growth of a number of weed species. Early and continuous flooding to a shallow depth of 2 cm helps to suppress the emergence and growth of problematic weeds *viz*., *Leptochloa chinensis* (Chauhan and Johnson, 2008). Continuous submergence to a depth of (2– 4 cm) flooding helps to suppress the emergence and growth of *Cyperus iria, Fimbristylis miliacea, Leptochloa chinensis* and *Ludwigia hyssopifolia*.

6.Soil solarization: Soil solarization is a method of heating the soil's surface by using transparent polyethylene sheets (LDPE film) placed on the soil surface to trap solar radiation. This raises the soil temperature to levels lethal for many soil borne pathogens and weed seeds, thus killing weeds before emergence. This technique can be effectively used in hot areas (Khan *et al*., 2003).

7.Biological method of weed control : Biological weed control using different herbivorous bio agents like fish, tadpoles, shrimps and ducks are used to control weeds in irrigated lowland rice in a few countries (Agropedia, 2009) but these cannot be used in aerobic rice, where there is no standing water. In an experiment in Arkansas, wild ducks feeding in a rice field contaminated with 420 kg ha^{-1} of red rice grain reduced red rice seed by 97per cent (Smith and Sullivan, 1980). In Indonesia, rice-fish (common carp and grass carp) farming system provided good control of sedges like *Fimbristylis miliacea* and *Cyperus iria* (Pane and Fagi, 1992).

Weed control by myco herbicides are now being studied to reduce herbicide dependency. COLLEGO, a powder formulation of *Colletotrichum gloeosporioides* (Penz.) Sacc. f. sp. *aeschynomene,* was registered in 1982 for the control of northern jointvetch (*Aeschynomene virginica* (L.) B.S.P.) in rice (Smith, 1992). Other promising fungi identified for the bio control of barnyard grass are *Exserohilum monocerus* and *Cocholiobolus lunatus* (Khadir *et al*., 2008) and *Alternaria alternata* for the control of barn yard grass (Jyothi *et al*., 2013). *Setosphaeria sp* cf *rostrata* was identified as potential fungi for the control of *Leptochloa chinensis* (Thi *et al*., 1999). The endemic fungus *Colletotrichum gloeosporioides f. sp. jussiaeae (C.g.j.)* controlled >80 per cent of water primrose in rice after four weeks (Boyette *et al*., 1979).

8 .Biotechnological approach of weed control: Herbicide resistant rice is a type of rice that is resistant to a particular herbicide or herbicides which would otherwise damage the crop. One of the main reasons for the development of herbicide-resistant rice was to obtain effective and selective control of weedy rice in rice crop. However, among weeds of rice, such resistance against herbicides was not reported, yet, in India. The major direct benefits of introducing Herbicide-resistant rice (HR-rice) are to: (1) improve control of weeds specifically associated with rice, such as weedy *Oryza* species; (2) substitute currently used herbicides with new ones that are more efficient and that have better environmental profiles; (3) provide new tools for managing weeds that have already developed resistance to current herbicides and (4) facilitate adoption of resource conservation technologies by improving weed management options. These benefits must be weighed against risks before the adoption of HR-rice in India. Malik et al. (2003) have suggested that herbicide resistant rice (HR-rice) would dramatically overcome weed problems in direct-seeded zero till rice and reduce the need to puddle soils and keep them continuously submerged.

Three major HR systems currently commercialized are based on resistance to amino acid bio-sysnthesis inhibiting herbicides viz. Imidazolinone (IMI), Glyphosate and Glufosinate and in rice, all three HR systems are being developed (Rao et al., 2007). Glufosinate-resistant and Glyphosate-resistant rice cultivars convey resistance to Glufosinate and Glyphosate, respectively, both of which are broad-spectrum, nonselective, post-emergence herbicides with no soil or residual activity. Both Glufosinate and Glyphosate-resistant rice are transgenic in nature. In contrast to IMI-rice, development of glufosinate-resistant crops was accomplished through metabolic detoxification of the herbicide. Information is limited on the development of Glyphosate-resistant rice. In India, HR-rice is yet to be commercialized.

Conclusion:

Weeds however are the major biological constraint in direct seeded rice production. To achieve effective long term and sustainable weed control, all suitable management techniques are to be wisely utilized in such a compatible manner as to reduce the weed population below the economic threshold levels without deteriorating environment quality. The use of any single strategy cannot provide effective, season-long, eco-friendly and sustainable weed control as weeds vary in their dormancy and growth habit. The main objective of the weed management approaches should be to deplete the weed seed bank from the soil and enable rice crop to be more competitive by either delaying the emergence or suppressing the weed emergence and growth. Thus the challenge for weed scientists is to develop innovative, effective, economical, and environmentally safe IWM systems that can be integrated into current and future cropping systems to bring a more diverse and integrated approach to weed management in rice.

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NUCLEAR OVERHAUSER EFFECT

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The Nuclear Overhauser Effect (NOE), which can be used to determine intra- (and even inter-) molecular distances. The NOE effect is the change in population of one proton (or other nucleus) when another magnetic nucleus close in space is saturated by decoupling or by a selective 180 degree pulse. To understand this effect, we have to first consider the consequences of applying a second radio-frequency during an NMR experiment (decoupling).

Double Resonance Experiments

There are several types of NMR experiments that depend on the introduction of a second irradiation frequency (B_1), i.e. irradiation of a nucleus other than the one being observed

There are two direct consequences of irradiating an NMR signal using the decoupler: decoupling and saturation:

1. **Decoupling**. Irradiation of a signal at the resonance frequency interferes with any coupling of the nucleus to others in the molecule. The effects of decoupling are almost instantaneous - once the decoupler is turned on coupling disappears on the order of fractions of a millisecond (assuming the decoupler power is high enough), when the decoupler is turned off, the coupling reappears on a similar time scale.

· If the B_1 frequency is on resonance and the power is high enough, then coupling can be completely suppressed. At weaker powers complicated effects arise. The most common experiment of this type is homonuclear decoupling in proton NMR spectra (HOMODEC), which is a simple and effective technique for establishing coupling relationships among protons. The experiment provides similar information to the 2D COSY experiment, but is less time consuming when only a few protons need to be assigned. For complex molecules homonuclear decoupling can become ineffective due to signal overlap, and 2D H-H correlation experiments such as COSY must be used. Similarly, heteronuclear decoupling provides information about the correlation between signals of different nuclei (e.g. proton and carbon signals), much in the way that CH-COSY experiments do.

If the B_1 frequency is not exactly on resonance, then reduced couplings are observed. This is used in the OFF RESONANCE DECOUPLING , in which we irradiate somewhere upfield or downfield of the proton signals, and observe the ^{13}C NMR spectrum, which shows much reduced J_{CH} values.

In *spin tickling* experiments one of the lines in a coupled multiplet is irradiated with very weak power. Lines in multiplets of other nuclei coupling to the irradiated one show additional splitting of individual lines in the multiplet which can be used to determine the relative signs of coupling constants.

Broad band proton decoupling is routinely used when observing heteronuclei to simplify spectra by removing the effects of proton coupling. Broad-band decoupling is almost always used when observing ^{13}C, but can also be helpful for observing ^{19}F, ^{31}P and other nuclei.

2. **Saturation**. When a proton is irradiated transitions between α and β states are induced, and the populations of the two states will tend to be equalized. The rate at which this occurs is a function of the strength of the decoupling field, but will in general be faster than T_1 relaxation. If the field is powerful enough

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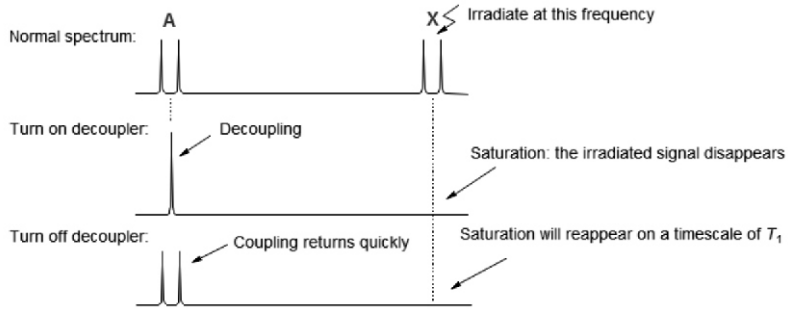
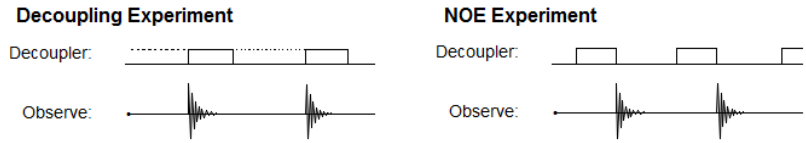
(i.e., if the induced transitions greatly exceed the rate of normal T_1 relaxation), the populations of the α and β states will become identical and the signal will disappear (become *saturated*). If the decoupler is turned off, normal signal intensity will return as a function of T_1. The coupling will return to normal on a much shorter time scale.



The Nuclear Overhauser Effect

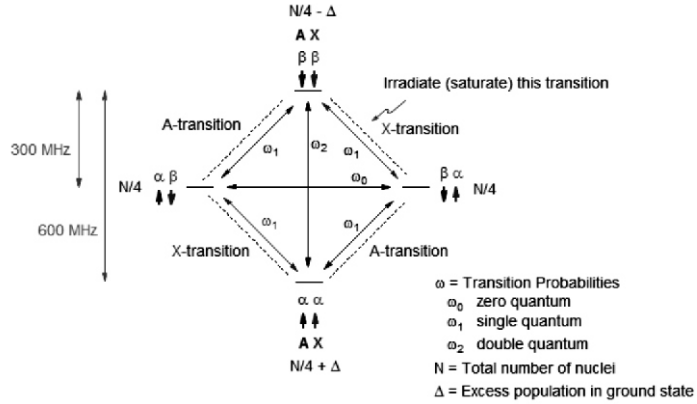
The alteration of normal spin population of a nucleus **X** by irradiation will cause the populations (and hence signal intensities) of other (non-irradiated) nuclei (**A**) to change *provided that **X** is causing T_1 relaxation of **A** by the dipole-dipole mechanism*. This is known as the Nuclear Overhauser Effect (NOE).

Distinction between Decoupling and the NOE experiment. In a decoupling experiment (HOMODEC) the B_1 irradiation *must be on during acquisition of the FID* (but not necessarily otherwise), and in an NOE experiment *the decoupler is on during a delay period, but may be turned off during the acquisition of the FID*.



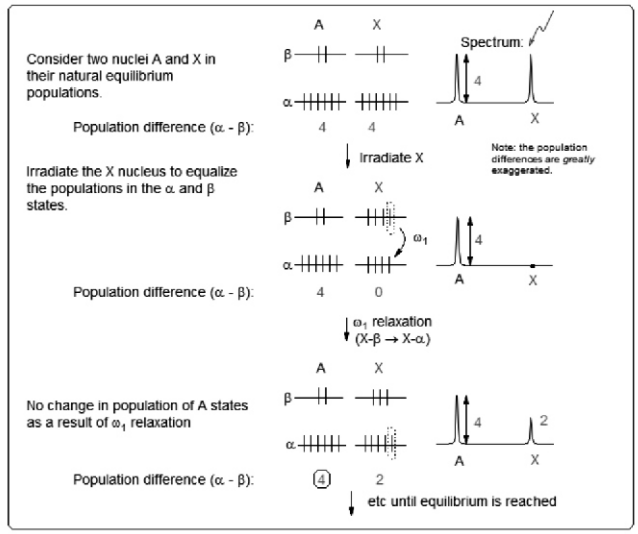
Origin of the NOE Effect. When a proton is close in space to another proton (or any other nuclei with spin > 0), their magnetic dipoles interact (ion,). This interaction is distinct from *J* coupling, which is not a through space effect, but is mediated by polarization of bonding electrons in the molecule. The effects of DD interactions on the appearance of NMR spectra is completely averaged by the normal tumbling of molecules in solution if the medium is isotropic and viscosity is low enough to allow sufficiently fast molecular motion (short enough correlation time, τ_c). The DD interactions between protons do, however, dominate the ^{1}H T_1 relaxation processes in most molecules that contain more than one proton.

To understand the NOE effect, consider a pair of protons **AX**, close in space, but not *J* coupled to each other (*J* coupling is unrelated to the NOE effect, but complicates the discussion). Such a system has four energy states, corresponding to the αα, αβ, βα, and ββ spin states. The DD interaction of the protons will cause T_1 relaxation between the spin states with the transition probabilities ω_1 (for the single quantum relaxation αα/αβ, αα/βα, αβ/ββ and βα/ββ), ω_2 (for the double-quantum relaxation αα/ββ) and ω_0 (for the zero-quantum relaxation αβ/βα). In the graphic below there will be an excess population of Δ in the αα state, and a deficiency of -Δ in the ββ state.



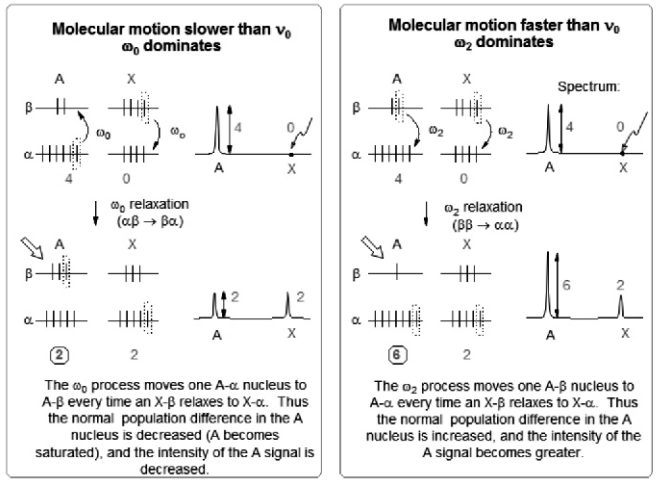
When the X-transition is irradiated, the populations of the αα and αβ states become equalized (saturated), as do the βα and ββ states. As relaxation occurs, the difference in these two populations depends crucially on which of the three relaxation processes dominates. If $\omega_2 > \omega_1, \omega_0$ then the βα/ββ population will tend to that of the ββ state, and the αβ/αα states will tend that of the αα state, hence there will be a larger population difference for the A transition (2Δ) than the equilibrium difference (Δ). Conversely, if ω_0 dominates, then the βα/ββ will tend to the βα population, and the αβ/αα will tend to the αβ population, i.e. the population difference will tend to 0. It is important to recognize that the ω_2 and ω_0 processes only occur by mutual interaction the spins of A and X by the DD mechanism, not by other relaxation processes that involve other mechanism for producing fluctuating magnetic fields.

Shown below is an analysis of the population of a sample (population difference *greatly* exaggerated) if ω_1 is the only relaxation pathway operative. First we irradiate the **X** transition, which will induce transitions of the X nucleus until the population is equalized. Then we turn off the decoupler and watch the sample

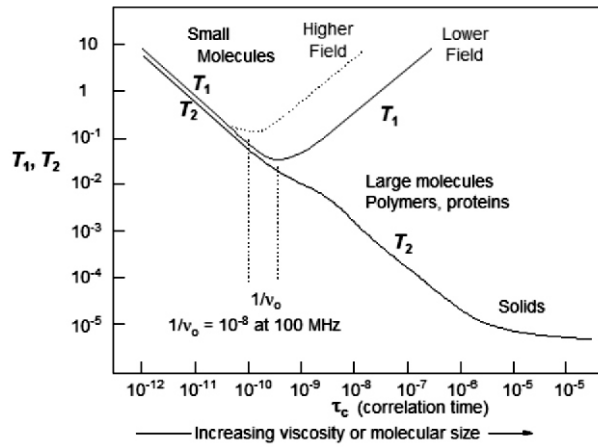


The ω_1 process simply restablishes the normal population difference between the α and β states for the X nucleus. A is not affected.

Now consider the situation when either the ω_0 or the ω_2 processes are the only ones operative. In the ω_0 process, the dipolar interaction between A and X causes an A nucleus to undergo an $\alpha \rightarrow \beta$ transition when the X nucleus relaxes from $\beta \rightarrow \alpha$ ($\alpha\beta \rightarrow \beta\alpha$). The net result is that as X returns to its normal population difference, it lowers the population difference for A. Thus, as the X intensity decreases, the A intensity decreases. If X is irradiated continuously then the signal for A will vanish (-100% NOE). **This is a negative NOE.**



For the ω_2 process, each time an X nucleus relaxes from β to α state, and A nucleus also undergoes a β to α transition ($\beta\beta \rightarrow \alpha\alpha$). This has the effect of increasing the population difference of A, i.e. an increase the area of A. **This is a positive NOE**. The phenomenon has sometimes been referred to as *spin pumping* - changing the population difference of X pumps A spins either from α to β or β to α.



The reason we get NOE population changes is that the three dipolar relaxation pathways contribute to differing extents depending a number of factors. A key one is that the balance between ω_2, ω_1 and ω_0 depends crucially on molecular motion (τ_c). In mobile solvents molecular motion is much faster than the Larmor precession frequency (ν_0). Under these conditions the double-quantum relaxation ω_2 is more effective than ω_1 or ω_0, because there is a better match between τ_c and 2 ν_0 (ω_2) than between τ_c and ν_0 (ω_1). If ω_2 is the *dominant* relaxation process, then we get a positive NOE.

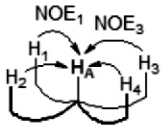
In real life, all three transition probabilities are finite. The equation governing the size of the NOE is shown below:

$$\frac{M^A}{M^A_0} = 1 + \overbrace{\frac{\omega_2 - \omega_0}{2\omega_1 + \omega_2 + \omega_0} \cdot \frac{\gamma_X}{\gamma_A} \cdot X_{DD}}^{\text{NOE}}$$

X_{DD} = mole fraction of DD relaxation of A by X

Thus when $\omega_2 > \omega_0$ the NOE will be positive, when $\omega_0 > \omega_2$ the NOE will be negative, and if $\omega_2 = \omega_0$ then there is no NOE. There will also be no NOE if the fraction of DD relaxationis small, *The maximum NOE observable is reduced to the extent that T_1 relaxation pathways other than DD between X and A are operative*. This includes intermolecular DD processes (for example by solvent molecules or by dissolved dioxygen) and relaxation by the CAS mechanism (common for heavy nuclei) or QR mechanism(seen for quadrupolar nuclei).

For small molecules in low-viscosity solvents molecular motion is faster than ν_0 leading to $\omega_2 > \omega_0$. A net positive NOE is expected. In fact, for such solutions the relationship $\omega_2 : \omega_1 : \omega_0$ is 12 : 3 : 2. Under these conditions the maximum proton-proton NOE that can be seen is 50% ($\gamma_X = \gamma_A$). What this means is that the sum of all of the NOE enhancements on a single proton cannot exceed 50%.



$NOE_1 + NOE_2 + NOE_3 + NOE_4 \leq 50\%$

- For small molecules in mobile liquid solution the double quantum relaxation is most efficient:

  $\omega_2 : \omega_1 : \omega_0 = 12 : 3 : 2$

  For the homonuclear case (A = X = ^{1}H):

  $NOE = 0.50 \cdot X_{DD}$

  For the heteronuclear case (A = ^{1}H, X = ^{13}C):

  $NOE = 1.99 \cdot X_{DD}$

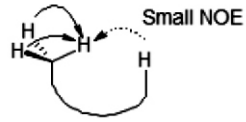
- When molecular correlation time is < ν_o (large molecules or viscous solutions) then:

  $\omega_0 >> \omega_1, \omega_2$

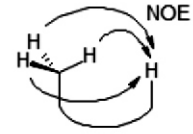
  For the homonuclear case (A = X = ^{1}H):

  $NOE = -1.0 \cdot X_{DD}$

One consequence of the fact that all NOEs on one proton cannot add up to more than 50% is that methyl groups as "receiver" will generally show rather small NOEs, because for any one proton in the CH_3 group, the main relaxation partners will be the other two protons within the methyl group. Remember that there is a $1/r^6$ distance dependence of DD relaxation. However methyl groups usually give well defined sharp peaks, typically in an uncrowded part of a spectrum, so even small NOE enhancements can be easily detected with modern pulse gradient NOE experiments.



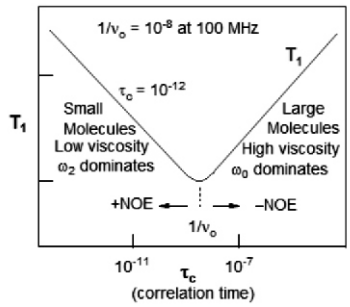
Me groups show small NOE effects

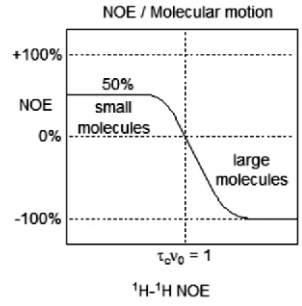


Me groups cause normal sized NOE effects in other protons

The size of the NOE is also directly proportional to the ratio of the magnetogyric ratios of the the "sending" (X) and "receiving" (A) nuclei. Thus the smaller the γ of a receiving nucleus, the larger will be the NOE produced by a irradiating the proton signals.

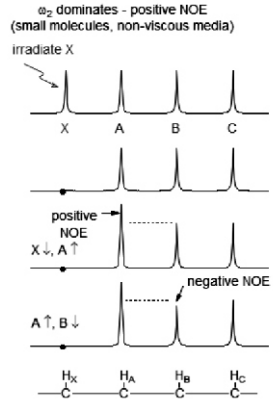
Effect of Molecular Motion and Molecular Size on NOE. For large molecules and/or high viscosity solvents (such as water or DMSO) molecular motion can become slower than the Larmor precession frequency, and the zero-quantum relaxation pathway then becomes very efficient ($\omega_0 > \omega_2$). Under these conditions negative NOEs approaching -100% can be observed. It is sometimes worthwhile to manipulate solvent viscosity and temperature to achieve negative NOE's, since these are inherently larger than the positive NOEs seen under conditions of fast molecular motion.



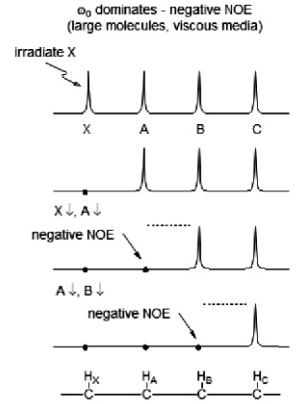


For molecules in the "crossover" region (MW around 1000) where the NOE effects may be very small, the ROESY (Overhauser Effect in the rotating frame) experiment can be used, which does not have this limitation.

The Relay NOE Effect. Since the NOE is the consequence of population changes in nucleus X, and since the effect causes the populations of nearby nucleus A to change, it is clear that there can be secondary perturbations of populations (relay NOE effect, or spin diffusion) where A affects B, B affects C, and so on. In other words, when the population of a proton is changed by an NOE, this change can itself influence the populations of other protons near it. In the fast molecular motion regime, relay effects alternate in sign down a chain, when in the slow motion regime, direct and relay effects both have negative signs.



H_B will show a small negative "relay" NOE once the population of H_A has been perturbed by the direct NOE from H_X.

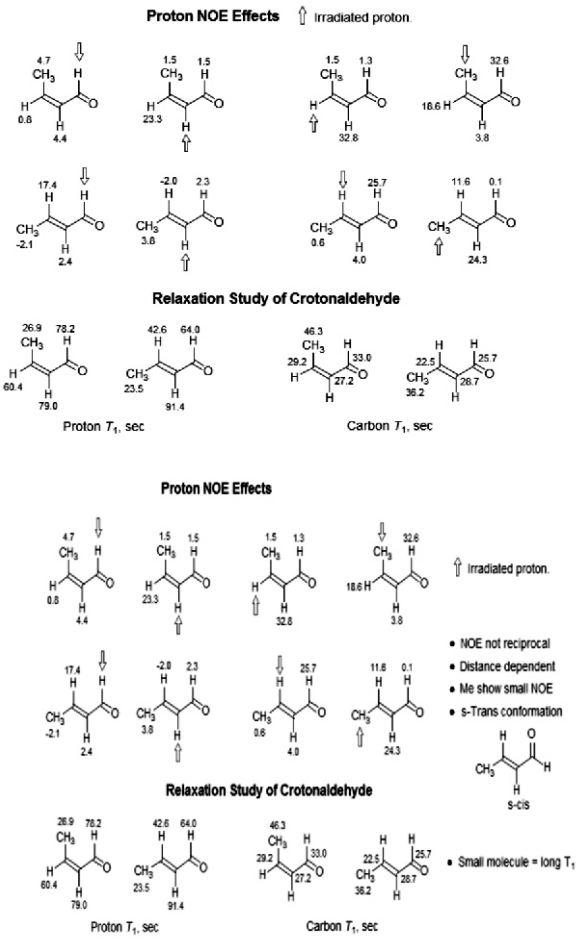


H_B will show a negative "relay" NOE once the population of H_A has been perturbed by the direct NOE, in spite of the fact that H_B is too far away to be directly affected by H_X. In favorable circumstances, this effect can propagate over several bonds.

To avoid false information from relay effects, irradiation times must be on the timescale of the T_1 of the A nucleus, or shorter, to minimize secondary population changes. False information is particularly easy to obtain when operating in the slow-motion regime, where both direct and relay NOEs have the same sign.

NOE Basics

The careful NOE study of *E*- and *Z*-crotonaldehyde (Rowan, McCammon, Sykes, *J. Am. Chem. Soc.*, **1974**, *96*, 4773) illustrates some important considerations in interpreting NOE data. The size of the NOE enhancement for a particular pair of proton is principally a function of two variables - the primary one is the distance between the "sending" and "receiving" protons (there is an $1/r^6$ dependence on distance). A secondary one requires consideration of what other protons are contributing to the DD relaxation of the "receiving" proton. If there are other protons that are closer than the "sending" one, then the "receiving" proton will of necessity show a smaller NOE enhancement. Thus when a Me group is the receiver, the NOE enhancement is always small (<5%) even when the "sending" proton is very close. This is because each methyl proton has two much closer DD coupled partners which provide the principal relaxation pathway, resulting in only a small contribution from more distant protons outside the methyl group.

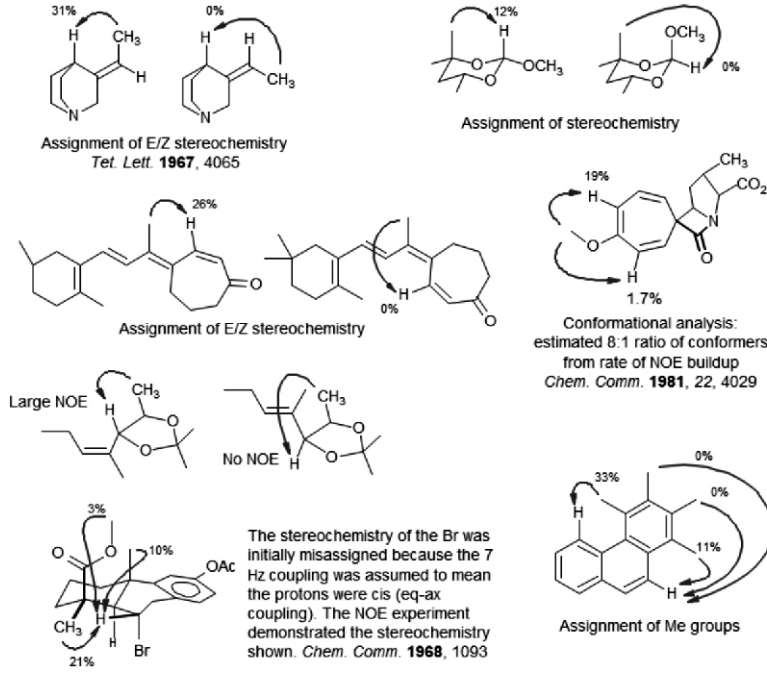


The NOE data for crotonaldehyde allow the conclusion that the compound is mostly present in the s-trans conformation, since the s-cis would show rather different NOE enhancements.

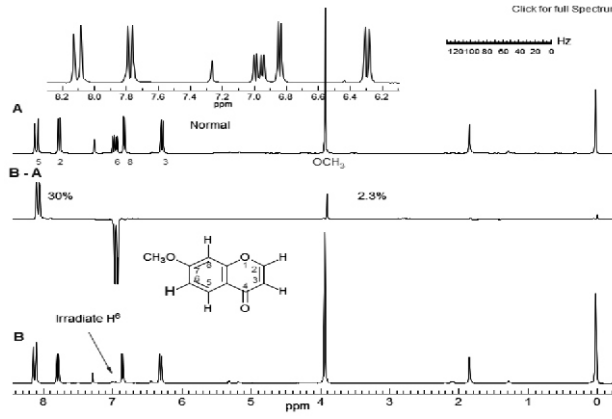
NOE Experiments

The earliest NOE experimental method involved the straightforward process of decoupling one proton for a few seconds and then measuring a spectrum (Anet, F. A. L.; Bourn, A. J. R. *J. Am. Chem. Soc.* **1965**, *87*, 5250). Careful peak integrations were then used to determine which protons showed enhanced integrations, and thus were close in space to the decoupled one. Because of the inherently low accuracy of integrations, only large NOE effects could be reliably detected in this way. Thus methyl groups were almost always used as the "sender" rather than "receiver" because a large fraction of the relaxation of a methyl proton occurs from DD interactions with the other two protons of the methyl group, and only to a small extent by external protons.

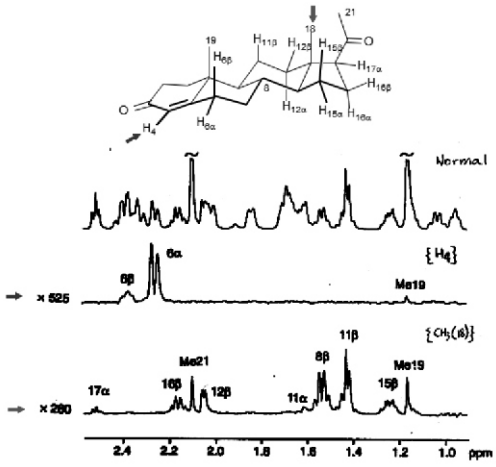
Some typical structural problems addressed in this way are shown below. NOE experiments are not often used for initial structure determination, but rather for refining details of a mostly known structure. Thus the most common application has been the determination of stereochemical and conformational relationships in relatively rigid molecules, since in conformationally mobile molecules NOE effects tend to be much smaller, and often were not reliably detectable by these direct methods.



With the development of stable spectrometers capable of precise difference spectroscopy an improved method for the measurement of NOE effects with higher accuracy became available (DNOE). Here a control spectrum, with the decoupler set to some innocuous frequency, is subtracted from the spectrum with irradiation of a specific multiplet. The resulting difference spectrum gives a large negative peak for the irradiated multiplet (it is saturated) and positive peaks for any proton whose area has been enhanced by the NOE interaction (occasionally these spectra are plotted with inverse intensities). Unaffected peaks are absent, or show a small sinusoidal oscillation due to small chemical shift mismatches caused by the decoupling process, which integrate to 0. NOE effects of less than 1% can be detected in this way.



A typical simple DNOE experiment on 7-methoxychromanone is shown below. Spectrum A is a normal ^{1}H NMR spectrum (200 MHz, $CDCl_3$ solvent) . Spectrum B was obtained by pre-irradiating signal *c* with the decoupler before taking the spectrum. The decoupler was off during the acquisition. The middle spectrum is the difference between the two (B minus A) (*Magnetic Reson. Chem.* **1985**, *23*, 90). Assign all of the signals in the spectrum.**For other NOE examples see**: 1, 2, 3.

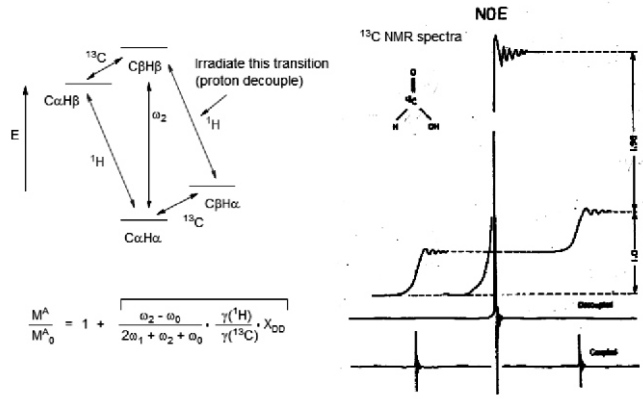


The current methodology for obtaining NOE spectra involves a pulse gradient method in which the enhanced signals are directly detected, without the artifacts introduced by subtraction, leading to very high quality NOE spectra (DPFGSE-1D-NOESY). A steroid example below from the original paper (*J. Am. Chem. Soc.* **1994**, *116*, 6037).

Measurement of H-H distances. The size of an NOE enhancement is strongly related to the distance between the two protons, but it is also a function of other relaxation processes operating on the "receiving" proton. Distances between protons are more directly related to the rate of buildup of the NOE enhancement. A series of experiments are carried out with inceasing mixing times, and the increase in NOE enhancement is followed. The closest protons will show the most rapid build-up rates of the NOE. This sort of experiment, usually performed using the 2D NOESY technique, can map H-H distances in complicated molecules ranging from large natural products, to polypeptides, small pieces of DNA and even small proteins.

NOE in Carbon-13 NMR Spectroscopy

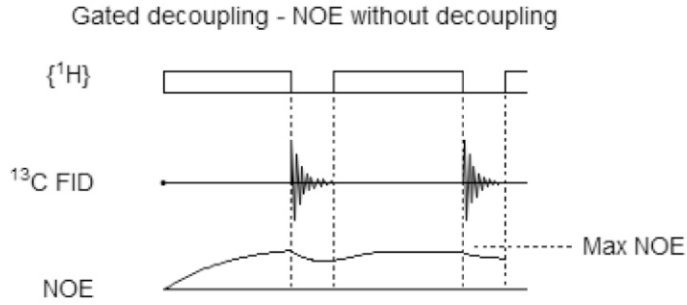
^{13}C spectra are commonly measured with noise-modulated ^{1}H decoupling. In most molecules the C-H carbons are relaxed almost entirely by the DD mechanism. Decoupling of the protons thus gives an NOE of the carbon signals. The carbons achieve a population difference like that of protons, so that much larger NOE's are observed, as high as 199% if the carbon is relaxed 100% by the DD mechanism.



The energy levels of four spin states for a ^{13}C-^{1}H pair is shown. Decoupling the protons equalizes the populations of the CβHβ and CβHα states, as well as the CαHα and CαHβ states. If ω_2 dominates, then the population difference between the Cα and Cβ energy levels is determined by the energy difference between the CβHβ and CαHα states, which is four times as large as the energy difference between the CαHα and CβHα states, hence one expects a much large NOE enhancement than for the H-H situation.

Coupled ^{13}C NMR Spectra with NOE. The measurement of undecoupled ^{13}C NMR spectra is usually very time consuming since many of the carbon signals are split into complex multiplets, and there is no NOE enhancement of signal intensities. However, a nearly maximum NOE enhancement can be achieved by use of *gated decoupling*, in which the decoupler is kept on during a delay period when the NOE enhancement builds

up, but turned off during acquisition of the FID, so that fully coupled spectra are obtained. This works because the decoupling effect turns on and off nearly instantaneously (microseconds), whereas the NOE enhancement builds up and decays on the time scale of T_1 (seconds).

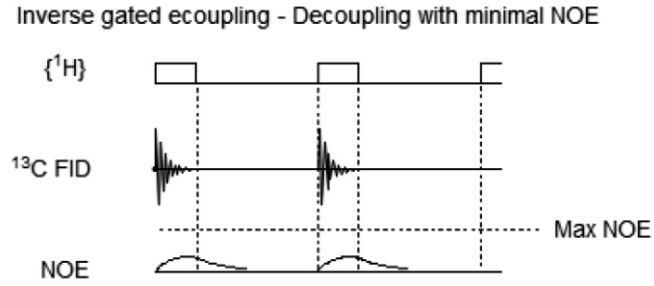


Integration of Carbon Spectra. ^{13}C NMR spectra cannot usually be accurately integrated since there are several effects which change the areas of the peaks:

1. Spectra are often run under *saturation conditions* with insufficient delay time between pulses for full recovery of magnetization. Since T_1 of carbons vary between 0.1 to >100 sec, individual pulses have to be as much as 500 seconds apart ($5T_1$) to permit complete relaxation of all carbons if accurate integrations are to be obtained.

2. The Nuclear Overhauser Effect increases the area of individual peaks depending on the extent to which DD relaxation versus other pathways relax a particular carbon.

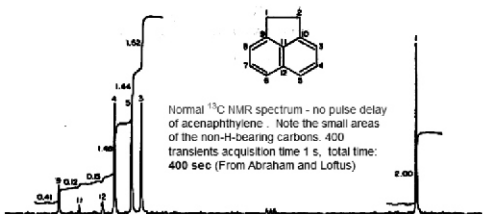
Spectra with minimal NOE enhancement can be obtained by using the *inverse gated decoupling* technique, in which the decoupler is on only during the short acquisition time, but off otherwise, so that only a small NOE enhancement builds up.

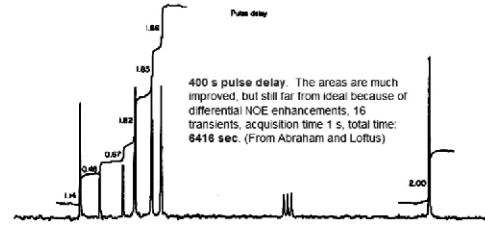


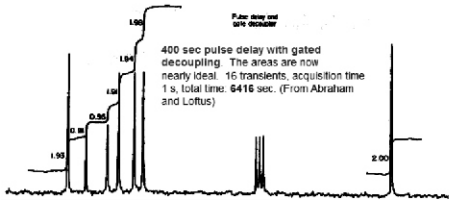
An alternative technique for obtaining integrable spectra is to use the relaxation reagent $Cr(acac)_3$, which will shorten T_1 for all carbons by the action of unpaired electrons on the chromium. This will both reduce the saturation problems (by decreasing T_1) and reduce or eliminate the NOE enhancement (by reducing or eliminating proton-carbon DD relaxation). Unfortunately, it is not feasible to add $Cr(acac)_3$ to all samples.

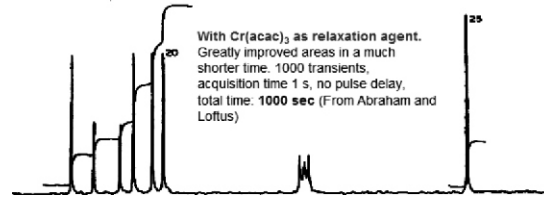
Below a series of ^{13}C NMR spectra which illustrate the problems in achieving accurate integrations of ^{13}C NMR signals, whose area can be strongly affected both by saturation effects (for quaternary carbons with very long T_1 values), and by the NOE enhancement.

Heteronuclear NOE









A number of heteronuclei have negative gyromagnetic ratios. Such nuclei will have the sign of NOE reversed, leading to reduction in intensity, nulled peaks, or negative signals if proton-X DD relaxation is present and proton decoupling is being used. Some common spin 1/2 nuclei with negative γ are ^{15}N, ^{29}Si, and ^{119}Sn. If spectra of these nuclei are taken with proton decoupling, then the NOE will reduce the intensity of the signals, or even make them negative. It is usually advantageous to take such spectra with pulse techniques that involve polarization transfer from proton to the heteronucleus to minimize the negative NOE.

NOE is observed only for nuclei relaxing by the dipole-dipole mechanism. For most quadrupolar nuclei (^{6}Li is a rare exception) the principal relaxation pathway is the QR mechanism, so that little or no NOE can be detected. Even many spin ½ nuclei with large chemical shift ranges (e.g., ^{77}Se, ^{199}Hg, ^{125}Te) show no NOE as a result of proton decoupling because the principal relaxation pathway is the CSA mechanism (Chemical Shift Anisotropy).

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PESTICIDES IN FOOD CHAIN

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Abstract

In the thirst of modernization and industrialization man has contributed pollution to the life and ecology of plants, animals and microbes. Increased demand for food and fiber has lead to the chemicalization of agriculture and we have reached on such a stage that modern agriculture is dependent on high yielding varieties, which can only be grown under the influence of fertilizers and pesticides. Pesticides are the man made chemicals which are being used to produce enough cheap food. In India, 90,000 MT of technical grade pesticides are used annually to control pests and plant diseases.Pesticides are classified as insecticides, fungicides, weedicides, herbicides, nematodicides and rodenticides; of which insecticides constitutes 77% of the total pesticides used in different agricultural and animal husbandry practices and in public health operations. Majority of these pesticides are beneficial when used for specific purposes, handled properly and applied as per the recommendations of the manufacturer.Application of pesticides to crops and animals may leave residues in or on food when it is consumed, and those specified derivatives are considered to be of toxicological significance.

Introduction

Pesticides residue refers to the pesticides that may remain on or in food after they are applied to food crops. The maximum allowable levels of these residues in foods are after stipulated by regulatory bodies in many countries. Exposure of the general populationof these residues most commonly occurs through consumption of treated food sources, or being in close contact to areas treated with pesticides such as farms or lawns.Many of these chemical residues, especially derivatives of chlorinated pesticides, exhibit bioaccumulations which could build up to harmful levels in the body as well as in the environment. Persistent chemicals can be magnified through the food chain and have beendetected in products ranging from meat, poultry and fish to vegetable oils nuts and various fruits & vegetables.If we look retrospectively, we find that the use of pesticides started during Second World War when these hazardous and toxic poisons were considered as chemical weapons. A swiss scientist Paul Muller invented DDT in the year 1939 which was considered as a wonder chemical that kills the insects, pests and was found wonderful in malaria control programmes. But soon after the discovery of DDT, its harmful effects also came into the knowledge of the scientists. In 1944, a famous biologist found harmful effects of DDT in birds, which produced thin shelled eggs, easily broken in nests resulting into failure of reproduction and decline of bird population.

The amount of pesticides used in India is very low (only 0.5 kg/ha) as compared to other developed countries, even then we have much higher pesticide residues in food of our country. There is a gradual increase in production and consumption of pesticides during last few decades. The pesticides consumption increased from 2353 MT during 1955 to 75033 MT (technical grade) in the year 1991 - 1992 and which is again in the decline phase with the adoption go integrated pest management practices and the pesticides consumption level declined to the level of 57353 MT (technical grade) in the year 2014 – 2015.

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Reasons for higher pesticide residues in India

1. Indiscrimate use of pesticides

The use of pesticides is comparatively more in certain crops while in some it is negligible. The farmers use pesticides more frequently and in increased doses than the recommended doses or procedures. It leads to the presence of high amount of residues in food commodities.

2. Disproportionate use of pesticides

The pesticides are used disproportionately in India in relation to places and the amount of pesticides residue varies from one place to another. Pesticide residues in the feed and fodder are solely responsible for their accumulation in animal and poultry. The states like Tamil Nadu, Arunachal Pradesh , Punjab, Harayana and Karnataka have highest use of pesticides in order to get more production while on the other hand the states like Bihar, West Bengal, North easternstates have lowest use of pesticides. It is because of illiteracy of farmers, poor economic conditions or due to lack of awareness. So the food commodities in high using states have more residues of pesticides.

3. Lack of education

Most of the farmers or laborers working in agricultural fields are either illiterate or having low formal education. They are not able to understand and read the instructions mentioned on pesticides containers or in the literature supplied with them. Their tendency is to use comparatively higher quantity of pesticides then recommended by the scientists/manufacturers. They ignore the required dilution factor and use much higher concentration of the pesticides. They are even not aware of the harmful effects of the pesticides and do not properly dispose the used containers of the pesticides.

4. Lack of extention activities

Inspite of Krishi Vigyan Kendra, Krishi Gyan Kendras and a network of extension workers of the government /NGO's, there is a lack or deficiency in proper extension activities in India. The farmers are not fully aware about how to use pesticides, what precautions they should take in order to reduce the acute and chronic effects of pesticides? Farmers do not keepproper difference between the last application of pesticides and harvesting the crop, which leads to increased level of pesticide residue in food items and ultimately in animal products.

5. Inadequate literature supplied by the manufacturers

The pamphlets/ literature supplied by the manufactures along with the pesticide packing is incomplete and inadequate. Though it is written in many regional languages/ scripts but the printing, letter size and quality of paper is so poor that even an educated person cannot read and understand it what to talk of farmers or laborers. It has been observed that one of the reasons to use a much higher concentration than the recommended ones is lack of proper literature.

6. For want of more production and profit

Most of the farmers have impression in their mind that spray/use of more pesticide will lead to higher production. Therefore, the desire of more production and profit leads to indiscrimate use of pesticides in crops which ultimately enters in the food chain.

7. Lack of safer pesticides

So far very few pesticides have been discovered which are harmless to human being or other domestic animals. Therefore, farmers have to use the available pesticides only which have a very narrow safety margin.

8. Use of banned pesticides

In our contrary most of the banned pesticides are available in market and are used in various agricultural operations. This is primary because of the failure of Govt. to formulate and implement effective policies regarding the use of pesticides.

Secondly, the socioeconomic condition of formers does not allow to strictly monitoring the use of dangerous pesticides in agriculture and animal husbandry. These pesticides have been banned because of their acute/chronic harmful effects on the animal/human health. Thus their use adds to the misery and poor health of farmers and consumers.

In spite of ban, DDT and BHC are still produced in India and we have 77% DDT and 95% BHC in India out of their total production in world.

9. Man is ultimate consumer

Man is the ultimate consumer of pesticide residues. Though fodder, water, air and other feed stuffs pesticide residues reaches in animals and then through milk, meat, egg and other animal products accumulates in human being. Various pesticide residues have been reported from animal products in our country; important among them are DDT, Carbaryl, Hepatochlor, PCB etc. These pesticide residues in animal products and other food items ultimately get accumulated in the man especially in the adipose tissue, blood and lymphoid organs. Most of research on pesticide toxicity has been directed towards the assessment of their acute effects. When fed to man or animals at very low doses daily for months or years, these accumulated pesticides in body, may harm the normal function causing various diseases in man and animals.

Status of pesticide residues in India

The presence of pesticide residues have been detected in various items and in food chain. The levels of the pesticides are found much higher than expected level because of heavy contamination of environment. A list of commodities is given in which very significant levels of pesticides are recorded (Table-1).

Table : 1 Pesticide residues in food chain

Sl.	Items	Pesticide residues detected
1.	Soil and water	Permethrin, Cypermethrin, Fenvelerate, Deltamethrin, DDT. Aldrin, Dieldrin, BHC, Heptachlor, Lindane, Endosulfan
2.	Air	DDT, BHC
3.	Fodder (Lucerne)	Monocrotophos, Phosphomidon, Endosulfan
4.	Cattle feed	Cypermethrin, DDT, BHC
5.	Pasture & Hay	DDT, Aldrin, Dieldrin, BHC, Heptachlor, Lindane
6.	Rice, Wheat, Flour, Oils	DDT, BHC
7.	Dairy Product, Baby milk powder, Butter, Ghee, Cow/buffalo milk	DDT, BHC, HCB, PCB, Heptachlor
8.	Meat, Eggs	DDT, Heptachlor, PCB, Carbaryl
9.	Liver, Kidneys, Hair, Skin	Cypermethrin
10.	Vegetables	Endosulfan
11.	Adipose, tissue of man	BHC, DDT, PCB, HCB, Heptachlor, Aldrin
12.	Human breast milk	BHC, DDT, Aldrin. Heptachlor, HCH

Besides, these are human milk, fat or tissue samples screened for the presence of pesticide residues were also found to have very significant levels of harmful pesticides. The BHC has been found from 0.120 to 1.22 PPM in human fat samples. Heptachlor, an organochlorine pesticide was found to be 0.425 PPM and DDT from 0.195 to 1.695 PPM. Even human breast milk is not free from DDT, which was found to have even 2.39 PPM levels. Similarly human blood was found to have a much higher concentration of 12.00 PPM as against of 0.050 PPM safe levels (no effect levels).

Strategies to combat with pesticide residues related problems

A. Government level

1. The farmers should be advised about the harmful effect of pesticide so that they should minimize the use of pesticides in crops. They should judiciously use the pesticides in term of their quantity and frequency.
2. It should be assured that the pesticides produced in country should be distributed proportionately so that the indiscriminate and the improportionate use can be avoided.

3. All emphasis must be laid on the development of Bio-pesticides like viral, bacterial or fungal pesticides or pesticides of botanical origin like Neem or Tulsi or of cow urine based pesticides, which can be used in crops to kill insect pests without polluting the environment.
4. The harmful pesticides like some organochlorines, organophosphate and carbamates must be banned strictly in India, their production, import or use should be completely banned.
5. To reduce the effect of pesticides residues, some herbal preparation should be developed which can overcome the immunopathological, neuropathic or nephropathy effects, there are many herbs mentioned in our Indian ancient literature, which can be scientifically validated to prevent and control the harmful effect of pesticides. This will certainly give a new direction to the world not to depend on synthetic things.

B. Individual Level

1. Use fresh foods as for as possible and after proper cleaning. Vegetable should be kept in lukewarm water with 0.89%salt for at least 30 min. before use.
2. Avoid the shining vegetables / fruits such as tomatoes, brinjal, lady's finger, apple etc.
3. Try to have such vegetables/fruits/cereals/pulses which are grown under organic farming.

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CLIMATE CHANGE AND ITS PONTENTIAL IMPACT ON TEMPERATE FRUIT PRODUCTION

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Introduction

Climate on Earth has changed many times during the existence of our planet, ranging from the ice ages to periods of warmth. During the last several decades increases in average air temperatures have been reported and associated effects on climate have been debated worldwide in a variety of forums. Climate change refer to any change in climate overtime whether due to natural variability or as a result of human activity (IPCC, 2007). Climate change is recognised as a significant man-made global environmental challenge. Human activities are affecting the composition of the atmosphere, influencing global and regional temperature and through these a large range of physical and biological processes. Global climate change is driven by the rising concentration of greenhouse gases in the atmosphere including CO_2, N_2O, CH_4 and CFC due to fossil fuel burning, rapid industrialisation and deforestation (IPCC, 2001). The atmospheric concentration of CO_2, CH_4 and N_2O has grown by about 31,151 and 17 per cent respectively in last 150 years. The IPCC (2007) reported that CO_2, CH_4 and N_2O concentration in atmosphere were 280 ppm, 715 ppb and 270 ppb in 1750 AD which rose to 379 ppm, 1774 ppb and 319 ppb by 2005 AD, respectively. According to studies carried out by the Intergovernmental Panel on Climate Change (IPCC), average air temperatures will increase between 1.4 and 5.8 ^{0}C by the end of this century, based upon modeling techniques that incorporated data from ocean and atmospheric behavior (IPCC. Climate change, 2001).This phenomenon is called as climate change which can be defined as "statistically significant variation in either the mean state of the climate or in its variability, persisting for extended period.

The mechanism by which climate warming exerts its influence on fruit production is poorly understood and available literature concerning the possible effects of climate warming on fruit trees is also scarce. There are two different types of studies: Those that track historical changes in temperature and relate them to actual experimental observations in tree phenology and fruit size, and studies that simulate tree behaviour based on the forecast of temperature rise in the near future. Changes in the frequency and intensity of droughts, flooding, and storm damage are expected. Climate change is expected to result in long-term water and other resource shortages, worsening soil conditions, drought and desertification, disease and pest outbreaks on crops. Vulnerable areas are expected to experience losses in agricultural productivity, primarily due to reductions in crop yields.

Climate change has a potential to greatly affect agriculture in the same way as agriculture affects climate change. It will affect fruit crops, through there direct and indirect effects. The potential direct effects of global warming are on chill requirement, flowering time, risk of frost, length of growing season, maturity/harvest, fruit quality and increased pressure of pests and diseases (Jones, 2003; Guedon and Legave, 2008). Indirectly there may be considerable impact on horticulture land use due to snow melt, availability of irrigation, frequently and intensity of inter and intra- seasonal droughts and floods, soil matter transformation

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and soil erosion. Higher temperature is likely to affect some horticultural fruit crops especially temperate fruit which require winter chilling in order to break dormancy. Strong warming in autumn when trees are entering dormancy and continued warming in winter will have negative effects on chill unit accumulation and thus flower bud quality and final fruit size and quality. The apple cultivation in Himachal Pradesh is shifting to higher altitude gradually due to insufficient chilling hours which is prerequisite for bud burst in apple and other temperate fruits (Rabir et al., 2007). Low temperatures ($14/9^0$c day/night) are not conducive to large anthocyanin concentrations while temperature of 30^0c and higher lead to lower anthocyanin synthesis (Tarara et al., 2008) Soil moisture deficit will occur more rapidly due to increasing evapo-transpiration rates and will increase the demand for irrigation (Doll, 2002). In southern Spain, it has been projected that climate change may reduce available water up to 30 per cent which increases irrigation requirement (Rodriguez Diaz et al., 2007). Higher temperature affect pollen viability and has resulted in flower bud drop in peach (Weinberger, 1956) and apricot (Ruez and Egea, 2008). Warming pre-blossom temperatures have also been reported to decrease fruit set and fruit production in apricot due to abnormal flower development and non-viable flowers (Legave et al., 2006). Over the last decade or so, climate change has gradually been recognised as an additional factor with which conventional pressure will have significant weight on the form scale, spatial and temporal impact on agricultural productivity. Climate change thus represents an additional burden that for farmers translates into production risks associated with crop yields, probabilities of extreme events, timing of field operations, and timing of investments in new technologies.

Causes of Climate Change.

Fossil fuel burning, rapid industrialization, deforestation, agricultural activities, modernisation (home appliances), space explosion, wetland destruction and land use change. Climate change is often linked to changes in modern climate of which one of the major causes is human activities. Increased fossil fuel usage contributes 5.5±5 billion tonnes of carbon dioxide. Rapid industrialization has increased CO_2 from 280 ppm in the pre-industrial era to 379 ppm, a 30 per cent increase. It is predicted that the level will be 450 ppm in 2050 resulting in 1.8-3^{o}C increase in temperature eventually. Cutting down forests particularly tropical rain forests has devastating effect on carbon cycle emission producing an extra 17 per cent of greenhouse gases. The global average to greenhouse gases from agriculture is only 13.5 per cent while as India contributes 28 per cent through agriculture (Aggarwal, 2008). The greenhouse gases are relatively transparent to incoming solar radiation, allowing the sun's energy to pass through the atmosphere to the surface of earth. The energy is then absorbed by the earth's surface. Some of the emitted radiation is absorbed by greenhouse gases and then re-emitted in all directions. The effect of this is to warm the earth's surface and lower atmosphere. CO_2 is largest contributor to greenhouse effect. Methane, nitrous oxide, chlorofluorocarbons and other greenhouse gases are present only in trace amounts, but can still have powerful warming effect (Table-1). The emission from agriculture is mainly due to rice fields, enteric fermentation in ruminant animals and nitrous oxides from application of manures and fertilisers.

Table-1: Major contribution of Green House Gases

Gas	% contribution	Global warming potential
CO^2	76 %	1
Methane	13%	21
Nitrous oxide	6%	290
Chloroflorocorban	5%	1500
Sulphur hexafluoride	Traces	

[Source : IPCC, 2001]

Environmental factors influenced by climate change

These include temperature, precipitation, frost, relative humidity, light

Temperature:

Through a series of observation and modeling studies the IPCC has shown that GHGs have resulted

in warming of the climate by 0.74°C between 1906 and 2005. This has in turn resulted in increased average temperature of global ocean, sea level rise and decline in glacial and snow cover (IPCC, 2007a).

Effect of temperature on flowering:

Temperature is often considered the most important factor influencing phonological phases of fruit trees in temperate climate (Chmielewski et al., 2004, Lu et al., 2006). Higher temperatures enhance biochemical reactions which consequently shorten the growing season and influences phonological phases of individual plants (Chmielewski et al., 2004). To this end it is widely reported that tree phenology is strongly correlated to temperature, and thus long term temperature changes have altered the fine-scale timing of plant phonological phases (Sparks et al.,2000, chmielewski and Rotzer,2002, Chmielewskiet al.,2004, Doi and Katano, 2008, Guedon and Legave, 2008, Vitasse et al.,2009). For the timing of blossoming, it is likely that winter and early spring temperature will be most important as they would correspond to main period of chilling and heat required. Temperate fruit trees develop their vegetative and fruiting buds in the summer and as winter approaches; the already developed buds go dormant in response to both shorten day lengths and cooler temperature. These buds remain dormant until they have accumulated sufficient chilling unit (CU) of cold weather.

If the buds do not receive sufficient chilling temperature during winter to completely release dormancy, tree will develop one or more deficiency symptom associated with insufficient chilling a) Delayed foliation b) reduced fruit set and increase buttoning and c) reduce fruit quality. If mild winter is followed by warmer spring, bud burst is advanced and onset of growth occur earlier (Root et al., 2003; Parmesan, 2007; Primack et al., 2009). However flowering may be delayed as mean temperature increases in winter and decreases in spring. Due to warm temperature in March buds opens earlier and are more susceptible to frost damage. Advancement of apple and pear tree full bloom dates in response to increase in mean annual temperature from 1973-2009 was observed (Stafan Grab, 2011). He found that 1°C increase in spring temperature would advance bloom by 3.6 days. Solar et al. (2008) found influence of temperature on bud break date in walnut (Table 2, Fig. 1). In P_1 mean monthly temperature from Jan-Feb was 3.7°C compared to P_2 with 4.6°C. Due to increase in temperature in P_2 both G139 and franquette had earlier mean bud break date (BBD) compared to P_1 and it was 20 April in G139 and 28 April 28 in franquette instead of 23rd April (G-139) and 5th May in frequette. In P_2 franqutte had BBD variation of 11 days while G139 had a variation range of 5 days instead of 30 and 34 days for franquette and G139 in P_1. This shows that early cultivar react to warming more uniformly while in later cultivar move variability at the onset of BBD could be expected due to increase late winter and early spring temperature. Legave et al. (2009) reported that increase in 1°C temperature in different locations in Europe resulted in mean advancement in date of flowering in apple and pear (Table-3). In apple mean advancement was 7-9 days while as in pear it was 10-11 days. All these results support strong impact of temperature in flowering time and show low interaction between genotypes. They also reported that global warming exert two opposite effects simultaneously, slow mean rate of completion of chilling requirement and higher mean rate of completion of heat requirement (Fig. 2).

Table 2: Influence of temperature on bud break date in walnut

Statics	G 139		Franqette	
	P 1	P 2	P 1	P 2
Average day of year	113	110	125	118
Date	23April	20April	5 May	28April
Latest date	127 ,May7	113,April 23	134, May14	124, May 4
Earliest date	93, April 3	108, April 18	104, April 29	113, April 23
Variation range (days)	34	5	30	11
Standard deviation (days)	11.4	1.5	10.8	3.9

Fig. 1: Influence of temperature on bud break date in walnut

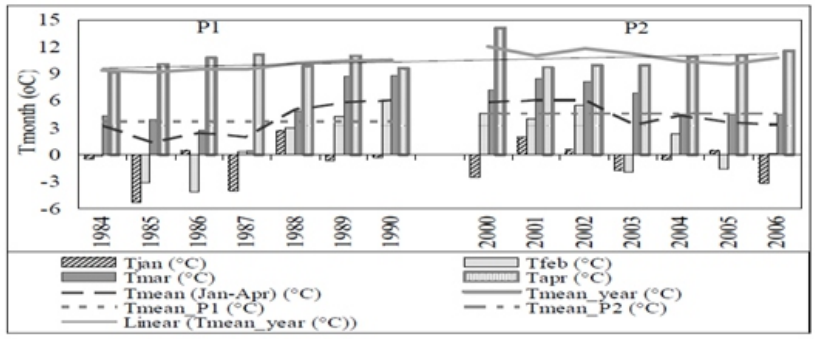
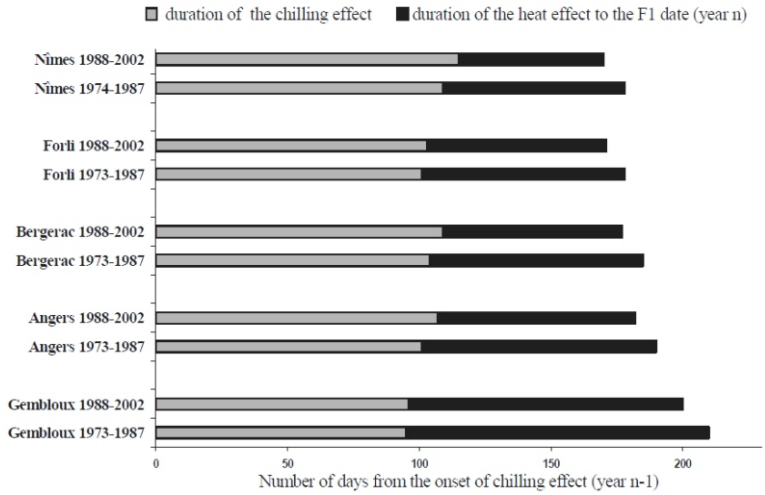


Table-3: Assessment of mean dates of flowering stages (calendar day) for different cultivars and locations, and corresponding mean advances (day) since the end of the 1980s (Source :Legaveet al ., 2009)

Cultivar and location	Observation period A 1975-1988 (14 years)	B 1989-2002 (14years)	B/A Mean advance
Apple Golden	Mean date of flowering F1		
Conthey	120-121	111-112	9
Angers	115-116	108-109	7
Forli	106-107	97-98	9
Nimes	101-102	93-94	8
Pear William	Mean date of flowering F1		
Conthey	115-116	104-105	11
Angers	104-105	94-95	10
Bergerae	101-102	91-92	10

Fig. 2: Effect of high temperature on growth period (Legave et al., 2009)



Effect of temperature on dormancy and flower development

Low warming scenario <1°C is unlikely to affect vernalisation of high chill fruit and if warming

scenario exceeds 1.5°C, it would significantly increase risk of prolonged dormancy for both stone and pome fruits. Mild winter results in delayed or irregular flowering reduced fruit set and extended flowering period. Climate change effects on winter chill have recently been analyzed for California (Baldocchi and Wong, 2008, Luedeling et al., 2009)),Germany (Luedeling et al.,2009)) and high-mountain oases in Oman (Luedeling et al., 2009)).Development and later expansion of leaf and flower buds are impaired (apple, black currant, raspberry). Increase in temperature and drought increased percentage of double pistil formation in nectarine (Flashman et al., 2010). Rodeigo and Herro (2002) also reported that warm temperature reduced normal pistil formation in apricot. Other effects of warm temperatures at the beginning of winter have been related with flower bud drop in peach and apricot (Ruiz and Egea, 2008).Warm pre-blossom temperatures have also been reported to decrease fruit set and fruit production in apricot due to abnormal flower development and nonviable flowers. This fact has been related to insufficient chilling accumulation (Legave et al., 2006)

Effect of temperature on yield:

Higher than normal temperatures affect the photosynthetic process through the modulation of enzyme activity as well as the electron transport chain (Sage & Kubien, 2007). Additionally, in an indirect manner, higher temperatures can affect the photosynthetic process increasing leaf temperatures and, thus, defining the magnitude of the leaf-to-air vapor pressure difference (D), a key factor influencing stomatal conductance (Lloyd & Farquhar, 2008). High temperature reduces fruit yield and consequently yield in peach cultivar Granada (Couto et al., 2010). Navatal et al. (2009) found that rise of diurnal air temperature in the interior of greenhouse promoted significant reduction in the production of pollen grains (Table-4 and 5). Guatum et al.2004 also found fluctuations in average minimum and maximum temperatures during apple bloom in relation to productivity. During 1998 the average minimum and maximum temperature remained between 10 and 23°C whereas in 1999 minimum and maximum temperatures were 15° and 29°C respectively. This increase in temperature causes low viability of pollen grains and ovule. In poor crop year, the flowering period was dry and desiccating.

Table-4: Morphological analysis, production and germination in vitro pollen grains of peach trees 'Granda' under distinct environments during the pre-blooming and blooming period during 2004, 2005

Treatment/year Anthers no normal pollen (%)	2004	2005	Average
Greenhouse	8.89	88.23	48.56
Orchard	5.84	2.22	4.03
Average	7.37	45.23	CV=13.32%
Anthers with more than 50% abortive pollen grains (%)			
Greenhouse	41.11	100.00	70.56
Orchard	19.91	33.25	26.58
Average	30.51	66.63	CV=3.51%
Production of pollen grains/anther			
Greenhouse	180.00	91.67	135.83
Orchard	455.00	226.67	340.83
Average	317.50	159.17	CV=36.30
Germination at 20 °C (%)			
Greenhouse	0.67	2.85	1.76
Orchard	41.06	4.62	22.84
Average	20.87	3.74	CV=32.32%
Germination of pollen grains at 25°C (%)			
Greenhouse	5.68	4.01	4.85
Orchard	0.00	3.65	1.83
Average	2.84	3.83	CV=31.86%

Table-5: Fruit set and production of fruit in peach var. Granda

Fruitset (%)			
Greenhouse	0.00	0.46	0.23
Orchard	2.22	5.59	3.90
Average	1.11	3.03	CV=39.12%
Yield (kg/tree)			
Greenhouse	0.00	0.35	0.18
Orchard	9.29	28.73	19.01
Average	4.65	14.54	CV=60.05%

(Source : Nava *et al.,* 2009)

Gautamet al. (2004) found reduction in yield of apple from 1996-2000 due to insufficient chilling hours (Table-6). Rabiret al. (2007) reported effect of temperature on shift of apple belt in Himachal Prades. Due to insufficient chilling hours accumulation at lower altitude which may result from rise in winter temperature, temperate fruit cultivation shifts to higher altitude where shortening of harvest period is reported. This again decreases photosynthetic accumulation and hence yields.

Table-6: Effect of winter chilling hours in relation to fruit productivity of Royal Delicious in H.P

Year	**Chilling hours (Nov-Feb)**	**Rainfall (mm)**	**Snowfall (mm)**	**Productivity (t/ha)**	**Overall productivity of state (t/ha)**
1996-97	1414	190.1	104.3	24.89	5.5
1997-98	1295	83.4	81.43	18.34	4.26
1998-99	1610	195	20.40	20.40	6.85
1999-2000	812	103.1	42.2	2.04	0.88

(Source : Gautam*et al.*, 2004)

Effect of frost susceptibility

In order to avoid frost damage of sensitive tissue in the cold winters of their regions of origin, trees from temperate or cold climates evolved a period of dormancy during the cold season. After certain duration of cold conditions (chilling), endodormancy is broken and the tree is ready to resume growth in spring. Chilling requirements vary substantially between species and cultivars from different parts of the world. Increased in winter temperature, anticipated in all scenario will result in a very substantial increase in the number of days with temperature above freezing and above 5^{o}C, thus extending and advancing growing season. Frost damage can also occur during dormant period, so the ability of plants to withstand winter frost may also be affected by climate warming. Zinone (2008) reported a that climate change results in expansion of growing areas into regional more susceptible to frost hence increasing risk of spring frost. Some Italian authors have reported a trend towards an increased risk of spring frost due to the expansion of growing areas into region more susceptible to frost (Zinoni and Antoleni, 2002; Zinoni, 2008). An increase in CO_2 concentration in the atmosphere reduces the resistance of some plants to freezing temperatures (Banker et al., 2005; Bertrand et al., 2007).

Effect of temperature on nutrients

High temperature increases availability of NH_4-N, total N and PO_4^{3-} while as concentration of NO_3-N,

calcium, sodium and magnesium decreases. It also enhance root growth increased GA, ABA and cytokinin. Eissenstat et al. (2001) found effect of high temperature and drought on root respiration and survivorship of apple roots. In dry soil root respiration is faster but nutrient availability is low due to lower soil water content. Root respiration of irrigated condition increases if temperature is elevated due to evaporation of water. Root survival during drought was high, in the ambient temperature, irrigated soil conditions and lowest in heated day soil conditions. The pattern of root survival is consistent with hypothesis that tree has some ability to maximize root efficiency by shedding inefficient roots and prolonging the longevity of more efficient roots. Tromp (1980) studied effect of root temperature and highlight intensity on dry weight, potassium and calcium uptake by apple tree (rootstock M9) [Table-7]. At low light intensity and low temperature, dry weight increment was reduced considerably; the effect was intensified by combining these factors. At each root temperature low light intensity gave decrease in absorption of K and Ca. However rates of Ca/K was hardly affected indicating that decrease was proportional to same for both ions, while as with respect to temperature K and Ca behave differently Ca proportion was much higher at low temperature than high root temperature which is indicated by increased Ca:K ratio at 8°C.

Table-7: Effect of root temperature and light intensity on dry weight increase, potassium and calcium by apple tree (root stock M9)

Light intensity	Root Temperature (°C)	Dry weight increase (g/tree)	Absorbed		Ca/K	Shoot Ca/K
			K (mg/ tree)	Ca (mg/ tree)		
High	18	28.1a	416a	410a	0.99a	0.59a
	8	18.5b	195b	392b	2.01b	1.05b
Low	18	15.7c	309c	301c	0.97c	0.59c
	8	9.6d	154d	331d	2.15d	1.09d

[Source : Tromp , 1980]

Effect of temperature on diseases and insects:

The change in climate results in the formation of new pathogen races and biotypes against which we have not tested any fungicide and therefore lead to further epidemic of new diseases. Wetter and warmer winter favours diseases (phytopathors, fussarium), drier and warmer summer favours diseases such as powdery mildew, sooty bark disease. The occurrence of stormy rains has increased bacterial gummosis of stone fruits. In raised mean annual temperature of 2°C butterflies will appear 2 to 3 weeks earlier and the range and distribution of butterflies will shift dramatically that effects pollination. Vary dry summer resulted in red spider mite and aphids more problem of attack an outdoor crops such as apple, raspberry.

Precipitation:

Climate change is expected to affect irrigation water demand due to increase in temperatures and changes in available soil moisture which is due to amount and distribution. Net irrigation requirements globally could increase or decrease by as much as 30 per cent by 2020 depending upon world region (Doll, 2002). In southern Spain, it has been perfected that climate change may reduce available water up to 34 per cent which increases irrigation requirement (Rodrguez Diaz et al., 2007).

The effect of deficit irrigation on yield and quality of the apple fruit is shown in Table-8. The current need to save water and improve the quality of agricultural production has raised the need of irrigation scheduling capable of achieving good results. Garcia et al. (2011) reported significance decrease in yield under different water stress (Table-9).

Table-8: Effect of deficit irrigation on yield and quality of the apple fruit

Fruit parameter	Effect	Reference
Yield	Decreased	Talluto *et al.* (2008)
Size	Decreased	Talluto*et al.* (2008)
Firmness	Increased	Mpelasoka*et al.* (2000)
Color	Improved	Killi *et al.* (1996)
TSS	Increased	Leib *et al.* (2006)
Aroma	Increased	Mpelasoka and Behboudian,2000
Storability	Improved	Mpelasoka and Behboudian,2000

Table-9: Effect of water stress on apple

Treatment	Yield (kg/tree)	No. of fruits/tree	Fruit weight (g)
T_1	5.3	59	91
T_2	7.1	63	114
T_3	7.9	68	117
T_4	7.9	66	120

[Source : Garcia *et al.*, 2011]

T_1 = severe stress; T_2 = moderate stress; T_3 = light stress; T_4 = no stress

Effect of deficit irrigation on fruit quality

Deficit irrigation increased TSS at harvest in peach (Gelly et al., 2003) and increased colour intensity in peach and apricot (Torreallas et al., 2000). Water stress enhanced red coloration in fruits. Since water stress reduces vegetative growth, light environment within the tree crown may improve colorations eventually (Naor, 2006). Miller et al. (1998) found that late water stress resulted in leaves with highest water content but if stress was given early, kiwi fruit at harvest had highest water content. Restricting water during the late phase of growth had an effect on fruit maturity due to `effect on ripening process.

Effect of moisture content an nutrient uptake

The uptake of nutrients by plants and subsequent distribution to the aerial parts is strongly influenced by environmental factors. This of course holds especially for the absorbing organ itself – the root – where soil moisture may direct affect the process of absorption. Water is essential to nutrient uptake by root interception, mass flow and diffusion. Roots intercept more nutrients especially Ca^{2+} and Mg^{2+} in most soil than in a dry soil because root growth is more extensive. Mass flow of soil water to supply transpiration stream transport most of NO^{-}_{3}, SO^{2-}_{4}, Ca^{2+} and Mg^{2+} to roots. Diffusion rate depends partly on soil water content, therefore with thickness water film or with a higher nutrient content, nutrients diffuse more readily. Tromp (1980) found that in both rootstocks (M9 and MM106) reduction of availability of water in soil reduced dry matter increment dramatically. The uptake of K and Ca was also reduced under drought conditions. However, Ca translocation in soil is less affected by drought than that of K which results in increased ratio of Ca/K with increasing dryness (Table-10). Tromp (1980) studied the ratio between absorption of Ca and K was not very marked, a slightly distinctly lower value was found at high humidity for both rootstock combinations. Translocation of nutrients such as Ca, Mg towards the root surface occurs mainly by mass flow whereas K diffusion is the main process. The highest uptake values were in general found at the high humidity level, at which transpiration was relatively low. This may result in a deficiency of Ca near the absorbing root surface, relative to potassium. Alternatively, in the opposite situation of low all humidity and a higher transpiration rate, the supply of K may have lagged behind that of Ca (Table-11).

Table-10: Effect of soil water conditions on potassium and calcium uptake and their ratio in apple tree

Rootstock	Soil moisture condition	Dry weight increase (g/tree)	Absorbed		Ca/K	Shoot Ca/K
			K (mg/ tree)	Ca (mg/ tree)		
M.9	Normal	14.0a	217a	309a	1.42a	0.91a
	Semi-dry	2.9b	50b	86b	1.72b	1.09b
	Dry	0.7c	15c	49c	3.27c	1.16c
MM.106	Normal	18.2a	226a	260a	1.15a	0.81a
	Semi-dry	4.7b	50b	99b	1.98b	1.26b
	Dry	3.8c	38c	78c	2.05c	1.35c

[Source : Tromp, 1980]

Table-11: Effect of relative humidity on potassium and calcium absorbed by the whole tree

Rootstocks	R.H	Dry weight increase (g/tree)	Absorbed K (mg/g)	Absorbed Ca (mg/g)	Ca/K	Shoot Ca/K
M.9	High	16.3	314a	193a	0.61a	0.53a
	Low	12.3	268a	204a	0.76b	0.63b
MM.106	High	25.4	385b	307b	0.80c	0.71c
	Low	13.4	222c	223c	1.00d	0.81d

[Source : Tromp, 1980]

Carbon dioxide

Changes in the concentration of CO_2 have potential to alter both physiological functioning, growth and structure of plants. Kumar and Parikh (2001) have reported that climate change on agriculture scenario of India results in loss of 32-40 per cent and 41-52 per cent for rice and wheat respectively. However, Bindi et al. (2001) found that CO_2 level elevated from current value of 350 to 550 ppm increased biomass by 40-50 as total biomass and dry weight. Elevated CO_2 has increased dry weight (Table-112) of strawberry (Wang and Bunce, 2004).

Table-12: Effect of elevated CO_2 treatments on dry weight of strawberry

CO_2 treatment (µ mol per mol)s	Dry weight (g per fruit)
Ambient (350)	2.05
Ambient +350	2.41
Ambient +600	2.84
CD(p=0.05)	0.05

[Source : Wang and Bunce 2004]

Effect of elevated CO_2 on fruit quality

The generalized effect of elevated CO_2 are shown in Table-14. High CO_2 increases dry matter, fructose, glucose and TSS (Table 13). High CO_2 growing conditions significantly enhanced level for ethyl hexanate, ethyl butanoate, methyl hexanoate, methyl bitanoate, hexyl acetate, hexyl hexanoate, furaneol, linalool and methyl octanoate.

Table-13: Effect of increased CO_2 on physiological and quality of fruits and vegetables

Physiological or quality parameter	Effect of high CO^2	Product	Reference
Photosynthesis	Increased	Potato	Jain *et al.* (2007)
Respiration	Decreased	Pears, apple, mango, lemon etc.	Fenseae*t al.* (2002)
Ripening	Decreased	Tomato	Klieber et a.,l (1996)
Stomatal conductance	Decreased	Spinach	Jain *et al.* (2007)
Firmness	Increased	Strawberry , raspberry	Haffn er*et al.* (2002)
Anthocyanin	Increased	Grape, strawberry	Wang *et al.* (2003)
Ascorbic acid	Increased	Strawberry ,orange	Wang *et al.* (2003)

Table-15 : Effect of carbon dioxide on fruit quality

Co2 treatment (µ mol per mol)	Sugar(mg/g dry weight)			
	Fructose	**Glucose**	**Sucrose**	**Total**
Ambient (350)	313.8	243.4	5.87	563.1
Ambient +300	364.4	259.7	6.43	630.5
Ambient +600	393	274.9	7.39	675.3
CD (P=0.05)	**10.23**	**11.56**	**o.15**	**15.36**

Adaptation strategies for mitigating effect of climate change

A) Breeding strategies:

a. These include development of new genotypes having resistance to high temperature, CO2 concentrations, heat and drought, marker assisted selection and development of transgenic having resistance to biotic and biotic resistance, crop diversification, and selecting a low chill variety in cold area will result in trees flowering too early and being damaged by late frosts, therefore, select early flowering and early ripening varieties for areas with intense summers (warm areas), while as late flowering ones for cooler areas.

B) Agronomic management strategies:

a) Development of cropping systems under various agro-climatic conditions, b) improvement in the irrigation and drainage systems, c) development of appropriate tillage and intercultural operations, d) integrated nutrient, weed, disease and pest management, e) development of water harvesting techniques, f) waste land utilization, g) development of crop specific models, h) use of modern technological tools for weather and i) development of pest and disease forecasting systems. Future research strategies for optimizing reduction under climate scenario

Crop improvement strategies:

Introduction of low chilling cultivars of pome, stone and nut fruits, introduction and collection of gene source from plant and animal kingdom for future improvement, diversification with other high value fruit crops(peach, apricot, walnut, kiwi), development of new genotypes having resistance to high temperature and CO_2 concentrations, marker assisted selection and development of transgenic having resistance to biotic and abiotic resistance and development of genotypes having resistance to heat and drought.

Conclusion

Understanding how climate changes will impact mankind in the decades to come is of paramount importance for our survival. Climate change impacts are to be looked not in isolation but in conjunction with all the aspect of agriculture and allied sectors. Temperature, carbon dioxide and ozone directly and indirectly affect the production and quality of fruit and vegetable crops grown in different climates around the world. It is necessary to develop phonological models in order to estimate the impact of climate change on plant development in different regions of the world. In the light of possible global warming, researchers should led more emphasis on development of low chilling, disease , insect, heat- and drought-resistance crops and at the regional level, those charged with planning for resource allocation, including land, water, and agriculture development should take climate change into account. Therefore, in the future more efforts are necessary to estimate the impacts of temperature rise on fruit trees, horticultural plants and agricultural crops. These estimations are possible and much easier to derive than reliable estimates of future crop yield changes.

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FOREST CONSERVATION ACT AND ITS DRAW BACKS

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Forest is a valuable component of human environment. For healthy living of human beings on earth, it is essential that at least one third of the land area on earth should be under forest cover. Covering the earth like a green blanket, these forests not only produce innumerable material goods but also provide several environmental services which are essential for life. The forest helps in keeping air fresh by producing oxygen by photosynthesis which is so vital for life on earth. They are rightly called as earth's lungs. The forest canopy acts as sink for green house gas CO_2 thereby reducing the global warning. It supplies food materials to those who live in forest and raw materials for many industries in the plains. The potential of the forest must be trapped and nurtured but we must stop over exploitation. Therefore, forest is to be protected on environmental and economic consideration and also in the interest of tribal people living there.

On 5th June, 1972, environment was first discussed as an item of international agenda in the UN Conference on human environment in Stockholm and thereafter 5th June is celebrated all over the world as World Environment Day. **The first Forest Act was passed in 1865**. Later on it was replaced by much more repressive act in 1878. The establishment of state property and the separation of customary rights became the primary objectives of the 1878 act. The several amendments to the 1878 Act, a single piece legislation was needed which led to the promulgation of the 1927 Act. It was timber oriented Act. There was no mention of conservation.

The United Nations Conference on human environment held in Stockholm in 1972 aroused a world wide environmental consciousness. It had its impact in India also. The **Forest Conservation Act 1980** was passed to arrest large scale deforestation. Department of Environment and Forest was established at the center. Indian people started recognising the significance of forest. All that time three fold classification of forest was reserved forest, protected forest and village forest. The revenue oriented policy is more evident in the Forest Act. Even as a revenue oriented legislation the Indian Forest Act is not devoid of defects. The Act prescribes punishment of six months imprisonment and fine of Rs. 500 for offences like felling of trees or clearing of land in Government forest. Such punishment is neither effective to prevent the commission of offences nor sufficient to compensate for the loss arising from such commission.

The Forest (conservation) Act 1980 does not fully transfer the powers over forest to the central government. It only makes it mandatory for the state government to get sanction of the central government before using forest land for non forest purpose. States frequently violated this act because of the ill-defined word - "non forest purpose" which provides loopholes for abuse of powers by state governments. Also the tribal people who were rooted in forests for ages, came to be looked upon as encroachers as per Forest Conservation Act 1980. Because of the threat of eviction, the tribal communities feel emotionally and physically alienated from government. There were series of protests all over the country against the Act by tribals and NGOs activists. As a result, the **National Forest Policy 1988** stresses that forests are first charge to tribal communities. This policy provided for the association of tribal people with the protection, regeneration and development of forests with a view to providing gainful employment to people living in and around forest.

During 1990s, as a result of activists & human right movements, Parliament passed a separate legislation in 1996 which is known as **Panchayat Extension to Schedule Areas (PESA) 1996**. [Menon, 2003] PESA was important not just because it provided a principle as well as basis for future law making concerning the tribals.

Forest Right Act 2006 gives forest communities a primary role in forest management. This act was

very advantageous for Adivasis and other forest dwellers of India. The tribal people are very simple, completely ignorant of modern framework and laws so they could not claim for their rights. (Frontline, 2008). The tribal people have not been destroyer of forest. They use forest resources in a sustainable way. (Bill, 2006) The law relating to forest should permit the tribal communities to exercise their age old rights in forest. (Advocacy internet,2006). They should be trained in modern cultivation methods. Training tribal people in making useful fancy articles out of bamboo and other forest produce will reduce the problem of unemployment among the tribal people. When development projects starts, the tribal people are displaced. They should be resettled but not at the plans choosen by Govenment instead they should given choice to select areas for their living. (Archang, 2005) This enable them to easily adapt themselves to new surroundings. They may also given services as guards and watchmen.

- The some of the significant features of Forest Right Act 2006 are as follows -
- The Act recognises the rights and occupation in forest land in forest dwelling Scheduled Tribes who have resided in such forests for generations but whose rights were not recorded.
- The Act provides for recognition of forest rights of other traditional forest dwellers who are living for at least three generations and a generation would mean a period of 25 years.
- The Act provides for conferring rights in National Parks and Sanctuaries Habitat.
- The Act recognises the right of ownership access to collect, use and dispose of minor forest produce which was traditionally collected within or outside village boundaries. The Act defines minor forest produce to include all non-timber forest produce of plant origin, including bamboo, brush wood, stumps, cane, tussar, cocoons, honey, wax, lac, tender or kendu leaves, medicinal plants and herbs roots and tubers.
- The Act provides for forest rights relating to government providing for diversion of forest land for schools, hospitals, anganwadies, drinking water, water pipelines, roads, electric and telecommunications lines.
- Gram Sabhas have been designated as competent authorities for initiating the process of determining the nature and extent of individual or community forest rights or both that may be given to forest dwellers.
- In order to implement the Forest Right Act 2006, Government taken to various steps eg. (Advocacy Internet, 2007)
- Arranging Gram Sabha and forming a Forest Right Committee at village level.
- Printing and distributing the huge number of application forms for land claiming.
- Prepared a booklet explaining the Act in simple language.
- Forest department conducted various training camps to guide the people how to fill forms giving evidences.

Between June 2008 to 2009, there have been more than 26 training programmes organized covering all 45 tribal talukas.

The law should also provide for co-ordination of central, state and local agencies and the members of the public in the planing and implementation of policies related to forest act. Provision should be made for creation of a strong enforcement machinery at the central level, with adequate trained staff. They should be provided with weapons, vehicles and other infrastructural facilities to protect and preserve forest from smugglers and encroachers. The law should be uniformly applied throughout the India.

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NUTRITIONAL FACTS OF OMEGA-3 FATTY ACID

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Omega - 3 - fatty acids is important in human physiology. It helps in keeping the body healthy. Health is a resource for every day life, not the objective of living. Thus the mental, intellectual, emotional and social health referred to a person's ability to handle stress, to acquire skills, to maintain relationship, all of which from resources for resiliency and independent living. For good health, good nutrition is necessary. Wecan say nutrition is the process of providing or obtaining the food necessary for health and growth.

2500 years ago, Hipporates,, "The father of medicine" said to his student, "Let thy (your) food be thy medicine and thy medicine be thy food." Moses Maimonides, the great 12th century physician repeated the Hippocratic statement when he said, "No illness which can be treated by diet should be treated by any other means." Actually Hippocrates and Maimonides were insisting their students practice " nutrient therapy."

In 1968, one of the minds of this century, twice Nobel Prize Winnners Linus Pauling coined a term - orthomolecular Nutrition where orthomolecular means - pertaining to the right molecule. In other words - optimum nutrition is the medicine of the future. Now a days, the evidence for nutritional therapy is becoming so strong that if the doctors today don't become nutritionist, the nutritionist will become the doctors of tomorrow.

The health benefits of omega - 3 - fatty acid are immense and they have been proven effective in the treatment and prevention of hundreds of medical conditions. It is actually polyunsaturated fatty acid with double bond. In human physiology three types of omega -3 fatty acids are involved -

1. ά - linolenic acid (ALA)- 18 carbon and three double bonds
2. eicosapentaenoic acid (EPA) 20 carbons and 5 double bonds
3. docossahexaenoic acid (DHA) 22 carbons and 6 double bonds

Mammals are unable to synthesize omega -3- fatty acid but ALA can obtain through diet & use it to form EPA and EPA forms DHA.

Its dietary sources are - Highest amount is present in flax seeds [11.4g/85g], It is present in very little amount in eggs [0.109/85g], strawberry and kiwi fruits [0.10-0.20g/85g], broceoli [0.10-0.20g/85g], some fishes eg. Salmon [1.1-1.9g/85g],tuna [0.21-1.1g/85g] sword & Tile fish [0.9g/85g], Cod and Catfish [0.22-0.30g/85g]. In milk it is absent.

Flax seeds are the richest source of omega-3- fatty acid. Flax is also known as common flax or linseed. Its botanical name is Linum usitatissium belongs to genus linum in the family Linaceae. Its oil is known as linseed oil. It is an annual plant grow to 1.2 m tall with slender stems. The leaves are glaucous green, slender lanceolate, 20-40 mm long and 3 mm broad. The flowers are pure bale blue, 15-25 mm in diameter with five petals. Flax seeds occur in two basic varieties - brown and yellow or golden. Both have similar nutritional characteristics and equal numbers of short chain omega-3-fatty acid. Three natural phenolic glucosides, secoisolariciresinol diglucoside p-coumaric acid glucoside and ferulic acid glucoside are found in commercial flax seeds. As a percentage of total fat, flaxseeds contain 54% omega-3-fatty acid (ALA) 18% omega-9-fatty acid [oleic acid] and 6% omega-6-fatty acid [linoleic acid].

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After ingestion, dietary lipids are hydrolyzed in the intestinal lumen[1]. The hydrolysis products- monoglycerides and free fatty acids- are then incorporated into bile salt - containing micells and absorbed into enterocytes, largely by passive diffusion. The process is efficient, with an absorption rate of about 95% which is similer to that of other ingested fats.Omega-3-fatty acid play important roles in the body as component of the phospholipids that from the structures of cell membrane[2].

In addition to their structural role in cell membrane, it also provide energy for the body and are used to form eicosanoids which have wide ranging functions in the body's cardiovascular, pulmonary, immune and endocrine system[3]. The potential health benefits of consuming omega-3-fatty acids are-

Cardiovascular disease-

Omega-3 fatty acid covers risk factors such as high blood pressure[4] lower risk of heart failure[5] coronary disease and fatal coronary heart disease[6]. It decreases blood platelet aggregation[7]. Studies showed a significant reduction in rates of sudden cardiac death with omega-3 fatty acid supplementation[8] because these have antiarrhythmic and antifibrillatory effects because ventricular fibrillation and other forms of arrythmia are the most common cause of sudden cardiac death. In 2016, Agency for health care research and quality (AHRQ) published a review on the effects of omega-3 fatty acid on CVD and on risk factors and intermediate markers of CVD[9] & concluded that it reduces the risk of cardiac death[10 11 12]. 2015-2020 Dietary Guidelines for American states that 250mg/day EPA and DHA is associated with fewer cardiac death in both healthy individuals and those with preexisting CVD[13]. The FDA also specifies that the dietary supplement should not recommend a daily intake of EPA & DHA higher than 2g[14].

Cancer Disease

Some studies suggests that higher intake of omega-3 fatty acid is associated with lower risk of breast cancer & colorectal cancer[15] maintain.

Alzheimer's disease, dementia & cognitive function-

Studies suggest that diets high in omega-3- fatty acids are associated with a reduced risk of cognitive declines, Alzheimer's and dementia[16]. Because DHA is an essential component of cellular membrane phospholipids in brain, researches hypothesize that omega-3 fatty acid might protect cognitive function by helping to maintain neuronal function and cell membrane integrity within the brain[17]. Lower serum DHA levels build up protein deposits called amyloids in healthy other adults, whereas higher DHA level is correlated with preservation of brane volume[18]. 100mg/day incremental increase in DHA intake was associated with 14% lower risk of dementia & 37% lower risk of Alzheimer disease[19].

Age related macular degeneration (AMD)-

AMD is a major cause of vision loss among older adults. Researchers have suggested that these omega-3 fatty acid have cytoprotective effects in retina[20]. people who consume higher amount of fatty acid have lower risk of developing AMD. DHA is a major structural component of brain and retina of the eye. Enough DHA has been linked to a reduced risk of macular degeneration which causes of permanent eye damage & blindness.

Mental disorders-

A 2016 meta - analysis of 26 - studies found a 17% lower risk of depression with higher omega-3 fatty acid[21]. However, a 2015 Cochrane review of 26 studies found insufficient evidence to determine wether omega-3 fatty acid (1000 to 6,600 mg/day EPA, DHA and other omega-3 fatty acid) are beneficial for major depressive disorder in adults[22].

Low level of omega -3 fatty acid have been reported in people with psychiatric disorder[23]. Studies have shown that omega-3- supplements can reduce the frequency of mood swings and relapses in people with schizophrenia[24] and bipolar disorders.

Anxiety is also a very common disorder and is characterised by constant worry and nervousness. It has been observed that people with depression or anxiety start taking omega -3 supplements, their symptoms get better[25].

Brain health in infants

Getting enough omega -3 fatty acid during pregnancy has been associated with numerous benefits[26] for the child including- higher intelligence, better communication and social skills, less behavioral problems, decreased risk of autism and cerebral palsy. Deficiency is linked to low intelligence, poor eye sight and an increased risk of several health problems.

Metabolic Syndrome

It is a collection of condition. It includes central obesity (belly fat), high blood pressure, insulin resistant, high triglycerides and low HDL level. Omega -3 s can have numerous benefits for people with metabolic syndrome. They can reduce insulin resistance, fight inflammation and improve several heart disease risk factors[27].

Inflammation

Sometimes inflammation persists for a long time even without an infection or injury being present. This is called chronic (long term) inflammation. Omega-3 fatty acid can reduce the production of molecule and substances linked to inflammation, such as inflammatory eicosanoids and cytokines[28].

Bone and Joint health

Osteoporosis and arthritis are two common disorders that affect the skeletal system. Studies indicate that omega -3 s can improve bone strength by increasing the amount of calcium in bone. This leads to a reduced risk of osteoporosis[29].

Sleep

Studeies show that sleep deprivation is linked to many diseases including obesity, diabetes and depression. Low level of omega -3 fatty acids are associated with low level of hormone - melatonin which helps people fall asleep. So low level causes sleep problems in children and obstructive sleep apnea in adults. Studies show that DHA improve the length and quality of sleep in children and adults[30].

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SUSTAINABLE MANAGEMENT OF MAJOR MARINE FISHERY RESOURCES: AN OVERVIEW

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Abstract

It is an exigent and paramount need to whirl commercial or economic fisheries towards sustainability while improving the management of fishery practice. People should adapt and understand the significance and essentiality of sustainable management. More endeavors are required for MSY (Maximum sustainable Yield) than MEY (Maximum Economic Yield) in fisheries. The overfishing methods include purse seining, long lining, gear boats, big trawling net, fishing in breeding season beside imperiling marine species can also ensure birds, sea turtles and other fishes. Due to such destructive fishing methods fish population is diminishing and it cannot be replenished. According to recent research fishermen remove more than 77 billion kilograms of wildlife from sea per annum. So, if we want depend on sea as lasting food source it is essentially important to adapt "Sustainable Fishing Practice". The best quintessence is blue fin Tuna-one of largest and fastest fish on Earth. Nevertheless, sustainably managing fishery resources is not an easy task as it requires co-operation at all levels of government, from local communities to nation and across the globe. The study is based on the reviews of standard research articles, reports of NGOs and websites.

Introduction

India is endowed with a wide diversity of water resources, which sustain a large fisheries sector in the country. India has a coastline of 8,118 km with an Exclusive Economic Zone (EEZ) stretching over 2.02 million km2, and a continental shelf covering 0.53 million km2. India also has inland water sources covering over 1,90,000 km and open water bodies with a water-spread area of about 740,000 hectares. Brackish water area that could be used for aquaculture is 1.24 million hectares, of which only 165,000 hectares have been developed. Total fish production from India's fisheries sector in 2009 was an estimated 7.60 million tonnes (Government of India 2010). The marine subsector contributed approximately 39 percent of total fish production, or 2.99 million tonnes. Fish has been an important source of animal protein for more than one billion people of the world. Two thirds of the total food are from the marine and inland capture fisheries. The rest is from aquaculture (FAO, 2002). Sustainable fishing means leaving enough fish in the ocean, respecting habitats and ensuring people who depend on fishing can maintain their livelihoods. Sustainable management of fisheries cannot be achieved without an acceptance that the long-term goals of fisheries management are the same as those of environmental conservation. The balance, termed inland fisheries, was accounted for by freshwater aquaculture, inland capture, and coastal aquaculture. India contributes nearly five percent towards global fish production.

Marine fisheries in India are a shared responsibility between the national and state governments. In a legal and constitutional sense, state governments are responsible for waters inside the 12-nautical mile territorial limit (22 km) while the Government of India (GOI) is responsible for waters between 12 nautical miles and the country's 200 nautical mile (370 km) EEZ. Marine fisheries management faces a number of challenges such as open access fishery property rights systems; weaknesses in several aspects of state- and national level legal and policy frameworks; low state government capacity for monitoring, control and

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surveillance (MCS); and knowledge gaps regarding the sustainability of key fish stocks. These kinds of issues are not unique to India.

What Is Fishing Capacity?

In general, capacity can be defined with reference to fishing inputs (vessels, potential effort) or outputs (potential catch) over a period of time by a vessel (or fleet) if fully utilized. Variations include: Fisheries scientists often view capacity based on comparisons between fishing effort (number of days fished, number of nets used, etc.), fishing mortality and MSY. When total mortality exceeds MSY, there is excess fishing capacity. Fisheries managers often see capacity in terms of the number of vessels (or total horsepower), average fishing days, and harvests relative to stock conservation goals. Economists will often measure capacity based on a level of potential fishing output and maximizing net benefits.

Composition of Gujarat's Marine Fishing Sector:

The marine fishery sector of Gujarat consists of 3 distinct sub sectors, viz, (i) traditional inshore fishing with non-mechanized traditional craft and gear; (ii) the mechanized sub sector with small motorized and mechanized boats; and (iii) deep sea fishing with ocean going vessels. The traditional sector using boats without any kind of mechanization has been the backbone of Indian fisheries, which accounts for 67% of the current fish production. The small motorized and mechanized boats constitute about 32% whereas the deep-sea vessels have been able to contribute only about 1% of the total marine catch. The gradual transformation of the Indian marine fishery sector roughly over a period of three decades from a subsistence traditional avocation to that of an industry was mainly through the State support and technical innovation. With the introduction of mechanization and expansion of the fleet, the marine fish production in the country has gone up from 0.53 million tons in 1951 to 2.96 million tons in the year 96-97 the highest production reported till today (Anon-2002). The harvesting efforts particularly in the inshore waters has almost reached a point of saturation, and the production has come to a plateau. For further increase in marine fish production, the efforts will have to concentrate in the pelagic resources of the inshore and offshore areas, besides managing the inshore resources in a sustainable manner. Though the deep sea and high sea resources remain underexploited, it is a daunting task for the Indian fishermen in the present juncture to harness it to its full potential, without innovative state intervention and technology support. The declaration of EEZ undoubtedly offers an opportunity for Indian fisheries sector to use its resource potential to sustainable limits.

Traditional Management of Fisheries:

Traditionally, fisheries management and the science underpinning it was distorted by its "narrow focus on target populations and the corresponding failure to account for ecosystem effects leading to declines of species abundance and diversity" and by perceiving the fishing industry as "the sole legitimate user, in effect the owner, of marine living resources." Historically, stock assessment scientists usually worked in government laboratories and considered their work to be providing services to the fishing industry. These scientists dismissed conservation issues and distanced themselves from the scientists and the science that raised the issues. This happened even as commercial fish stocks deteriorated, and even though many governments were signatories to binding conservation agreements.

The Unclos & EEZ:

The U.N Convention on the Law of the Sea (UNCLOS) is a new ocean regime introduced in 1982. It was duly ratified and came into force as an international law in November 1994. This was a landmark event in the history of global marine fisheries exploitation. It has established the Exclusive Economic Zone (EEZ) and provided a regulatory framework by improvising the coastal and other States with jurisdictional rights and duties. It offers an international mechanism to pursue sustainable development of the marine and coastal areas. Under Article 57 of UNCLOS, the EEZ “shall not extend beyond 200 nautical miles from the territorial sea baselines”: It is an “area beyond and adjacent to the territorial sea” for which there is a separate legal regime. Prior to the advent of UNCLOS, the fishery jurisdiction of coastal States was co-terminus with their own territorial waters, which in the case of India was up to 19.2 kms. UNCLOS prescribes that every coastal State should assess the Maximum Sustainable Yield (MSY) that can be harnessed from its EEZ.

Status of Marine Fisheries Resources:

The availability and distribution pattern of marine fishery resources. In India follow a pattern typical of tropical waters. The fishery resource is constituted by a large variety of species (nearly 15-70 species at finfishes; and about 1000 species of shellfishes) coexisting in the same fishing ground. The mum-species fishery comprises of over 200 commercially important finfish and Shellfish species. The important varieties belong to the pelagic groups such as the sardines, anchovies. mackerel, carangids, Bombay duck, ribbonfishes, seer fishes, tunas; demersal finfish groups such as the sharks, rays, croakers (sciaenids), perches, silver bellies, Lizardfishes, catfish; crustaceans such, as the penaeid and non-penaeid shrimps, crabs and lobsters; and cephalopods viz., squids and fishes. The abundance of these stocks varies from region to region and from season to season with large pelagic like tunas being more abundant around island territories and small pelagics like sardines and mackerel supporting a fishery of considerable magnitude along the southwest and southeast coasts. The Bombay duck and non-penaeid shrimps form a good fishery along the northwest coast, while perches are dominant in the southwest and southeast coasts, especially in the Gulf at Manner, Palk Bay and Wedge Bank. Among his, species/groups contributing to more than one lakh tons a year are oil sardine, Mackerel, Bombay duck; ribbonfishes, carangids, perches, croakers, shrimps and cephalopods. The annual catchable potential yield (of as many as 68 species/groups of fishes) in the Indian EEZ is validated by a Committee as 3.93 million tones consisting Q f 2.02 million t of demersal, 1.67 million t of pelagic and 0.24 million t of oceanic resources (Anon, 2000) of which the present annual average production of about 2,72 million t forms 6-9.2%.

Sustainability:

Sustainable development is a globally accepted goal for natural resource management, identified at UNCED 1992. The basic principle that governs sustainable development of fisheries is that, it must be conducted in a manner that does not lead to over-fishing, or for those stocks that are over-fished; the fishery must be conducted such that there is a high degree of probability that the stock(s) will recover and also fishing operations should be managed to minimize their impact on the structure, productivity, function, and biological diversity of the ecosystem. The general stagnation in marine fish production during the last decade gives rise to concern about the sustainability of Indian fisheries.

- The major issues that have to be addressed to overcome stagnation and decline in marine fish production in India are identified as:
- Unregulated open access fisheries. Over capitalization and unwarranted capacity overload.
- Excessive fishing pressure in the coastal areas up to about 50 m depth zone on target species resulting in declining trends in their catch and catch rates.
- Decrease in area available in the coastal waters per active fisherman /boat for conducting fishing operations.
- Lack of enthusiasm among the entrepreneurs for extension of fishing to the deeper waters.
- Discards/indiscriminate exploitation of juveniles/sub-adults of many commercially important species by reducing the mesh size and resulting discards.
- Damage to the benthos and benthic ecosystem by continuous sweeping of the same ground by shrimp trawlers, often destroying the food web of commercially exploitable species.
- Inter and intra-sectoral conflicts among different categories of fishermen particularly between the artisanal and mechanized groups of fishermen and Coastal Fishery Resources of India - Conservation and Sustainable Utilization also between those engaged in coastal artisanal fishing and coastal aquaculture.
- Harvest ad post-harvest losses.
- Ecosystem degradation affecting the productivity and the carrying capacity.
- Threats from climate changes and natural calamities.
- Lack of Participatory Fisheries Management.

- Lack of effective enforcement of MFRA.
- Lack of implementation of Code of Conduct for Responsible Fisheries.
- Absence of an informed management regime.
- Global pressures on trade.

Approaches For Sustainable Development:

Indian marine Fisheries have been facing the serious crisis of unsustainable development which is visible in various fronts of development, including ecological economic and social fronts. In a multi species multi-gear marine fisheries where there are changing species ratios changing exploitation patterns, changing predator-prey relationships, loss of biota and destruction of juveniles of almost all fish and shellfish species, increase of bycatch, and discards, ensuring sustainability is a difficult but necessary task (Modayil, 2005). Towards this end, adoption of sustainable fishing practices, diversified multi-gear and resource specific fishing and complementary maricultural practice by traditional Fishermen to supplement their income are being advocated. Some of the options are as follows.

Conclusion:

Marine fisheries in India. beset with problems of over capitalization, over capacity, increased operational expenses and reduced catch rates, is a -cross roads seeking proper, direction and guidance. In the context of globalization and challenges of global competition in trade and economics, there is urgent need for policy interventions at tl1e state and national levels which will ensure sustainable exploitation of the marine resources as well as better livelihood opportunities for the fisherfolk. It is also necessary to encourage and facilitate resource management initiatives from within the fishermen communities themselves.

Fisheries management is a continuous and interactive process, where, economic, social and ecological costs and benef11s are to be understood and interventions designed. According to Hillborn (2002), the key to successful Fisheries management is not confined to better science, more reference points and precautionary approaches but rather in implementing better sys ems of marine governance which provides incentives for all the stakeholders (fishermen. scientists and managers) to make decisions that will be in their interest as well as contribute to societal goats, Co-operative research where scientific research is conducted in partnership with the industry is also gaining importance recently.

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ZERO TILLAGE IN WHEAT

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Introduction

Zero tillage is also called as no till. Zero tillage is an extreme form of minimum tillage. Primary tillage is completely avoided and secondary tillage is restricted to seedbed preparation in the row zone only.

In zero tillage, herbicide functions are extended. Before sowing, the vegetation present has to be destroyed for which broad spectrum, nonselective herbicides with relatively short residual effect (Paraquat, Glyphosate etc.,) are used.

Till planting is one method of practicing zero tillage. The machinery accomplishes four task in one operation: clean a narrow strip over the crop row, open the soil for seed insertion, place the seed and cover the seed properly. A wide sweep and trash bars clear a strip over the previous crop row and planter-shoe opens a narrow strip into which seeds are planted and covered.

In zero tillage, herbicide functions are extended. Before sowing, the vegetation present has to be destroyed for which broad spectrum, nonselective herbicides with relatively short residual effect (Paraquat, Glyphosate etc.,) are used.

No-till farming (also called zero tillage or direct drilling) is a way of growing crops or pasture from year to year without disturbing the soil through tillage. No-till is an agricultural technique which increases the amount of water that infiltrates into the soil and increases organic matter retention and cycling of nutrients in the soil. In many agricultural regions it can reduce or eliminate soil erosion. It increases the amount and variety of life in and on the soil, including disease-causing organisms and disease suppression organisms. The most powerful benefit of no-tillage is improvement in soil biological fertility, making soils more resilient. Farm operations are made much more efficient, particularly improved time of sowing and better trafficability of farm operations.

Meaning of Zero Tillage

No-till farming (also called **zero tillage** or **direct drilling**) is a way of growing crops or pasture from year to year without disturbing the soil through tillage. No-till is an agricultural technique which increases the amount of water that infiltrates into the soil and increases organic matter retention and cycling of nutrients in the soil.

The idea of modern no-till farming started in the 1940s with Edward H. Faulkner. No-till farming is widely used in the United States and the number of acres managed in this way continues to grow. This growth is supported by a decrease in costs related to tillage; no-till management results in fewer passes with equipment for approximately equal harvests, and the crop residue prevents evaporation of rainfall and increases water infiltration into the soil.

Important Consideration For Zero Tillage

Ensure that standing stubble is not longer than 15 cm.

Calibrate the zero till machine before planting so that proper amount of seed and fertilizer is placed in the field.

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Seed depth should be kept at 5 cm.

Use of granular fertilizers so that pipes of the ZT machine are not choked.

Apply first irrigation after 15-20 days of sowing.

Use flat fan nozzle for spraying herbicides.

Use of Earthworms In Zero - Tillage Farming

Earthworms form burrows which can enhance gas exchange and improve water infiltration rates 2-10 times in soils.

Stabilizes soil aggregates, improves soil structure and limits erosion.

Increase in the extent and density of plant roots.

Breakdown of organic matter.

Effects of Zero Tillage

1. Increase the potential for ground water
2. Decreased soil erosion
3. Reduced surface runoff
4. Early sowing
5. Greater infiltration
6. Reduction in machine use
7. Reduction in tillage cost
8. Saving irrigation
9. Less weed problem due to less soil disturbance
10. Control of erosion
11. Improved soil health
12. Retention of residues provide a food source to beneficial insect, earthworms and predators
13. Reduce pollution
14. Higher grain yield
15. High soil moisture content due to both improved soil structure and the decrease in evaporation due to the crop residue mulch.

Why Zero Tillage….

Zero tillage will be useful concept where :

a) Conventional tillage has not yield more.

b) Requirement of energy too high.

c) Requirement of labour too high.

d) In medium to fine textured soils, use of heavy implements can result in formation of hard puncturing wet conditions.

Advantages of Zero Tillage

a) Reduces labor, saves time.

b) Saves fuel.

c) Reduces machinery wear.

d) Improves soil tilth.

e) Increases organic matter.

f) Traps soil moisture to improve water availability.

g) Reduces soil erosion.

h) Improves water quality.

Comparison Between Conventional And Zero Tillage System

Erosion	Maximum	Less
Soil physical health	Increase compaction due to heavy traffic, formation of plough pan.	Reduced compaction due to reduced traffic.
Soil biological health	Lower due to frequent disturbance.	More diverse and healthy biological properties and populations.
Water infiltration and soil organic matter	Lower after soil pores are clogged. Reduced soil organic matter.	More water infiltration and more soil organic matter build-up in the surface layers.

Issues	Conventional tillage	Zero tillage
Weeds	Controls weeds and also causes more weed seeds to germinate.	Weeds are a problem especially in the early stages of adoption, but problems are reduced with time.
Soil temperature	More variable.	Moderated.
Diesel use and costs	High and high costs operations.	Much reduced and lowest costs operations.
Yield	Can be lower where planting delayed.	Yield is same or higher if planting done more timely.

Table 1. Response of different morphological attributes of wheat to different tillage practices

Variety		Zero Tillage	Conventional Tillage	Deep tillage
No. of spikelets per spike	Punjab-11 Millat-11	18.67 16.29	17.90 16.74	17.86 16.58
No. of grains per spike	Punjab-11 Millat-11	55.10 50.73	51.03 49.98	53.94 52.04
1000-grain weight (g)	Punjab-11 Millat-11	51.23 49.45	45.73 43.18	47.93 46.04
Grain Yield (t ha-1)	Punjab-11 Millat-11	5.20 4.54	4.76 4.30	4.71 4.26
Straw Yield (t ha-1)	Punjab-11 Millat-11	14.13 12.45	12.40 12.36	12.62 12.06

Table 2. Major farm inputs used in wheat production in Haryana

Particulars	Conventional tillage	Zero tillage	Change (%)
Human labour (human days/ha)	54.9	51.2	6.68
Machine labour (hours/ha)	9.6	5.2	46.30
Seeds (kg/ha)	112	108	3.73
Irrigation water (m3/ha)	1581.7	1302.5	17.65

Table 3. Yield, cost and return in CT and ZT methods of wheat production in Haryana

Particulars	Conventional tillage	Zero tillage	Change (%)
Yield (t/ha)	5.37	5.47	1.86
Operational Cost (Rs/ha)	29935	26124	-12.73
Gross Income (Rs/ha)	59070	60181	1.88
Net Income (Rs/ha)	29135	34057	16.89
Cost of Grain Production (Rs./ha)	5.57	4.78	-14.34

Table No.-4 Effect of different Sowing Method and Herbicides on Grain Yield of Wheat

Treatments	Grain yield(t /ha)		
	2013-2014	2014-2015	Pooled
Zero tillage	3.65	3.67	3.66
Conventional tillage	3.24	3.31	3.27
CD(P=0.5)	0.033	0.009	0.018

Conclusion

Zero tillage means the crop production system, where the soil is left undisturbed from harvest to planting, except for nutrient injection and planting or drilling is accomplished in a narrow seed bed. Weed control is accomplished primarily with herbicides glyphosate.

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DIABETES MELLITUS AND ITS COMPLICATIONS

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Introduction

Diabetes mellitus is a chronic metabolic disorder that prevents the body to utilize glucose completely or partially. It is characterized by raised glucose concentration in the blood and alterations in carbohydrate, protein and fat metabolism. This can be due to failure in the formation of insulin or liberation or action. It is a resulting condition when the body doesn't produce enough insulin or cannot use the insulin properly in the system. The glucose in the blood cannot move into cells and convert into energy, but rather builds up in the bloodstream. This buildup harms both the cells seeking fuel as well as the organs and tissues exposed to higher glucose levels. Lack of insulin may be due to over production of other hormones which are antagonistic to insulin e.g. glucogon, hormones of the pituitary, adrenaline and thyroid or due to increase production of substances which inactivated insulin e.g. insulinase and insulin antagonists present in plasma.

Diabetes can be divided up into two distinct types:

Type I: In Insulin Dependent Diabetes Mellitus (IDDM) also known as Juvenile onset diabetes patients depend on insulin. There is usually sudden onset and occur in the younger age group and there is an inability of pancreas to produce adequate amount of insulin. This may be caused by virus of due to autoimmunity.

Type II: Non-Insulin Dependent Diabetes Mellitus (adult onset diabetes). Insulin may be produced by pancreas but action is impaired most patients with type II diabetes mellitus are obese, type II is initially treated by changes in diet and through weight loss.

Predisposing Factors

1. **Heredity:** There is an even stronger inheritance pattern for type II diabetes, those with type II ancestors or relatives have very much higher changes of developing type II.
2. **Age:** This disease mainly occurs in middle aged people of age group between 45-65 years.
3. **Obesity:** Although most type II diabetics are obese. In obesity there is impaired insulin uptake by receptors in target tissues.
4. **High intake of sugar:** A high intake of sugar is certainly associated with a high prevalence of obesity. It is unlikely that sucrose has a specific diabetogenic effect.
5. **Infections:** There is increasing evidence that type I diabetes, especially in the younger patients, the virus may trigger an autoimmune reaction in the pancreatic islets and this impairs insulin secretion and ultimately destroys the beta cells.
6. **Acute stress:** In acute cases of stress blood glucose levels may rise quite profoundly and in extreme cases diabetic ketosis and coma also may result particularly in those with a genetic predisposition.
7. **Disease of pancreas:** A minority of cases of diabetes occur as a result of diseases which destroy the pancreas and lead to impaired secretion of insulin, e.g. pancreatitis, haemachromatosis, carcinoma of

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pancreas and pancreatectomy.

Symptoms of Diabetes Mellitus

1. Hyperglycaemia
2. Glycosuria
3. Fluid and electrolyte imbalance
4. Acidosis
5. Polyuria and nocturia
6. Polydipsia
7. Polyphagia
8. Dehydration
9. Fatigue and loss of weight
10. Increased excretion of potassium, magnesium and phosphorus.

Metabolism In Diabetes Mellitus

Diabetes mellitus is primarily due to deficiency in insulin production, the metabolism of carbohydrates, fats and proteins is affected as insulin is essential for the utilization of glucose in the body. Diabetes mellitus interferes with the body's ability to convert digested food in energy. and growth. When we eat the body converts food into glucose, a simple sugar that is our main source of energy. Once glucose becomes available in the metabolism blood stream, it must enter the cell to provide this energy. The pancreatic hormones insulin is required to allow glucose to enter the cells. In a healthy person, the pancreas's beta cells needed to matches the amount of food ingested. Blood sugar regulation is accomplished by the most finally controlled system in the body blood sugar should remain in a very small range of approximately 70-120 mg/ dl even after a heavy meal.

Complications Due To Abnormal Metabolism

Short term complications:

Hyperglycaemia: When insulin is not being produced or is ineffective, the formation of glycogen is decreased and the utilization of glucose in the peripheral tissues is reduced. As a consequence the glucose that enters the circulation from various sources is removed more slowly and hyperglycaemia follows when blood sugar levels may range from 120-150 mg/ dl and above as against 75-90 mg/ dl in normal person.

Hypoglycaemia: It is defined as a condition in which there is blood glucose concentration of less than 45 mg/ d1. Sweating, trembling, hunger, confusion drowsiness, in co-ordination and nausea are some of the symptoms of hypoglycaemia.

Glycosuria: Glycosuria is a condition in which glucose is excreted in urine. In diabetes mellitus blood glucose level after a meal is very high (250-350 mg/dl). The kidney is not able to absorb excess level (normal 180 mg/dl renal threshold) of glucose which escapes reabsorption is excreted in urine.

Ketoacidosis and coma: Diabetic ketoacidesis is a state of severe insulin deficiency which is characterized by hyperglycaemia, acidosis and elevated blood ketones and which may progress to coma.

Fluid and electrolyte imbalance: The loss of glucose in the urine represents a wastage of energy and entails an increased elimination of water and sodium.

Acidosis: With a deficiency of insulin, lipogenesis decreases and lipolysis is greatly increased. In diabetes mellitus the ketoses are produced at a rate that for exceeds the ability of the tissues to utilize them and the concentration in the blood is greatly increased. Acetone is excreted by the lungs and gives the characteristic fruity odour to the breath. Acetoacetic acid and 13- hydroxy butyric acid excreted in the urine (ketonuria) being fairly strong organic acids these ketones combine with base so that the alkaline reserve is depleted and acidosis results.

Polyuria and nocturia: Polyuria occurs when the blood glucose level is 180 mg/ dl glucose increases the

osmolality of the glomerular filtrate and thus prevents the reabsorption of water as the filtrate passes down the renal tubules. In this way the volume of urine is markedly increased in diabetes and polyuria and nocturia occur.

Dehydration: The loss of water and electrolytes continue depletion of extracellular fluid leads to the clinical features of severe dehydration.

Fatigue and loss of weight: It is due to impaired utilization of carbohydrate which lead to loss of body tissue and wasting may occur.

Increased excretion of potassium magnesium and phosphorus: Glycogen and protein 'is cells associated with water and intracellular electrolytes. As glycogen and protein are catabolised, glucose, water and electrolytes, particularly potassium are released into the extracellular space. As increased urinary excretion of potassium, magnesium and phosphorus therefore occurs in uncontrolled diabetes.

Long term complications: The long term complication of diabetes includes - Cardiac failure : Diabetes affects the blood vessels, the blood and the heart. Diabetic patients are at great risk of developing atherosclerosis. The susceptibility of the diabetic to atherosclerosis is due to several factors. Hyperlipidemia occurs in one-third to one half of patients. HDL levels are reduced in type II diabetes, possibly enhancing susceptibility to atherogenesis.

Kidney failure: Thickening of the capillary basement membranes occurs in long standing diabetes and precedes the development of nepropathy i.e. degenerative disease of the nephrons can result kidney failure.

Blindness: Thickening of the capillary basement membranes occurs in long standing diabetes and precedes the development of retinopathy i.e. degenerative disease of the retina results blindness.

Neuropathy: Peripheral nerve dysfunction is common in diabetes peripheral neuropathy (pain and numbness in the extremities usually in the feet and legs) is common in diabetes mellitus, wound healing is delayed in diabetics due to neuropathy.

Suggestion

For delaying or preventing developments of complications in diabetes mellitus following points should be consider-

- Dietary calories should be 60-70% from carbohydrates 15-20% from protein and 15-25% form fat.
- Simple sugars should be restricted.
- High protein and high fibre diet specially water soluble fibre should be prescribed.
- Fat with high PUFA like vegetable oil is preferred.
- Increases physical activity.
- One glass milk should be taken at night.

Foods to be avoided	Foods permitted
Simple sugars (glucose, honey, syrup, sweets dried fruits, cake, candy, fried foods, alcohol, nuts, Jaggery, sweetened juices.	Green leafy vegetable, fruits except banana, lemon, clear soups, onion or tea, skimmed and butter milk, spices fats, cereals, pulses, egg, nuts roots, artificial sweetener.

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ROLE OF PLANT GENETIC RESOURCES IN NUTRITIONAL SECURITY AND AGRICULTURAL SUSTAINABILITY

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Abstract

The utilization of plant genetic variability is crucial for ensuring an ample and stable supply of diverse food crops as well as for enhancing their nutritional quality. The role of effective conservation, management and use of plant genetic resources in ensuring the availability of a diverse range of nutritious food crops is recognized throughout the work of the National Bureau of Plant Genetic Resources (NBPGR) at national level and Bioversity International globally. The nutritional quality of food crops is among the major considerations that are important in both the improvement and conservation of genetic resources. Increased reliance on major food crops has been accompanied by a shrinking of the food basket which humankind has been relying upon for generations. The shrinking of agricultural biodiversity has reduced diversity of crops and plant species thereby increasing the level of vulnerability among users, particularly the weaker sections of the society. However, a paradigm shift in attitude of policy makers and the public has been noticeable over the decades with regard to the quality of life as related to the quality of food as well as diverse sources of food. Many of the neglected crops have gained attention worldwide after having successfully raised the interest of decision-makers particularly for nutritional traits. These traits are being searched with greater emphasis than in the past in recognition of their role in combating diet imbalances. It is already known that a lack of diversity is a crucial issue, particularly in the developing world where diets consist of starchy staples to a great extent with less nutrient-rich foods. At the same time it is acknowledged that the consumption of a variety of foods across and within food groups almost guarantees adequate intake of essential nutrients and important non-nutrient factors. The chapter analyses aspects the links among plant genetic resources, human health and nutrition, and agricultural sustainability.

Introduction

One of the grand challenges facing society in the 21st century is to produce sufficient nutritious food in the face of climate change, population growth, and rapid urbanization, and to do so in an environmentally sustainable manner. The United Nation's Sustainable Development Goal No. 2 explicitly recognizes the pivotal role that genetic diversity plays for food security, nutrition and sustainable agriculture. Plant biodiversity represents the primary source for food, feed, shelter, medicine and many other products and means that make life on Earth enjoyable (WCMC, 1992; UNEP, 1995). Crop genetic diversity constitutes plant genetic resources that provide the basic building blocks to improve the productivity, resilience, and nutritional composition of crops. Genetic resources: defined in the Convention on Biological Diversity as 'genetic material of actual or potential value.' They constitute a subset of 'biological resources' (essentially all biotic components of ecosystems with actual or potential use or value for humanity). It is estimated that nowadays only 30 crops provide 95 percent of human food energy needs and just four of them – rice, wheat, maize and potatoes – provide more than 60 percent. Given the significance of a relatively small number of crops for global food security, it is of pivotal importance to conserve the diversity within these major crops.

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While the number of plant species that supply most of the world's energy and protein is relatively small, the diversity within such species is often immense. If the 20th century witnessed the undertaking of systematic collecting to rescue the genetic resources of staple crops (Pistorius, 1997), the 21st century has started with the awareness of the need to rescue and improve the use of those crops left aside by research, technology, marketing systems as well as conservation efforts. These underutilized crops (referred to also by other terms such as minor, neglected, underexploited, traditional, niche crops etc.) have been included in worldwide plans of action after having successfully raised the interest of decision-makers. The traditional knowledge related to wild subsistence contributes significantly in nutritional security of small holder farmers from tribal pockets, and hilly and mountainous agro-ecologies.

Increased reliance on major food crops has been accompanied by a shrinking of the food basket which humankind has been relying upon for generations (Prescott-Allen and Prescott-Allen, 1990). This nutritional paradox (Ogle and Grivetti, 1995) has its roots in the agricultural 'simplification', a process that favoured some crops instead of others on the basis of their comparative advantages for growing in a wider range of habitats their simple cultivation requirements, easier processing and storability, nutritional properties, taste and so on. Though the simplification process lowered food quality, it increased the chances of successful harvests, which in turn allowed survival through narrow but abundant sustenance (Collins and Hawtin, 1999). A change in attitude has been noticeable over the last 5-10 years among policy-makers and the public with regard to the quality of life as related to the quality of food as well as diverse sources of food. Vitamins and other micronutrients are, for instance, being searched for in crops and plant species with greater emphasis than in the past in recognition of their role in combating diet imbalances. Many of the underutilized crops have been included in worldwide plans of action after having successfully raised the interest of decision-makers.

Is already known that a lack of diversity is a crucial issue, particularly in the developing world where diets consist of starchy staples to a great extent with less nutrient-rich foods such as animal source food, fruits and vegetables being available, accessible or known to be important for a balanced diet. At the same time it is acknowledged that the consumption of a variety of foods across and within food groups almost guarantees adequate intake of essential nutrients and important non-nutrient factors (Bioversity International, 2011). While several research studies have already well documented the links between dietary diversity and diet quality and nutritional status of children (Arimond and Ruel, 2004; Kennedy *et al.,* 2007; Rah *et al.,* 2010; Savy *et al.,* 2008), as well as associations between dietary diversity, food security and socioeconomic status (Hoddinott and Yohannes, 2002; Ruel 2003; Thorne-Lyman *et al.,* 2009). The concept of sustainable diets and the relationship between the multidimensional determinants of environmental sustainability, accessibility, cultural acceptability and nutritional adequacy etc. have been examined in some of the recent studies (Timothy *et al.,* 2006; Keding, 2010; Keding *et al.,* 2007, 2012; Fanzo *et al.,* 2012; MSSRF, 2014). Moreover, a key element that needs to be understood is how to promote diversity to improve the efficiency and sustainability of food systems while at the same time alleviating the negative impacts of the dietary transition (Fanzo *et al.,* 2012). The outcome of a recent case study on Subsistence Farming, Agrobiodiversity, and Sustainable Agriculture suggests a policy framework for bringing sustainable agricultural development to subsistence farming agroecosystems (Bisht *et al.,* 2014). It could also help in exploring and advocating the potential of various suggested "add-value" interventions to native agrobiodiversity in addressing livelihood and nutritional security of small-holder farmers.

Plant Genetic Resources, nutrition and health: Understanding the links

Farming systems rich in agrobiodiversity are characterized by a range of crops, many of which may be represented by numerous traditional varieties even in the same field. Agrobiodiverse systems tend to comprise smaller quantities of multiple species for culinary, medicinal, and cultural uses. They often tolerate or encourage valuable wild plants within fields, on field margins, and in adjacent natural areas. Before the emergence of modern industrial agriculture, farms everywhere were richer in biodiversity than they are today. Agrobiodiverse systems now tend to be found more in developing countries, among indigenous communities and small-holder farmers, and in extreme or marginal environments. Economic and social development often leads people to abandon these valuable assets, thus preventing agrobiodiversity from contributing to

improving the health and livelihoods of disadvantaged populations (Timothy *et al.,* 2006; Keding *et al.,* 2012).

Plant genetic resources could be more effectively utilized to improve diets and nutrition. Eight hundred million people in the world have diets insufficient in energy, and some 2 billion suffer from micronutrient deficiencies. Improving accessibility to a range of crops would offer nutritional benefits to the rural and urban poor. Farming systems that maintain and use agrobiodiversity have strong potential for improving this accessibility and thus improving nutrition, because they often produce indigenous, neglected, and underutilized food crops and gathered foods rich in nutrient quality. In different parts of the world this potential has been recognized, and efforts made to build on it (Timothy *et al.,* 2006; Keding 2010; Keding *et al.,* 2007, 2012). For example:

- In Brazil, buriti (*Mauritia vinifera*) and some other indigenous palm fruits are noted sources of beta-carotene (provitamin A). The Brazilian Ministry of Health promotes the consumption of these foods through national and local activities directed at sustainable small-scale production, product development, and marketing.
- In Sub-Saharan Africa, indigenous leafy vegetables are potentially rich sources of micronutrients and antioxidants. To promote production and consumption of African leafy vegetables, the International Plant Genetic Resources Institute (IPGRI, now Bioversity International), in collaboration with the World Vegetable Centre (AVRDC) and national partners in eight countries, has combined research, public education, dissemination of information, support to small-scale producers, and facilitation of links to retail markets. Consequently, in Nairobi, Kenya, supermarket sales of leafy vegetables have increased 10-fold over a period of one to two years, and the informal market sector has grown.
- *Moringa oleifera* (Drumstick tree) is a fast-growing, multipurpose tree whose leaves contain high levels of vitamins A and C, calcium, iron, and protein. There are now multiple efforts underway to incorporate *Moringa* into agricultural systems and the diets of people at risk of malnutrition in India, Sub-Saharan Africa, and other regions.

In addition, these plant genetic resources can be utilized by plant breeders and scientists to add nutrients like beta-carotene and zinc to staple crops.

Dietary diversity increases the chances that individuals will meet their dietary requirements. Fruits, minor vegetables, and leaves used as condiments, spices, or sauce ingredients can be grown in small quantities and add variety and essential nutrients to diets otherwise dominated by carbohydrates. Agrobiodiversity is an underexplored avenue for giving both food producers and consumers access to greater dietary diversity. A recent study in a subsistence-oriented mixed farming system in an upland region of the Philippines showed that the diversity of agricultural production-comprising cultivated and gathered products such as fruits, vegetables, and multiple varieties of rice—was important to ensuring food security and reducing the risk of temporary food shortages. Increasing biodiversity in home gardens is another way to promote dietary diversity among producers. In Bangladesh, Helen Keller International projects show that homestead food production focused on a wide variety of fruits and vegetables and integrated with animal husbandry enables households to diversify and increase the quality of their diet. A recent project promoting home gardens and income generation in the Terai area of Nepal through training, technical assistance, and seed distribution significantly improved nutritional knowledge and consumption of 16 types of micronutrient-rich vegetables and fruits. Food consumers more broadly could also benefit. Information on the contribution of indigenous food species to people's diet and nutrient intake, however, is almost non-existent. Most food consumption surveys either underestimate or ignore indigenous and wild foods, as do the food balance sheets of the FAO of the United Nations, which are widely used to estimate global food supply.

There is growing evidence from the epidemiological literature that optimal health requires more than just essential nutrients. Specific plant foods also have so-called functional properties that are associated with reduced risks of chronic diseases and improved health overall. Important examples of crops underutilized in modern farming systems are buckwheat and finger millet, which have blood glucose–lowering effects.

Particular seeds such as flax, pumpkin, and walnuts, contain high levels of omega-3 fatty acids, which are highly protective against chronic diseases. Leafy vegetables and other plant foods contain carotenoids such as lycopene and lutein, which, in spite of having no provitamin A activity, appear to reduce the risk of certain types of cancers. These carotenoids, as well as other widespread compounds called phenolics, act as antioxidants and prevent damage to the body's cells and tissues. All these resources could be more effectively mobilized in farming systems to help control the rapidly emerging problem of chronic diseases. Although many of these foods, or supplements containing specific food constituents, can be purchased, local sources can be more accessible and affordable for people with limited resources. Moreover, these widely distributed species are components of nutritious food systems for which other potential benefits remain to be investigated.

Unfortunately, commercialization of markets potentially limits the opportunities of small-scale farmers to produce and sell minor crops or to compete against the produce of local or foreign commercial farms. Supermarket conglomerates prefer to sell commodities with greater volume, longer shelf life, and guaranteed delivery, while often dictating prices and terms of supply and payment that small farmers cannot operate with. Policy actions are also needed. Policymakers should incorporate agricultural biodiversity into existing global policy tools on nutrition and health. Legislators should introduce measures to use land and other natural production resources to enhance the ability of all to make use of plant genetic resources. Policymakers should promote local markets and facilitate access to international markets for the products of agrobiodiversity. Finally, they should strengthen the links between human and ecosystem health for the conservation of genetic resources.

Focussed policies recommended for achieving food and nutritional security

APM (Alleviating Poverty and Malnutrition in Agri-Biodiversity Hotspots of India) project funded through IDRC-CRDI and DFATD in Canada was implemented jointly by M S Swaminathan Research Foundation (MSSRF) and the University of Alberta. It aims to address issues related to small-holder and family farmers for moving towards food and nutritional security through sustainable agricultural practices. The project focus is on rural communities in three sites in India (Odisha, Tamil Nadu and Kerala) to apply knowledge gained in these three agrobiodiversity hotspots, more broadly across India and other regions. Various efforts such as increasing usage of simple community-centred mechanisms over the three-and-a-half year period contributed towards the objective of reducing poverty and malnutrition. The APM project has been addressing the agriculture-nutrition disconnect, to recommend interventions for scaling up and for appropriate public. The research outcomes range from increasing farm productivity, enhancing food and nutrition security, enhancing farm livelihood diversification options and use of ICT for increasing development impact, to capacity building of community-based institutions for sustainability. One among various studies and research outcomes were shared during the National Consultation on "New Opportunities for Nutritious Foods and Climate Smart Agriculture" in Delhi on 21 August 2014 during which stakeholders from Government, development and multilateral agencies participated. At the close of the consultation, the group came up with a set of recommendations for "pathways to food and nutrition" (http://www.mssrf.org/content/ focussed-policies-recommended-achieving-food-and-nutritional-*security*). These are:

- Advocate for promotion of nutritious millets in the Public Distribution System (PDS) and among the general population for food and nutritional security.
- Ensure effective procurement and distribution of millets in the PDS
- Ensure effective extension in site-specific ways through public, civil society organizations and community-based institutions
- Identify and reduce gender, social and economic barriers related to productivity enhancing initiatives in agro biodiversity hotspots
- Recognize importance of agro-biodiversity in conditions of climate change and provide financial and

other support to farmers for nutritious underutilized crops

- Ensure access to appropriate seeds for home gardens through PDS to ensure that home gardens with benefits nutrition function effectively
- Systematize regular and age-appropriate nutrition and gardening education through schools and through community-based adult education
- Scale-up gender specific labour-saving tools to assist in gardening and in agricultural production
- Promote and support better access to water including water harvesting systems to increase availability of vegetables and fruits
- Ensure appropriate nutrition training and education for service providers and communities and employ tools to assess key nutritional quality indicators
- Expand use of technology for community-specific agricultural information dissemination through public and civil society organizations
- Build a mechanism for community based organizations to work effectively with other organizations to problem solve, discuss and identify best practices

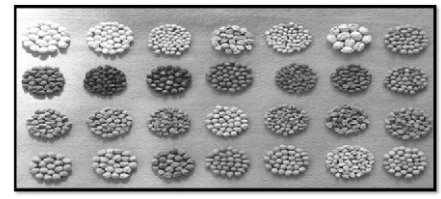
North East Slow Food & Agrobiodiversity Society (NESFAS)

Established in 2012, NESFAS emerged as an outcome of the collaborative activities between the Indigenous Partnership for Agrobiodiversity and Food Sovereignty (The Indigenous Partnership) and Slow Food International (*http://nesfas.org/*). While Slow Food brings into play the importance of pleasure through good, clean and fair food, which goes hand in hand with our responsibility towards the environment, the Indigenous Partnership reaffirms the importance of local food systems and the age old role of Indigenous Peoples as guardians of agrobiodiversity which is inextricably linked to their cultural identity and their rights towards food sovereignty and food security. NESFAS is a platform to promote the importance of local agricultural practices for livelihood and well- being of local communities. It does so by connecting people to the pleasure and importance of local food that is:

- responsibly produced
- protects environment and land
- preserves biodiversity and cultural practices and knowledge
- enhances our health and the well-being of local communities
- reaffirms pride in traditional culture and identity
- recognizes the role of women as custodians of local cuisines and food ways

Conclusion

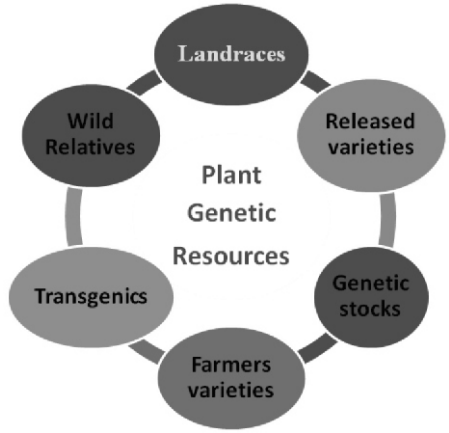
India is land of diversity of several economically important plants. Several agro-biodiversity hotspots are predominantly inhabited by tribal families and are characterised by culinary and curative (medicinal plants) diversity. However, economic and public policy compulsions often lead to a shift in their attention from endemic agrobiodiversity to modern high yielding varieties. The tribal farmers and farmers in mountainous areas have been conserving the agrobiodiversity at personal cost since millennia and in which women play a key role. Further, the malnutrition situation in India is a cause for concern. Unfortunately majority of these high malnutrition burden areas, fall under agrobiodiversity hotspots. The challenge, therefore, is the development and adoption of agricultural strategies that can help alleviate poverty and malnutrition in agrobiodiversity hotspots. The agrobiodiversity in small-holder and tribal subsistence farming, therefore, needs to be used for creating more nutrient-rich food in an ecologically sustainable manner.



(Maize)

(Tomato)

Glimpse of Variability in Crop Genetic Resources



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DISEASES OF BETELVINE AND INTEGRATED MANAGEMENT IN UTTER PRADESH

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Introduction

Betelvine (*Piper betle* L.) is an important cash crop and cultivated in the several states of the country with an area of about 52,000 ha. In Utter Pradesh, it is cultivated in an area of 4000 ha for its leaves, known as "Pan". Betel leaves are richest source of Vitamins and minerals, essential for human health. The crop is cultivated in artificially prepared garden; locally called "Bareja", construction of which varies in different parts of the state. In Jhansi region, outer walls are made of stones block, thatching is done by spreading a thin layer of grass on bamboo splits which are securely fastened with vertical bamboos, supporting the entire roofing. Around Jhansi, Chhatarpur and other parts of the state, outer wall is made of grass held by bamboo. This structure (bareja) provides moist, humid and shaded condition inside; favorable for vine growth these conditions are also congenial for development of many root and aerial diseases like, Stem rot or basal rot (Monhanty and Das Gupta, 2005). Betelvine cultivation in Utter Pradesh is a highly specialized job, confined to a particular community, called "Chaurasia". The techniques are age old and followed strictly from generation to generation.

Problems in Betelvine cultivation in Utter Pradesh

- Incidence of Foot rot and leaf rot, Dry root rot, Stem rot, bacterial leaf spot, Bacterial leaf blight and Anthracnose diseases. Apart from this attack of Red spider mite and Coccid insect.
- Due to climate change, high temperature in April, May and June and low temperature in the month of December and January.
- Lack of knowledge among farmers about the use of balance fertilizer and suitable fungicides at proper time.

Important Diseases of Betelvine

Moist, humid and shaded conditions inside the bareja are also congenial for development of many root and aerial diseases. Important diseases of betelvine are as –

1. Foot rot and leaf rot disease:

This is the most common and destructive fungal disease of betelvine caused by *Phytophthora nicotianae* var. Parasitica occurring at almost every betelvine growing area of Utter Pradesh. It has been reported that this disease causes losses up to 60-70 per cent every year. The extent of losses varies from 5-90 percent (Dasgupta and Sen, 1999; Dasgupta *et. al.,* 2008). Low temperature, high humidity and diffused light that prevail inside the baroj favours vine growth and are also congenial for the growth of the pathogen. The disease appear as circular, dark brown to blackish water soaked spot which rapidly covers the major portion of the leaf lamina under favorable condition. The disease normally appears in rainy season and more destructive when drizzling occur for 2-3 days. In Utter Pradesh studies showed that Metalaxyl + Mancozeb, Copper oxychloride 50 WP and *Trichoderma viride* were highly effective in reducing the intensity of the Phytophthora foot and leaf rot. Effectiveness of the Copper oxychloride formulation in reducing the intensity of Phytophthora rot also confirmed by Mohanty and Das Gupta, 2005; and Maithi *et. al*. 1978. The foot rot caused by *P. arasitica* was claimed to be ameliorated by soil application of Bordeaux mixture

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(Dasgupta,1993; Dasgupta and Sen, 1999; Dasgupta *et al.,* 2008 and Dasgupta and Maiti, 2008). The foot rot was completely checked when cuttings were dipped in streptomycin solution and the plants were sprayed with Bordeaux mixture (1 %) twice a month (Saksena, 1977).

Application of Bio-agent like *Trichoderma* in betelvine plots reduced the foot rot of betelvine. Roy *et al.* (2005), Mohanty *et,al*. (2000) and D'Souza et.al. (2001) also reported the effectiveness of *Trichoderma* in reducing disease incidence of betelvine. Sengupta et. Al. (2011) also reported the superiority of *Trichoderma* application in betelvine plots against foot rot of betelvine.

2. Stem rot or basal rot:

The disease caused by *Sclerotium rolfsii* commonly known as seedling blight, foot rot, collar rot and Southern blight of many crops (Talukder, 1974; Ahmed, 1986). *Sclerotium rolfsii* initiate infection usually at the collar region of susceptible host, as result of which white cottony growth appears, which later forms white sclerotia in the collar region of dead plants. (Punja and Grogan, 1985). It is more destructive when associated with *Phytophthora* sp. Disease normally appears when temperature of soil and humidity in bareja is high. These conditions are common in May-June and July. The sclerotia of *Sclerotium rolfsii* can germinate mycelogenically forming mycelia which again form sclerotia depending upon environmental and nutrition status of the substratum (Aycock, 1966). The disease can be effectively controlled by soil application of *Trichoderma viride* @ 2.5 kg/ha with FYM or cutting treatment with Hexaconazole 5EC @ 0.01 per followed by soil drenching with same (Tripathi 2010). *Trichoderma harzianum* and some of the systemic fungicide have been consistently recommended for *Sclerotial* stem rot control by Singh and Singh (2005).

3. Dry root rot:

The disease caused by *Rhizoctonia bataticola* is also a limiting factor in betelvine production. Maximum damage occurs in the month of October –November when temperature was 28 - 30 ^{0}C and humidity 40-90 per cent. The roots of infected plants turn dark brown or purple colour. Soil application of *Trichoderma viride* highly effective against the disease as reported by Tripathi (2010) whereas Singh and Singh (2005), Maithi *et. al*. (1978) and Mohanty and Das Gupta (2005) found the Carbendazim and *Trichoderma harzianum* quite effective against root rot disease of Betelvine.

4. Leaf spot and Stem anthracnose:

This disease caused by *Colletotrichum piperis* is also important disease and often appears alongwith bacterial pathogen *Xanthomonas* sp. Soon after rain break in April-May, the disease appears on leaves. As the temperature increases, stem girdling occurs and disease appears as blackish lesions on stem. The fungus produces large number of acervuli containing short, hyaline conidiophores and block coloured setae. The leaves show small black circular spots initially which later enlarge and develop to a size of 2 cm in size, become concentric and covered with a yellow halo. The affected leaves turn pale yellow and dry up with large black dots in the centre of the spots. Black, circular lesions may develop on the stem, enlarge rapidly and girdle the stem resulting in withering and drying.

The fungus remains in the infected plant debris in the field. The primary infection is through the soil-borne conidia, spread by rainwater splash or splash irrigation. The secondary spread in the field byures by air-borne conidia. For the Management of the disease collect and destroy the infected vines and leaves. Spray 0.2 per cent Carbenzazim or 0.5 per cent Bordeaux mixture after plucking the leaves.

5. Powdery mildew-

The disease caused by *Oidium piperis*, produces profusely branched, hyaline and septet hyphae on the surface of the leaves. The disease affects the crop at all stages of its growth and infection is mainly noticed on tender shoots and leaves. Whitish powdery growth is seen on both the surface of leaves which later enlarges and cover the major portion of the leaves. When the disease advances, the whitish growth turns to brown blotches and in severe cases, the leaves turn yellow and defoliation occurs. Dry humid weather during the months of May-July is favorable conditions for disease development.

The fungus survives in the infected crop residues in the soil. The secondary spread in the field is through wind-borne conidia and carried through splash irrigation. For the management of the disease collect

and burn the infected leaves. Spray 0.2 per cent Wettable Sulphur or dust Sulphur at 25 kg/ha after plucking the leaves.

6. Bacterial leaf spot, Leaf blight and Stem canker:

This disease is caused by *Xanthomonas campestris* pv. betlicoea and produces three types of symptoms. Leaf spot appears on leaf lamina and are brown to dark brown surrounded by yellow halo. The disease starts as small water soaked lesion on the lower surface and after few days, the spot develops on upper side of the leaves. In stem canker, elongated brown spots of various sizes appear on the stem. In severe cases, stem gets cracked. On splitting such vine, black streak throughout the vascular bundles can be seen extending to several nodes. In leaf blight, "V" shape discolored area appears along the leaf margin and covers the considerable portion of leaf lamina. Water soaked spot can also be observed. For the management of bacterial diseases cutting should be treated with Streptocyclin (6 gm in 30 lit water) and after appearance of disease spray of Streptocyclin (6 gm in 40 lit of water) or copper oxy-chloride 0.1 per recommended.

Integrated Management approaches

The betelvine garden "Bareja" provides moist, humid and shaded condition inside; favorable for the development of diseases. Application Chemical/ fungicides are more practical for the management betelvine disease. However, to reduce toxic hazards of human being as the betel leaves are directly chewed immediately after harvest. The effective control measures against these diseases are needed, besides eco-friendly approach for betelvine production and protection is need of the day. The following control measure included under integrated disease management for betelvine.

1. Improve Cultivation Practices-

Tropical climate of Utter Pradesh is suitable for Betelvine cultivation. The crop requires moist soil and sandy place with high humidity. Betelvine plantation is being done in the month of February and March. Upper one meter length of betel plant was used for plantation. Immediately after planting, cutting is covered by grass mulch and frequent water was sprayed to check the moisture loss.

Table 1: Varietals performance against diseases of betelvine.

S. No.	Cultivars	Foot rot disease (% mortality)	Basal rot disease (% mortality)
1.	Bangla	10	7
2.	Bilahri	9	8
3.	Kalkatia	0	7
4.	Kanker	1	5
5.	Kapoori	2	6

2. Integrated nutrient management

Most of the cultivators of Utter Pradesh are applying the nutrients through the oilcakes only. Imbalance fertilizer application is common and farmers are spending a lot of money to supply the nutrients through various types of oilcakes (Sesame, Mustard etc.) which favors the incidence of various diseases. The betelvine crop requires heavy quantity of nitrogen (150 kg), phosphorus (80-100 kg) and potash (80 kg) per hectare. Application of 75 per cent NPK through fertilizer and 25 per cent through oil cakes or application of 50 per cent NPK through fertilizer and 50 per cent through oil cakes was found optimum for betelvine crop (Maurya 2005). Application of com straw and sesame oil cake supplied nutrients in betelvine field as well as reduced diseases in betelvine garden (Mehrotra and Tiwari, 1976).

Table 2: Effect of Integrated Nutrient Management on yield of Betelvine.

Fertilizer dose	No. of leaves per plant	Yield (q/ha)
100% NPK + 0% oil cakes	11.795	61.97
75% NPK + 25% oil cakes	11.06	59.96
50% NPK + 75% oil cakes	11.465	59.25
25% NPK + 75% oil cakes	11.50	48.47
0% NPK + 100% oil cakes	10.83	54.33
C.D. at 5%		**11.45**

100 % NPK dose N 150 + P2O5 + 50 kg/ha, Oil cakes 25 q/ha.

3. Soil Treatment

Soil should be treated with 1 per cent Bordeaux mixture or 0.2 per cent Copper oxy –chloride or application of *Trichoderma viride* 2.5 kg/ha with FYM for management of the betelvine diseases.

4. Seed/Cutting Treatment

Seed treatment with Streptocyclin (6 gm in 30 liter of water) then in Copper fungicide (0.2 %). Tiwari and Mehrotra (1968); Mehrotra and Tiwari (1976) found that dipping of betelvine cutting in a *Trichoderma viride* cell suspension effectively reduced the diseases. Where the Sclerotial wilt is a major problem, cutting will be treated with Hexaconazole (0.1 %).

5. Irrigation and drainage system for betel crop

Betelvine crop requires frequent irrigation but it is very sensitive to water logging during rainy season. To maintain 70 per cent humidity in bareja, 2-3 times sprinkler irrigation per day should be given, while in winter season, one irrigation after 2-3 days is required. In rainy season, drainage system should be proper. The absence of drainage system on flat and the consequent excess soil moisture leads to reduction or complete crop failure by impeding soil aeration and due to incidence of root rot disease.

6. Need based application of Chemicals

Soil drenching with 0.1 per cent Bordeaux mixture or 0.2 per cent Copper oxy –chloride at 20 days interval in rainy season. General spray of Mancozeb in the month of October and spray of Dichorvas 76 EC or Dimethoate 30 EC @ 0.1 % for protection from sucking pest like mealy bug, mites and white fly as and when required.

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MARINE FISH DIVERSITY: IT'S NUTRITIONAL IMPORTANCE, PRESENT SCENARIO AND FUTURE PROSPECTS

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Introduction

Marine diversity is diversity of biota in coastal & ocean area. Based on genetic variability in species more diversity was reported in benthic area and at coastal area than that of pelagic and open ocean(Pierre, 1998).The total number of estimated living fish species might be close to 28,000 in the world. Day (1989) has described 1418 species of fish under 342 genera from the British India water. Talwar (1991) has described 2546 species of fish belonging to 969 genera, 254 families and 40 orders. Another study said that In India 2163 species of finfish have been recorded from upland cold (157; 7.26%), warm waters of the plain (454; 20.99%), brackish water (182; 8.41%) and marine environment (1370; 63.3%). Greater diversity is available in the sea than the land, so people are exploit more than 400 species with the help of advanced mechanization finally it threats to marine species (Geoffrey et al., 2007).

Fish act as the major protein provider to the world's population, it provide at least 20% of protein to peoples. The developing countries were more depends on fish as food (Béné et al. 2007). The major source of fishes was small scale fisheries, from which more than half of the protein and minerals supply was there for poor countries of Africa and South Asia (Beare, 2012). When comparing with other meat products fish contains 18-22% easily digestible protein and essential amino acids which, human bodies can't produce. Fish meat also contains other important nutrients like vitamins, calcium, phosphorus, copper, iodine etc. the lean fishes contains good protein content but less vitamins, while fatty fishes have about 8-10% fat content and little amount of vitamins and calcium. Apart from meat, fish oil is having fat soluble vitamins and useful for vitamin deficiency prevention in human body. The research also proves that good amount of seafood in diet can be useful to control over the blood cholesterol level and it reduces the risk of heart diseases. The fish oil have medicinal values for pharmaceuticals, daily useful products like soap, make up material etc. and in dailyfood consumption it will helpful for keeping skin and eyes healthy and prevents blindness in children (Khan and Ullah, 1986).

2. Present Scenario And Major Threats To Fish Diversity:

2.1. Overexploitation of natural resources

The exponential growth in human population experienced in the last decades has lead to an overexploitation of marine living resources to meet growing demand for food. Worldwide, fishing fleets are two to three times as large as needed to take the present day catches of fish and other marine species and as what our oceans can sustainably support. The use of modern techniques to facilitate harvesting, transport and storage has accelerated this trend. Overexploitation or overfishing is the removal of marine living resources to levels that cannot sustain viable populations. Ultimately, overexploitation can lead to resource depletion and put a number of threatened and endangered species at risk for extinction. Overexploitation of natural resources means resource extraction, hunting, and fishing for food, pets, and medicine.A greater variety of species at a higher trophic level is exploited in the sea than on land. Humans exploit over 400 species as food resources from the marine environment, whereas on land only tens of species are harvested for commercial

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use. Exploitation of marine biodiversity is also far less managed than on land, yet exploitation technology is becoming so advanced that many marine species are threatened to extinction. Overexploitation does not only affect open ocean or pelagic ecosystems but also the coastal and intertidal areas (Thompson et al., 2002).

Based on FAO's analysis of assessed commercial fish stocks, the share of fish stocks within biologically sustainable levels decreased from 90% in 1974 to 68.6% in 2013. Thus, 31.4% of fish stocks were estimated as fished at a biologically unsustainable level and therefore overfished. Of the total number of stocks assessed in 2013, fully fished stocks accounted for 58.1% and under fished stocks 10.5%. The under fished stocks decreased almost continuously from 1974 to 2013, but the fully fished stocks decreased from 1974 to 1989, and then increased to 58.1% in 2013 (FAO, 2016). Thus a total of almost 80% of the world's fisheries are fully to overexploited, depleted, or in a state of collapse. Study done by Worm (2000) stated that 29% of fish and seafood species have collapsed (i.e., their catch has declined by 90%) and are projected to collapse latest by 2048, unless immediate actions are taken. Worldwide, about 90% of the stocks of large predatory fish stocks have already collapsed.All fishing activities, if not conducted in a sustainable non-destructive manner, can lead to overexploitation of marine living resources. Overexploitation of marine resources has major impacts on marine systems as a whole, but the target species are generally the most affected. Fishing effect can be divided into: direct effect and indirect effects (Geoffrey et al., 2007).

2.1.1. Direct Effects: Direct effects of fishing creates disturbances in physical structure, it is completely depend on variety of gear. These effects are growth and recruitment overfishing (Jennings & Kaiser, 1998). In sea major effects are happened by the operation of trawling to non-target species, trawls are destroyed by molluscan and echinoderm.

2.1.2. Indirect Effects: Examples are ghost fishing, trophic cascading effectsand food web competition(Pauly et al., 1998). This effects of fisheries, focusing on the top predators and herbivores of the food web, is globally visible in the disappearance of large fish, sharks, turtles, crustaceans and plants and consequent increases in smaller fish species, sea urchins, etc. together with increase in their phytoplanktonic or macrophyte food (Temkar et al., 2013).

2.2. Pollution

Pollution is entry of foreign material in to the nature by human impact or chemical substances (Oil), which are directly or indirectly, affects to health of 80% marine resources such as fishes. Accumulation of nutrients in coastal water through agriculture run-off leads to eutrophication (Temkar et al., 2013).

2.2.1. Major Types of Pollutions Damaging Marine Fish diversity

2.2.1.1. Oil Pollution: It makes a layer on the surface of water andleads to decrease of penetration of light leads to production, clogging gills with oil and suffocation in finfishes with alternation of body temperature.

2.2.1.2. Thermal Pollution: Major causes for thermal pollution for fish diversity viz., use of water as cooling agent, soil erosion, deforestation of shorelines and run-off from hot-paved surfaces, it results decreases of dissolved oxygen finally leads to dis-integration in ecological relation. Most of the fishes can tolerate with limited temperature changes but not continuously changes due to it leads to thermal shock. Apart from the sewage pollution, organic pollution, metal pollution, agricultural run-off, etc. also have negative impacts on ocean fish diversity.

2.3. Habitat loss and degradation

"Habitat destruction and fragmentation" is creates risk to house of organism, it is a critical threat to marine fish diversity (Gray, 1997). It is estimated that every day between 1960 and 1995, a kilometer of coastline was developed, causing permanent losses of valuable habitats, such as coastal wetlands, sea-grass meadows and rocky shores (Airoldi & Beck, 2007). Approximately 20% of the world's coral reefs were lost and an additional 20% degraded in the last several decades of the twentieth century. Moreover, approximately 35% of the mangrove area was also lost during this period (Anon, 2005). Following are the major impacts of Habitat Loss on biodiversity (Airoldi et al., 2008 & Dobson et al., 2006).

2.3.1. The Loss of Resident Species: Every habitat has a unique community with species of plants and animals. It has been predicted that the consequences of habitat loss would probably be much more profound

than the loss of individual species, because of the ecological interactions between species leading to a chain of impacts (Airoldi et al., 2008).

2.3.2. The Loss of Food Resources: Most biogenic habitats are highly productive compared to simpler habitats. They produce large amounts of nutrients and organic matter that can be directly used by other organisms as food resources. The loss of habitat also implies the loss of these food resources leading to negative effects on the survival and productivity of other species or communities with more profound impacts on food chains (Airoldi et al., 2008 & Dobson et al., 2006). For example, the loss of seagrass meadows results in a reduction in the number of species and abundance of fishes.

2.3.3. Gears which causes Habitat loss and destruction

2.3.3.1. Bottom Trawling: In which more problem to bottom long-living fish, molluscanand echinoderm species than the target species.

2.3.3.2. Muroami Fishing: It is a fishing technique of coral, uses an encircling net together with pounding devices and crushing effect of pounding process on the coral heads has been described as having practically long lasting and totally destructive effects(Temkar et al., 2013).

2.4. Introductions of Invasive Alien species and their implication

It is a major threat to world oceans fin fish diversity.Species are called non-native species or invasivewhenthey are ecologically or economically harmful by eliminating of food chains.Speciescompete the food and space, etc. with native population this ultimately harms the ecosystem and changing the naturally established population (Temkar et al., 2013).

Introductions of alien species can happen either deliberately or inadvertently. But nowadays in aquaculture, new species are introduced manually for getting good production for profit oriented business, and unfortunately these species gets introduced into marine or in any other ecosystems. In these new found habitats they compete for food and space with the endemic population changing the characteristics of natural population through breeding. This ultimately harms the ecosystem and changing the naturally established population.

2.4.1. Population, Community, Genetic and Ecosystem Effects: Introduction ofnon-native species are harmful to native species through hybridization and finally extinction of rare species occur.These species can cause the decline of native species directly through competition, predation, or disease, or by altering ecosystem processes such that native species begin to die out. If invading species interact with natives primarily through competition for limited resources, removal of the exotic should produce a compensatory increase in native populations if species supply is not limited.

2.4.2. Conservation Measures for Exotic Species Introduction: Potential control mechanisms include import restrictions, mechanical and chemical control programs and the use of other exotic species to reduce target species and restore environments and communities.

3. Future Prospects For Conservation of Fish Diversity:

3.1. Marine Protected Areas

"Marine Reserves or Marine Protected Areas" are established both as fisheries management tools and for the protection of fish diversity. There is ample evidence that MPAs provide a host of benefits to the exploited populations within their boundaries. Ideally, marine reserves should encompass representative regions/habitats so as to protect as much of the regional biodiversity as possible. However, the degree to which reserves achieve the goal of "protecting" species is uncertain. Given that, the majority of marine species are not eaten (at least not yet), closing areas to fishing or collecting does not necessarily address the primary threats to most of the species. MPAs may be of limited benefit where habitat loss and fragmentation, pollution and climate change are contributing to declines in marine biodiversity (FAO, 2011).

3.2. Ranching

This technique was originated in USA in 1870. The process consists of artificial recruitment of organisms in natural environment for improvement of their depleted stocks. The technique uses the hatchery

breed juveniles in controlled condition were reared up to desirable size and then gets released in to the environment. The major steps were; brood stock development, breeding, larval rearing on large scale, nursery rearing, release of seed at suitable site and monitoring of the released and natural stock to assess the impact (Rao, 1996).

3.3. Threatened or Endangered Species Designations

Threatened species include organisms likely to become endangered if not properly protected. Endangered fish species are need protection in order to survive, as they are in immediate danger of becoming extinct. Once species are "listed," they become subject to national recovery programs and will be placed under international protection. Severe monetary penalties can occur if threatened and endangered species regulations are broken and can even result in jail sentences.

3.4. Regulatory Measures

The Indian Fisheries Act of 1897 (modified in 1956) is a landmark in the conservation of fishes. Besides provision to and monitor gears, mesh size and observance of fishing or closed seasons, the Act also prohibits the use of explosives or poisons to indiscriminate killing of fish in any water at present. The ministry of agriculture, Government of India is modifying the Indian Fisheries Act to incorporate all the relevant legal to conserve fish germplasm resource. The creation of sustainable fisheries is largely completed through regulatory actions including the collection of the best scientific data available.

3.5. Fisheries Management

This process is majorly applicable for regulation of fisher's use of fisheries resource with control over the fish mortality. Fish mortality is denotes the fish population removed by the fishery annually. Particularly, fisheries management directed towards the maintaining fish stock abundance and a size and age structure that give the maximum average yield or catch sustainable over the long term and for achieving this success various management rules and regulations were used. When regulating the use of fishery resources, economic efficiency and the social dimensions of the fishery must also be factored into management analysis (FAO, 2011).

3.5.1. Input controls: These restrictions include restrictions on the number of fishing units through limiting the number of licenses or permits issued, restrictions on the amount of time units can spend fishing, such as individual effort quotas and restrictions on the size of vessels and/or gear. The drawback for this management observed that a limit on fleet capacity and amount of efforts by fishing industry cannot be effectively controlled. But it is most important presently,because it should be appropriate access rights and regulates the inputs to appropriate levels in their own economic interests which useful for conserving or stopping the over fishing (FAO,2003; 2009; 2011).

3.5.2. Output controls: Theoretically this management gives estimation and implementation of optimal catch to be harvested from a stock. Output control is a popular management measure for fisheries, particularly for large-scale fisheries and there is an even greater interest in extending its application, in association with limited entry, with the current wide-spread interest in individual transferable quotas (ITQs). Another tool for output control is setting a total allowable catch (TAC). Which was further divided in to individual quotas by fishing nation, fleet, fishing company or a fisherman (FAO, 2003; 2009; 2011).

3.5.3. Technical measures: These measures majorly control over gear restrictions, mesh size regulations, use of advanced by-catch reduction devices etc. The major control for gear restriction are minimum mesh size or dimensions of mouth opening of nets or traps, which was useful for control fishing mortality of smaller fishes (juveniles) i.e. growth overfishing. It may also be designed to reduce the total catch by reducing the potential efficiency of the fisher.The use of subsidiary devices such as by-catch reduction devices (BRDs), turtle excluder devices (TEDs) and grids can be useful for management of by-catches which wasalready over-exploited or threatened species and these should be utilized by fisheries management authorities as necessary. As per the fisheries maritime guidelines of Andhra Pradesh, West Bengal, Andaman and Nicobar use of these devices is becomes must and net without this devices there is jail statements were implemented (FAO, 2003; 2009; 2011).

3.5.4. Spatial-Temporal measures: This management measures restrict the fishing activity for certain times or seasons and by restricting fishing in particular areas. Those protected areas were useful for reduce the mortality rate of individuals of either target or non-target species in vulnerable life stages and this causes reduction of impact of direct and indirect effects of fishing on the ecosystem. Another use of area closure is used to protect the crucial and critically important fish habitats for supporting the ecosystem activities. The time closure useful for management of spawning or recruitment activities of the fish diversity. Fishing ban for particular season was important for particular regional fisheries, which gives good impact for multiplication of species for future generations and most importantly for stock replenishment. Along Indian waters earlier there was conflicts about the different fishing ban period for each states, which presently replaced by common fishing ban for west and east coast (each 61 days). For west coast it is from 1st June to 31st July and for east coast from 15th April to 15th June (Indian Express, 2015). So overall these measures are subject to the same social and economic problems in open access systems as all other control measures throughout the country (FAO, 2003; 2009; 2011).

3.6. Control of the impact from fishing gear on habitats

As some of the fishing practices like bottom trawling, Muroami fishing etc. through the fishing gears or material causes negative impacts on biotic and abiotic habitats. Because, during operation of trawling, gear touches or scrapes the bottom and there is limited knowledge about long term effects of such destruction. So to monitor this a precautionary approach is recommended in the use of high-impact fishing methods in critical habitats. Use of towed gear with reduced bottom contact is a technical option in such areas. Prohibition of certain gear in some habitats like trawling in coral reef and seagrass areas and replace a high-impact fishing method with one with less impact on the bottom, e.g. trapping, longlining or gillnetting.

3.7. Fisheries Co-management

It is management process where fisherman and government both shares responsibility and authority for the management of fishery. Through consultations and negotiations, the partners develop a formal agreement on their respective roles, responsibilities and rights in management. The failure of fisheries also reassessed and managed again. So the impactful thing in this management measure is greater local stewardship; greater responsibility, authority and participation of fishermen in decision-making and recognition of not just fish, but the ecosystems in which they live.

3.8. Ecosystem based Fisheries Management

The important principle of this management is sustainable fisheries development to cover the ecosystem as a whole.Its main aim is always contribute to the stability of employment and economic activity in the fishing industry and to the protection of marine biodiversity on which fisheries depend. As a society, we are recognizing the limits of the sea to provide resources and of our abilities to stay within those limits.This management measures ensure that, despite variability, uncertainty and likely natural changes in the ecosystem, the capacity of the aquatic ecosystems to produce fish food, revenues, employment and more generally other essential services and livelihood is maintained indefinitely for the benefit of the present and future generations (FAO, 2003; 2009).

3.9. Research

Various organizations organizes seminars, symposiums and conferences give impetus to researches in fish diversity and associated conservation strategies help to identify areas of future research, analyze current trends in aquatic fish diversity and even conduct specialized studies. Which overall useful for conservation of fish diversity for present and future needs. Various organizations in India like Central Marine Fisheries Research Institute, Central Institute of Fisheries Technology, National Bureau of Fish Genetic Resources, Central Institute of Brackish Water Aquaculture, Central Institute of Fisheries Education were working on conservation of marine fish diversity for present and future generations.

4. Conclusion

Conservation of fish diversity is important from the fact that bulk of our capture production still comes from the wild. Conservation needs must be aimed towards preserving existing fish diversity and also

the evolutionary processes that foster fish diversity. The pressure on natural habitats associated with increasing population and economic growth will continue to lead to the loss of biological fish diversity. Recognition of the scale of problem, the nature of the underlying causes and the limited resources available to counteract powerful destructive trends will definitely lead to a best way of conserving the biological fish diversity of the aquatic ecosystems of India.

After reviewing present and future scenario for fin fish,there are priorities focus more on protect endangered and threatened species by establishing protected areas, regulate and prevent ocean pollution, manage marine fisheries through fisheries regulations for fulfillment future and present need. And also try to conserve coastal marine ecosystem through policies, different integrated coastal zone management programs, etc.

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CLIMATE SMART FARMING: PARAMOUNT AND USER-FRIENDLY CLIMATE TOOLS FOR FARMERS

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Abstract

Climate change and agriculture are interrelated processes, both of which take place on a global scale. Climate change affects agriculture in a number of ways, including through changes in average temperatures, rainfall, and climate extremes (e.g., heat waves); changes in pests and diseases; changes in atmospheric carbon dioxide and ground-level ozone concentrations; changes in the nutritional quality of some foods; and changes in sea level. Climate change is already affecting agriculture, with effects unevenly distributed across the world. It will probably increase the risk of food insecurity for some vulnerable groups, such as the poor. Agriculture contributes to climate change by anthropogenic emissions of greenhouse gases (GHGs), and by the conversion of non-agricultural land (e.g., forests) into agricultural land. Agriculture, forestry and land-use change contributed around 20 to 25% to global annual emissions in 2010.There are range of policies that can reduce the risk of negative climate change impacts on agriculture, and to reduce GHG emissions from the agriculture sector. Climate Smart Agriculture (CSA) is an approach for addressing the development efforts towards the technical, policy and investment condition related issues to achieve sustainable agriculture development for food security under climate change along with eradication of poverty. CSA is a dire need of hour in current climate changing scenario for agriculture. This review paper provides an overview of climate change and agriculture, while paying some specific attention to the impact of climate change on Indian agriculture. This broad-brush account covers both the agronomic and economic aspects of the impact of climate change.

Introduction

Exponential growth of CO2 and other greenhouse gasses in the atmosphere is causing climate change. It is any significant long-term change in the expected patterns of average weather of region (or the whole Earth) over a significant period of time. It is about non-normal variations to the climate, and the effects of these variations on other parts of the Earth (Chatterjee 1998 and Chattopadhyay1997). These changes may take tens, hundreds or perhaps millions of year. But increased in anthropogenic activities such as industrialization, urbanization, deforestation, agriculture, change in land use pattern etc. leads to emission of green house gases due to which the rate of climate change is much faster. Climate change scenarios include higher temperatures, changes in precipitation, and higher atmospheric CO2 concentrations. It affects agriculture, forestry, human health, biodiversity, snow coverand aquaticto mountain ecosystems (Achanta 1993, Adams et. *al.,* 1998 Priyadarshi 2009 and Rai 2010). Changes in climatic factors like temperature, solar radiation and precipitation have potentials to influence crop production. Agriculture is an economic activity that is highly dependent upon weather and climate in order to produce the food and fibre necessary to sustain human life. Not surprisingly, agriculture is deemed to be an economic activity that is expected to be vulnerable to climate variability and change. The vulnerability of agriculture to climate variability and change is an issue of major importance to the international scientific community. The effects of agriculture on GHG emissions are also large. Agriculture is a major part of the global economy and uses substantial fossil fuel for farm inputs and equipment.

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Climatic change could affect agriculture in several ways such as quantity and quality of crops in terms of productivity, growth rates, photosynthesis and transpiration rates, moisture availability etc (2005 Cline 2007, Hoffmann 2011 and IPCC 1992). Climate change is likely to directly impact food production across the globe. Increase in the mean seasonal temperature can reduce the duration of many crops and hence reduce the yield. In areas where temperatures are already close to the physiological maxima for crops, warming will impact yields more immediately (IPCC, 2007). Drivers of climate change through alterations in atmospheric composition can also influence food production directly by its impacts on plant physiology. The consequences of agriculture's contribution to climate change, and of climate change's negative impact on agriculture, are severe which is projected to have a great impact on food production and may threaten the food security and hence, require special agricultural measures to combat with.

Why Climate smart agriculture needed?

As per FAO estimate, by the year 2050 world population will increase by one-third and food required by 60%. Already cumulative impact of climate change since last decade has effect on productivity. Agriculture has become a high risk profession-farmers increasingly prefer t migrate. In India as per National Sample Survey Organization 2005 estimate 60% farmers like to leave farming. This has direct impact on socio-economic process. Already countries after countries are facing social turmoil with growing local terrorism and riots for food. In India this is reflected by expansion of Naxalite and MAOs activities in various states. A movement that encourages young individuals to crimes of extortion and dacoity which has spread over $1/3^{rd}$ of its total district in which they are present. It is possible to make agriculture a sustainable livelihood means but this will requires intensive efforts at ground level, local level where agriculture exists and it has to be made climate smart.

Means of Climate Smart Agriculture (CSA)

The Food and Agriculture Organization of world (FAO) has initiated this concept. Climate smart agriculture (CSA) contributes to achievement of sustainable development goals (Fig 1). It integrates social, economical and environmental development to meet challenge of providing sustainable (a) livelihood to farmers (b) food security to hungry million and eradication poverty. CSA compose of four pillars-

- Sustainably increasing agriculture productivity and income adapting and building resilience to climate change.
- Reducing or removing green house gas (GHS)emission wherever possible.
- It uses agriculture as a major tool for mitigation of GHG, CO_2 by laying emphasis on its unique capacity to absorb CO_2 and release oxygen through photosynthesis process. It envisages achieving this through increased cropping, by reducing rain fed areas through integrated water and river basin management and expansion of agriculture on wasteland, wetland, degraded fallow areas and introducing urban agriculture.
- CSA involves crop pattern based on soil health and moisture analysis to support crops which can be sustained
- Agro-advisory
- Predicted weather pattern long term, medium term and week to week basis given by Meteorology Department, this prior to kharif and rabi season.
- After unexpected weather that changes have occurred for corrective action to prevent crop loss.
- Crop production that contributes to food security by addressing current and projected climate change impacts through adaption and mitigation.

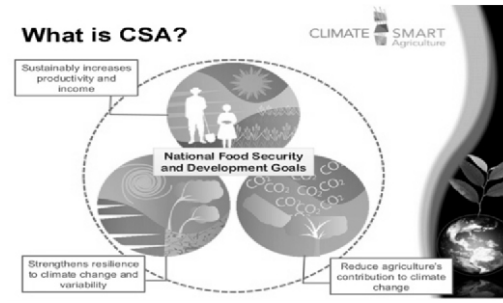

Fig -1 Showing diagrammatic representation of Climate Smart Agricultur

Impact of climate change on world's agriculture

Climate change is likely to directly impact on food production across the globe. Increase in the mean seasonal temperature can reduce the duration of many crops and hence reduce final yield. In areas where temperatures are already close to the physiological maxima for crops, warming will impact yields more immediately (IPCC, 2007). World agriculture faces a serious decline within this century due to global warming. Overall, agricultural productivity for the entire world is projected to decline between 3 and 16 % by 2080. Developing countries, many of which have a average temperatures that are already near or above crop tolerance levels, are predicted to suffer an average 10 to 25% decline in agricultural productivity the 2080s (Table 1). Rich countries, which have typically lower average temperatures, will experience a much milder or even positive average effect, ranging from a 8% increase in productivity to a 6% decline. Individual developing countries face even larger declines. India, for example, could see a drop of 30 to 40%.

Table 1: Predicted effects of climate change on agriculture over the next 50 years

Climatic element	Expected changes by 2050's	Confidence in prediction	Effects on agriculture
CO_2	Increase from 360 ppm to 450 - 600 ppm (2005 levels now at 379 ppm)	Very high	Good for crops: increased photosynthesis; reduced water use
Sea level rise	Rise by 10 -15 cm Increased in south and offset in north by natural subsistence/rebound	Very high	Loss of land, coastal erosion, flooding, salinisation of groundwater
Temperature	Rise by 1-2oC. Winters warming more than summers. Increased frequency of heat waves	High	Faster, shorter, earlier growing seasons, range moving north and to higher altitudes, heat stress risk, increased evapotranspiration
Precipitation	Seasonal changes by ± 10%	Low	Impacts on drought risk' soil workability, water logging irrigation supply, transpiration
Storminess	Increased wind speeds, especially in north. More intense rainfall events.	Very low	Lodging, soil erosion, reduced infiltration of rainfall
Variability	Increases across most climatic variables. Predictions uncertain	Very low	Changing risk of damaging events (heat waves, frost, droughts floods) which effect crops and timing of farm operations

Source: Climate change and Agriculture, MAFF (2000)

Impact of climate change on India's agriculture

India's agriculture is more dependent on monsoon from the ancient periods. Any change in monsoon trend drastically affects agriculture. Even the increasing temperature is affecting the Indian agriculture. In the Indo-Gangetic Plain, these pre-monsoon changes will primarily affect the wheat crop (>0.5°C increase in time slice 2010-2039; IPCC 2007). In the states of Jharkhand, Odisha and Chhattisgarh alone, rice production losses during severe droughts (about one year in five) average about 40% of total production, with an estimated value of $800 million. Increase in CO_2 to 550 ppm increases yields of rice, wheat, legumes and oilseeds by 10-20%. A 1oC increase in temperature may reduce yields of wheat, soybean, mustard, groundnut, and potato by 3-7%. Much higher losses at higher temperatures. Productivity of most crops to decrease only marginally by 2020 but by 10-40% by 2100 due to increases in temperature, rainfall variability, and decreases in irrigation water. The major impacts of climate change will be on rain fed or un-irrigated crops, which is cultivated in nearly 60% of cropland (Fig 2). A temperature rise by 0.5oC in winter temperature is projected to reduce rain fed wheat yield by 0.45 tonnes per hectare in India (Lal et *al.,* 1998, Aiken 2009 and Bohle et. *al.,* 1994). Possibly some improvement in yields of chickpea, rabi maize, sorghum and millets; and coconut in west coast. Less loss in potato, mustard and vegetables in north-western India due to reduced frost damage. Increased droughts and floods are likely to increase production variability.

Recent studies done at the Indian Agricultural Research Institute indicate the possibility of loss of 4 – 5 million tons in wheat production in future with every rise of $_1o_C$ temperature throughout the growing period. Rice production is slated to decrease by almost a tonne/hectare if the temperature goes up by 2 o C. In Rajasthan, a 2oC rise in temperature was estimated to reduce production of Pearl Millet by 10-15%. If maximum and minimum temperature rises by 3oC and 3.5oC respectively, then Soyabean yields in M.P will decline by 5% compared to 1998. Agriculture will be worst affected in the coastal regions of Gujarat and Maharashtra, as fertile areas are vulnerable to inundation and salinisation.

Impacts of Climate Change on Agriculture

Global climatic changes can affect agriculture through their direct and indirect effects on the crops, soils, livestock and pests. The increase in temperature can:

- Reduce crop duration.
- Increase crop respiration rates
- Alter photosynthate partitioning to economic products
- Affect the survival and distribution of pest populations
- Hasten nutrient mineralization in soils
- Decrease fertilizer-use efficiencies
- Increase evapo-transpiration rate

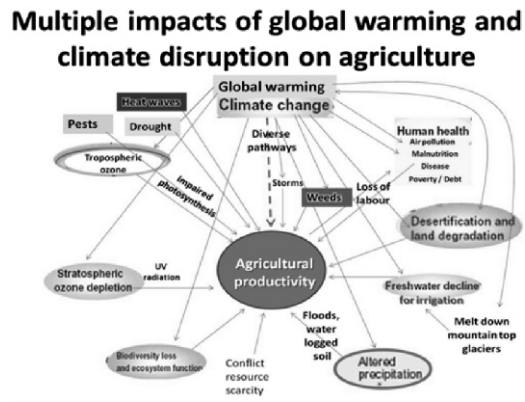

Fig. 2 Showing various effects of climate change on agriculture

- Insect-pests will become more abundant through a number of inter- related processes, including range extensions and phenological changes, as well as increased rates of population development, growth, migration and over-wintering.
- An increase in atmospheric carbon dioxide level will have a fertilization effect on crops with C3 photosynthetic pathway and thus will promote their growth and productivity.

Weather impacts on agriculture

- Rainfall drives water availability and determines Sowing time (rainfed crops)
- Temperature drives crop growth, duration; influences milk production in animals and spawning in fish
- Temperature, RH influence pest and diseases incidence on crops, livestock and poultry
- Radiation influences the photosynthetic productivity
- Wet & dry spells cause significant impact on standing crops, physiology, loss of economic products (eg. fruit drop)
- Extreme events (eg. high rainfall/floods/heat wave/cold wave/cyclone /hail/frost) cause enormous losses of standing crops, live stock and fisheries

In the long run, the climatic change could affect agriculture in several ways:

- Productivity, in terms of quantity and quality of crops.
- Agricultural practices, through changes of water use (irrigation) and agricultural inputs such as herbicides, insecticides and fertilizers.
- Environmental effects, in particular in relation of frequency and intensity of soil drainage (leading to nitrogen leaching), soil erosion, reduction of crop diversity.
- Rural space, through the loss and gain of cultivated lands, land speculation, land renunciation, and hydraulic amenities.
- Adaptation, organisms may become more or less competitive, as well as humans may develop urgency to develop more competitive organisms, such as flood resistant or salt resistant varieties

of rice.

Climate change – mitigation and adaptation in agriculture

- Assist farmers in coping with current climatic risks by providing value-added weather services to farmers. Farmers can adapt to climate changes to some degree by shifting planting dates, choosing varieties with different growth duration or changing crop rotations (Aggarwal 2009 Bhatia 2005).
- An Early warning system should be put in place to monitor changes in pest and disease outbreaks. The overall pest control strategy should be based on integrated pest management because it takes care of multiple pests in a given climatic scenario.
- Participatory and formal plant breeding to develop climate-resilient crop varieties that can tolerate higher temperatures, drought and salinity.
- Developing short-duration crop varieties that can mature before the peak heat phase set in.
- Selecting genotype in crops that have a higher per day yield potential to counter yield loss from heat-induced reduction in growing periods.
- Preventive measures for drought that include on-farm reservoirs in medium lands, growing of pulses and oilseeds instead of rice in uplands, ridges and furrow system in cotton crops, growing of intercrops in place of pure crops in uplands, land grading and leveling, stabilization of field bunds by stone and grasses, graded line bunds, contour trenching for runoff collection, conservation furrows, mulching and more application of Farm yard manure (FYM).
- Efficient water use such as frequent but shallow irrigation, drip and sprinkler irrigation for high value crops, irrigation at critical stages.
- Efficient fertilizer use such as optimum fertilizer dose, split application of nitrogenous and potassium fertilizers, deep placement, use of *neem, karanja* products and other such nitrification inhibitors, liming of acid soils, use of micronutrients such as zinc and boron, use of sulphur in oilseed crops, integrated nutrient management.
- Seasonal weather forecasts could be used as a supportive measure to optimize planting and irrigation patterns.
- Provide greater coverage of weather linked agriculture-insurance.
- Intensify the food production system by improving the technology and input delivery system
- Adopt resource conservation technologies such as no-tillage, laser land leveling, direct seeding of rice and crop diversification which will help in reducing in the global warming potential. Crop diversification can be done by growing non-paddy crops in rain fed uplands to perform better under prolonged soil moisture stress in kharif.
- Develop a long-term land use plan for ensuring food security and climatic resilience.
- National grid grain storages at the household/ community level to the district level must be established to ensure local food security and stabilize prices.
- Provide incentives to farmers for resource conservation and efficiency by providing credit to the farmers for transition to adaptation technologies.
- Provide technical, institutional and financial support for establishment of community banks of food, forage and seed.
- Provide more funds to strengthen research for enhancing adaptation and mitigation capacity of agriculture.
- Developing cultivars tolerant to heat and salinity stress.
- Resistant cultivars to flood and drought.
- Modifying crop management practices.

- Improving water management.
- Adopting new farm techniques such as Resource Conserving Technologies (RCTs).
- Crop diversification.
- Improving pest management.
- Better weather forecasting.
- Crop insurance and harnessing the indigenous technical knowledge of farmers.
- Developing Climate-ready Crops

Conclusion

Even a preliminary consideration of the problem of climate change and agriculture raises three basic questions. First, what is and will be the nature and extent of the biophysical and agronomic impact of climate change on agriculture? A related issue is the economic and social impact that results from the effects of climate change on agriculture as a system of production. Secondly, since climate change is a phenomenon that is already under way, to what extent is agricultural production already suffering the impact of climate change? Thirdly, what is the nature of the current impact of climate change on Indian agriculture? Climate change is driven by global warming, which is, in turn, caused by the emission of greenhouse gases as a result of human activity on Earth. The consequent increase in temperatures is, in general, deleterious to plant life. At the same time, the increase in atmospheric concentration of the most potent greenhouse gas, carbon dioxide, has a beneficial effect on plant growth. In general, however, the beneficial effect of this carbon fertilisation is not as significant as was originally estimated. Estimating the actual impact of global warming on crops in the field is a more complex task, and must take into account other factors, including changes in precipitation, water balance, soil conditions, nutrient availability and so on. Agronomic crop models, which relate the productivity of specific crops to a variety of inputs and have been calibrated based on conditions of production for specific regions, provide some of the most convincing estimates of the damage that global warming will inflict on agriculture in different parts of the world (Khan et. *al.,* 2009 Lal et. *al.,*1998 Chen 2005 and Pasupalak 2009). The effect of global warming on various crops also significantly depends on the latitude in which the crop is grown. In higher latitudes, increased temperatures of upto about 1.5 deg C may actually provide for increased productivity whereas any increase in temperature lowers productivity in lower latitudes.

Climate change, the outcome of the "Global Warming" has now started showing its impacts worldwide. Climate is the primary determinant of agricultural productivity which directly impact on food production across the globe. Agriculture sector is the most sensitive sector to the climate changes because the climate of a region/country determines the nature and characteristics of vegetation and crops. Increase in the mean seasonal temperature can reduce the duration of many crops and hence reduce final yield. Food production systems are extremely sensitive to climate changes like changes in temperature and precipitation, which may lead to outbreaks of pests and diseases thereby reducing harvest ultimately affecting the food security of the country. The net impact of food security will depend on the exposure to global environmental change and the capacity to cope with and recover from global environmental change. Coping with the impact of climate change on agriculture will require careful management of resources like soil, water and biodiversity. To cope with the impact of climate change on agriculture and food production, India will need to act at the global, regional, national and local levels.

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RESPONSIBLE AND IMPROVED POST-HARVEST PRACTICESIN THE FIELD OF FISHERIES FOR FOOD SECURITY AND NUTRITION

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Abstract

From very ancient times, fish is regarded as an important source of food, which plays vital role in fighting hunger and malnutrition. Fish is a very good source of cheap protein, good fat, highly unsaturated omega-3 fatty acids, vitamins and minerals. Due to the highly perishable nature of fish, it undergoes a series of changes immediately after caught, the major reasons for which are autolysis, microbial activity and rancidity and in some cases physical damages. Increased risk of perishability coupled with poor post-harvest handling has led to high losses of fish, in both marine and inland fisheries.Therefore,aquatic resources need to be properly managed and all those involved in fish processing, distribution and marketing should be encouraged to reduce post-harvest losses and waste, improve the use of by-catch to the extent that this is consistent with responsible fisheries management practices, if their contribution to the nutritional, economic and social well-being of the growing world's population was to be sustained.

Introduction

In India, fisheries is a flourishing sector with huge potential and a key economic activity. India has achieved 11–fold increase in fish production in just six decades, i.e. from 0.75 million tonnes in 1950-51 to 9.6 million tonnes during 2012–13(FAO, 2014), revealing the vibrancy of the sector. From very ancient times, fish from the oceans and other aquatic sources, have been an important source of food. Fish plays an important role in fighting hunger and malnutrition. Fish is notonly a source of proteins and healthy fats, but also a unique source of essentialnutrients, including long-chain omega-3 fatty acids, iodine, vitamin D, and calcium. Fisheries have also provided livelihood and economic benefits for those engaged in activities related to the harvesting, processing and trading of fish. However, with increased knowledge and the dynamic development of fisheries, it was realized that living aquatic resources, although renewable, are not infinite and need to be properly managed, if their contribution to the nutritional, economic and social well-being of the growing world's population was to be sustained.Owing to the highly perishable nature, fish undergoes a series of changes after catching, the main reasons for which are autolysis, bacterial activity and rancidity and in some cases physical damages (mechanical stress, direct sunlight etc.). High perishability of fish coupled with poor post-harvest handling has led to high losses, even to the extent of 15%, in both marine and inland fisheries. Therefore, strengthening of postharvest infrastructure in the form of better fish landing and handling facilities, cold chains, storage facilities, ice plants, transportation, etc., as well as effective marketing system requires urgent attention.

Fish and fishery products are among the most traded agricultural and food commodities with more than one third of production entering international trade. A specific feature of fish trade is the wide range in product types and markets. Significantly, one half of international fish trade originates from developing countries for which fish is an important earner of foreign exchange. Developed countries accounted for about 80 percent of the total value of imports of fish products.Article 11 of Code of Conduct for Responsible Fisheries (CCRF) deals with responsible post-harvest practices and trade and has provisions dealing with responsible use of fish including measures to protect consumer health, responsible international trade and laws and regulations relating to fish trade.

Article 11 named ***Responsible Post-Harvest Practices and trade*** is divided into three sections as follows:

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i. Responsible Fish Utilization
ii. Responsible International Trade
iii. Laws and Regulations Relating to Fish Trade

1. Responsible Fish Utilization

Although there are cases where fish is caught purely for own consumption (subsistence fishing), is exchanged for goods rather than money (barter trade) or caught for sport, a large proportion of fish is caught and processed so that it can be sold. It is apparent, therefore, that the responsible use of the current production is of prime importance to the health of the fishing industry, the fish consuming people of the world and many others whose livelihood depends on fish as food. The industry and infrastructure of world fisheries depends, to a large extent, on the final sale of product between retailer and consumer where fish or fish based products pass in one direction and money passes in the other.Other reasons why there is a need to get fish to consumers with minimal loss and with optimal efficiency are related to the fact that it represents a valuable source of nutrients to many people in the world. The ultimate reason for the majority of fishing and fish raising activities is to contribute to food supplies. Fish is often not considered important in terms of national food security because it contributes little in the way of calories and food security, for a nation, is usually measured in terms of carbohydrate availability per head of population. However people do not live on carbohydrate sources such as grains and tubers alone.

1.1. Responsibilities

FAO CCRF article 11 describes responsibilities of the industry that produces fish as food under 3 main categories.

- To the consumer, in providing safe and wholesome food
- To the resources including the fish, that they are not wasted
- To the environment that they are sustainable and the activities for food production do not affect the environment adversely.

While the above responsibilities are to be carried by the fish producing industry, it is the responsibility of the countries to ensure that these responsibilities are followed in the right spirit.

a) Ensure right of consumers to safe, wholesome and unadulterated fish and fishery product
b) Establish and maintain national quality assurance system
c) Set minimum quality and safety standards
d) Support projects to improve post- harvest utilization of fish
e) Processing, transporting and storage methods should be environmentally sound
f) Encourage to reduce post-harvest loss
g) Encourage use of by-catch
h) Environment friendly-use of resources
i) Promoting consumption of fish
j) Cooperate to develop value added fish products
k) Source identification
L) Environment should get due consideration while framing law

1.2. India's Efforts Towards Responsible Utilisation of Fish

For almost a decade now, country has put food processing and waste utilization as national priority. In order to remove multiple control system on food quality, Food safety and standards Authority of India has been established under the recent Food Safety and Standards Act, 2006. Under this, it is aimed to develop more harmonized domestic standards with international standards. FSSAI is also mandated to facilitate the food quality evaluation. Various central Acts like Prevention of Food Adulteration Act, 1954, Fruit Products Order, 1955, Meat Food Products Order, 1973, Vegetable Oil Products (Control) Order, 1947, Edible Oils Packaging (Regulation) Order 1988, Solvent Extracted Oil, De- Oiled Meal and Edible Flour (Control) Order, 1967, Milk and Milk Products Order, 1992 etc. have been repealed after commencement of FSS Act,

2006. Though it would take some time before FSSAI takes shape befitting to such a vast country with its mammoth population, it is a big step forward for India ensuring safe and wholesome food to its citizen and consumers of food produced in the country. This will also reduce the gap between the quality standards of food that is exported to developed countries, and that is consumed by domestic population.

Formation of National Fisheries Development Board is another giant step forward. Among main stumbling blocks, the lack of infrastructure is the major one. In a way it is responsible for our failure in maintaining quality and keeping fish fit for human consumption. Further the level of knowledge on handling, processing and hygiene are also stumbling blocks to development. A lot of support is being provided by NFDB for processing along with extension of knowledge for processing.Aquaculture authority is the regulatory authority for culture practises and is making aquaculture practices more eco-friendly and sustainable. They have put caps on level of intensification of culture and are providing support for culture practices and provide guidance in appropriate land and water use. Their guidelines being linked to licenses and subsides are getting implemented.Marine Products Export Development Authority under the ministry of commerce was set up for export promotion. They are supporting the aquaculturists and fishers financially and technically to be capable of exporting quality products for generating valuable foreign exchange. Their project with Network of Aquaculture Centres in Asia (NACA) has resulted in the formation of National Centre for Sustainable Aquaculture (NACSA). NACSA has done commendable work in organizing small scale farmers and building their capacity to produce shrimps and fish in a sustainable way enabling them to export to international markets. NFDB and Ministry' of food processing are making very strong efforts in building infrastructure for harvesting, pre-processing, transport and marketing. However, the size of the country and the size and diversity of population place challenges that cannot be managed easily. The quality regime is fast changing globally. To adjust to multiple quality standards and specifications of a variety of fish products is not an easy task. Further, the gap in the quality levels between fishes sold in domestic market and exported to developed countries is too big to cover. Infrastructure as well as extension support needed for a fisher population of 11 million is enormous. Not the least is the requirement of HRD support. It would take few years for a country like India to overcome these challenges. However, efforts in the right direction are likely to bring positive changes in coming years.

1.3.Constraints To Optimal Use of Fish Once Caught

Fish spoils and becomes inedible more rapidly than almost any other food. Unless consumed soon after death it soon becomes unacceptable and therefore may be lost as an item of nutritional value. Preservation and processing techniques involving reduction of temperature (chilling and freezing), heat treatment (canning, boiling and smoking), reduction of available water (drying, salting and smoking) and changing the storage environment (packaging and refrigeration) can reduce the rate at which spoilage happens and thus allow fish to be distributed and marketed on a world-wide basis. However, when things go wrong with the infrastructure and mechanisms designed to preserve the product, fish can be lost to the system because they become spoilt before they can reach the consumer. Examples might include the disruption of power supplies causing interruption in supplies of ice or freezing and cold storage facilities for low temperature preservation, the failure of packaging materials to keep dried fish dry, faulty machinery in the canning industry producing incomplete sterilisation, failure of transport infrastructure in distributing a product to market or the breakdown of a vehicle carrying perishable goods. The fragility of fresh fish as a food item also means that if marketing conditions are disrupted or changed from normal, fish that cannot to be sold within its designated shelf-life becomes spoilt and so has to be discarded. This is particularly a problem with fish that is not preserved in any way and at tropical ambient temperatures may only have a few hours of useful storage life remaining by the time it reaches the retail stage. In many cases if it is not sold today, it will no longer be edible tomorrow.

There are many thousands of different species of fish available in the seas, rivers and lakes of the world. As a consequence there are many thousands of different types of food stuffs derived from fish that require preservation and processing in order to reach their eventual consumer in optimum condition and with minimum loss. Although the general principles of fish preservation and processing are the same for the majority of products and species and are transferable between types, each type has its own characteristic

composition, size, shape and intrinsic chemistry. In addition the physiologicalcondition and therefore the chemical makeup of a particular specimen can depend on where it is caught, when it is caught, whether it is male or female, its age and maturity and other factors beyond the control of the catcher of the fish. In aquaculture systems, of course, these factors are much more easily controlled and the post–harvest changes in the products from aquaculture should be more easily determined and predicted. However, the variety of raw material entering the basket of food generally known as fish makes the need for research and development of post–harvest systems for handling this raw material of prime importance. This is particularly so with the exploitation of novel species and stocks for which the handling and nutritional properties may not be known. Fish as food, like all food stuffs, runs the risk of causing illness of the consumer if measures are not taken to prevent or eliminate contamination from pathogenic microorganisms, toxins or contaminants. The safety of fish as food is an all important aspect of the need to protect fish consumers and ensure the sustainability of the industry. Without consumer confidence in the safety of fish as food the demand can collapse having a knock on effect to the rest of the industry. It only takes a minor publicised occurrence of food poisoning, for example, to cause drastic economic effects for the whole industry as consumers stop buying fish.

1.4. Responsible Consumption

Focusing on the food-security implications of fish trade is a major step in the movement towards responsible fish utilization and trade as advocated by the Code of Conduct for Responsible Fisheries. States should encourage the use of fish for human consumption. When a domestically consumed fish obtains an export market, its price tends to rise. Though this is a good outcome for the fisher, the higher price may squeeze domestic consumers out of the market. The strong possibility of diversion of pelagic species for fishmeal production the world over highlights the importance of developing a code of conduct for trade in fishmeal to ensure that direct food-security concerns are considered. Steps should be taken at the global level to articulate a code of conduct for responsible fish trade. To build up a movement for sustainable consumption, consumers in developed countries should use legislation and consumer action methods in their own countries, rather than support the use of non-tariff barriers by their governments. Campaigns for "responsible consumption" undertaken by socially oriented environmental movements can prove to be widely beneficial. Invoking the Lacey Act in the United States, which allows United States courts to prosecute importers whose actions contravene environmental laws in other countries, is one example. Such actions strengthen the cause of the great majority of fishers, provide dividends to honest entrepreneurs in developing countries and add to the well-being of consumers in the developed world. The use of ecologically benign fishing techniques, which yield low-quantity but high-quality output, will also be stimulated. Sustainable consumption becomes linked to sustainable production through sustainable trade.

2. Responsible International Trade

Fish and fishery products are highly traded and trade in fish and fishery products is dynamic. During the period from1976 to 2011, the fishery trade grew significantly at an average annual rate of increase of 8.3 % in value terms. This rise was aided by structural changes in the fishery sector, including the growing globalization of fisheries and aquaculture value chain, and by the outsourcing of processing to countries where comparatively low wages and production costs provide a competitive advantage. In addition, increasing consumption of fishery commodities, trade liberalization policies, globalization of food systems and technological innovations furthered the overall increase in international fish trade. Improvements in processing, packaging, transportation and changes in distribution and marketing significantly changed the way fishery products were prepared, marketed and delivered to consumers.All these factors facilitated and increased the movement of production in relative terms from local consumption to international markets. The share of production (live weight equivalent) entering international trade as various food and feed products increased from 25 percent in 1976 to 39 percent in 2011, reflecting the sector's growing degree of openness to, and integration in, international trade.Trade in fish and fishery products is characterized by a wide range of products types and participants. In 2011, 197 countries reported exports of fish and fishery products. The role of fishery trade varies among countries is important for many economies, in particular for developing nations. Trade in fish represents a significant source of foreign currency earnings in addition to the sector's important role in employment, income generation and food security.

Capture fisheries are levelling off while aquaculture continues to rise, thus affecting the nature of the sector's supply. The distribution chain, including the location and nature of processing activities, is constantly adjusting itself to changes in technology, communication and transportation. Fare trade and liberalized markets also increase the global nature of the sector. Trade is therefore more responsive to global, regional and national changes in supply and demand characteristics. The demand for fish and fishery products reflects changing consumer preferences and purchasing power, as well as demographic changes.International trade in fish and fishery products should not compromise the sustainable development of fisheries and responsible utilization of living aquatic resources. States should ensure that measures affecting international trade in fish and fishery products are transparent, based, when applicable, on scientific evidence, and are in accordance with internationally agreed rules.

2.1. Transportation of Fish And Fish Products

Fish is often transported from the landing site/ harbour to the local markets, pre-processing and processing centres in open trucks and insulated vehicles with or without ice. Fish meant for local sales is often carried by small scale vendors in plastic or metallic tubs with or without ice. Transportation in insulated trucks with iceis the most efficient method as it helps in maintaining the chilled condition. The simplest and most common method adopted on-board and on land to extend the storage life of fish is by icing, as lowering temperature by icing not only slows down the rigor mortis process, but also reduces the spoilage rate. Although a method of extending the shelf life, icing should be done carefully. Fish kept in thick layers in a box with ice can cause high pressure between the ice and fish causing cells to break. Different types of ice can be used for chilling fish like liquid ice, flake ice, and tube ice. Chilled Sea Water (CSW) that includes ice and seawater can chill the fish raw material very fast. However, if the fish is kept in water for a long time some colour pigments from the skin as well as some soluble and nutritive substances can be released and loaded into the environment. Using CSW can also create sensory change in the fish e.g. higher salt content after chilling and storing. A common way to chill the fish is to arrange it with ice in a fish box. The fish box should be made of material that is easy to clean. For a box or a tub containing fish, thermal insulation is essential to minimize ice consumption and to keep inside temperature more independent of outside temperature. Polyurethane can be injected in between a double wall for insulation and to give increased strength. Tubs with iced fish should have good drainage to discharge water from the melting ice.The frozen fish and fish products are usually transported under packed conditions inside cartons to the overseas markets in reefer containers. The temperature is maintained at - 18 to - 20°C throughout the transit in order to maintain the cold chain. Products like canned fish are packed in cartons and are transported under ambient temperature as they don't require cold chain.

2.2. Fish Marketing System In India

Fish marketing can be defined as all those functions involved from the point of catching of fish to the point of final consumption. Fish passes through several intermediaries from the landing centre or fish pond to the consumer. The intermediaries are involved in providing services of head loading, processing, preservation, packing and transporting. As the fish, like any other product moves closer and closer to the ultimate consumer, the selling price increases since the margins of the various intermediaries and functionaries are added to it. The domestic fish marketing system in India is not well developed and is mainly carried out by private traders with a large number of intermediaries between producer and consumer, thereby reducing the fisherman's share in consumer's rupee. Some of the problems in fish marketing include high perishability and bulkiness of material, high heterogeneity in size and weight among species, high cost of storage and transportation, no guarantee of quality and quantity of commodity, low demand elasticity and high price spread, assembling of fish from too many coastal landing centres and lack of information on fish price and production.

3. Laws And Regulations Relating To Fish Trade

- Laws, regulations and administrative procedures applicable to international trade in fish and fishery products should be transparent, as simple as possible, comprehensible and, when appropriate, based on scientific evidence.
- States, in accordance with their national laws, should facilitate appropriate consultation with and

participation of industry as well as environmental and consumer groups in the development and implementation of laws and regulations related to trade in fish and fishery products.

- ❖ States should simplify their laws, regulations and administrative procedures applicable to trade in fish and fishery products without jeopardizing their effectiveness.
- ❖ When a State introduces changes to its legal requirements affecting trade in fish and fishery products with other States, sufficient information and time should be given to allow the States and producers affected to introduce, as appropriate, the changes needed in their processes and procedures. In this connection, consultation with affected States on the time frame for implementation of the changes would be desirable. Due consideration should be given to requests from developing countries for temporary derogations from obligations.
- ❖ States should periodically review laws and regulations applicable to international trade in fish and fishery products in order to determine whether the conditions which gave rise to their introduction continue to exist.
- ❖ States should harmonize as far as possible the standards applicable to international trade in fish and fishery products in accordance with relevant internationally recognized provisions.
- ❖ States should collect, disseminate and exchange timely, accurate and pertinent statistical information on international trade in fish and fishery products through relevant national institutions and international organizations.
- ❖ States should promptly notify interested States, WTO and other appropriate international organizations on the development of and changes to laws, regulations and administrative procedures applicable to international trade in fish and fishery products.

4. Conclusion

Fisheries in India has been rapidly changing in recent years due to the vast improvement in handling technology, transportation and consequent market penetration. All those involved in fish processing, distribution and marketing should be encouraged to reduce post-harvest losses and waste, improve the use of by-catch to the extent that this is consistent with responsible fisheries management practices and use the resources, especially water and energy, in particular wood, in an environmentally sound manner.Adopting responsible post harvest practices along with better marketing strategies and modernization of the infrastructural facilities can not only help in improving the fisherman`s share of the catch, but also in improving the foreign exchange earnings of the country.

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MEETING THE NUTRITION NEEDS OF THE POOR: ROLE OF FISH

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Abstract

In the world where early one-third of humanity is affected by deficiency disease and over seventieth of the earth is roofed with water from which aquatic foods represent a vital component of the world food basket to enhance the nutrition, health, and welfare of all peoples.Fish makes a vital contribution to the survival and health of a significant portion of the world's population. Fish is highly essential in the developing worldand fast-growing civilization. Fish provides essential nutritive elements, especially quality proteins and fats (macronutrients), vitamins and minerals (micronutrients).The contribution of fish to unit food and nutrition security depends upon convenience, access and cultural and private preferences. Access is primarily determined by location, seasonality,and value but at the individual level, it also depends upon a person's physiological and health condition and how fish is ready, braised and shared among unit members. The sustained and speedy growth of cultivation over the past thirty years has resulted that40% of all fish currently consumed is derived from farming.

Introduction

According to the United Nations Food and Agriculture Organization (FAO), 805 million individuals worldwide were travail from hunger in 2014 – a number more massive than thecommon population of the European Union (EU), Russia and Japan. Thisdoes notmean that food is becoming limited.The reason is just opposite: Agriculture currently yieldsunevenly one-third more calories in arithmetical terms that would be required to feed everyone, and food production is still risingfaster than the global population. Hunger has different causes: for example poorness, lack of access to land, water,and different resources.

Nutrition and deficiency disease isdispersed highly unequally – by regions of the world, by poor and rich, and by gender. The vast majority of people those suffering from hunger live in rural areasof risingcountries – in other words in those places where the food isin indeed produced. They have virtually no chance to defend themselves against hunger caused by poverty, war, environmental disasters or drought. Women are particularly severely affected. In many countries, they bear the brunt of the work in the field, but still have fewer rights, given that 90 percent of the world's arable land belongs to men. The face of hunger is rural and female in most cases.

The world's agricultural output is adequate nowadays to feed all its individuals, a minimum of in strictly arithmeticalterms. Still, one out of 9 individuals in the world goes to bed hungry daily and this happens despite the actual fact that the right of people to be free from hunger – that's to possess access to food in enough amount and quality – may be ahuman right that is entrenched in terms of binding law of nations in the International Covenant on Economic, Social and Cultural Rights (UN Social Covenant).There are several reasonswhy individuals do not haveadequateaccesstofood. However, hunger is notacceptable.

India is endowed with a vast and rich diversity of natural resources especially soil, water, climate, agricultural diversity and aquatic flora and fauna ranging from small freshwater pond to open and deep-sea fisheries.To analyze the agricultural and allied production potential in the context of sustainability, there is a

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need to give paramount importance for the efficient and best management practices for conservation of these natural resources.India is a leading fish producing nation in the world. Being home to more than 10% global fish diversity, the country ranked second in aquaculture production. Indian fisheries are increasingly contributing to the nutritional security of the country with the present production of fish and shellfish from capture and aquaculture fisheries being around 11.4 million tonnes in 2016-17. Fisheries arecontributing over 1% of the total GDP and 5.3% of agricultural GDP.The country is blessed with substantial aquatic resources with 29,000 km of rivers, 0.3 million ha of reservoirs, 0.2 million ha of floodplain wetlands, 0.72 million ha of upland lakes and 2.02 million area of Exclusive Economic Zone(EEZ) surrounding the seas (8,129 km of coastline).The different segment of fisheries – marine capture fisheries, mariculture, coastal aquaculture, inland capture fisheries, freshwater aquaculture, coldwater fisheries, fish processing and post-harvest technology and trade – contributing to nutritional security and makes a significant component of food basket of the country.

Human body and its nutritional requirements

To be healthy and fit, our diet (what we regularly eat and drink) must be sufficient in quantity and variation to meet our energy and nutrient needs. Most foods havemany different nutrients; no single food, except breast-milk, provides all the nutrients needed. The most effective approach, therefore, to make sure the body gets all the requirednutrients is to eat different types of foods. Nutrientsare classified as carbohydrates, fats, proteins, vitamins or minerals. Water and dietary fiber are also necessary. Each nutrient has specific work and is made for the body tissues through thecourses of digestion and absorption.

Table 1 – Daily energy requirement of Human body

Constituents	Men	Women
Energy (kcal)	2500	2000
Protein (g)	55	50
Carbohydrates (g)	300	260
Sugar (g)	120	90
Fat (g)	95	70
Saturates (g)	30	20
Salt (g)	6	6

Carbohydrates are the elementarysource of energy. They vary in quality from simple sugars to complex starches. Sugars are found in sweet foods like honey, and in milk and fruits. Major sources of starches are cereals, root vegetables, pulses (beans, lentils, peas) and a few fruits like plantains and bananas.

Dietary fats and oils are rich sources of energy and give essential fatty acids. They can be obtained from both animals and plants. Animal sources we consider fatty meats, poultry like duck and goose, butter,clarifiedbutterand oily fish. Plant sources containoilseeds(sunflower, safflower, sesame) and legumes (peanuts, soybeans).

Fig 1:-Harvard food pyramid

(Source- http://www.hsph.harvard.edu/nutritionsource/pyramids.html)

Proteins,which are long chains of amino acids,form many of the essential structural material of the body; they arenecessary for its growth, functioning,and repair. The body can build several amino acids but some, referred to asessential amino acids, must be obtained from food. Different foods contain varying quantities of those nutrients. Animal products are a major source. However, a combination of vegetable sources also can satisfy the body's requirements. Rich sources of proteins include meat, fish, farm product, pulses, nuts, and cereals.

Table 2 – Recommended amount of food items per day for a human.

Food	Recommended amount (gm/day)	
	Adult Man	Adult Woman
Cereals(rice/wheat)	520	440
Pulses	50	45
Meat/Fish	30	30
Egg	1	1
Milk	200	150
Oil/fats	45	25
Sugar/molasses	35	20
Roots and tubers(potato etc.)	60	50
Green leafy vegetables (spinach, etc.)	40	100
Other vegetables (cauliflower, etc.)	70	40

Vitamins are essential to nearly all the body's chemical processes and for sustaining thehealth and integrity of body tissue. They are typically required in small quantities but must be consumed habituallybecause many of them are not deposited well in the body. Vitamin A is found in animal products, particularly part like liver and products like eggs and milk, but many fruits and vegetables such as carrots, mangoes, and papaya hold carotenes, chemicals that the body can transform into vitamin A. Good sources of vitamin C are vegetables and fruits. The B complex occurs in cereals, legumes, meat, poultry and dairy products.

Minerals are essential to structures such as bones and teeth (calcium) and processes such as energy relocation (iron) andworking of the body and brain (iodine). We need relatively large amounts of some minerals, such as calcium -found in peas and beans, milk, meat and cheese - and much-reducedamounts of others minerals, for example, iron - found in meat, fish and shellfish, dark green leafy vegetables and nuts.

Fish as healthy food

Fish is one of the healthiest foods on the earth. It is fullofessential nutrients, such as protein and vitamin D. Fish is the world's best source of omega-3 fatty acids, which areextremely important for our body and brain.Fish is a high-protein, low-fat foodthat provides a range of healthyprofits. White-fleshed fish is lower in fat than any other source of animal protein, and oily fish are rich in omega-3 fatty acids, or the "good" fats. Since the human body cannot make major amounts of these essential nutrients, fish are an important part of the diet. Also, fish are little in the "bad" fats commonly found in red meat, called omega-6 fatty acids.

Table 3 - Proximate composition of seafood

Type of fish	**Moisture %**	**Protein %**	**Fat %**	**Ash%**	**Carbohydrate %**
Fatty fish	68.8	20.0	10.0	1.2	Negligible
Lean fish	81.8	16.4	0.5	1.3	< 0.5
Crustaceans	76.0	18.8	2.1	3.1	< 0.5
Mollusks	81.0	12.0	1.5	2.6	2.9

Why should we eat the fish?

- Fish is an important food source of many vitalnutrients, including high-quality protein,iodineand various vitamins, and minerals. Fatty types of fish are also high in omega-3 fatty acids and vitamin D.
- Fish could lower our risk of heart attacks and strokes. Intake a minimum of one serving of fish per week has been connected to thereduced risk of heart attacks and strokes, 2 of the world's biggest killers.
- Fish contains nutrients that are crucial throughout development. Fish is high in omega-3 fatty acid fatty acids, that is crucial for thedevelopment of the brain and eyes. Itis suggested that expecting and nursing mothers certify to eat enough omega-3s.
- Fish could increase grey substance within the brain and defend it from age-related deterioration. Fish consumption is connected to thereduced decline in brain preformation in maturity. Those who eat fish frequently even have additional grey substance within the brain centers that manage memory and feeling.
- Fish may prevent and treat depression, making people a happier person.Omega-3 fatty acids can be beneficial against depression, both on their own and when taken with antidepressant medications.
- Fish is the only dietary source of vitamin D. Fatty fish is an excellent source of vitamin D, an essential nutrient that more than 40% of people may be deficient in.
- Eating fish has been linked to reduced risk of type 1 diabetes and several other autoimmune diseases.Some research shows that children who eat more fish have a comparatively lower risk of developing asthma.
- People who eat fish regularly, have minimum risk of developing macular degeneration, leadingcause of vision impairment and blindness. There is preliminary prooves that eating fatty fish like salmon may lead to improved sleep.

Role of Fish Lipids in Human Nutrition

To achieve a balanced diet, there is a need to reduce total fat intake,andit is also essential to make sure that the type of fat we eat is right. The fat that is not beneficial to human is the hard "saturated" fat which comes mainly from the fat of land animals such as cows and sheep.

1. Food with low fat: Fish is a chief source for a low-fat diet. It is low in calories, and many of the fish do not contain any saturated fat. The nutritional value of fish varies according to the location it is harvested, the method of harvesting and cutting of fish, and the age of the fish. The method used for cooking also important for nutrient quality of cooked fish.

2. Reduce the cholesterollevel in the blood: Cholesterol is the type of fat which is naturally produced by our bodies and is also found in the diet. It is essential for life but too much of it circulating in the bloodstream is a problem, and it is usually deposited in the lining of the blood vessels, causing them to narrow. The heart then has to work harder to pump blood around the body. Blood clotting can result,and the cholesterol deposits can be very hard. Tissues can become deprived of oxygen when the blood vessels become blocked. Unsaturated fats can help to reduce the cholesterol level in the blood, thus lowering the risk of heart disease. Fatty fishes such as mackerel, sardines, herring,and sprats are rich in unsaturated fats having Omega-3 fatty acids which are valuable for health.

3. Source-Omega-3 fatty acids: Two fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic (DHA), collectively known as omega-3, are essential fatty acids. Omega fatty acids are not synthesized in the body. Fishes, such as salmon, trout, mackerel, herring,and sardines are admirablehomes of Omega fatty acids.

A. Schizophrenia symptoms can be eliminated or at least vastly diminished by oral

supplementation with EPA.

B. DHA is the essential for the human brain tissue and is most abundant in the grey matter of the brain and the retina. Low levels of DHA have been associated with depression, memory loss, dementia and visual problems. DHA is particularly important for fetuses and infants; the DHA contents of a newly born baby's brain triples during the first three months of life. Optimal levels of DHA are therefore crucial for pregnant and lactating mothers. They cannot be made in the body, hence are essential in the diet.

C. The special Omega-3 oils from fish have been shown to have a lowering effect on blood fats. This decreases the chance of the blood vessels clogging with cholesterol. Omega-3 can also make blood less "sticky," and it, therefore, flows more efficiently around the body. This can reduce the risk of a heart attack. They also help to reduce blood pressure a little and keep the heartbeat steady. Omega-3 oil in fish can reduce the risk of dying from heart attacks.

4. Prevent cancer: Fish oils can help to prevent cancer cells progressing to the tumor stage. They may also reduce inflammation and provide relief for people who have rheumatoid arthritis and even some skin disorders such as psoriasis.

5. Needed for the development of Brain: Omega-3 oils can play an important part in aiding the development of thebrain. Expectant mothers are advised to eat much oil-rich fish in the last three months of pregnancy to assist the baby's brain growth. A good supply of Omega-3 oils assists the development of nerves and eyesight.

Role if fish protein in human nutrition

Being building material of the body,proteins are important for growth and development of the body, maintenance,and repairing of damaged tissues and production of enzymes and hormones essential for many body processes. The importance of fish in providing easily digested protein of high biological value is well documented. In the past, thishas served as an explanation for stimulating fisheries and aquaculture activities in many of the countries. On a fresh weight basis, fish contains a goodquantity of protein, about 18-20%, and contains all the eight essential amino acids including the sulfur-containinglysine, methionine, and cysteine. As maximum maize-baseddiets lack these compounds, rural areas

Amino acid	Mackeral	Pomfret	Sardine	Oil sardine	Hammer Head Shark	Silver belly	Sol
Leucine	11.0	18.4	12.4	13.4	9.1	5.5	6.7
Phenylalanine	4.2	6.2	4.8	6.1	5.4	5.4	3.8
Valine	6.0	6.4	8.8	5.9	5.6	7.3	6.9
Methionine	4.3	4.7	2.9	3.8	3.1	2.1	1.9
Tryptophan	1.1	1.8	Traces	Traces	2.1	--	--
Threonine	5.5	6.4	4.9	4.7	4.7	5.8	5.6
Arginine	6.8	8.2	6.2	7.0	6.3	13.5	19.2
Lysine	6.5	3.7	6.1	8.0	5.1	6.4	7.4
Histidine	1.9	0.7	0.8	1.7	3.1	3.9	2.4

Table 4- The amino acid composition of commercially important fishes.

In some part of India dependent on maize greatly benefit by increasing their fish consumption. Fish also balancescassava-based diets which are low in protein.

Conclusion

By 2050, global population will be unable to meet its requirements for food through current agricultural practices.We must drastically renovate the global agricultural system to deliver food security and net greenhouse gas immersion without losses of available water and wild habitats. This can only be achieved

by more resource-efficient agriculture. This willessential to combine locally applicable crop and animal genetic upgrading and resilient agronomic practices that harness local ecosystem services to diminish inputs and close nutrient loops while sequestering carbon. The success of these on-farm activities will hang on restoring degraded lands and conservation remaining natural habitats to ensure the sustained provision of wider ecosystem services.

India like many other developing countries has not yet eliminated problems of undernutrition in each age group of people especially among children of its poor communities. Availability of vast and varied fishery resources of the country, both marine,and inland, helps to protect from nutrient deficiency the people,especially in rural communities. Fish isa good source of many of the essential nutrients and easily digestibility, contributing to improved food intake. Although Indian fisheries require more exploration and more consciousness of the people, it is now serving the nation for making a complete source of energy through thevarious process.

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ASSESSMENT OF SOIL FERTILITY FOR MAXIMUM PRODUCTIVITY

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Soil fertility: Soil fertility is defined as the quality that enables the soil to provide proper nutrient compounds in proper amounts and in proper balance for the growth of specified plants. Soil fertility is also defined as the ability of soil to supply adequately the nutrients normally taken from the soil by plants.

Soil Productivity: - Soil Productivity is the capacity of the soil to produce crops with specific system of management and is expressed in term of yields.

All productive soils are fertile, but all fertile soils need not be productive due to some problems like water logging ,alkali, saline, adverse climate etc.

Soil fertility and Soil productivity

	Soil fertility		Soil productivity
1.	It is the inherent capacity of the soil to provide essential chemical elements for plant growth	**1.**	Soil productivity emphasizes the capacity of soil to produce crops and is expressed in terms of yield
2.	A combination of soil properties and an aspect of soil – plant relationships	**2.**	An economic concept and not a property of soil
3.	Soil fertility is vital to a productive soil. But a fertile soil is not necessarily being a productive soil. Many factors can limit production, even when fertility is adequate. For e.g., soils in arid region may be fertile but not productive	**3.**	Soil fertility is one factor among all the external factors that control plant growth like air heat (temp.), light, mechanical support, soil fertility and water. Plant depends on soil for all these factors except for light
4.	Organic matter in the soil improves soil fertility by mineralization of nutrients	**4.**	Organic matter also improves soil productivity by improving soil porosity, aggregation and physical condition of soil thus modifying the soil environment for crop growth.

Concepts of soil fertility and soil productivity

- It is evident from the early writing of **Theophrastus (372 – 287 BC)** even before the advent of Christian era, Greek and Romans realised the impact of soil on the growth of plants and made a mention about the application of organic wastes and saltpetre for the plants.
- The first experiment aimed at elucidating the increase in the weight of plant during its

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growth was reported by **Nicholas (1401 - 1446).**

- **Jan Baptiste van Helmont (1577-1644**) attributed the increase in weight of willow shoot to water.
- But a German chemist, **Glauber (1604-1668)**, who attributed the growth of plants to the absorption of saltpeter (KNO3) from the soil.
- **John Woodward** (during the year about 1700) first conducted water culture experiments on spearmint and emphasised that the growth factor is some terrestrial matter but not the water.
- **Jean Baptiste Boussingault (1802-1882)** carried out field plot experiments. He was called as 'father of field plot technique'.
- **Justus von Liebig (1803-1873)** put forth the 'law of minimum' which states that the yield is governed by the limiting nutrient and is directly proportional to the factor which is minimum in the soil.

The criteria of essentiality put forth by Arnon- In the nature there are nearly one hundred three elements of them nearly ninety elements are taken in by the plants. In order to distinguish the elements which are essential from those which may be taken in by the plants but are not essential, Arnon (1954) has laid down the following criteria.

1. The plant must be unable to grow normally or complete its life cycle in the absence of the element.
2. The element is specific and cannot be replaced by another.
3. The element plays a direct role in plant metabolism. It appears that an element would have to be considered essential even if it has not been possible to demonstrate that it fulfils the second criterion of essentiality. For ex., for many bacteria, diatoms and other algae, vitamin B12 is known to be essential, but the essentiality of cobalt per se has not been demonstrated. According to this criterion, molybdenum and chlorine cannot be considered as essential though they are functional in plant metabolism since they can be replaced by vanadium and halides respectively. D.J. Nicholas gave more exact definition of essential elements and advanced the term "functional or metabolic nutrient" to include any mineral element that functions in plant metabolism, whether or not its action is specific.

Plant nutrition: Plant nutrition is defined as the supply and absorption of chemical compounds required for plant growth and metabolism. It is the process of absorption and utilization of essential elements for plant growth and reproduction.

Nutrient: Nutrient may be defined as the chemical compound or ion required by an organism. The mechanism by which the nutrients are converted to cellular material or used for energetic purposes are known as metabolic processes.

Beneficial elements: The elements, the essentiality of which for growth and metabolism has not been unequivocally established, but which are shown to exert beneficial effects at very low concentrations are often referred to as beneficial elements, or potential micronutrients. The beneficial effect of these nutrients may be due to the ability of these elements affecting the uptake, translocation and utilization of the essential elements. They may be essential only for certain plant spices or under specific conditions. e.g.: Silicon, vanadium, cobalt and aluminium.

Nutrient use efficiency:-Nutrient use efficiency (NUE) may be defined as yield per unit input. In agriculture, this is usually related to the input of fertiliser, whereas in scientific literature, the NUE is often expressed as fresh weight or yield per content of nutrient. Improvement of NUE is an essential pre-requisite for expansion of crop production in marginal lands with low nutrient availability. NUE not only depends on the ability to efficiently take up the nutrient from the soil, but also on the transport, storage, mobilization, usage within the plant, and even on the environment.

Nutrient use efficiency is defined as the extent to which the nutrients and management practices interact to give a specified yield level.

$$\text{NUE (\%)} = \frac{\text{Yield with applied nutrient} - \text{Yield without applied nutrient}}{\text{Amount of nutrient applied}} \times 100$$

Factors affecting NUE

A. Soil factors: The most important factors are soil physical conditions, soil fertility and soil reaction. On soils with poor physical condition, plant growth will be poor due to impeded drainage, restricted aeration and unfavourable soil temperature due to which the nutrients will not be used efficiently. Coarse textured soils are usually poorer in available nutrients than fine textured soils. On such soils nitrogen and potassic fertilizers should be more frequently applied than in fine textured soils. The higher the fertility status of the soil, the lower is the response. Soil reaction is an important consideration in the selection of right type of P fertilizers. The higher the organic matter status, the more is the nutrient use efficiency.

B. Climatic factors: include temperature, rainfall and its distribution, evaporation, length of day and growing season. Rate of nitrification is slower in cooler climate than in warmer climate, hence more amounts of fertilizers should be added in cool climate. Higher amount of fertilizers are required in high rainfall region due to leaching to obtain an expected yield potential. In arid regions, soil moisture is a limiting factor to get higher nutrient use efficiency. The higher the light intensity, the better is the nutrient use efficiency.

C. Crop factors: CEC of plant roots influences the fertilizer responsiveness of the crop. A large ramifying root system of the plant absorbs nutrients more efficiently. The time of application of fertilizer should match the pattern of nutrient uptake to increase nutrient use efficiency. For legumes N fertilizer may be reduced as they can fix atmospheric N to increase N use efficiency.

D. **Agronomic factors**: include selection of fertilizer responsive crops and varieties, timely sowing, proper spacing, proper dose, time and method of fertilizer application to increase the yield and thereby increasing NUE.

How to enhance nutrient use efficiency

Use efficiency of any nutrient can be increased by achieving potential yields of crops by optimizing the factors of crop production.

1. Selection of suitable crops and varieties, which are input responsive recommended for the region.

2. Sowing or planting the crops at optimum time.

3. Maintaining optimum plant population.

4. Use of organic manures and bio fertilizers to supplement nutrients and also to bring ideal conditions for crop growth.

5. Inclusion of legumes in the cropping system as intercrop.

6. The crops should be irrigated at least to save life at critical growth stages.

7. Fertilizer scheduling must be based on soil test values to prevent nutrient deficiencies or luxury consumption.

8. P and K fertilizer and part of N fertilizer should be applied as basal and N in splits doses; for light textured soils K also should be applied in splits.

9. Band placement of fertilizers preferable to prevent losses. (Especially P to reduce fixation).

10. Under moisture stress condition, foliar application of urea at 2% concentration is effective.

11. Micronutrient deficiencies should be corrected instantly.

12. ZnSO4 should be applied as package once in two seasons @ 25-50 kg/ha.

13. Problem soils must be ameliorated by taking reclamation measures.

NUE of individual nutrients also can be increased by following the above management practices along with some specific measures as follows

Nitrogen use efficiency: can be increased through

- Split application of nitrogenous fertilizers to prevent losses due to leaching.
- The use of slow release nitrogenous fertilizer like urea formaldehyde, sulphur coated urea, Neem coated urea etc.
- Use of nitrification inhibitor (E.g.: N-serve) to retard the conversion of NH4 +-N to NO3
- N to prevent leaching and make it available to crops for quite longer period.
- By the integration of inorganic N with organic sources the soil physical condition can be optimized besides adding nutrients to the soil.

P use efficiency can be increase by decreasing P fixation and balanced application of the nutrients. P fixation can be reduced by judicious application of organic manures, application of P fertilizer by placement, inoculation (either seed or soil) with phosphorus solubilising bacteria like *Pseudomonas*, *Bacillus megathrium* var. *phosphaticum*.

K use efficiency: can be enhanced by preventing leaching loss either by split application on light soils, applying organic manure and balanced application of nutrients.

S use efficiency: Sulphur in soil solution is present as SO4 and more prone for leaching losses. The losses can be prevented by applying organic manures to improve water holding capacity of the soil and it also acts as a source of S. S oxidation can be facilitated by providing oxidized conditions in the soil.

Fe use efficiency: Most available form of iron is Fe2+. All the measures which govern the soil reaction will influence Fe availability. Fe availability is more in acidic soil pH. Application of organic manures including green manuring improve the use efficiency of iron by

- Acidifying the rhizosphere due to the release of organic acids
- Supplementing with iron after decomposition
- Act as substrate for heterotrophic bacteria that can reduce ferric to ferrous form (e.g., *Bacillus, Clostridium and Klebsiella* etc.).
- The microbes also produce chelating ligands called as 'siderophores' that can form complex with Fe3+, which can be absorbed into the plant.
- Reclamation of alkali soils if deficiency appears on standing crop foliar application of Fe.

Zn use efficiency

- Zn fertilizer should not be applied with phosphatic fertilizers.
- Maintaining the soil pH between 5.5 – 6.5 by applying organic manures.

Soil fertility: is concerned with the inherent capacity of soil to provide nutrients in adequate amounts and in proper balance for the growth of specified plants when other factors such as light, moisture, temperature and the physical condition of the soil are favourable. Soil fertility is an aspect of the soil plant relationship viz., plant growth with reference to plant nutrients available in soil.

Justus Von Liebig 1840 propounded the 'law of Restitution' which states that in order to maintain soil fertility nutrients removed from the soil by crops must be restored by the application of manures and fertilizers.

The assessment of nutrient supplying capacity of the soil is soil fertility evaluation. It necessitates understanding of certain major concepts having definite bearing on soil fertility.

The law of minimum was put forward by Von Liebig which envisages that if a soil contains optimum / adequate amounts of all but one nutrient element, crop growth is regulated by that single nutrient.

Approaches for soil fertility evaluation: The wide variety of diagnostic techniques used so far can be broadly grouped into

1. Soil Analysis
2. Plant Analysis
3. Biological methods

4. Visual symptoms of nutrient deficiency or toxicity.

Soil testing and plant analysis are useful tools for making recommendations for application of fertilizers to crops. Soil testing gives a measure of the availability of nutrients to crops; plant analysis indicates the actual removal of the nutrients from the soil.

Objectives of soil testing:

1. Grouping soils into classes relative to the levels of nutrients for suggesting fertilizer practices.
2. Predicting the probability of getting profitable responses.
3. Helping to evaluate soil productivity.
4. Determining specific soil conditions like alkali, salinity and acidity which limits crop yields.

Available nutrients: Plants draw their nutrients from air, water and soil. The bulk of mineral nutrients come from soil. Soil available form of nutrient is that fraction which is distributed in different discrete chemical forms, which often exist in a state of dynamic equilibrium and constitute the pool from which plants draw it. Soil available form of a nutrient is also that fraction whose variation in amount is responsible for significant changes in yield and responses. The nutrient available to biological organisms is termed as bio available nutrient.

Chemical methods for estimating nutrients

Soil testing includes measurement of available N, P, K, and S, micronutrient, lime and gypsum requirement, besides measuring pH, EC and calcium carbonate, texture by Bouyoucos hydrometer method.

The different extractants for the available nutrients

Nutrient	Extractant
Available P	0.5 M NaH CO3, pH 8.5 Olsen's extractant
	0.03 N NH4F + 0.025 NHCl Bray's No.1 extratant
Available K	Neutral normal ammonium acetate
Available S	0.15 % CaCl2
Available Zn, Fe, Cu, Mn	0.005 M DTPA, pH 7.3 Diethylene Triamine penta Acetate
Gypsum requirement	Schoonover method
Lime requirement	Shoemaker et al.

Rating limits of soil test values

Nutrient	Low	Medium	High
Organic carbon (%)	Below 0.5	0.5 – 0.75	Above 0.75
Available N (kg ha-1)	Below 280	280 – 560	Above 560
Available P (kg ha-1)	Below 10	10 – 24.6	Above 24.6
Available K (kg ha-1)	Below 108	108 – 280	Above 280

Available S (ppm)	Deficient < 10 ppm	Sufficient > 10 ppm
DTPA Zn	Deficient < 0.6 ppm	Sufficient > 0.6 ppm

Visual symptoms of nutrient deficiency or toxicity: - Chemical analysis of plants may indicate the presence of more than 90 elements but 16 of them have been established to be essential for their successful growth and development; as per the criteria of essentiality. A constant balanced supply of these nutrients is essential for normal plant growth. Any imbalance among them leads to the emergence of nutritional disorders owing to their deficiencies or toxicities when an essential nutrient is in extremely short / excess supply, the plant suffers from its deficiency which is manifested in the form of specific sign termed as deficiency / toxicity symptom of the nutrient

Visual deficiency: - symptoms are generally characteristic enough to permit easy identification of the deficiency of a nutrient as these appear on particular plant part at specific growth stage. The mobility of nutrients with in a plant differs markedly. Nutrients like N, P and K are readily translocated from old to young leaves under stress condition and are termed as mobile nutrients within the plant and they show up their deficiencies initially on the old leaves. The nutrients such as calcium sulphur, boron and iron which are not retranslocated are called immobile nutrients and their deficiency symptoms first appear on young leaves. Mobility of other nutrients is intermediate. E.g.: Shortening of internodes due to Zn deficiency results primarily from impaired auxin metabolism.

The visual identification of nutrient deficiencies or toxicities is considered as a simple and inexpensive diagnostic tool in plant nutrition as it does not involve the use of any analytical equipment.

Limitations:-

- Confident diagnosis by this approach requires much experience as the symptoms of some nutrient deficiencies are difficult to differentiate.
- By the time the deficiency / toxicity symptoms appear, the crop has undergone marked set back and the ameliorative measures taken at that time may not produce optimum yields. The appearance of deficiency symptoms is an extreme limit of nutrient deficiency but even if the symptoms are not manifest, reduction in the yield of crop may occur. This condition has been termed as hidden hunger.

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MOLECULAR PROBES AND THEIR APPLICATIONS IN GENETIC ENGINEERING AND MEDICAL RESEARCH

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Introduction

Molecular probes are small DN*A or RNA segments that recognize complementary sequences in DNA or RNA molecules and thus allow identification and isolation of these specific sequences from an organism. Antibodies are also used as probes to recognize specific protein sequences. Although, initially these probes were developed and used for genetic engineering research such as selection of bacteria containing recombinant DNA, analysis of mRNAs in a cell or identification of the presence of DNA sequences within a genome but are now frequently used for a variety of purposes including diagnosis of infectious diseases (Aquino de Muro *et al*., 1994; Katoch *et al*., 1994, 1997; Kaminski *et al*., 1995; Sharma *et al*., 1996; Belak *et al*., 2009; Bexfield *et al*., 2011), variety of microbiological tests (Chuba *et al*., 1998; Smorawinska *et al*., 1992) and forensic tests. Any nucleic acid can be used as a probe provided it can be labeled to permit identification and quantitation of the hybrid molecules formed between the probe and sequence to be identified. In practice, double and single stranded DNAs, mRNAs, and other RNAs synthesized *in vitro* are all used as probes. DNA/ RNA probe assays are faster and sensitive so that many conventional diagnostic tests for viruses and bacteria involving culturing of the organisms are being fast replaced by molecular probe assays. While culture tests can take days or even months, molecular probe assays can be performed with in few hours or minutes.

Preparation of Probes

Nucleic acid-based molecular probes can be prepared using a variety of methods.

1. Genomic DNA Probes

Extract the DNA from an animal or plant tissue. Digest extracted DNA with a restriction enzyme such as *Eco*RI or *Hin*d III which cuts DNA at specific sites or positions where a specific sequences recognized by the enzyme is found. Run the digested DNA on an agarose or polyacrylmide gel electrophoresis to separate fragments of different sizes. Isolate DNA of specific fragment from a particular band identified through southern blots by hybridization with specific labeled mRNA or cDNA molecules. Clone this DNA in a vector. Allow chimeric vector to infect bacteria for multiplication where it can make billions of copies. DNA probes prepared in this manner can be used for southern blotting and RFLP analysis.

2. cDNA Probes

A DNA sequence corresponding to a part of a specific gene can be obtained by reverse transcription of mRNA. cDNA thus obtained can be cloned and used as a probe.

3. RNA Probes

High specific activity RNA probes or riboprobes may also be synthesized from DNA templates cloned in expression vectors such as SP6 (which infects *Salmonella typhimurium*) and T7 phage (infects *E.coli*). This is achieved through RNA synthesized *in vitro* and labeled simultaneously with labeled nucleotides. RNA probes offer several advantages over DNA probes. Since these are single stranded and provide improved signal or

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hybridization blots.

4. Synthetic oligonucleotides as probes

DNA probes with known nucleotide sequence can also be synthesized chemically using automated DNA synthesizers. These synthetic probes will be efficient only when they are not more than 20-40 nucleotides in length.

Labeling of probes

The detection of homologous sequences after hybridization with the probe is very difficult as the probes transmit no signal of their own. Therefore, for the success of the probe assay it is necessary to develop simple, safe and sensitive techniques to label the probes.

Types of Label

1. Radioactive Labels

Nucleic acid probes can be labeled using radioactive isotopes (e.g., ^{32}P, ^{35}S, ^{125}I, ^{3}H). Detection is by autoradiography. Radiolabeled probes used to be the most common type but are less popular today because of safety considerations as well as cost and disposal of radioactive waste products.

2. Nonradioactive Labels

Compared to radioactive labels, the use of nonradioactive labels have several advantages: such as safety, higher stability of probe, efficiency of the labeling reaction, detection *in situ, l*ess time taken to detect the signal. Some examples of nonradioactive labels are as follows:

(a) Biotin

Biotin labeling of probes exploits the affinity which the glycoprotein avidin has for biotin. Avidin is commonly found in egg white. Biotinylated probes are prepared through a nick-translation reaction by replacing nucleotides with biotinylated derivatives. After hybridization and washing, detection of hybrids is done by a series of cytochemical reactions which finally give a blue color whose intensity is proportional to the amount of biotin in the hybrid.

(b) Digoxigenin

Digoxigenin is another chemical derived from plants and may be used in nick translation to produce digoxigenin labeled probes. The probes are used in hybridization; after washing away free probes,the filter is incubated in a detection buffer containing a digoxigenin specific antibody (antidigoxigenin)coupled with an enzyme (usually alkaline phosphatase)After appropriate washing, the alkaline phosphatase activity is detected by using a suitable substrate that yields colour due to the enzyme action.

(c) Alternatives to Biotin and Digoxigenin

The techniques of non-radio isotopic labeling have been further expanded and new methods have been used in which nucleotides have been conjugated with the other ligands that produce some detectable signals e.g., fluorescence, enzyme activity etc.

Applications of Molecular Probes

Molecular probes can be used for both basic and applied studies in the field of Genetic Engineering and Medical research. Some of their applications are discussed under these categories.

(a) Detection of genes on Chromosomes

In situ hybridization (ISH) is a technique which permits detection of DNA or RNA sequences in cell smears, tissue sections and metaphase chromosome spreads. The method is based on the formation of double stranded hybrid molecules which form between a DNA or RNA target sequence and the complementary single standard labeled probe. Satellite chromosomes with NORs (nuclear organizing regions) are recognized using probes for ribosomal DNA in wheat, barley etc. Telomeres have been identified in human and other eukaryotes using a telomeric sequence as a molecular probe showing that telomeres of all chromosomes carry the same sequences.

(b)Development of RFLPs

Molecular probes are used in restriction fragment length polymorphisms (RFLPs). RFLPs can be studied in a set of related species using a random or a specific DNA probe. The similarities and differences have been used to deduce phylogenetic relationships both in plants and animals (Gill *et al*., 1991; Deshpande *et al*., 1998). Thus molecular probes can be used for evolutionary studies. RFLPs have been used to prepare chromosome maps in humans, mice, fruit fly and in plants including maize, tomato and rice. Once a large number of RFLPs are available in a species the parents, F1, F2 generations can be used to study their inheritance and linkage relationship and genetic linkage maps can be prepared. In this way they can be used for plant and animal breeding (Parasnis *et al.,* 1999).

(c) Detection of Diseases

The application of nucleic acid probes has particularly been evident in accurate detection of diseases caused by parasites and pathogenic microorganisms. Through the development of DNA–DNA and RNA–DNA hybridization procedures and recombinant DNA technolology, the isolation of species-specific gene sequences is readily achieved *(* Brooker *et al.,* 1990 and Stahl *et al .,1992)* such as *Mycobacterium tuberculosis , Vibrio cholerae* etc. Probes are now available for a number of parasitic Protozoa and Helminthes e.g., Leishmania (Kala-azar), Trypanosoma (Sleeping sickness) using Kinetoplast DNA (kDNA) a repetitive DNA sequence as probe and Schistosoma (human blood fluke) using Ribosomal RNA gene as probe are diagnosed by Southern blotting technique(Vasavirama, 2013).

In India, a diagnostic probe for the detection of malaria has been constructed at the Astra Research Centre India (ARCI). Probes are also used for antenatal diagnosis of congenital diseases, herpes virus and number of sexually transmitted diseases.

(d) Detection of Changes to Nucleic Acid Sequences

A change to the DNA sequence is a mutation, which could involve deletion, insertion, or substitution. Changes in certain gene sequences can cause inherited diseases such as phenylketonuria and sickle cell anemia and they can be diagnosed by probe detection. Nucleic acid probes have successfully been used to detect those mutations.

(e) Detection of Tandem Repeat Sequences

Tandem repeat sequences are usually 30–50 bp in length. Their size and distribution are distinctive for an individual. They can be detected using nucleic acid probes and PCR. They are the basis of so-called "DNA fingerprinting" which can be used in forensic science to confirm the identity of a person with the help of blood, semen (sperms), hair roots, tears, saliva etc left at the scene of a crime. This technique can also be used for paternity tests and sibling confirmation etc.

Molecular probes permit a highly reliable and extremely efficient detection of nucleic acid sequences complementary to the employed probes. Molecular probe assays are faster and sensitive than conventional diagnostic methods. Therefore the use of molecular probes has become today's most sophisticated and sensitive technology for a variety of uses involving biological systems both in basic and applied studies in the field of molecular biology and biotechnology including their commercial use.

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NUTRITIONAL VALUE OF MEDICINAL PLANTS AND THEIR CULTIVATION

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Abstract

Plants that possess therapeutic properties or exert beneficial pharmacological effects on the human body are generally designated as medicinal plants. These plants naturally synthesize and accumulates secondary metabolites like alkaloids, sterols, terpenes, flavonoids, saponins, glycosides, cyanogenics, tannins, resins, lactones, quinines and volatile oil etc. in addition to secondary metabolite these plants also contain minerals, vitamins, carbohydrates and proteins etc play an important role overcoming deficiency problems in human beings. Food is the major source for serving the nutritional needs, but with growing modernization some traditional ways are being given up. Affluence of working population with changing lifestyles and reducing affordability of sick care, in terms of time and money involved, are some of the forces that are presently driving people towards thinking about their wellness and lure towards medicinal plants and due to ever increasing demand for medicinal plants people are cultivating medicinal plants in a commercial way and getting higher return compared to traditional crop. Some of the important nutritionally rich and cultivated medicinal crops in India are *Moringa oleifera, Aegle marmelos, Mucuna pruriens, Spilanthes acmella, Withania somnifera, Zingiber officinale, Asparagus racemosus, Annona muricata, Phyllanthus emblica, Chlorophytum borivilianum, Commiphora wightii* and *Morus alba.*

Introduction

Medicinal (MPs) play an important role in the nutrition as well as healthcare of people around the world, especially in developing countries. Until the advent of modern medicine, man depended on plants for treating human and livestock diseases. Human societies throughout the world have accumulated a vast body of indigenous knowledge over centuries on medicinal uses of plants, and for related uses including as poison for fish and hunting, purifying water, and for controlling pests and diseases of crops and livestock. About 80% of the population of most developing countries still use traditional medicines derived from plants for treating human diseases. China, Cuba, India, Sri Lanka, Thailand, and a few other countries have endorsed the official use of traditional systems of medicine in their healthcare programs. For example, the Indian systems of medicine "Ayurveda," "Sidha" and "Unani" entirely, and homeopathy to some extent, depend on plant materials or their derivatives for treating human ailments. People in villages and remote areas primarily depend on traditional medicines as the modern system is out of reach and expensive. Many among the educated in Asian and African countries use traditional medicines for reasons of firm belief that they are more effective than modern medicine for certain chronic diseases, they do not have side effects of some of the modern medicines, and/or for economic reasons. Thus, in many societies, traditional and modern systems of medicines are used independently.

Today there is a worldwide growing demand for high quality, certified organic herbal products and foods. This has created an unsustainable harvesting of medicinal plants (MPs) and other products from natural forests. The commercial production of MPs fills this market by providing green health alternatives to another eco-friendly product for both domestic and industrial uses. However, conservative estimates put the economic value of medicinal plant-related trade in India to the order of Rs 1000 crores/year, and the world

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trade over US $60 billion. At present, these resources from the wild are depleting rapidly, and several medicinal plants are threatened with the extinction. In spite of this, most of the commercial medicinal plants are collected from the wild either legally or illegally, from all over the Himalaya and other parts of the country for various purposes, while only a small number of species is cultivated.

Adolescents, who are young people between the ages of 10 and 19 years, constitute over 21.4 per cent population in India. India has the largest national population of adolescents (243 million), followed by china (207 million), United States (44 million), Indonesia and Pakistan (both 41 million). Adolescence is characterized by an accelerated growth rate associated with rapid muscular, skeletal and sexual development. The process of bone formation and resorption in the body is continuous and in adolescents the rate of formation predominates over that of resorption. Therefore, adolescents must consume diets that are balanced and adjusted to their requirements in order to meet calcium recommendations and to obtain the energy and nutrients that promote mineral utilization. Calcium is a key element for building the skeleton and maintaining the bone mass throughout life. Calcium deficiency leads to inadequate mineralization of bone matrix, resulting in rickets in children and adolescents and, along with other risk factors, contributing to possible osteroporosis in adulthood. Hence, the consumption of adequate calcium is important both in adults as well as age old people. So, inclusion of nutritionally rich medicinal plants and their value added product will overcome the malnutrition, underweight and nutritional disorders in all age groups of people. Some of the nutritionally rich Medicinal plant and their cultivation are given below

a)Ashwagandha

Botanically ashwagandha is called a *Withania somnifera* belongs to family solanaceae. Ashwagandha has many beneficial elements, including flavonoids. Ashwagandha contain different natural antioxidants: superoxide dismutase, catalase and glutathione peroxidase which are responsible as a health promoters. It has been used to treat inflammation, fevers and to protect against infection or illness. It has been used to boost the immune system, improve memory and to promote overall wellness. The roots (0.2-0.5 %), leaves, fruits and seeds contain a number of alkaloids and withanolides (steroidal lactones) and are widely used in Ayurveda, Unani, Siddha and Allopathy systems of medicines to cure a number of diseases. The roots are used for sedatives, antiseptic, aphrodisiac and adoptogenic properties and also rich in vitamins, protein, calcium, iron and magnesium. Inclusion of ashwagandha in dietary supplement improves the overall development of health of human beings by balanced supplying of nutrition. Nutrient composition of Ashwagandha root powder (Per 100g) obtained by chemical analysis is as follows, Moisture was found to be 7.45%, Ash was found to be 4.41g, the amount of Protein was 3.9g, Fat was 0.3g, the amount of Crude Fiber was 32.3g, Energy was 245Kcal, Carbohydrate was 49.9g, Iron was 3.3mg, the Calcium content was 23mg, Total carotene was 75.7 µg and Vitamin C was 5.8mg/100g. Nutrient composition of ashwagandha indicated its nutrient potentiality to overcome nutritional problem and inclusion in dietary supplements will improve health. This plant grows wild in many parts of India and is cultivated mainly for its roots in parts of Rajasthan, Madhya Pradesh, Andhra Pradesh and other states. The crop can be grown as a rainfed or irrigated crop in south India. CIMAP and ICAR has developed improved cultivars of ashwagndha viz., Poshita, Rakshitha, Chethak and Pratap which gives higher yield and economic return compared to local cultivars.

b)Shatavari

Botanically shatavari is called as *Aspergus racemosus* belongs to family liliaceae. Shatavari roots are used mainly as lactogogue, which promotes secretion of breast milk. It is useful in improving the lost body weight and is also considered as an aphrodisiac. The root is useful in curing dysentery, diabetes and tuberculosis. In general it helps to maintain the health by providing immunity to diseases. Shatavari is rich in vitamins, proteins and other essential aminoacids and nutrient composition of Shatavari root powder (Per 100g) obtained by chemical analysis is as follows, Moisture was found to be 9.5%, Ash was found to be 3.55g, the amount of Protein was 2.47g, fat was 0.11g, the amount of Crude Fiber was 2.5g, Energy was 22Kcal, Carbohydrate was 3.39g, Iron was 2.17mg, the Calcium content was 26mg, Total carotene was 87.5 µg and Vitamin C was 3.7mg/100g and inclusion of shatavari in dietary supplements will improve the health and shatavari is a thorny climber, which grows to a height of 180 cm an dprefers lateritic and red loamy soils with

adequate drainage and it is propagation through root suckers or seed. The tubers are economic parts used either as fresh or after drying. The tuber comes to maturity within 12-14 months after planting depending upon soil and climatic conditions.

c) Ginger

Zingiber officinalis is the botanical name of ginger and is important spice and medicinal crop of India and accounts for 45 % of the worlds ginger production. Mainly grown in Kerala and on very small area in Karnataka, Tamil Nadu, West Bengal, Bihar, Himachal Pradesh, Uttar Pradesh and Maharashtra. Area under cultivation in India is about 63,000. ha with total production of about 2 lakh tonnes. Ginger is propagated by using portions of mother rhizomes called as sets. Each healthy set to be used for planting should be 2.5 to 5 cm long, weighing 20-25 g and having two or three buds each. The seed rhizomes should be treated with Dithane M-45 @ 3 g per liter of water for 30 minutes, drained and then used for planting.

Nutrient composition of Ginger root powder (Per 100g) obtained by chemical analysis is as follows moisture was found to be 13.3%, Ash was found to be 4.05g, the amount of Protein was 6.08g, fat was 3.6g, the amount of Crude Fiber was 20.1g, Energy was 214.12Kcal, Carbohydrate was 39.35g, Iron was 9.8mg, the Calcium content was 88.7mg, Total carotene was 76.7µg and Vitamin C was 9.2mg/100g. Polyphenols content was found to be 19.80 mg and Free radical scavenging activity (DPPH) was found to be 67.16% in Ashwagandha root powder while in Shatavari root powder Polyphenols was 5.78mg and Free radical scavenging activity (DPPH) was 77.3%. Polyphenols content was found to be 776.2mg and Free radical scavenging activity was found to be 73.52% in Ginger root powder. Nutritive value of ashwagandha, shatavari and ginger root were presented in table 1.

Table1: Proximate analysis, minerals and vitamin content of dehydrated medicinal herbs powder Per 100 g

Nutritive Values	Ashwagandha root powder	Shatavari root powder	Ginger root powder
Moisture (%)	7.45	9.57	13.03
Ash (g)	4.41	3.55	4.05
Protein (g)	3.9	2.47	6.08
Fat(g)	0.3	0.11	3.6
Crude Fiber (g)	32.3	2.5	20.1
Energy (kcal)	245	22	214
Carbohydrate (g)	49.9	3.39	39.35
Iron (mg)	3.3	2.17	9.8
Calcium(mg)	23	26	88.7
Total carotene(µg)	75.7	87.5	76.7
Vitamin C (mg)	3.7	5.8	9.2

d) Drum stick

Moringa olifera is the scientific name of Drumstick and it is grown for its nutrient rich tender, but full grown pods, leaves and flowers which are used for culinary preparations. Fruits are rich in vitamin C (120 mg/100g), carotene (110 mg), phosphorus (110 mg) and minerals like magnesium (28 mg), potassium (259 mg), sulphur (137 mg), chlorine (423 mg) etc. The crop is grown in homesteads for family sues or cultivated commercially for market. Tender leaves and flowers are comparable to that of colocasia in vitamins and minerals and have great role for combating malnutrition of urban and rural masses. Certain morigna types principally grown for its foliage are reported from West Indies. Drumstick roots are good substitute for horse radish. Root, bark and seed have many industrial uses also. Origin and distribution Originated in South West India, drumstick became a popular vegetable in South Indian states. The crop is widely distributed in India, Sri Lanka, Pakistan, Singapore, Malaysia, Cuba, Jamaica and Egypt. Nutritive value of moring olifera is incomparable 4 times more Vitamin A than Carrot, 4 times more Calcium than Milk, 2 times more Iron than Spinach, 7 Times more Vitamin C than Oranges, 3 times more Potassium than Banana, 2 Times more protein than Eggs and Yogurt and Leaves are also rich in copper, manganese, zinc, selenium, and magnesium,folates,

vitamin-B6 (pyridoxine), thiamin (vitamin B-1), riboflavin, pantothenic acid, and niacin. It contains 0% cholesterol.

Health benefits of Drumstick

1. Very helpful in management of Cardiac diseases. It contains 0% cholesterol and also beneficial for patients suffering from Hypertention.
2. Taking leaves regularly as a part of diet reduces chances of cancer to 80%. It is also recommended as a diet of Cancer patients for healthy and quick healing.
3. Rich in Beta-carotene and Vitamin A, it improves Eye vision and also prevent Ageing Macular Degeneration.
4. It should be included in diet chart of Diabetics as beneficial in managing Sugar level.
5. Soup prepared from leaves is helpful in treating Menstrual cramps.
6. Cooked leaves if taken daily for 3 weeks removes or flushes out all the toxins from the body. It also improves immunity.
7. Leaf paste gently fried in castor oil can be applied over inflammations and swellings.
8. Rich in Calcium, very good to improve bone density. To improve bone health of kids, about 1 teaspoon of leaf juice should be mixed with milk and given twice daily.
9. Leaf juice with lemon juice can be mixed and applied over face to overcome black heads and acne.
10. Pregnant ladies should be given cooked leaves especially in last trimester for easy delivery. It also reduces post delivery complication and increases milk secretion in lactating women.
11. Zinc in drumstick leaves plays vital role in hair-growth, spermatogenesis, and skin health.

Drumstick is predominantly a crop of dry and arid tracts. However intensive cultivation with good irrigation and systematic cultural practices will give good yield especially for annual type. The plant put forth luxuriant growth at 25-30o C. Higher temperature results in heavy flower shedding. Crop is also injured severely by frost. Though the crop comes up well in all types of soil, performance is better in sandy loam rich in organic matter. A pH range of 6.0 – 6.72 is most ideal. Perennial types are propagated through limb cutting of 90-100 cm length and 5-8 cm diameter. Annual types are propagated by seeds. Average seed weight is 0.288 g and 10 g contain 35 seeds. Seeds @ 625 g/ ha can be either sown in pits or transplanted after raising seedlings in polythene bags. Transplanting of seedlings can be made one month after sowing. It is always advisable to raise a few plants additionally in polythene bags for purpose of gap filling. Time of sowing of seeds for annual seed drumstick or planting of limb cuttings varies from region to region depending on receipt of monsoon. As drumstick is nutritionally very rich in protein, carbohydrates, vitamins and aminoacids inclusion of these in dietary supplements will improve especially children's and women.

Herbal Medicines in Dietary Supplements

Dietary supplements and herbal remedies are popular complementary or alternative products for people. These are the supplements that are intended to supplement the diet and contain one or more dietary ingredients (including vitamins, minerals, herbs or other botanicals, amino acids, and other substances) or their constituents. These are intended to be taken by mouth as a pill, capsule, tablet, or liquid and are labeled on the front panel as being a dietary supplement. Such products may range from isolated nutrients, dietary supplements, and diets to genetically engineered “designer” foods, herbal products, and processed foods such as cereals, soups, and beverages. These botanicals are sold in many forms as fresh or dried products, liquid or solid extracts, tablets, capsules, powders, tea bags, and so forth. For example, fresh ginger root is often used in various food stores; dried ginger root is sold packaged in tea bags, capsules, or tablets, and liquid preparations made from ginger root are also sold in the market. A particular group of chemicals or a single chemical may be isolated from a botanical and sold as a dietary supplement, usually in tablet or capsule form. An example is phytoestrogens from soy products. Details of some of the nutritional benefits of medicinal plants are presented in Table 2.

Table 2. Details of some nutritional valuable of medicinal plants

Scientific name	Common name	Part (s) used	Constituents	Uses
1. *Aeglemarmelos* Correa ex Roxb.	Bael tree	Leaves, fruit	Aegelin, aegelenine, marmin, proteins, amino acids	Diarrhoea, piles,cardiotonic,laxative, jaundice hypoglcaemic
2. *Annonamuricata* L.	Soursop	Leaves, fruit, Root bark, stem bark, Seed	Anonaine, annonamine, casuarine, nornuciferine	Diabetes, cardiovascular, cancer, Insomnia, heart affections
3. *Annonareticulata* Linn. (Bullock's heart)	Netted custard apple	Leaves, fruit, root bark, stem bark, seed	Dopamine, pinene, amino acids, carbohydrates,	Anticancer, wound healing, analgesic, antiproliferative
4. *Amranthusspinosus* L.	Thorny amaranth	Leaves, stems	Alkanes, sterols, spinasterol, sponins	Fever, toothache, diuretic, leucorrhoea
5. *Ammimanjus* L.	Greater ammi	Seeds	Xanthotoxin, ammidin, majurin, ammirin	Leucoderma
6. *Asparagus racemosus*Willd	Shatavari	Tubers	Satavarin-I-IV, shatavarin IV, sarsapogenin	inflammation, burning sensation, excessive perspiration
7. *Boerhaaviadiffusa* L.	Punarnava	Roots, extract of plant	Hypoxanthinin, 9-L-ara binofuranoside, . -sitostrerol, ursolic acid	Skin diseases, urinary troubles, ulcers leprosy, cirrhosis of liver
8. *Commiphorawighti* (Arn.) Bhandari	Guggul	Oleo-gum resin	Gum resin 3.2%, Z-guggulsterone, E-guggulosterol I, II, and III	Anti-inflammatory, rheumatism, hyperlipidemia, thrombosis,
9. *Dioscoreabulbifera* Linn.	Yam wild	Bulbils	Furanoidnorditerpenes, sinodiosgenin, diosgenin ß, smilagenone,	Conjunctivitis, leucoderma, dyspepsia, urinary discharges, jaundice, diabetes, bronchitis,
10. *Feroniaelephantum* Correa	Elephant-apple	Leaves, fruits, bark, gum resin	Beta carotene, vitamin B, vitamin C, thiamin and riboflavin	Diarrhea, dysentery, throat problems, cures flatulence

Scientific name	Common name	Part (s) used	Constituents	Uses
11. *Morindacitrifolia* L.	Noni	Fruits	Carbohydrates, vitamin C, iron, potassium	convulsions, cough, diabetes, kidney disorders
12. Moringaoleifera Lam.	Drumstick tree	Root bark, stem bark, leaves, fruits and seeds	Arginine, histidine, vitamins, carbohydrates, Iron	Heart disease, anemia, arthritis, respiratory, digestive disorders.
13. *Morus alba* L.	White mulberry	Leaves, fruits	Moracin, steppogenin-4′-O-β-D-glucoside, mulberroside A	Constipation, diabetes, neuroprotective
14. *Mucunapruriens* (L.) DC.	Velvet bean	Young pods and seeds	L-DOPA, serotonin, nicotine, bufotenine	Vomiting, cramping, arrhythmias, hypotension, nausea
15. *Pimentadioica* (L.) Merr.	Allspice	Leaves and dried fruits	Eugenol, quercetin, beta-carotene, iron	High blood pressure, diabetes, muscle pain, indigestion
16. *Phyllanthusembllica* Linn.	Indian gooseberry	Fruit	Vitamin C, tannins	Laxative, anaemia, nutritive tonic, antiscorbutic
17. *Syzugiumcumini* (L.) Skeels	Java plum	leaves, bark, fruits and seeds	Anthocyanins, glucoside, ellagic acid	Digestive, biliousness, stomachic, astringent, diuretic
18. *Sauropus androgynous* (L.) Merr.	Multivitamin Plant	Leaves, root and stem	Carotenoids, antioxidant vitamins, minerals	Antidiabetes, wound-healing, antioxidant, flavour, cooking
19. *Withaniasomnifera* (L.) Dunal	Ashwagandha	roots	Withanolides, withaferins, isopellertierine, sitoindoside VII and VIII	Antiseptic, aphrodisiac, adaptogenic properties
20. *Gingiberofficinalis* Roscoe	Ginger	Rhizomes	carbohydrates, protein, zingerone, shogaols	Motion sickness , nausea, vomiting, cough, throat disorders, constipation

Conclusions and Future prospects

Future prospects: 1. Medicinal plants and their derivatives will continue to play a major role in medical therapy in spite of advances in chemical technology and the appearance of cheap, synthesized, complex molecules from simple ones through highly specific reaction mechanisms. The reaction involved is either difficult or expensive to duplicate by classical chemical method. For example in Vitamin A, disogenin and solasodine of plants, where stearic forms are possible, chemical synthesis yields a mixture of the isomers which may be difficult to separate. The product obtained by synthesis may therefore be toxic or have a different therapeutic effect than what is obtained in nature.

2. Drug development out of medicinal plants is less costlier than synthetic drug development. Reserpine is a good example of this. The synthesis of reserpine costs approximately Rs.1.25/g, whereas, commercial extraction from the plant costs only Rs.0.75 /g.

3.There has been a tremendous upsurge in the demand for phytopharmaceutical raw medicinal herbs and vegetable drugs of Indian origin from the Western nations. There is also an increase in domestic demand for raw material used for perfumeries, pharmacies and biopesticidal units. The demand for traditional herbal drugs is also increasing rapidly mainly because of the harmful effects of synthetic chemical drugs and also because of an expansion of pharmacies manufacturing natural drug formulations.

4. India is the source of cheap labor and skilled manpower which readily absorbs technological change and also adopts the same.

5. In addition, these crops have many virtues like drought hardiness, capability to grow on marginal lands. They are relatively free from cattle damage and hence, can be profitably grown in areas where stray cattle or wild animals or pilferage is a major problem. As it is, medicinal plants are better earners than many of the field crops. Since they are new crops, there is an immense scope for further improvement in their productivity and adaptability, in order to obtain further increase in returns. They are suitable for incorporating into various systems of culture like intercropping, mixed cropping and multitier cropping.

Conclusion

In developing countries more than 80 per cent of the population relies on traditional medicines, mostly plant drugs, for their primary healthcare and these are nutritionally rich compared to vegetables and cereals. Herbal remedies are available in all chemists and grocery stores. Ayurvedic products are reasonably cost effective and well accepted by patients. They are easily available and do not have side effects. These herbal drugs and Indian medicinal plants are also rich sources of beneficial compounds including protein, Vitamins, minerals and antioxidants and components that can be used in functional foods. Newer approaches utilizing collaborative research and modern technology in combination with established traditional health principles will yield rich dividends in the near future in improving health, especially among people who do not have access to the use of costlier western systems of medicine. Bio Pharma companies need to carry out more extensive market penetration and research for herbal medicines to be more frequently used by consumers. All manufacturers in India with the support of State and Central Governments have to set up a world standard laboratory in quality control, R&D facility which would facilitate and help exporters in respect to quality assurance of drugs exported from India. A reasonable status of scientific vigour is needed to assess the threat status of species to be banned.

The conservation status of all species in trade should also be studied. This clearly opens up a huge challenge for conservationist, policy makers, researchers, industry and farmers to manage one of the most important natural resources, medicinal plants and aromatic plants wisely.

Also, numerous nutraceutical combinations have entered the international market through exploration of ethnopharmacological claims made by different traditional practices. To truly consume a healthy diet, the vast majority of the diet must be composed of health-promoting foods and nutraceuticals but disease-promoting foods or junk food must be avoided. Ninety percent of the daily diet should be made up of nutrient rich plant foods, whose calories are accompanied by health-promoting phytochemicals. These foods or nutraceuticals obtained from medicinal plants construct a health-promoting, disease-preventing diet with protective substances. The rich nutrient food intake will provide maximum protection against not only infections, asthma, and allergies but also against heart disease and cancer in adulthood.

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MORINGA: CONCERNING NUTRITION AND ENVIRONMENT

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Moringa commonly called the Horseradish tree, Drumstick tree, Ben oil tree, Miracle tree, and Mother's Best Friend, known for its multi-purpose attributes and wide adaptability. *Moringa oleifera* Lam (syn. *Moringa pterygosperm*a), the most widely cultivated species of a monogeneric family Moringaceae. It is one of the 14 species of family Moringaceae, native to India, Africa, Arabia, Southeast Asia, South America, and the Pacific and Caribbean Islands (Iqbal et al., 2006). It is a small, fast-growing, drought deciduous tree or shrub that reaches 12 m in height at maturity. It has a wide-open, typically umbrella- shaped crown, straight trunk (10-30 cm thick) and a corky, whitish bark. The plant (depending on climate) has leaflets 1-2 cm in diameter and 1.5-2.5 cm in length. Cream-colored flowers emerge in sweet-smelling panicles during periods of drought or water stress when the tree loses its leaves. Originally *Moringa* considered as a tree of hot semi-arid regions (annual rainfall 250-1500 mm), which is adaptable to a wide range of environmental conditions; from hot dry to hot, humid and wet conditions. The tree is tolerant to light frosts, but does not survive as a perennial under freezing condition.

Each part of the *Moringa* tree has beneficial properties, which is why it is called the miracle tree.

Nutrition Value:

The *Moringa* tree is an extraordinary concentrate of vitamins, dietary minerals and proteins. The leaves, pods and flowers packed with nutrients important to both humans and animals. Where diets lack in these essential nutrients the *Moringa* tree makes a major contribution to human health especially for Rural communities. *Moringa* is substitute for oranges, carrots, Bananas and milk, which are not part of daily diet as they are too expensive for Rural Peoples. Dried and powdered moringa can be mixed with food and drinks.

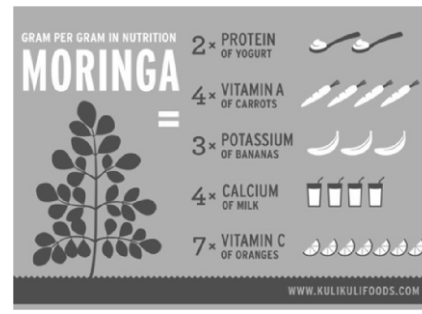

Figure : Showing Nutritonal value

The pods are highly nutritious containing all the essential amino acids (Ramachandran et al., 1980). The leaves are a very rich source of nutrients and contain the essential vitamins A, C and E. Leaves are also rich in biologically active carotenoids, tocopherols and vitamin C have health-promoting potential in maintaining a balanced diet and preventing free-radical damage that can initiate many illnesses (Smolin et al, 2007). *Moringa* trees have been used to combat malnutrition especially among infants and breastfeeding woman in many developing countries, particularly in India.

Medicinal Value:

A number of natural compounds have been isolated from *M. oleifera* leaves including fully acetylated glycosides bearing thiocarbamates, carbamates or nitriles (Faizi et al., 1995). Glycosides containing isothiocyanates, malonates and flavonoids also identified and isolated in the leaves of the plant. (Faizi et al., 1995; Bennett et al., 2003; Miean et al., 2001). Plant glycosides can be used as treatments for cancer or chronic conditions such as high cholesterol and atherosclerosis (Chumark et al., 2008; Ghasi et al., 2000). Plant flavonoids are important to the diet becauseof their effects on human nutrition. These phyto chemicals can modulate lipid peroxidation involved in atherogenesis, carcinogenesis and thrombosis and

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other known properties of free radical scavenging or inhibition of hydrolytic and oxidative enzymes (phospholipidase A2, cyclooxygenase, lipooxygenase), shows strong antioxidant and anti-inflammatory activity (Siddhuraju et al., 2003). Numerous studies have indicated that flavonoids also have anti-carcinogenic, anti-viral and anti-estrogenic activities. OO EXPENSIVETHE **DAILY DIET AS THEY ARE**

Environmental Significance:

The firm roots of the *Moringa* are drought-resistant and counteract the phenomenon of erosion. Its processed leaves produce a strong fertilizer that can be used in agriculture. The shredding of its dried seeds and leaves produces a highly nutritious powder that can be used in the kitchen and is also excellent as animal feed. The stem and bark planted as a hedge in courtyards which provides wind protection, shade and support for climbing garden plants. The plant wood is relatively soft so could not used in heavy construction but provides a good fuel for cooking. The fiber from the bark used to make ropes. The *Moringa* flowers also produce a good honey. It also used as plant growth enhancer. Its spray had a wide range of beneficial effects on plant crop which accelerated growth of young plants. Plants were firmer, more resistant to pests and disease, longer life-span, heavier roots, stems and leaves, produced more fruit, larger fruit, increase in yield 20-35%f even a fraction of these results could be reproduced in the field, it could be a great help in increasing food supplies for millions of hungry people (Fahey, 2005). The tree's seeds have a strong antibacterial action that can be used to purify water. EXP

Moringa is an excellent multiuse plant Used to improve the health and nutrition of communities In Sudan moringa has a great potential to cultivate as an economically profitable crop and contribute in poverty elevation. increasing the agricultural production, improving the nutrition of some farmers and their families and counteracting the effects of climate change with awareness-raising and reforestation interventions.

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HOW TO AVERT GLOBAL WARMING

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Abstract

Current increase in the temperature of the earth's surface and atmosphere is called global warming. The increasing quantity of green house gases in our atmosphere produced by human activities is the main cause of global warming .Global warming is damaging the earth's climate as well as the physical environment. Global warming is harming the environment in several ways including stronger hurricanes and cyclones, desertification, increased melting of snow and ice, sea level rise .The present study comprises the tips by which global warming can be prevented.

1. Recycle

A great earth saving tip is cycling unwanted paper bottles.If possible upcycle tobles furniture and other outdated items to keep landfills clean .You can recycle almost anything e.g.paper aluminum foils,cans ,news papers . Landfils can be reduced by recycling .

2. **Spread the Awareness**

Always try your best to educate people about global warming and it's causes and after affects. Tell them how they can contribute their part by saving energy that will be good for the environment. Gather opportunities and establish programs that will help you to share information with relatives, friends and neighbors.

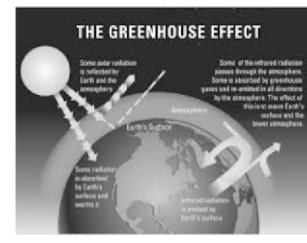
3. Reduce Your Needs

Reduce or use less new products resulting in a small amount of waste . Even if u need to buy consider buying ecofriendly products.

4. Reuse Items

Reuse bottles plastic containers and other items bought at the grocery store. Reuse of water bottles yogurt cups ,bread ties and other items is being conscious about what is already out there .It will lessen having to purchase other items.Disposable products can be used into.Some other form instead of throwing them away.

5. Use of Compact Fluorescent Light(CFL)



CFL consumes 70% less energy than ordinary bulbs .Therefore replace pordinary bulbs by CFL.

6. Install a Programmable Thermostate

The easiest and most cost effective advice is simply adjusting your thermostat up 10 in the summer .A programmable thermostat doesn't cost much and its cost can be recovered from the amount that you save by reducing energy .

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7. By Energy Efficient Product

By energy efficient product as they can help us to save good amount of money on your energy bill and energy too .

8. Reduce Waste

Burning of waste releases toxic gases in the atmosphere which result in global warming . Land fills are the major contributor of methane and other greenhouse gases. Reusing and recycling old items can significantly reduce our carbon footprint as it takes far less energy to recycle old items than to produce items from starch.

9. Use Less Hot Water

Aboid taking frequent showers and use less hot water it will help in saving energy require to produce that energy .By energy saving geysers and dishwasher for our home .

10. Go Solar

Many people have caught the energy efficient band wagon of solar energy .Having solar panels installed is something readily possible and available incentives and discount given by government agencies and energy companies make energy companies make energy something to look into.

11. Turn off The Lights

There is no need for the light to be on when room is not in use.

12. Go Green

Using energy star appliances will not only save money ,but also the amount of energy wasted inn your home. Various ways to go green are –start using essential oils ,stop junk mail, give up bottled water ,reduce waste ,conserve energy, conserve water etc.

13. Plantaion

Global warming can be reduced by plantation than any other method.They take in CO2 and give O2 during the process of photosynthesis whivh is main source of global warming.

14. Use Clean Fuel

Smart cars, electric ,cars run on vegetable oil ,etc……are great examples for using renewable energy .Supporting companies that provide these products will help the rest of the mainstream manufacturing companies convert over.

15. Downloading of Earth Saving Apps

Apps like Wiser EMS not only help to calculate your energy costs ,but provide tools and ways to save energy and money.

16. Save Energy

The less CO2 is released into the atmosphere on less consumption of energy .Setting your thermostat using your smart phone or changing the type of light bulb you use is a great start .

17. Replacement of Filters on Air Conditioners and Furnace

If you are not replacing filters not only you are wasting energy but also breathing in dirty air. Several pounds of CO2 can be saved per year on cleaning a dirty air filter.

18. Turn off Electronic Device

Turn off electronic devices when you are moving out for a couple of days or more. Unnecessary usage of electronic appliances will not only save fuel i.e.coal by which wer get electricity but also increase the lifetime of your gadgets.

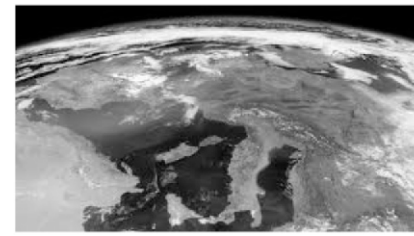
19. Tune are car regularly

Regualar maintenance will help your car function properly and emit less carbon dioxide.

20. Look for Renewable Fuel Option

If you can not afford an electric car by the cleanest gasoline as possible. When car shopping ,look at the benefits of options that provide renewable fuel .Although it might may be pretty penny now ,you are on the ground level of forwarding level of forward thinking.

21. Water Conservation



Water conservation is very important .If we added up the water wasted by the millions of Americans brushing their teeth ,we could provide water to more than 23 nations with unclean drinking water. Remember it takes energy to draw and filter water from underground. Taking a quick 5 minute shower will greatly conserve energy . The type of shower head used ,will also aid in combating global warming. Take showers instead of baths. Showers use less water than baths by 25%.Over the course of year that's hundred of gallons saved.

22. Do Not Put Clothes in Dryer

Use Clothesline to dry your clothes .Clothes shouldnot be put in the dryer anyway,think of your grandmother when you do this.

23. Take Natural Diet

Not only natural diet cuts down the energy costs used by factories who produce processed food but also do the heath benefits speak wonders for those who take natural diet.

Eat Naturally: Not only do the health benefits speak wonders for those who eat naturally, but it cuts down the energy costs used by factories who produce processed food.

24. Use Bike

Bike riding is healthy because it reduces the amount of CO2 released into the air .Walking is another way to reduce global warming

25. Use Kitchen Cloth

Use kitchen cloth instead of paper towels. Paper towels produce nothing but wasted energy. Think of the factory pollution, as well as the tree consumption.

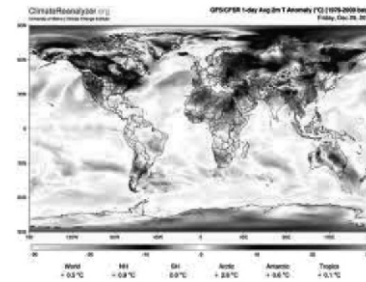
26 . Check Tyeres Regularly

When you drive make sure your tires are inflated properly. If not, then your vehicle might consume more fuel which in turn release more CO2 in the atmosphere. Keep your engine properly tuned and drive less aggressively. Aggressive driving and frequent applying of brakes hampers the engine and can even lower the mileage of your car.

27. Get Home Energy Audit Done

Call a home energy audit company and get an audit done for your home that will help you to identify areas that consume lot of energy and are not energy efficient at all.

28. Be a member of the Global Warming Community



Connecting with others will help you become more conscious of the impact we all have. The Climate Change National Forum and Global Humanitarian Forum are great avenues to know the latest facts, statistics, and efforts in making a difference.

29. Celebrate Arbor Day and Earth day

Although most of us hear about these days in passing, see what the buzz is all about. Plant a tree, pick up trash, or join a forum.

30. Adapt Carpool

By carpooling driving can be less consequently fuel can be saved and global warming can be reduced .You have colleagues who live in the same area then you can combine trips. If u need to go to local market then either walk or go by bicycle which are also great form of exercise .Oil and gasoline are biggest source of pollution emitting fumes, energy waste can be reduced by cutting down consumption.

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METHODS OF NEMATODE MANAGEMENT

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Study of free living and plant parasitic nematodes is known as nematology. Nematode is derived from two Greek words viz: Nema (means=thread) and oides (means=like). Nematodes are thread like organisms, they are also known as eelworm or round worms because round in cross section. Nematodes are triploblastic, bilaterally symmetrical, unsegmented, pseudocoelomatic invertebrates with a triradial oesophagus and lacking specialized organs for respiration and circulation. Nematodes cause diseases in man as well as in plants. The studies of plant parasitic nematodes are undertaken as a part of plant pathology. Study of nematodes which are parasitic exclusively on man and domesticated animals is known as Helminthology or Parasitology.

The following methods for controlling phytonematodes are generally practiced:

(i) Regulatory method (ii) Physical method (iii) Cultural method (iv) Chemical method (v) Biological method (vi) Host resistance.

(i) Regulatory Method

Regulatory method involves certain measures, self-imposed or enforced by state laws which prevent entry of any serious pest or disease agent into a geographic area, to which it is exotic, from outside that area within or outside the country. These regulatory measures fall under the category of "Quarantine regulations".

The most important example is Golden nematode of potato, *Globodera rostochiensis* and *Globodera pallida* which is indigenous to high Andean valleys of Peru, South America where potato originated. Similarly stem and bulb nematode, *Ditylenchus dipsaci is* also an example for introduction of 'Lucerne race' that got entry from somewhere through seed.

Nematode in International Quarantine: 14 plant parasitic nematode genera belonging to *Anguina, Aphelenchoides, Ditylenchus, Globodera, Heterodera, Meloidogyne, Radopholus, Rotylenchulus, Tylenchulus, Xiphinema, Helicotylenchus, Nacobbus, Pratylenchus* and *Rhadinaphelenchus* have been cited as quarantine objects in the quarantine measures that have been listed in the regulation of different countries. At present domestic quarantine exists against Golden nematode of potato, Globodera *rostochiensis* and *Globodera paitida* in Tamilnadu.

(ii) Physical Method

The physical methods include the use of heat, irradiation, somatic pressure etc.

Heat:

Most successful measure used, so far controlling nematodes. In general, most of the nematodes cannot tolerate more than 50-60°C

Heat treatment of soil :

Sterilization of soil by steam is practiced since long to treat the seed beds, green house beds and other small areas. The small quantity of soil can be sterilized in an autoclave at 30lb pressure per square inch for 30 minutes. In some countries electric soil sterilizers are used to sterilize the soil.

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Hot water treatment :

Widely used for killing the nematodes within plant tissues before planting and has been useful against the nematodes infesting bulbs, corms, tubers, seeds and roots of plants. The first published record, of hot water treatment of living plant material for nematode control seems to be that of Marcinowski (1909) who treated ferns and begonias for 5 minutes at 50°C to kill *Aphelenchoides fragariae.*

Irradiation :

Irradiation also kills nematodes. UV light also kills nematodes.

Osmotic pressure:

Feder (1960) reported 100% nematode mortality when sucrose or dextrose was added to nematode infested; soil @ 1 to 5% by weight.

Washing process:

Some plant parasitic nematodes spread through soil adhering to potato tubers, bulbs and other planting material such spread is more important in respect to cyst forming species. Therefore, washing can considerably reduce the risk, but in practical it is difficult to wash with, sufficient care to remove all soil.

Seed cleaning :

Modern mechanical seed cleaning methods have developed to remove the seed galls from normal healthy wheat seeds.

Ultrasonics:

Ultrasonics has little effect on *Heterodera spp*. Practically not feasible.

(iii) Cultural control :

1. Fallow :

Fallowing is the practice to keep the land free from all vegetation for a specific period. Many nematodes can be managed by depriving them of plants on which they feed. Non cyst forming nematodes are specially reduced by his method. Even some cyst forming nematode *viz.. H. avenue* is adversely affected since it is, highly susceptible to desiccation.

2. Flooding:

Flooding, the land for long time is not acceptable for long period, but for a specified period it may be practiced. Due to flooding, of land, the oxygen content of soil is decreased and nematodes are killed by asphyxiation. Some Chemicals *viz..* H_2S, NH^3, propionic and butyric acids develop it flooded lands which are toxic to nematodes.

3. Destruction of infected plants:

The crop residues, left after the harvest should be destroyed or burnt so that nematodes may not survive on that.

4. Selection of healthy propagating material:

For the plants which are propagated vegetatively, this method can be employed successfully by selecting uninfected plants or parts of plants for propagation. The land to be planted is known to be free from specific species of plant parasitic nematodes, particularly when the spread of the nematode is only by seeds, seedlings or other nursery stocks.

The citrus nematode *(Tylenchulus semipenetrans),* golden nematode of potato *(Globodera rostochiensis),* coffee lesion nematode *(Pratylenchus coffeae),* burrowing nematode *(Radopholus similis)* can be checked by selecting nematodes free planting material.

5. Crop rotation:

By growing a non host crop in between 2 susceptible ones the population level of the nematode is brought down below the damaging threshold. Many of the economically important nematodes viz.

root knot, cyst, reniform, lesion nematodes has wide but somewhat delineated host ranges.

More than 100 years ago, crop rotation as the best method .of control of sugar beet cyst nematode, *Heterodera schachtii* had been recommended by JuIius Kuhn.

Most effective means of Molya disease control caused by *Heterodera Avenue* in wheat. Growing non hosts like mustard, gram etc., for 1-2 years brings down the population of *H.avenae* appreciably to raise a successful wheat crop subsequently.

Many dicotyledonous crops can be grown as alternatives to wheat, barley, oats and sorghum to control the cereal cyst nematode *(Heterodera avenae),* maize cyst *(Heterodera zeae)* or sorghum cyst nematode *(Heterodera sorghi).* Likewise monocotyledonous including cereals and some crucifers are known to poor or non hosts of root knot nematodes infecting cereals. African marigold, sesamum, asparagus, mustard etc have been reported to be antagonistic to the root knot, reniform and some other nematodes.

6. Trap cropping:

Trap crops are those plant species which are highly susceptible to nematode parasite of the major crop and are planted so as to get infested by the nematode at a particular stage of growth of the plant and then crop is destroyed before the nematode can complete its life cycle. Oats have been practiced as a trap crop for cereal cyst nematode in England. Similarly cowpea causes the root knot nematode eggs to hatch; the hatched larvae enter into roots and develop to immobile stage, Then the crop is destroyed before the maturity of nematodes.

Solanum nigrum stimulates hatching of eggs of *Globodera rostochiensis.* The second stage larva penetrates the roots but cyst development is poor. Crotolaria is highly susceptible to invasion by root knot nematode but the larvae fail to mature into adults.

7. **Antagonistic or enemy plants:**

These plants produce toxic substances which destroys the nematodes in soil. Some grasses, mustard, asparagus, crotolaria, sesamum, neem etc have been reported as antagonistic plants.

a) Mustard:

Mustard oil contains allyl isothiocyanate, which is toxic to nematodes. Hatching of cyst nematode are neutralized by growing mustard along with potato.

b) Marigold:

Oostenbrink and his associates *(1957)* studied the relationship between marigold *(Tagetes erecta* and *Tagetes patula)* and root infecting nematodes. They observed that the population of *Paratylenchus, Tylenchorhynchus* and *Rotylenchulus* could be reduced considerably. This effect is due to root exudates of marigold which contain a-terthienyl compound that is toxic to nematodes.

c) Asparagus:

Rhode and Jenkins (1958) reported that populations of *Trichodorus christie* are not supported by *Asparagus officinal is for more than 40 to 50 days.*

d) Crotolaria:

Ochse and Brewton (1954) suggested that crotolaria root system exert a toxic effect on root knot nematode populations. The population of *Xiphinema americanure* also decreased due to *Crotolaria spectabilis.*

e) Sesamum

Atwal and manger (1969) reported that root exudate from sesame (*Sesamum oreintalis*) has nematicidal properties against root knot nematode *(Meloidogyne incognita).*

f) Margosa *(Azadirachta indica)*

It is reported to have at least two nematicidal compounds nimbidin and thionemone which are toxic to nematodes.

8. Adjusting the time of planting

Nematode life cycle depends on the climatic factors. Adjusting the time of planting helps to avoid nematode damage. In some cases crops may be planted in winter when soil temperature is low and at that time the nematodes cannot be active at low temperature. Early potatoes and sugar beets grow in soil during cold season and escapes cyst nematode damage since the nematodes are not that much active, to cause damage to the crop during cold season. Most of the nematodes (except cereal cyst, potato cyst nematodes and ear cockle nematode which are active in cool weather) are slower in invasion and reproduction during, winter than in summer. Late planting of susceptible rabi crops helps the crop to escape early nematode damage.

9. Manuring

Raising green manure crops and addition of more amount of farm yard manure, oil cakes of neem and castor, press mud and poultry manure etc enriches the soil and further encourages the development of predacious nematodes like *Mononchus* spp. and also other nematode antagonistic microbes in the soil which checks the parasitic nematodes in the field. Application of $CACN_2$, NaCN and urea cynamide is effective in controlling root knot nematodes which may be due to release of HCN or NH_3 to the nematodes.

(iv) Chemical Control:

The discovery of nematicidal properties of DD by Corter (1943) and nematicidal properties of EDB by Christie (1945) marked the beginning of new era in nematode control. *Types of Nematicides*: The nematicides which are in commercial use may be grouped into two:

a) Fumigants b) Non fumigants

The fumigant includes compounds belonging to halogenated hydrocarbon and isothiocyanate groups while the non fumigants consist of organophosphates and carbamates.

Halogenated Hydrocarbons:

1. DD mixture

Mixture of 1-3 dichloropropene and 1-2, dichloropropane generally used @ 400-500 litres per ha as a pre plant soil fumigant.

2. Telone:

Mixture of cis and trans isomers of 1, 3- dichloropropene. Introduced by Dow chemical company in 1956. It is used @ 200 lit/ha.

3. Ethylene Dibromide (1, 2-dibromoethane)

Cannot be used for bromine sensitive plants like onion, garlic, lilly etc. Generally used @ 60 litres/ha.

4. Chloropicrin:

Trichloronitro methane and primarily developed as a soil fungicide to control fungal wilts of plants but is found most useful to control root-knot nematodes. Generally used @ 500 lit/ ha. It is available in the trade name of larvacide, picfume and commonly called as tear gas.

5. Methyl bromide

Kills nematodes, fungi, bacterial weed seeds and insects which are present in the soil. It is marketed under the trade name of Embafume, Bedfume, Dowfume MC2, Pest master, Meth-o-gas and Terabol.

6. DBCP:

Chemically it is *1, 2* dibromo-3 chloropropane. It is generally used @ 20 to 50 lit/ha depending upon the crop and soil type. It is marketed under the trade names of Fumazone and nemagon. Restrictions have been imposed on its manufacturing because of its potential for causing cancer in some

laboratory animals and sterility in man.

Isothiocyanate Group:

1. Dazomet:

3, 5 dimethyl-tetrahydro 1,3, 52, H thiadiazinethion. It has a complex effect with nematicidal, insecticidal, fungicidal and herbicidal action. It is applied as preplant soil fumigant @ 20-35 g/sq.m. it is marketed under the trade name of Mylone and Bassamid.

2. Metham Sodium:

The active ingredient is sodium N-methyl dithiocarbamate (the sodium salt of methyldithiocarbamic acid), it is highly phytotoxic, therefore an interval of two weeks or more must be allowed between application and planting. It is used @ 700-1000 lit/ha and marketed under the trade names of Vapam, Sistan, Vitafume and Unifume.

3. Trapex;

20% (w/w) product of an organic solvent, generally xylol with or without emulsifier. Used to control the nematodes, soil insects and weeds. It has been found effective against cyst forming nematodes.

NEMATICIDES COMMONLY FOUND IN WORLD MARKETS:

S. No.	Common name	Trade name	Manufacturer	Formulation and classification
1	Aldicarb	TEMIK	Union Carbide Corp	Granular nematicide/ insecticide Nonfumigant
2	Carbofuran	Furadan	Niagra Chemical	Granular and flowable nematicide/ insecticide Nonfumigant
3	Chloropicrin	Larvacide, Picfume, Tear gas	Great Lakes Chem Corp	Liquid Fumigant nematicide/insecticide
4	1,3-D	Telone	Dow Chemical Co.	Liquid Fumigant nematicide
5	DBCP	Fumazone, Nemagon	Dow Chemical Co.	Emulsifiable/non emulsifiable liquid nematicide Fumigant
6	DD Mixture	D-D, Vidden - D, Nematox	Shell Chemical	Liquid Fumigant nematicide
7	EDB	Dowfume W-40, Dowfume-W-85, Soil fume-40, Soilfume-85, Bromofume-85, Nemex-42, Nemex-85,	Dow Chemical Co.	Liquid Fumigant nematicide
8	Ethoprop	Mocap	Mobil Chemical Co.	Granular/emulsifiable Liquid nematicide Nonfumigant
9	Fenamiphos	Nemacur	Chemagro	Granular/emulsifiable (Mobay) Liquid nematicide Nonfumigant

S. No.	Common name	Trade name	Manufacturer	Formulation and classification
10	Fensulfo--thion	Dasanit	Chemagro (Mobay)	Granular nematicide Nonfumigant
11	Methyl bromide	Embafume, Bedfume, Dowfume MC2, Pest master, Meth-o-gas and Terabol	Dow Chemical Co.	Gas Fumigant nematicide
12	Metham sodium	Vapam	Stauffer Chemical Co.	Water soluble solid nematicide/fungicide/ herbicide
13	Oxamyl	Vydate	Dupont de Nemours	Granular /water soluble liquid nematicide/ insecticide Nonfumigant

Organophosphates :

1. Parathion:

Contact poison and was first used by Dimock and Ford (1950) to control the chrysanthemum foliar nematode. It is available under the trade names of Ekatex, Folidal and Thiophos as 50 EC.

2. Dichlofenthion:

Less phytotoxic and kills many kind of nematodes at normal dose. This chemical was introduced by Vergenia chemical company as nematicide in 1956. It is usually used @ 1501it/ ha to control the nematodes. It is sold under the trade names of vc-13 and Hexanema as 55 granule and 75 EC.

3. Thionazin:

Most effective against sting nematode of maize, when used @ 1kg a.i./na as raw treatment. It is available under the trade names of Zinophos, Cynem and Nemaphos as 10% granule.

4. Fensulfothion:

Promising nematicide and soil insecticide. It is sold under the trade name of dasanit and terracur-P as 5 to 10% granules.

5. Phenamiphos:

Highly effective systemic nematicide against most of the plant parasitic nematodes. Readily absorbed by roots as well as by leaves and translocated both up and downward in the plant system. It can be used @ 40 to 80 kg/ha to control the nematodes. Available in market as Nemacur as 10% granule.

6. Ethoprop:

Non fumigant, non systemic and has efficient contact action with good soil movement and residual properties. It can be used @ 40 to 80 kg/ha depending upon the soil type and species of nematodes. Sold under the trade name Mocap 10G.

7. Phorate:

Systemic pesticide and is absorbed by roots and subsequently translocated to aerial parts of the plant. Generally, used @ 20 to 30 kg/ha. Available under the trade name Thimet as 10% granules.

Dithiocarbamates:

Derivatives of carbamic acid and have OCON-group in the molecule.

1. Carbofuran:

Systemic nematicide and effective against a variety of nematodes. It is also used for seed treatment to control the nematodes during the early stage of plant growth. Its trade name is Furadan and formulated as 3% granules and 50% of SP or PP. Generally applied @ 30-50 kg/ha.

2. Oncol:

Formulated as 3% or 10% granules and 50% wettable powder. Used @ 30-50 kg/ha. Also used for seed treatment @ 3 to 6% to check the nematode infestation during early stage.

3. Oxamyl:

Systemic nematicide which can be sprayed to the foliar to control the nematodes on roots. Also controls foliage nematodes. Used @ 10-20 lit/ha. Sold as thioxamyl, Vydate and Du Pont 1410.

4. Methomyl:

Systemic nematicide formulated as 90% wettable powder and used @ 40-80 kg/ha. Sold under the trade name Lannate.

(vi) Biological control

Biological control aims to manipulate the parasites, predators and pathogens of nematodes in the rhizosphere in order to control the plant parasitic nematodes. Addition of organic amendments such as farm yard manure, oil cakes, green manure and press mud etc encourages the multiplication of nematode antagonistic microbes which intern checks the plant parasitic nematodes.

The addition of organic amendments acts in several ways against the plant parasitic nematodes. Organic acid such as formic, acetic propionic and butric acids are released in soil during microbial decomposition of organic amendments. Ammonia and hydrogen sulphide gases are also released in soil during decomposition. These organic acids and gases are toxic to nematodes. Nematode antagonistic microbes multiply rapidly due to addition of organic matter. Organic amendments improve soil conditions and helps the plants to grow. The organic matter also provides nutrition for the crop plants.

Predacious Fungi

Most of the predacious fungi come under the order Moniliales and phycomcetes. There are two types of predacious activities among these fungi. They are nematode trapping fungi, endoparasitic parasitic fungi and egg parasitic fungi.

Trapping Fungi or nematophagous fungi :

Capture nematode by *various* technique like sticky branches *(Dactylella lobata);* sticky *knobs (Dactylella ellipsospora); sticky network (Arthrobotrys oligospora) constrictingring (Dactylella bembicoides) non constrictingring (Dactylaria Candida).*

Endozoic fungi :

Natural enemies of plant parasitic nematodes. Infectious agents of these fungi are simple or flagellate spores. The simple spores are ingested by the nematodes and reach the oesophagus where they germinate, penetrate the oesophagus and colonise the body cavity eg: *Harposporium anguilhtlae.* The flagellated spores stick to the nematode and encyst before germination, penetration and colonization of the host. Eg: *Catenaria anguillulae* and *Catenaria vermicola.*

Egg parasitic fungi :

Fungal parasites have been found to be parasitic on eggs and cysts of nematodes. Such fungi are called opportunistic fungi. These are species of *Paecilomyces verticillium*, *Cylindrocarpon, Fusariitm, Phoma, Gliocladium, Cephalosporium* etc. Plant parasitic nematodes which are sedentary in nature are commonly parasitized by these fungi. BIOCON, a commercial product has been developed in Philippines.

Bacteria :

Release metabolites that have a killing or inhibitory effect on phytonematodes like species of

Bacillus, Pseudomonas and *Clostridium.* Various formulation of *Bacillus thuringiensis* are found toxic to eggs and larvae of *Meloidogyne* sp *invitro.* Dipel and SAN 415, strains of *B.thuringiensis* subsp Kurstaki have been found to reduce the population of *Tylenchulus semipenetrans* and *Meloidogyne javanica.* Cr-371 another isolate of *B.thuringiensis* is also effective in reducing galling by *Meloidogyne* on tomato under glasshouse and field.

Penetration *of Anguina tritici* is reduced on wheat seedlings when wheat seeds are treated with *Bacillus subtilis, Bacillus cereus* and *Bacillus pumilus* alone and in combination with *Pseudomonas* sp. *Pasteuria penetrans,* a mycelial endospore forming bacterium is an obligate parasite on large number of nematodes.

Ricketssiae :

These organisms are observed in *Heterodera goettingiana* and *Globodera rostochiensis*.

Tardigrades :

Feed on several nematodes and other soil organism and also known as water bears because of their pawing manner of locomotion. *Hypsibius myrops,* a tardigrade has been cultured on *Panagrellus redivivus* and can reduce population of *Ditylenchus dipsaci.*

Collembolans :

Active predators of nematodes feeding rapidly especially on eggs. *Onchiurus armatus, Isotojna viridis* and *Hypogastrura* sp. destroy cysts of *Heterodera cruciferae.*

Mites :

Inserra and Davis (1983) observed a mite, *Hypoaspis aculifer* to be predaceous on root knot and cyst nematodes.

Enchytraelds :

Antagonistic nature of enchytraeids against nematodes has been suggested by Jegen (1920), In a study, *Heterodera schachtii* were found to get digested by enzymatic secretion of the immature enchytreids which entered the sugarbeet roots.

Protozoans :

Weber *et al.* (1952) reported an organism, Theratromyxa species preying on second stage juveniles of *Globodera rostochiensis* and some other nematodes.

Predaceous nematodes :

Cobb postulated the use of predaceous nematode for bio-control of plant parasitic nematodes. Most predaceous nematodes belong to the group Mononchida, Dorylaimida, Diplogasterida and obligatory form of Aphelenchoidea like Seinura.

Predatory nematodes have either a large open stoma armed with teeth or Denticles used in seizing and or swallowing them whole. Eg; *Diplogaster* sp., *Tripyla* etc. or a pharynx equipped with an onchiostyle for piercing the prey eg. *Seinura.*

(vii) Host plant resistance:

The cultivars which have been observed to show resistant reaction against nematodes are summarized below.

S.No.	Crop	Nematode	Resistant Cultivar
1	Wheat	*Heterodera avenae*	Aus I5854,Aus 10894,Loras,Katyil
2	Barley	*Heterodera avenae*	Rajkiran, C164, B.P.-264, BH-75
3	Potato	*Meloidogyne incognita* Globodera rostochiensis	Kufri Deva Kufri swarna

S.No.	Crop	Nematode	Resistant Cultivar
4	Tomato	*Meloidogyne arenaria*	Nematox, VFN-8, Atkinson, Manafucei, NTDR-1
		Meloidogyne incognita	Punjab NR-7, Hisar Lalit-Pusa selection 120, Nema red, Hawaii-7246, Hawaii-7747, NTR-I Patriot, Atkinson, Karnataka hybrid
		Meloidogynep javanica	Leader, Atkinson, Manlucei, Nematox, Resistant Bangalore, Biggest, Bonus, Contess, Better, Boy, Pusa 120, Calmart, Montecarlo, Motabo, Motella, Pelican
5	Brinjal	*Metoidogyne incognita*	Banaras giant. Black beauty, Gola, Vijaya. Mysore green, Pusa purple Long Black, PantRituraj, Rajendra
		Meloidogyne javanica	Ghatikia white, Vijaya hybrid, Mysore Green, Arkasheel, Sonepat
6	Chilli	*Meloidogyne javanica*	Pusajwala, Pusa sadabahar,ca-63
		Rotyenchiilus reniformis	Pusa jwala
7	Carrot	*Metoidogyne incognita*	Black
8	Okra	*Metoidogyne incognita*	Arka Anamika, U R O-3
		Meloidogyne javanica	Long Germ smooth
9	Cucumber	*Meloidogyne incognita* *Meloidogyne javanica*	S-445(muskmelon) Improved long Green
10	Cauliflower	*Meloidogyne incognita* *Meloidogynep javanica*	Superial Maghi. Dania, Pusa late, Pusa snow ball.
11	Cabbage	*Meloidogyne javanica*	American Special ball head, Suttons Eclipse Drumhead
		Meloidogyne lincognita	American Special ball head, Red Drumhead
12	Frenchbean	*Meloidogyne lincognita*	Banat, Blue lake, Stringless, Bountiful FIAT, Brown beauty, Cambridge, Countness, Gallaroy, Kenya-3, Pinto WS-114
13	Pea	*Meloidogyne lincognita*	C-50,A-70, B-58
14	Winged bean	*Meloidogyne lincognita*	LBNC3
15	Cowpea	*Meloidogyne lincognita* *Rotylenchulus reniformis* Heteroderapcajani	C 512, IHR29-5, IC9641, 82-1-b-5V-16 Sel A, Sel 1-2, Sel 44, P33-2-1 (E9)NP2

S.No.	Crop	Nematode	Resistant Cultivar
16	Chickpea	*Metoidogyneincognita*	Selection No.501
17	Soybean	*Meloidogyne incognita*	Forest, JS-2, Selection DS 74-20- 1
18	Cotton	*Meloidogyne incognita* *Meloidogyne javanica*	Suman, Supriya, H-77. MCU-5. DC1-121 , Surat Dwarf, Gujarat cotton-100, Coker Wild-124 B-4 Empire, CNH 40, DCI-191, Aleppo 40, Tashkant 3, Coker Wild- 100
19	Groundnut	*Tylenchorhnychus brevilineatus*	Tirupati 2 and Tirupati 3
20	Banana	*Radopholus similis*	Kadali, Kunnan, Pedalimoongil, Tongat, Ayirani Kapoovan, Peykunnun, Pisang seribu, Vennettu Kunnan
21	Citrus	*Tylenchulus semipenetrans*	Trifoliate orange
22	Muskmelon	*Meloidogyne incognita*	France D, Chemiari, HED 7-25-3. Goldstar, Perlita
23	Coffee	*Pratylenchus coffeas*	Robusta root stock
24	Pepper	*Meloidogyne javanica* *Meloidogyne incognita*	Pusa Jawala, 579, Suryamukhi Black, Jwala, Bull Nose, Hungarian wax, Chinese giant Pusa jawala, Kalluvally, balancotta, Karimunda, Narayakodi, Pedappan
25	Tobacco	*Meloidogyne javanica* *Meloidogyne incognita*	Diebel Basma, Dixie bright, Mandrene Koseme, SPG28, SPG41, Motihari Motihari, Bitri, Hepti

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NATIONAL FOOD SECURITY: CHALLENGES AND OPTIONS IN FISHERIES

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Abstract

Food security has persistently been recognized in the global flora as one of the world's main challenges and growing demand for food has put additional pressure on natural resources. Mitigation through more inclusive approaches is needed to enhance food security, rural employment and gender equity to promote the sustainable management of natural resources.Fisheries and aquaculture of fish, shell fish and sea weeds has been recognized as future food and a solution for malnutrition. Fish either produced through fish farming activityor captured from wild marine or freshwater stocks, is a primary source of protein and minerals. Fish is one of the most efficient converters of feed into high quality food.The growing need for nutritious and healthy food will increase the demand of fisheries products from inland and marine sources, whose productivity is already highly stressed by excessive fishing pressure, growing organic pollution, toxic contamination, habitat degradation and climate change. Looking towards 2050, the question is how fisheries governance, the national and international policy and legal frameworks will ensure a sustainable harvest, maintain biodiversity and ecosystem functions and adapt to climate change. The global evidence on record reveals that fisheries play pivotal role in health and food security. Focus of the present topic centered on the main changes affecting the fisheries sector, including geographical expansion, fishing capacity-building, natural variability, environmental degradation and climate change.

Key words: Fisheries and National Food Security

Introduction

India has vast potential for fisheries from both inland and marine resources. It has a large marine product and processing potential with varied fish resources along the 8129 km long coastline, 28000 km of rivers and millions of hectares of reservoirs & brackish water. Units mostly exist in the small-scale sector as proprietary/partnership firms or fishermen cooperatives. Over the last decade, the organized corporate sector has become increasingly involved in preservation, processing and export of coastal fish. The wide variety of fish resources found in inland waters, coastal areas and deep seas comprising India's Exclusive Economic Zone has a large potential of growth. Fisheries play an important role in the national economy. It is also a major contributor to foreign exchange earnings. During 1997-98, the estimated foreign exchange earning was about Rs 4486 Cr which is increasing at an average annual rate of 17.3%. The country exports annually around 390738 ton of processed sea foods with an export value of Rs 5124.6 Cr. The size of the market is Rs 26000 Cr.

Global food requirements in the year 2050 will depend on the size and nature of the world population, efforts to eliminate under nutrition and to what extent diets change. These variables must be considered when policy makers plan for the future in such areas as food production, trade and development assistance. To meet the food requirement of the growing population in India, the country needs to boost the food grain production by 1.34% annually to 280.6 million tons by 2020-21. Presently, India is expected to produce around 250.42

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million tons of food grains including 102.75 million tons of rice and 88.31 million tons of wheat for 2016-17. However, the demand is estimated to be around 98.79 million tons of rice and 77.36 million tons of wheat. Meanwhile, ICAR is said to conduct basic and strategic research related to crop improvement, production and protection technologies in pulses and other crops to achieve the higher agricultural productivity. The demand for the protein rich pulses is growing in the country on improved health awareness.

Food requirement and role of fisheries in National GDP

Fisheries are an important sector in India- it provides employment to millions of people and contributes to food security of the country. While the marine sector is almost constituted by capture fisheries, aquaculture has been the principal contributor in Inland fisheries sector, with a share of 78%. About 20-30% of wild fish caught are used as fish meal, primarily for aquaculture and these small fishes are also important for food security and livelihoods for coastal communities and for healthy ecosystems. Marine Fisheries contributes to food security and provides direct employment to over 1.5 million fishermen besides others indirectly dependent on the sector. According to the CMFRI Census 2016, there are 3,288 marine fishing villages and 1,511 marine fish landing centres in 9 maritime states and 2 union territories. The total marine fisher folk population was about 4 million comprising in 864,550 families. Nearly 61% of the fishermen families were under BPL category. The average family size was 4.63 and the overall sex ratio was 928 females per 1000 males. Almost 58% of the fisher folk were educated with different levels of education. About 38% marine fisher folk were engaged in active fishing with 85% of them having full time engagement. About 63.6% of the fisher folk were engaged in fishing and allied activities. Nearly 57% of the fisher folk engaged in fish seed collection were females and 43% were males. The contribution of fisheries to total GDP is 1.4% and to agricultural GDP is 5.4% (2016-17).

Fish for Health and Wealth

Fish is a food of excellent nutritional value and it makes a very significant contribution to the diet of many fish-consuming communities in both the developed and developing world. Fish provides high quality protein and a wide variety of vitamins and minerals, including vitamins A and D, phosphorus, magnesium, selenium, and iodine, especially in marine fish. Fish is also a valuable source of essential fatty acids and its protein is easily digestible. Even in small quantities, fish can have a significant positive impact on improving the quality of dietary protein intake by complementing the essential amino acids that are often present in low quantities in the rice-and-vegetable diets typical of many developing States. In particular, fish is a rich source of lysine which is an essential amino acid that is often deficient in rice diets with little animal protein.

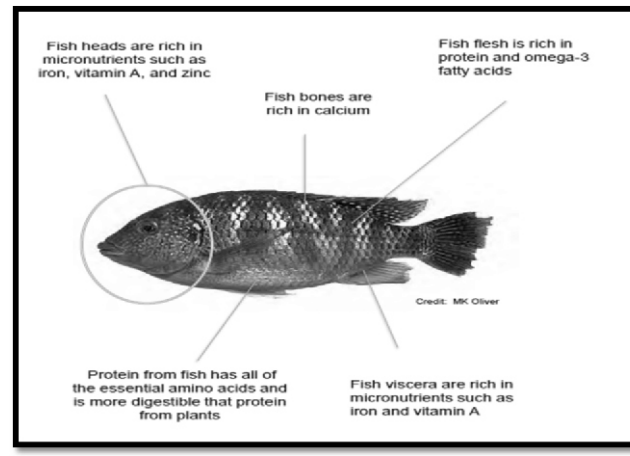

Figure 1: Fish and Nutrition

Recent research shows that fish is much more than just an alternative source of animal protein. Closely spaced pregnancies, as often seen in developing States, can lead to the depletion of the mother's supply of essential fatty acids, leaving younger siblings deprived of this vital nutrient at a crucial stage in their growth. This makes all fish and especially fatty fish, such as tuna, mackerel and sardine, particularly good components of the diet of pregnant and lactating women. It is therefore apparent that fish makes a valuable contribution to the nutritional quality of the diets of the populations of many developing countries in the Asia-Pacific region. Hunger and malnutrition remain amongst the most devastating problems facing the world's poor. Tragically, a considerable portion of the global population is currently suffering from one or more forms of nutrient deficiencies. This remains a continuing travesty of the recognized fundamental human right to

adequate food, and freedom from hunger and malnutrition. The challenge is to rapidly accelerate the pace by which hunger and malnutrition are eliminated and fisheries has an important role to play in this effort by providing fish and other marine and fresh-water products. This can be especially important for poor artisanal fisher folk whose livelihoods depend upon small-scale fisheries activities. With support for aquaculture, the worldwide availability of good quality marine and fresh water animal products can be increased allowing per capita supplies to keep pace with the increase in demand.

Globally, two-thirds of the total food fish supply is obtained from marine and inland capture fisheries; the remaining one-third being derived from aquaculture. The contribution of capture fisheries to per capita food supply has stabilized at 15 to 16 kg per capita during the period 1970-2017. Recent increases in per capita availability were obtained from aquaculture production. On an average, for all countries in the world except China, aquaculture's contribution to per capita food availability grew from 0.5 kg in 1970 to 1.8 kg in 2017 - at an average rate of 4.5 percent per annum. In China, where fish farming practices have deep traditional roots, the per capita supply from aquaculture is reported to have increased from around 1 kg to nearly 19 kg over the same period, an annual average growth of 11 percent.

The main factor behind the high demand for staple food fish within most developing countries is their greater affordability to the poorer segments of the community. At present food fish represents the primary source of animal protein (contributing more than 25% of the total animal protein supply) for about 1 billion people within 58 countries worldwide, including many developing countries and LIFDCs (value excludes China). Although per capita levels as high as 180 kcal a day are reported from countries such as Japan and Iceland, the average energy supply from fish is only 20 to 30 kilocalories per capita per day. In the diets of many countries, fish contributes more than or close to 50 percent of total animal proteins. The International Conference on Sustainable Contribution of Fisheries to Food Security, held in Kyoto, 1995, recognized that aquatic products contribute meaningfully to the maintenance of good nutrition.

The relationships between fish and food security & nutrition involve many different "pathways", direct and indirect, operating at different levels from households to macro, global level, each having its own dynamic. Some pathways combine their effects towards food security and nutrition as, for example, in poor communities where fish is at the same time a source of nutrition and a source of income. The different pathways from fish to food security and nutrition along the four dimensions of food security are:

(i) First, food availability, in terms of the production and use of fish as human food but also for feed, especially in the context of a growing demand for fish.

(ii) Second, access to food, through the fact that fish and all related economic activities in the "fish-chain" represent an important means to generate jobs, income and wealth, with positive effects from household level to broader economic scales.

(iii) Third, and importantly, the contribution of fish to good nutrition – the "utilization" dimension of food security.

(iv) The fourth dimension (stability) results from the combination of availability and access at macro-level which is itself a function of the sustainability of the sector – and of access, availability and utilization at the micro/household level.

Finally, to consider the contribution of fisheries and aquaculture to food security and nutrition, one need also to take into account losses and waste, including by-catch discarded at sea, post-harvest loss, and consumer waste.

Trends in fish consumption: Fish for whom?

Fish demand has been rising in both the developed and developing world at more than 2.5 percent per year (Peterson and Fronc, 2007) and, as wealth increases in highly populated countries such as China and India, demand levels are likely to rise more strongly (Garcia and Rosenberg, 2010). Increased market demand has been key to the emergence of the aquaculture sector. Growth in catfish and tilapia aquaculture has

satisfied consumer demand in the whitefish markets, in which the share of wild products has decreased considerably over time. World population growth, but more importantly the combination of urbanization, increased levels of development, living standards and income are key drivers of the increase of animal food demand and in particular of fish and seafood (Speedy, 2003). The largest growing market over at least the next decade is likely to be found in emerging economies with growing wealth and urbanization. In China, for example, the demand for fish is projected to increase from 25.4 kg per person per year in 2017 to 41 kg per person per year by 2030 (World Bank, 2017). The global figure of apparent fish consumption of 19.2 kg/capita/year masks strong regional differences, which result from less efficient local market channels but also from differences in cultures, beliefs, diet habits and purchasing powers of the populations. All those factors strongly influence consumption levels.

Table 1: World Fisheries and Aquaculture production (5 years)

	2010	2011	2012	2013	2014
Production (million tonnes)					
Aquaculture					
Inland	36.9	38.6	42.0	44.8	47.1
Marine	22.1	23.2	24.4	25.5	26.7
Total aquaculture	**59.0**	**61.8**	**66.5**	**70.3**	**73.8**
Capture					
Inland	11.3	11.1	11.6	11.7	11.9
Marine	77.9	82.6	79.7	81.0	81.5
Total capture	**89.1**	**93.7**	**91.3**	**92.7**	**93.4**
Total	**148.1**	**155.5**	**157.8**	**162.9**	**167.2**

Indian fisheries are increasingly contributing to the nutritional security of the country. The country has an important role in global fisheries as the second largest producer of fish in the world and higher enhancement levels as compare to world production levels.

Future challenges in Fisheries and Aquaculture

In assessing future challenges for the fisheries sector, a number of key issues that span the entire sectors which are of primary policy importance. These challenges include:

- Maintaining the contribution made by fisheries and aquaculture to food security, employment, national economic development and recreation. Depending on geography, access to markets and affordable technology, the contribution of fish to food security comes not only from fish produced for direct local food consumption, but also from aquatic products of all types which can be sold domestically or exported for funds, as well as those which generate income through recreation, tourism and employment. Access to all potential contributions is not automatic and specific interventions are required to achieve full access.
- Strengthening the base for fisheries management and aquaculture development through improved data collection and scientific assessment so that decisions concerning management and development options could be more rationally based and informed.
- Improving governance and more effective conflict resolution - as fishery resources become scarcer the intensification of regional fishery conflicts should be anticipated; promoting national capacity building and the strengthening of regional institutions; developing objective performance indicators relevant to governance.
- Facilitating greater transparency in fisheries sector decision making at all levels through greater

stakeholder participation in national and regional processes. Such transparency, which is now being called for widely in many international fisheries instruments, has the benefit of promoting greater acceptance of decisions when stakeholders have been consulted and involved.

- Reducing by-catch and discards through the use of more selective gear and fishing operations and innovative and value-added processing and market development for species currently discarded and expanding and promoting uniform quality criteria for internationally traded fish and fish products. In the interests of food security and the best utilization of limited resources, the prevention of post-harvest losses should be pursued as a matter of high priority.
- Promoting cooperation in fish trade with a view to avoiding disputes and imposition of sanctions; minimizing the impact on international fish trade on those groups most vulnerable to food insecurity.
- Integrating coastal area planning and management more effectively.

While some increment in marine capture fishery production may be anticipated in the longer run as the benefit of improved management is secured and production from under and non-utilized resources is increased, the primary goals for marine fisheries in the medium term is to ensure that production, and the aggregate contribution marine fisheries make to global food security, is at least maintained. In the medium to long term, the major challenge facing marine fisheries is improved and responsible management of stocks. Such management requires the regulation of production in a precautionary manner so that excessive effort, leading to overfishing, is not applied to target stocks. In addition, ecosystem management, that takes account of fishing impacts on non-target stocks, is becoming more common, and will add a further complicating dimension to the management process. Within the context of marine fisheries management, challenges that have been highlighted by the international/national community.

A major challenge for aquaculture and inland fisheries will be to maintain and where sustainable, enhance the contributions made to regional fish supplies. Aquaculture contributed 91 percent of total world aquaculture production. Moreover, aquaculture makes a major contribution to global food security and more opportunities still exist to further expand its role. For example, small reservoir fisheries have potential to develop as community-based management initiatives gain greater favor. The greatest threat to the sustainability of inland fishery resources is environmental degradation. Aquatic pollution, destruction of fish habitats, water abstraction and impacts on aquatic biodiversity are all increasing.

The potential for further growth of aquaculture in the region is promising. Such growth could be realized through improvements in technologies and resource use, intensification, integration of aquaculture with other farming activities and development of additional areas for aquaculture. However, aquaculture will face significant challenges including:

- Meeting growing demands for seed, feed and fertilizers, in terms of quantities and quality;
- Reducing production losses through improvement in fish health management;
- Increasingly severe competition with other resource (land/water/feed) users;
- Deteriorating quality of water supplies resulting from aquatic pollution;
- Successful integration of aquaculture with other farming activities, and promotion of small-scale low-cost aquaculture in support of rural development;
- Improvements in environmental management including reduction of environmental impacts and avoidance of risks to biodiversity through better site selection, appropriate use of technologies, including biotechnologies, and more efficient resource use and farm management; and
- Assurance of food safety and quality of products.

The precautionary approach to Fisheries and its implications on Fisheries research

The present status of many fishery resources around the world indicates that management practices need to be improved. An acceleration of the process of evolution of fisheries management and a broadening of its scope are required to take fully into account the explicit requirements of the 1982 United Nations

Convention on the Law of the Sea, UNCED Agenda 21, the Convention on Biological Diversity, the outcome of the International Conference on Responsible Fishing (Mexico, 6–8 May 1992), the outcome of the UN Conference on Straddling Fish Stocks and Highly Migratory Fish stocks (New York, 1993–95), and the FAO International Code of Conduct for Responsible Fisheries. The uncertainty and risk resulting from the limitations in fisheries management systems and scientific information, as well as natural variability (including climate change) is progressively being recognized and should be taken into account by adopting more precautionary management strategies.

The problem lies in using the proper approach for each type of issue. On the one hand, over-protecting the resource (by taking a highly precautionary approach) may have significant consequences in terms of foregone development options and could lead to economic and social chaos in fishing and related industries and communities and the fishery sector which rightly refuses to be assimilated to a polluting industry. On the other hand, being over-optimistic as to human capacity to regulate sustainably the production system for its benefit while preserving the options of future generations, could also have significant negative consequences for the resources and ultimately for fishing communities.

In designing precautionary management strategies, it will be important to realize that fishermen are part of the ecosystem and that without an appropriate consideration of the risk to their community (both in the short- and long-term), the level of compliance will be low and enforcement excessively costly. This does not mean that when necessary conservation measures appear to be costly they should not be applied. It means, however that, whenever possible, precautionary objectives should be met, minimizing to the extent compatible with these objectives, the costs to the fishing community. This aspect is of particular relevance for small-scale fisheries and traditional coastal communities which have usually few alternatives to fishing.

Conclusion

Food security is achieved when 'all people, at all times,have physical, social and economic access to sufficient,safe and nutritious food to meet their dietary needsand food preferences for an active and healthy life'. Fishes have always been animportant component of human food, particularlyaround lakes, rivers, deltas, floodplains and coastalareas, and particularly on small islands. This importancehas spread globally with the development oftrade. Fisheries may contribute to food security in two ways: (i) directly as a source of essential nutrients;(ii) indirectly as a source of income to buy food.Because of their contribution to total global output,and to the numbers of people involved in fishing, inland and marine capture fisheries play a substantial role inthese respects.

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PHYTOREMEDIATION: A GREEN TECHNOLOGY TO REMOVE ENVIRONMENTAL POLLUTANTS

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Introduction:

Land and water are precious natural resources. Unfortunately, they have been subjected to maximum exploitation and severely polluted due to anthropogenic activities. All countries have been affected, though the area and severity of pollution vary enormously. Each source of pollution has its own damaging effects to plants, animals and ultimately to human health, but those that add heavy metals to soils and waters are of serious concern due to their persistence in the environment and carcinogenicity to human beings. Heavy metals that have been identified in the polluted environment include As, Cd, Cr, Cu, Hg, Ni, Pb and Zn. Heavy metals cannot be destroyed biologically but are only transformed from one oxidation state or organic complex to another. The presence of any metal may vary from site to site, depending upon the source of individual pollutant (Lone M. I., et. al., 2008). Excessive uptake of metals by plants may produce toxicity in human nutrition and cause acute and chronic diseases. For instance, cadmium and zinc can lead to acute heart, brain, kidney, gastrointestinal and respiratory damages. High concentrations of heavy metals in soil can negatively affect crop growth, as these metals interfere with metabolic functions in plants, including physiological and biochemical processes, inhibition of photosynthesis, and respiration and degeneration of main cell organelles, even leading to death of plants (Schwartz C. et al., 2003). Soil contamination with heavy metals may also cause changes in the composition of soil microbial community, adversely affecting soil characteristics (Kurek E., et.al, 2004).

Phytoremediation is an emerging, efficient and eco-friendly green engineering technology that utilizes the natural properties of plants to remediate soil and water contaminated with heavy metals and/or organic contaminants such as solvents, crude oil, polycyclic aromatic hydrocarbons (PAHs) and other toxic compounds from contaminated environments.

Fundamental Processes and Characteristics-

Phytoremediation processes rely on the ability of plants to take up and/or metabolize pollutants to less toxic substances. The uptake, accumulation and degradation of contaminants vary from plant to plant. The plants used in phytoremediation are generally selected on the basis of their growth rate and biomass, their ability to tolerate and accumulate contaminants, the depth of their root zone, and their potential to transpire groundwater (Oh, K., et. al., 2013). Phytoremediation involves the use of particular types of plants capable of hyper-accumulating contaminants in the ground. There are various types of phytoremediation . :

1) Phytoextraction known as phytoaccumulation or phytoabsorption. This process came from the discovery of a variety of wild plants that concentrate high amounts of essential and non-essential heavy metals in their foliage. The degree of accumulation of metals such as Zn, Ni and possibly Cu often reaches 1% - 5% of the dry weight (Raskin, I., et.al, 1997). Pb is extremely insoluble and not generally available for plants to uptake in the normal range of soil pH. To acquire these soil-bound metals, phytoextracting plants have to mobilise them into the soil solution. This can be accomplished in different ways, from metal chelating molecules to acidifying the soil with protons extruded from the roots. However, this is also very dangerous as these chelating molecules increase the solubility of metals within the soil (Prasad, M.N.V. et. al., 2003).

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2) Phytodegradation, where plants take up and break down contaminants through the release of enzyme and metabolic processes such as photosynthetic oxidation and reduction. In this process organic pollutants are degraded and incorporated into the plant or broken down in the soil.

3) Phytovolatilisation, in which plants take up volatile contaminants and following transpiration, release non-toxic substances into the atmosphere.

4) Phytostabilisation, in which some plants can seize or immobilize contaminants. This method limits the movements of contaminants through erosion, leaching and wind or soil dispersal.

5) Rhizodegradation, where the roots of some plants help in the microbial degradation of contaminants.

Phytoremediation of various inorganic pollutants such as As, Cd, Co, Cr, Cu, Hg, Ni, Pb, Se and Zn has been extensively studied. This is mainly based on the use of natural hyper-accumulator plants with exceptional metal-accumulating capacity, which can take up metals to concentrations at least an order of magnitude greater than the normal plants growing in the same environment. These plants have several beneficial characteristics such as the ability to accumulate metals in their shoots and an exceptionally high tolerance to heavy metals (Ahmadpour, P. , et.al. , 2012). At present, there are totally more than 400 species of hyper-accumulator plants for As, Cd, Mn, Ni, Zn etc. have been found. For instance, some hyper-accumulator plants and their accumulation concentration (mg/kg dw) for various metals are: *Astragalus racemosus*, 14900 for Se; *Ipomea alpine*, 12300 for Cu; *Psychotria douarrei*, 47500 for Ni; *Pteris vitatta*, 20,000 for As ; *Thlaspi caerulescens*, 51600 for Zn and 18000 for Cd and *Thlaspi rotundifolium*, 8200 for Pb; (Wang X. J. , et.al. , 2003). Plants studied for phytoremediation of various metals, metalloids, non-metals, nutrients and organic contaminants were reviewed and listed among which American pondweed , Indian mustards, forage kochia , Ken-tucky bluegrass , Scirpus spp., coontail , hybrid poplars, duckweed, corn, alfalfa, common arrowhead , water hyacinths ,willow, and ryegrass are very popularly used (Oh, K., et.al., 2014).

Plants as Bioremediator:

An abundance of plants can be used to clean up contaminated soil. There are several members of family Brassicaceae that work well as accumulators and hyper-accumulators. *Brassica juncea* and *Brassica olearacea* remove large quantities of heavy metals such as Cr, Ni, Pb, U and Zn from the soil . *B. juncea* also acts as a hyper-accumulator for Cu (Khokhar, A.L., 2012). A group of plants from different families share the characteristics of being accumulators for Cr, Hg, and Pb. These are the rape seed plant (*Brassica napus Linn.*), hydrilla (*Hydrilla verticillata*) and the water hyacinth (*Eichhornia crassipes*) . Sunflower (*Helianthus annus L.*) and Common osier (*Salix viminalis Linn.*) have also shown their ability to accumulate hydrocarbons, as well as degrade PAHs (Polycyclic aromatic hydrocarbons) in soils. Coconut palm (*Cocos nucifera L.*), corn (*Zea mays*) and sunflower (*Helianthus annus L.*) can store up radioactive elements such as Caesium and Uranium.

Among the wildflowers there are a few which can trap multiple metals. Within the Brassicaceae amily there are three such flowers: *Arabidopsis* bundles (Cd, Fe and Zn), *Thlapsi* (Pb, Zn, Cd and Ni) and *Brassica rapa* sylvestris (Cd and Cr) . Other flowers efficient in accumulating heavy metals, especially Cd, Pb and Zn are Aster (Asteraceae), *Cistus salvifolius* (Cistaceae), *Hypericum perforatum* (Hypericaceae), Yarrow (*Achillea millefolium*) and Chives (*Allium schoenoprasum*). The last two are very effective accumulator for Cadmium. Many plant cultivars tolerant to toxic metals are *Cynodon dactylon*, *Vetiveria zizanioides*, *Festuca rubra* and *Typha latifolia* (Pandolfo,C.,2012). Some of the metal-tolerant plants are available commercially in some countries. For instance, vetiver grass (*V. Zizanioides*) was successfully demonstrated as a fine plants in protection Pb/Zn mine spoils in China. In Australia, vetiver grass was used to stabilize landfill and industrial waste sites contaminated with heavy metals such as As, Cd, Cr, Ni, Cu, Pb, and Hg (Truong ,P. N. et.al.,1996). *V. Zizanioides* has potentials within the bioremediation field with a high tolerance to a range of trace elements such as As, Cu and Cd (Khan, A.G., 2003). Other grasses worth of mention are Colonial Bentgrass (*Agrostis castellana*) which accumulates As, Pb, Zn, Mn and Al, for hydrocarbons rhizodegradation /accumulation the Buffalo grass (*Buchloe dactyloides*) and Bermuda grass, or lawn grass (*Cynodon dactylon*) have shown remarkable results in treating Polycyclic aromatic hydrocarbons (PAHs) in soil and they are also cost effective considering the low maintenance required (McCutcheon, S.C. et.al, 2003).

Conclusion:

As an emerging hopeful technology, phytoremediation for using in management and remediation of contaminated soils has its advantages and limitations. The most positive characteristics are that phytoremediation is a natural and *in situ* remediation system driven by solar and green plants. It is faster than natural attenuation and can conserve the soil resources. It is inexpensive, and does not induce the secondary contamination. Successful phytoremediation can reduce movement of pollutants towards groundwater, sustains the soil structure, and enhance the soil quality and productivity.

The largest barrier to the advancement of phytoremediation, however, may be public opposition to genetic modification in general. Because all natural hyperaccumulator species are small in size, genetic modification can be used to introduce this technology to other species or to increase the biomass of the natural hyperaccumulators in order to create effective phytoremediators.

Despite its constraint, phytoremediation has potential and must be considered as a green option for the clean-up of urban and other contaminated environment.

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ORGANIC FARMING IN INDIA: A BETTER TOOL FOR NUTRITIONAL SECURITY AND CLIMATE RESILIENCE

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Abstract

Organic agriculture is a production system that sustain the health of soil, ecosystem and people. It relies on ecological process, biodiversity and cycle adapted to local conditions, rather than the use of inputs with adverse effects. Organic agriculture combines innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved. Organic agriculture is developing rapidly and today at least 162 countries produce organic foods commercially. India ranks 10th among the countries in terms of cultivable land under organic certification. In India the governments of mountainous states viz., Uttarakhand, Sikkim and Mizoram have undertaken significant initiatives to turn their states completely organic. The principles, components and various forms of organic farming have been discussed in this chapter.

Introduction

The term organic agriculture was coined by Lord Northbourne, an agriculturist motivated by Steiner's biodynamic approach in 1940 while Albert Howard firstly applied principles and scientific knowledge in organic agriculture and he is known as 'Father of Organic farming'. Green revolution technologies involving greater use of synthetic agrochemicals such as fertilizers and pesticides with adoption of nutrient-responsive, high-yielding varieties along with expansion of irrigated area under crops have led to substantial increase in the productivity of crops, especially food grains (from 522 kg/ha in 1950-51 to 2125 kg/ha in 2012-13) culminating into the change from 'ship to mouth' India to "food exporter' country (Ravisankar *et al*, 2016). However, this increase in production has slowed down and in some cases there are indications of decline in productivity and production. Besides, damage to natural resources, loss of biodiversity, nutritional imbalance in soils, less nutrient use efficiency, increased cost of cultivation, unsustainability in agriculture and environmental and human health problems are some other ill effects of green revolution technologies in the country. (Ramesh *et al,* 2016)

Increasing awareness about conservation of environment as well as health concerns caused by harmful synthetic agro-chemicals has resulted in paradism shift in consumers' preference towards safe food with niche markets promoting organic agricultural produce. The scientists are more concerned about harmful impacts of pesticides on human and environmental health. However, once again the need for an appropriate technology suitable to our requirements is being felt. The practice of organic farming, said to the best known alternative to the conventional method and is based on the similar principles underlying our traditional agriculture.

Present Scenario and Future Prospects

As per FIBL survey (2011), 1.8 million farmers across 162 countries are now growing organically produced commodities on more than 37.2 m ha. The countries with large acreage under organic agriculture are Australia, Argentina and China (Ganai *et al*, 2016). The demand has increased at a compounding rate of 8.9% per annum from 2001 to 2011. India has brought 4.9 m ha area under organic certification process. Out of this cultivated area accounts for1.18 m ha (24.1%) while remaining 3.71 m ha (75.9%) is wild forest

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harvest collection area. Currently India ranks 10th among the top ten countries having the cultivable land under organic certification. Sikkim state has been declared as organic state from January, 2016 and has the highest net sown area (100%) under organic certification while Madhya Pradesh is having largest area (2,32,887 ha) under organic production system. The domestic market for organic products in the year 2014-15 was estimated at rupees 875 crore. Different parts of India have developed their own local or regional system for ecological agriculture that is now gathered in one umbrella *term 'Jaivik Kheti' or 'Jaivik krishi* (Ravisankar *et al,* 2016).

It is estimated that various organic resources having the total nutrient potential of 32.41 m tonnes will be available for use in 2025. Out of these organic resources, a large quantity of tapable potential of major nutrients viz., N, P and K from human excreta, livestock dung and crop residues have been worked out to be only 7.75 m tonnes.

Concept and Principles of Organic Farming

Organic agriculture is one among the broad spectrum of production methods that are supportive of the environment. Organic production systems are based on specific standards precisely formulated for food production and aim at achieving agro ecosystems, which are socially and ecologically sustainable. It is based on minimizing the use of external inputs through use of on-farm resources efficiently compared to conventional agriculture. Thus the use of synthetic fertilizers and pesticides is avoided.

As per the definition of the USDA study team on organic farming "organic farming is a system which avoids or largely excludes the use of synthetic inputs (such as fertilizers, pesticides, hormones, feed additives etc) and to the maximum extent feasible rely upon crop rotations, crop residues, animal manures, off-farm organic waste, mineral grade rock additives and biological system of nutrient mobilization and plant protection".

As per International Federation of Organic Agriculture Movement (IFOAM) an international umbrella organization for organic farming, *"Organic agriculture is production system that sustains the health of soils, ecosystem and people. It relies on ecological process, biodiversity and cycle adapted to local conditions rather than the use of inputs with adverse effects. Organic agriculture combines tradition; innovation and science benefit the shared environment and promote fair relationship and a good quality of life for all involved."*

In simple words, organic farming is a form of agriculture that relies on techniques like crop rotation, green manuring, use of FYM/vermi-compost, and biological pest control. In organic farming fertilizers, herbicides, insecticides and fungicides are put to use which are considered natural such as bone meal from animals or pyrethrin from flowers and it excludes or strictly limits the use of synthetic fertilizers and pesticides; plant growth regulators; antibiotic use in livestock; genetically modified organisms; human sewage sludge; and nano-materials for reasons including sustainability, openness, independence health, and safety. Organic agriculture aims at a sustainable production system based on natural process. Key characteristics of organic agriculture are:

- relies primarily on sustainable use of local and renewable resources;
- minimal use of purchased inputs, only as complementary to local resources;
- makes efficient use of solar energy and potential of biological systems;
- maximizes recycling of plant nutrients and organic matter; maintains diversity in the production systems;
- ensuring the basic biological functions of soil-water-nutrient-human continuum and,
- provides farm animals natural conditions according to their ecological role and behaviour.

The concept of organic farming in India is based on the following principles:

1. The principle of health- farming should sustain or enhance soil health, plant animal and human.
2. The principle of ecology- farming should be based on ecological system and cycle, emulate and help sustain them.
3. The principle of fairness- farming should have equity, respect and justice for all living things.

4. The principle of care- farming should protect the health and wellbeing of current and future generations and environment.*

Organic Farming as a Tool for Poverty Alleviation

Organic agriculture contributes to poverty alleviation and food security by a combination of many features, such as:

conserving bio-diversity and nature resources on the farm and in the surrounding area; increasing income and/or reducing costs; increasing yields in low-input areas; producing safe and varied food; being sustainable in the long term.

Major Emphasis on

To convert the conventional farming into organic farming the major emphasis must be given on following parameters.

1. Enrichment of soil – Abandon use of chemicals, use crop residue as mulch, use organic and biological fertilizers, adopt crop rotation and multiple cropping, avoid excessive tilling and keep soil covered with green cover or biological mulch.

2. Management of temperature - Keep soil covered, Plant trees and bushes on bund.

3. Conservation of soil and rain water – Dig percolation tanks, maintain contour bunds in sloppy land & adopt contour row cultivation, dig farm ponds, maintain low height plantation on bunds.

4. Harvesting of sun energy – Maintain green stand throughout the year through combination of different crops and plantation schedules.

5. Self reliance in inputs – Develop your own seed, on-farm production of compost, vermicompost, vermiwash, liquid manures and botanical extracts.

6. Maintenance of life forms – Develop habitat for sustenance of life forms, never use pesticides and create enough diversity.

7. Integration of animals – Animals are important components of organic management and not only provide animal products but also provide enough dung and urine for use in soil.

8. Use of renewable energy – Use solar energy, bio-gas and bullock driven pumps, generator and other machine.

Major Components of Organic Farming

The organic farming is an integrated management approach of some essential components in effective ways which are as follows:

1. Organic manures

(a) Bulky organic manure: It generally contains fewer amounts of plant nutrients as compared to concentrated organic manure. It includes FYM, compost and Green manure.

Farm yard manure (FYM)/composts: FYM is the decomposed mixture of dung and urine of farm animals along with litter and left out materials of fodder or roughages. On an average, it contains 0.5% N, 0.25% P_2O_5 and 0.5% K_2O. In addition to these nutrients, it also contains a number of other plant nutrients such as Ca, Mg, S, Zn, Cu Fe, Mn etc.

Large quantities of waste material are available as vegetable refuse, farm litter, such as weeds, stubble, *bhusa*, sugarcane trash, sewage sludge and animal waste in houses and in areas like human and industrial refuse; therefore, excreta can be converted into useful compost manure.

(b) Concentrated organic manure: Concentrated organic manures are those materials that are organic in nature and contain higher percentage of essential plant nutrients such as nitrogen, phosphorous and potash, as compared to bulky organic manures. These concentrated manures are made from raw materials of animal or plant origin. The concentrated organic manures commonly used are oilcakes, blood meal, fishmeal, meat meal and horn and hoof meal.

(c) Green manuring: Green Manuring, wherever feasible, is the principal supplementary means of adding organic matter to the soil. The green manure crop supplies organic matter as well as additional nitrogen,

particularly if it is a legume crop which fix nitrogen from the air with the help of its root-nodule bacteria. A leguminous crop producing 25 tones of green matter per hectare will add about 60 to 90 kg of nitrogen when ploughed under. The green manure crops also exercise a protective action against erosion and leaching. The most commonly used green manuring crops are: Sunhemp (*Crotalaria juncea*), Dhaincha (*Sesbania aculeata*), Cluster bean (*Cyamopsis tetragonoloba*), Senji *(Melilotus parviflora*), Cowpea (*Vigna catjang*/*V. sinensis*), Berseem (*Trifolium alexandrium*) etc.

2. Suitable crop rotation: The selection of optimal crop rotation is important for successful sustainable agriculture. Crop rotation is very important for soil fertility management, weed, insects and disease control. Legumes are essential in any rotation and should occupy 30 to 50 percent of the land or growing of any pulse crop at least once in every three years.

3. Intercropping and mixed cropping : Intercropping is growing of two or more crops in same piece of land in definite row arrangement. this practice ensures better utilization of natural resources viz., land, sunlight, moisture, nutrients and provide more net profit, serves as insurance against crop failure and ultimately food and environment and livelihood security. Intercropping also plays a vital role in effective management of weeds. Mixed cropping is growing of two or more crops in same piece of land without any row ratio. Cropping with legume crop is also suitable for fertility restoration point of view.

4. Crop residue: In India there is a great potential for utilization of crop residues/ straw of some of the major cereals and pulses. About 50% of the crop residues are utilized as animal fed, the rest could be very well utilized for recycling of nutrients. Adequate attention is required to use the residues after proper composting with efficient microbial inoculants.

5. Mulching: Mulches contribute to weed management in organic crops by reducing weed seed germination, blocking weed growth and favouring the crop by conserving soil moisture and maintaining favourable soil temperature.

6. Wastes: Industrial , municipal and sewage wastes : Among the industrial by products and molasses and pressmud from sugar industry have good manurial value. Addition of pressmud improves the soil fertility and enhances the activity of microbes. In India, the total municipal refuse is about 12 m t/annum containing about 0.5% N, 0.3% P_2O_5 and 0.3% K_2O. Sewage sludge is available to an extent of 4 million tones per annum containing 3% N, 2% P and 0.3% K. Separation of the toxic wastes at the source will minimize the concentration of heavy metal elements in the sludge.

7. Bio fertilizers: Bio-fertilizer offers an economically attractive and ecologically sound means of reducing external inputs and improving the quality and quantity of internal sources. These are less expensive, eco-friendly and sustainable. The beneficial micro-organisms in the soil that are greater significance to horticultural situations are biological nitrogen fixers, phosphate solubilisers and mycorrhizal fungi.

Types of Bio fertilizers: There are two types of bio-fertilizers.

a. Symbiotic N-fixation- These are Rhizobium culture of various strains which multiply in roots of suitable legumes and fix nitrogen symbiotically. Almost 50% demands of N are met by these microorganisms in legumes.

Rhizobium: It is the most widely used bio fertilizers, which colonizes the roots of specific legumes and can fix up to 100-280 kg N/ha in one crop season.

b. Asymbiotic N-fixation- This includes Azotobacter, Azospirillium, BGA, Azolla and Mycorrhizae, which also fixes atmospheric N in suitable soil medium. They grow on decomposing soil organic matter and produce nitrogen compounds for their own growth and development, besides that they leave behind a significant amount of N in surroundings.

8. Bio-pesticides: Bio-pesticides are natural plant products that belong to the so-called secondary metabolites, which include thousands of alkaloids, terpenoids, phenolics and minor secondary chemicals. Botanical insecticides are ecologically and environmentally safer generally affect the behaviour and physiology of insects rather than killing them. Among them Neem (*Azadirachta indica*) has justifiably received the maximum attention. All parts of the Neem tree possess insecticidal property but seed kernel is most active. Some of other commonly used botanical insecticides are Nicotine, Pyrethrum, Rotenone,

Subabilla, Ryanin, Quassia, Margosa, Acorus etc.

9. Vermicompost and Vermiwash: It is also known as 'worm compost' which is produced by the activity of earthworms. It is a nutrient rich, natural fertilizer and soil conditioner, it contains nearly 0.5-1.5% N, 0.1-0.3% P_2O_5 and 0.15-0.5% K_2O as well as various vitamins, growth hormones and immobilized microflora. Either natural or exotic species of earthworm like *Eudrillus euginae* are normally used. The process of producing vermicompost is called as vermicomposting while liquid fertilizer collected after passes with water through a column of worm activation is called as vermiwash. Vermiwash contains many microorganisms like *Rhizobium sp., Azotobacter* and phosphate solubilizers and is effectively used as foliar spray.

Different Forms of Organic Agriculture

1. Biodynamic Agriculture

Biodynamic agriculture is a method of farming that aims to treat the farm as a living system which interacts the environment, to build healthy, living soil and to produce food that nourishes and vitalizes and helps to develop mankind. These techniques enhance, rejuvenate, add to and maintain soil quality. Cow horns and cow dung, after being buried together in the earth, make the most wonderful humus to spread on the land. the important component of biodynamic farming are turning in plant materials such as green crops and straw, not using chemical fertilizers and pesticides, avoiding soil compaction by machinery or animals, particularly in wet weather keeping soil covered by pasture, crops or mulch not destroying the soil structure by poor farming practices such as excessive use of rotary hoe or cultivation unsuitable weather. so many formulations and preparations have been made but formulation 500 (cow horn compost) and 501 (horn-silika) are most popular and are being used by a large number of farmers.

2. Panchgavya Krishi

Panchgavya is a bioenhancer prepared from five products obtained from cow; dung, urine, milk, curd and ghee. Dr Natrajan, a Medical practitioner and scientist from Tamilnadu Agricultural University, has further refined the formulation suiting to the requirement of various horticultural and agricultural crops. It contains many useful microorganisms such as fungi, bacteria, actinomycetes and various micronutrients. The formulation act as tonic to enrich the soil, induce plant vigour with quality production.

3. Natural Farming

Natural farming emphasizes on efficient use of on-farm biological resources and enrichment of soil with the use of *Jivamruta* to ensure high soil biological activity. Use of *Bijamruta* for seed/ planting material treatment and *Jivamruta* for soil treatment and foliar spray are important components. *Jivamruta* has been found to be rich in various beneficial microorganisms such as *Azospirillum, Trichoderma*, Yeast and moulds, *Pseudomonas* and PSM.

4. Rishi Krishi

The Rishi Krishi word has been drawn from the Vedas. In this method, the natural farming has been mastered by farmers of Maharashtra and Madhya Pradesh. In Rishi Krishi, all on-farm sources of nutrients like compost, cattle dung manure, green leaf manure and crop biomass for mulching are exploited to their best potential with continuous soil enrichment.

5. Natueco Farming

Natueco methods emphasize farming by knowing nature more and more through critical scientific inquiries and experiments. This farming system follows the principles of eco-system networking of nature. It is beyond the broader concepts of organic or natural farming in both philosophy and practice. Instead, the emphasis is given on the simple harvest of sunlight through the critical application of scientific examination, experiments, and methods that are rooted in the neighbourhood resources. It depends on developing a thorough understanding of crop physiology, geometry of growth, fertility and biochemistry. There are three relevant aspects of Natueco Farming :

(a) Soil - Enrichment of soil by recycling of the biomass by establishing a proper energy chain.

(b) Roots - Development and maintenance of white feeder root zones for efficient absorption of nutrients.

© **Canopy -** Harvesting the sun through proper canopy management for efficient photosynthesis.

6. Homa Farming

Homa farming has its origin from Vedas and is based on the principle that "you heal the atmosphere and the healed atmosphere will heal you" The practitioners and propagators of homa farming call it a "revealed science". It is an entirely spiritual practice that dates from the Vedic period. The basic aspect of homa farming is the chanting of Sanskrit mantras (Agnihotra puja) at specific times in the day before a holy fire. The timing is extremely important. Agnihotra is the basic Homa fire technique, based on the bio-rhythm of sunrise and sunset, and can be found in the ancient sciences of the Vedas.

7. Effective Microorganisms (EM)Technology

It is a consortium culture of different effective microbes commonly occurring in nature. Most important among them are : N_2-fixers, P-solubilizers, photosynthetic microorganisms, lactic acid bacteria, yeasts, plant growth promoting rhizobacteria and various fungi and actinomycetes. In this consortium, each microorganism has its own beneficial role in nutrient cycling, plant protection and soil health and fertility enrichment.

Insect, Pest and Disease Management

The incidence of insect, pest and diseases are comparatively very low in organic production system as compared to inorganic system because several factors such as application of oil cakes having insecticidal properties, use of green manures like *Calotrophis* and higher content of phenols in plant parts. Natural enemies of crop pests and diseases such as coccinellids, spiders micromus, chrysopa, syphids are generally found higher under organic management in compare to inorganic and integrated management systems. Coccinellids naturally reduce the hoppers and leaf folders are found many times higher in many crops such as cotton, soybean, groundnut, maize potato fields. the number of spiders are also found much higher in organic system as compared to inorganic system. The biopesticides prepared or collected from locally available farm animal, plant and microorganisms are many times effective to control the insects and diseases. For example neem seed kernel extract, tobacco extract (nicotine) and cow urine, light trap, pheromone trap and soft soap are generally used to control the pests and diseases (Ravisankar *et al,* 2016).

Conclusion

Looking at the tremendous increase of population in the country, our compulsion would be not only to stabilize the agricultural production but to increase it further in a sustainable manner. The scientists are realizing the fatigue of green revolution in the country in the form of stagnation in crop yields plateau and diminishing return of falling dividends. In this situation, Indian agriculture must move towards adoption of organic farming approach in intensive agriculture areas and 'certified organic farming' with a combination of tradition, innovation and modified scientific cultivation in drylands and rainfed areas for food security, climate resilience and increase farmers income.

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INDIGENOUS GERM PLASM CHARACTARESTIC FEATURE OF POULTRY BREED IN INDIA

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Introduction

India possesses rich germplasm of poultry with 18 recognized breeds. The Aryans invaded India and included chicken in their culture. Due to lesser attention paid, many of these breeds are on verge of extinction. Many of these Indian breeds are known by the local names and many types and subgroups developed over a time through natural or artificial selection, making a good variety of genetic material. The important local breeds of poultry are listed below. Many of these breeds possess characters of economic importance. Adoptability of these to unfavorable environment is stated to be high and needs attention for conservation. Indigenous/ native breeds of chicken are playing an important role in rural economies in most of the developing and underdeveloped countries. They are part of balanced farming system that have vital roles in the rural households as a source of high quality animal protein and emergency cash income and play a significant role in the socio cultural life of the rural community and woman empowerment. Performance of native fowl can be improved by change in husbandry feeding and better health cover. Indian native breeds are well known for their tropical adaptability and disease resistance, while their colour plumage helps in protecting themselves against predators. India has made considerable progress in broiler production in the last two decades. High quality chick, equipments, vaccines and medicines are available. With an annual output of 41.06 billion egg and 1000 million broilers. India rank fourth largest producer of egg and fifth largest producer of poultry broiler in the world. The broiler production has also sky rocketed at an annual growth rate of about 15percent at present. In the present chapter efforts have been made to present the importance of indigenous fowl to rural economy and their important for higher production performance

Ankaleshwar - The native tract is Bharuch and Narmada districts of Gujarat. The named with the place where it has been bred i.e. Ankleshwar in Bharuch district of Gujarat. The breeding tract ranges to Jumbusar, Zagadia, Bharuch, Hansot and Valia of Bharuch and Dediapada, Rajpipla, Tilakwada and Nadod of the Narmada district of Gujarat as shown in **Figure 1**. Body is small and medium sized bird, body Plumage is Frizzled and Normal, and colour is golden yellow, yellow with black strips or white golden with black strips. Golden yellow plumage is predominant in cocks while Black golden is more common in hens. Feathered legs, cap feather and bearded feathers are also observed in some of the birds. Skin colour is yellow and pinkish, combs size is large in cock and small in hen, single and rose comb type red in colour, wattles is red, ear lobe is white, eye ring colour is yellow reddish. **A shank is** Yellow or black in colour. Body weight of Cock is 1.759±0.007 kg and hen is 1.487±0.006 kg. Age at first egg is 5.92±0.008 months, Fertility rate is 91.3%. Hatchability on total egg production is 92.4%, broodiness is usual. Egg shell colour is cream/brown/white. Annual egg production (numbers) poor egg production (79.35±0.291 per annum), weight of an egg is 34.3 grams. Age at slaughter is 16.59±0.073 months, slaughtering weight is 1.687 kg and dressing percentage is 62.44%. This breed is mainly reared by tribal communities in South Gujarat for backyard poultry farming. They are maintained without vaccination and medication, and have reasonable feed efficiency as they survive on 25-30 grams of grains, scavenging and maintain excellent fertility.

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present case, complete eversion of uterus and cervix through vagina was suspected to have occurred following delivery calf by forced traction leading to irritation and severe straining added with presence of undetached portion of the foetal membrane in vagina However, Arthur et al. (1996) believer that uterine eversion and prolapsed were associated with onset of uterine inertia during third stage of labour, when a portion of detached placenta occupied birds canal and protruded from vulva. Usually the size of utero-vaginal prolapsed mass varies from approximately 10cm-30cm in diameter. Sharma and Dhami (2007) and Kumar et al. (2011) successfully managed postpartum uterine prolapsed in cows. The favorable prognosis in present case could suggested that prompt handling of uterine prolapsed could save the animal from unnecessary suffering and fatality. The success in the present case could be the immediate repositioning and timely management made before any damage/ mutilation and bleeding or necrosis/ gangrene occurred.

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ENVIRONMENTAL EFFECTS OF IRRIGATED AGRICULTURE

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Abstract

Irrigation is the largest water user worldwide. In the process of storing, diverting, transporting, irrigating, consuming, and draining water, the natural hydrology of a watershed is changed significantly. These changes impact the natural environment. River flows are altered and reduced and sometimes depleted; groundwater levels may be lowered by pumping or raised by over irrigation; wetlands may be created or dried up. Although many of the environmental impacts of irrigation are negative, irrigation plays a critical role in providing food and fiber for our growing population. Most of the world's fruits and vegetables are grown with irrigation. Providing the same food without irrigation would likely have even greater environmental impacts. We must educate the public of the benefits of irrigated agriculture and work to minimize the negative environmental impacts. Irrigated agriculture is critical to the global food supply. Although irrigated agriculture has serious environmental impacts, the alternatives would have much greater negative impacts. Although there are undoubtedly irrigated areas that create excessive negative environmental impacts and should be abandoned, elimination or significant reductions in irrigated agriculture is not an option. We, as scientists and teachers, must help farmers minimize negative impacts and help society understand the tradeoffs so we can make rational decisions.

Introduction

The environmental impacts of irrigation relate to the changes in quantity and quality of soil and water as a result of irrigation and the effects on natural and social conditions in river basins and downstream of an irrigation scheme. The impacts stem from the altered hydrological conditions caused by the installation and operation of the irrigation scheme. Environmental impacts of irrigation are the changes in quantity and quality of soil and water as a result of irrigation and the ensuing effects on natural and social conditions at the tail-end and downstream of the irrigation scheme(Pokrovskii and Vladimir 2011). The impacts stem from the changed hydrological conditions owing to the installation and operation of the scheme. An irrigation scheme often draws water from the river and distributes it over the irrigated area. As a hydrological result it is found that:

- the downstream river discharge is reduced
- the evaporation in the scheme is increased
- the groundwater recharge in the scheme is increased
- the level of the water table rises
- the drainage flow is increased

About 25% of the world's fresh water supply is diverted from rivers, lakes and groundwater by humans. All agriculture, through tillage, monoculture, and addition of synthetic chemicals, affects the environment. The impacts of irrigated agriculture may be somewhat different than rainfed agriculture. In the process of

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collecting, storing, diverting, transporting, spreading, consuming, and draining water; and enabling intensive agricultural activities on otherwise marginal or non-productive lands; water, land, plant, animal, and human resources are changed (Hellmich and Simon, 2015). Some of these changes are positive; others are negative. It is important that we are aware of the changes and their impacts, so that we can minimize the negative impacts and evaluate the benefits and costs of irrigated agriculture.

What Is Irrigation?

Irrigation, sometimes referred to as an irrigation scheme, is the act of redirecting water for a specific purpose. This purpose is usually to water agricultural crops, to maintain landscapes, or to provide much needed water during a drought. Less often, irrigation is used to control dust, to get rid of sewage, and to aid in mining projects. This article takes a closer look at the environmental impact of irrigation.

Irrigation can also be done extracting groundwater by (tube) wells. As a hydrological result it is found that the level of the water descends. The effects may be water mining, land/soil subsidence, and, along the coast, saltwater intrusion.

Irrigation projects can have large benefits, but the negative side effects are often overlooked. The lower the irrigation efficiency, the higher are the losses. Although fairly high irrigation efficiencies of 70% or more (i.e. losses of 30% or less) can be obtained with sophisticated techniques like sprinkler irrigation and drip irrigation, or by precision land levelling for surface irrigation, in practice the losses are commonly in the order of 40 to 60%.

1. ENVIRONMENTAL IMPACT OF IRRIGATION

1.1. Direct Environmental Impact of Irrigation

An irrigation scheme draws water from groundwater, rivers, lakes or overland flow, and distributes it over an area. Hydrological, or direct, effects of doing this include reduction in downstream river flow, increased evaporation in the irrigated area, increased level in the water table as groundwater recharge in the area is increased and flow increased in the irrigated area. Likewise, irrigation has immediate effects on the provision of moisture to the atmosphere, inducing atmospheric instabilities and increasing downwind rainfall(Hellmich and Simon, 2015), or in other cases modifies the atmospheric circulation, delivering rain to different downwind areas(Pokrovskii and Vladimir 2011). Because irrigation systems deal with redirecting water from rivers, lakes, and underground sources, they have a direct impact on the surrounding environment. Some of these impacts include: increased groundwater level in irrigated areas, decreased water flow downstream of sourced rivers and streams, and increased evaporation in irrigated areas. Increased evaporation in irrigated areas can cause instability in the atmosphere, as well as increase levels of rainfall downwind of the irrigation. These changes to the climate are a direct result of changes to natural moisture levels in the surrounding atmosphere. Increases or decreases in irrigation are a key area of concern in precipitation shedstudies that examine how significant modifications to the delivery of evaporation to the atmosphere can alter downwind rainfall.

1.2. Indirect Environmental Impact of Irrigation

Irrigation systems also have an indirect impact on the surrounding environment. These indirect effects may not be as immediately noticeable as the direct issues. Additionally, these effects take a longer time to develop and produce longer-lasting changes. He indirect effects of waterlogging and soil salination occur directly on the land being irrigated. The ecological and socioeconomic consequences take longer to happen but can be more far-reaching.

Some irrigation schemes use water wells for irrigation. As a result, the overall water level decreases. This may cause water mining, land/soil subsidence, and, along the coast, saltwater intrusion.Irrigated land area worldwide occupies about 16% of the total agricultural area and the crop yield of irrigated land is roughly 40% of the total yield (Friedrich and Wieser, 2003). In other words, irrigated land produces 2.5 times more product than non-irrigated land. This article will discuss some of the environmental and socioeconomic impacts of irrigation. Irrigation can result in the following indirect impacts:

1.2.1 Waterlogging

Waterlogging refers to the saturation of soil with water. Soil may be regarded as waterlogged when it is nearly saturated with water much of the time such that its air phase is restricted and anaerobic conditions prevail. In extreme cases of prolonged waterlogging, anaerobiosis occurs, the roots of mesophytes suffer, and the subsurface reducing atmosphere leads to such processes as denitrification, methanogenesis, and the reduction of iron and manganese oxides(Hellmich and Simon, 2015). Waterlogging occurs when the soil becomes oversaturated with water, promoting anaerobic conditions. With anaerobiosis, plant roots become unhealthy due to a number of chemical reactions, including a reduction in soil iron and manganese oxides.

1.2.2 Soil Salinization

Soil salinization happens when the salt content in soil increases above normal, naturally occurring levels. Irrigation draws a significant amount of water from an area, moving it to agricultural or landscaped lands. The area that has lost a significant amount of water is often left with concentrated salt levels in the decreased water levels left behind. High salt levels make it difficult for plants to absorb the necessary amount of water and nutrients from the soil.Soil salinity is the salt content in the soil; the process of increasing the salt content is known as salinization (Gastav and cassel, 1931). Salts occur naturally within soils and water. Salination can be caused by natural processes such as mineral weathering or by the gradual withdrawal of an ocean. It can also come about through artificial processes such as irrigation.

1. Natural occurrence

Over long periods of time, as soil minerals weather and release salts, these salts are flushed or leached out of the soil by drainage water in areas with sufficient precipitation. In addition to mineral weathering, salts are also deposited via dust and precipitation. In dry regions salts may accumulate, leading to naturally saline soils. This is the case, Proper irrigation management can prevent salt accumulation by providing adequate drainage water to leach added salts from the soil. Disrupting drainage patterns that provide leaching can also result in salt accumulations.

2. Dry land salinity

Salinity in drylands can occur when the water table is between two and three metres from the surface of the soil. The salts from the groundwater are raised by capillary action to the surface of the soil(Hellmich and Simon, 2015). This occurs when groundwater is saline (which is true in many areas), and is favored by land use practices allowing more rainwater to enter the aquifer than it could accommodate. For example, the clearing of trees for agriculture is a major reason for dryland salinity in some areas, since deep rooting of trees has been replaced by shallow rooting of annual crops.

3. Salinity due to irrigation

Salinity from irrigation can occur over time wherever irrigation occurs, since almost all water (even natural rainfall) contains some dissolved salts (Hellmich and Simon, 2015). When the plants use the water, the salts are left behind in the soil and eventually begin to accumulate. Since soil salinity makes it more difficult for plants to absorb soil moisture, these salts must be leached out of the plant root zone by applying additional water. This water in excess of plant needs is called the leaching fraction. Salination from irrigation water is also greatly increased by poor drainageand use of saline water for irrigating agricultural crops.

Salinity in urban areas often results from the combination of irrigation and groundwater processes. Irrigation is also now common in cities (gardens and recreation areas).

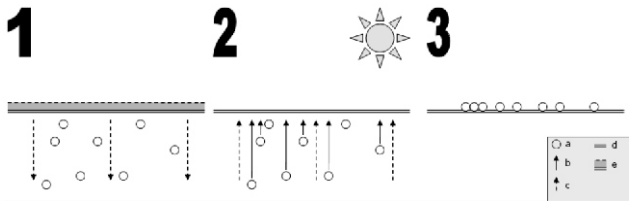

Figure 1: Rain or irrigation, in the absence of leaching, can bring salts to the surface by capillary action

1.2.3 Ecological Damage

Ecological damage takes longer to occur and notice than waterlogging and soil salinization. One of the most significant causes of ecological damage is in reduced downstream river flow. When river flow is dramatically reduced, it can lead to disappearing wetlands and flood forest ecosystems. Additionally, it results in insufficient drinking, industrial, and municipal water supplies. Because less water finds its way into the ocean, coastal erosion may occur, which damages coastal ecosystems such as mangroves and their habitats. In addition, saltwater makes its way from the ocean into estuaries in increased amounts, which significantly changes the ecosystem and habitat of these waterways as well. Ecology is not synonymous with environment, environmentalism, natural history, or environmental science. It is closely related to evolutionary biology, genetics, and ethology. An important focus for ecologists is to improve the understanding of how biodiversity affects ecological function. Ecologists seek to explain:

1. Life processes, interactions, and adaptations
2. The movement of materials and energy through living communities
3. The successional development of ecosystems
4. The abundance and distribution of organisms and biodiversity in the context of the environment.

There are many practical applications of ecology in conservation biology, wetland management, natural resource management (agroecology, agriculture, forestry, agroforestry, fisheries), city planning (urban ecology), community health, economics, basic and applied science, and human social interaction (human ecology). For example, the Circles of Sustainability approach treats ecology as more than the environment 'out there'. It is not treated as separate from humans. Organisms (including humans) and resources compose ecosystems which, in turn, maintain biophysical feedback mechanisms that moderate processes acting on living (biotic) and non-living (abiotic) components of the planet. Ecosystems sustain life-supporting functions and produce natural capital like biomass production (food, fuel, fiber, and medicine), the regulation of climate, global biogeochemical cycles, water filtration, soil formation, erosion control, flood protection, and many other natural features of scientific, historical, economic, or intrinsic value.

1.2.4 Socioeconomic Damage

Reduced water flow can also have other less obvious effects on socioeconomic health. Specifically, irrigation may lead to decreased fishing and shipping opportunities. One example of reduced fishing opportunities can be seen in Pakistan within the Indus River. Here, water has been over extracted for agricultural purposes. This has threatened the local fish populations which causes an imbalance in the natural food chain. Over extraction of water in the Indus River also affects local human populations, who rely on fishing as a source of dietary protein and economic activity. Shipping opportunities are also affected as large ships and other water transportation vehicles are left with insufficient water to appropriately navigate, reducing trade and economic activity in certain areas. Socioeconomics (also known as social economics) is the social science that studies how economic activity affects and is shaped by social processes. In general it analyzes how societies progress, stagnate, or regress because of their local or regional economy, or the global economy. Socioeconomics is sometimes used as an umbrella term with different usages. The term 'social economics' may refer broadly to the "use of economics in the study of society" (Gustav and Cassel, 1931) More narrowly, contemporary practice considers behavioral interactions of individuals and groups through social capital and social "markets" (not excluding, for example, sorting by marriage) and the formation of social norms (Hellmich and Simon, 2015). In the latter, it studies the relation of economics to social values.

1.3 Adverse Impacts

1.3.1 Reduced river flow

The reduced downstream river flow may cause:

1. Reduced downstream flooding
2. Disappearance of ecologically and economically important wetlands or flood forests
3. Reduced availability of industrial, municipal, household, and drinking water

4. Reduced shipping routes. Water withdrawal poses a serious threat to the Ganges. In India, barrages control all of the tributaries to the Ganges and divert roughly 60 percent of river flow to irrigation

5. Reduced fishing opportunities. The Indus River in Pakistan faces scarcity due to over-extraction of water for agriculture. The Indus is inhabited by 25 amphibian species and 147 fish species of which 22 are found nowhere else in the world. It harbors the endangered Indus River dolphin, one of the world's rarest mammals. Fish populations, the main source of protein and overall life support systems for many communities, are also being threatened

6. Reduced discharge into the sea, which may have various consequences like coastal erosion.

1.3.2 Increased groundwater recharge, waterlogging, soil salinity

Increased groundwater recharge stems from the unavoidable deep percolation losses occurring in the irrigation scheme(Postel, 1993). The lower the irrigation efficiency, the higher the losses. Although fairly high irrigation efficiencies of 70% or more (i.e. losses of 30% or less) can occur with sophisticated techniques like sprinkler irrigation and drip irrigation, or by well managed surface irrigation, in practice the losses are commonly in the order of 40% to 60%. This may cause the following issues:

1. Rising water tables
2. Increased storage of groundwater that may be used for irrigation, municipal, household and drinking water by pumping from wells
3. Shallow water tables - a sign that the aquifer is unable to cope with the groundwater recharge stemming from the deep percolation losses
4. Where water tables are shallow, the irrigation applications are reduced. As a result, the soil is no longer leached and soil salinity problems develop
5. To mitigate the adverse effects of shallow water tables and soil salinization, some form of watertable control, soil salinity control, drainage and drainage system is needed
6. As drainage water moves through the soil profile it may dissolve nutrients such as nitrates, leading to a buildup of those nutrients in the ground-water aquifer. High nitrate levels in drinking water can be harmful to humans, particularly infants under 6 months, where it is linked to "blue-baby syndrome".

1.3.3 Reduced downstream river water quality

Owing to drainage of surface and groundwater in the project area, which waters may be salinized and polluted by agricultural chemicals like biocides and fertilizers, the quality of the river water below the project area can deteriorate, which makes it less fit for industrial, municipal and household use. It may lead to reduced public health.Polluted river water entering the sea may adversely affect the ecology along the sea shore (see Aswan dam).

The natural buildup of sedimentation can reduce downstream river flows due to the installation of irrigation systems(Hellmich and Simon, 2015). Sedimentation is an essential part of the ecosystem that requires the natural flux of the river flow. This natural cycle of sediment dispersion replenishes the nutrients in the soil that will in turn, determine the livelihood of the plants and animals that rely on the sediments carried downstream. The benefits of heavy deposits of sedimentation can be seen in large rivers like the Nile River. The sediment from the delta has built up to form a giant aquifer during flood season, and retains water in the wetlands. The wetlands that are created and sustained due to built up sediment at the basin of the river is a habitat for numerous species of birds.

1.3.4 Lost land use opportunities

Irrigation projects may reduce the fishing opportunities of the original population and the grazing opportunities for cattle. The livestock pressure on the remaining lands may increase considerably, because the ousted traditional pastoralist tribes will have to find their subsistence and existence elsewhere, overgrazing may increase, followed by serious soil erosion and the loss of natural resources. The depletion of groundwater aquifers, which is caused by the suppression of the seasonal flood cycle, is damaging the forests downstream of the dam.

2. NEGATIVE AND POSITIVE IMPACTS OF IRRIGATION

The effects of irrigation will be grouped into impacts on the quantity and quality of water resources, impacts on soil quality and sustainability, and impacts on human health and nutrition. The goal of this presentation is not to provide detail or data about specific impacts of irrigation, but to describe the wide range of both negative and positive impacts.

2.1 Water Quantity Impacts

As a large consumer of water, irrigation reduces the quantity of water available for other uses. Because most irrigation occurs in arid areas where water is a limiting resource, water consumption for irrigation may limit the development of other human activities. Through collecting, storing, diverting, transporting, and consuming water, the natural hydrology of watersheds is changed. Although a portion of the water diverted from rivers for irrigation returns as drainage flows, irrigation diversions always reduce the overall flow in the river system. Reduced flows usually result in reduced aquatic and wildlife habitat. While many of the impacts of irrigation reservoirs and diversions are negative, there are also positive impacts. Reservoirs create habitat for fish and wildlife and recreation opportunities for humans. Hydropower is often generated at irrigation dams. Flood control reduces risks and flood damages for those who live downstream. Reservoir releases can provide river flows during dry seasons when natural flows might normally cease. In some cases, irrigated agriculture increases groundwater levels. When water is diverted from a river and spread across an arid area, seepage from canals and deep percolation from fields may increase groundwater storage, resulting in increased domestic water supplies, creating wetlands and wildlife habitat, and providing return flows to rivers in seasons when they might otherwise be dry.

2.2 Water Quality Impacts

Drainage water from irrigated fields is nearly always lower quality than the water diverted from the river or pumped from the groundwater. As water runs across and percolates through field soils, it picks up sediments, nutrients, pesticides, and naturally occurring substances such as salts. Because much of the applied water is evapotranspired by the crops, most substances in the applied water are more concentrated in the drainage water. Drainage water from rainfed agriculture also carries sediments, nutrients and agricultural chemicals. However, water quality problems may be greater in arid irrigated areas because there is less water (rainfall and river flows) to dilute and transport the pollutants. Also, because irrigation application is controlled, there are greater opportunities to control drainage from irrigation.

2.3 Soil Quality Impacts

Soil quality, or the ability of soil to provide sustained high productivity, can be diminished by irrigation. Salt accumulation reduces soil productivity and eventually results in poisoning of the land. About 25% of irrigated land suffers to some degree from irrigation induced salinization and productivity has declined severely on 10% of irrigated land (IBRD, 1992). Salt accumulation is usually caused by inadequate drainage, and is often associated with waterlogging. Salt is always imported at some concentration with irrigation water. It must be leached through the soil and disposed of with drainage water to the ocean or some other acceptable sink. Salts always exist in groundwater. When irrigation with inadequate drainage results in high groundwater tables, evaporation of groundwater from the soil surface will result in salinization of the soil. Prevention of salinization requires good management of irrigation water, including adequate leaching of salts from the soil, drainage for the removal of salts, and ultimately, transport and disposal of the salts to the ocean or other sinks. Irrigation allows cultivation of marginal agricultural lands such as prairie soils that are susceptible to drought and wind erosion. When the natural vegetative cover is removed in preparation for cropping, drought and wind can combine to create serious wind erosion damage. Pressurized irrigation systems have allowed cultivation of steep lands that can erode badly during rain storms.

2.4 Impacts on the Quality of Human Life

With all the potential negative environmental impacts of irrigation, why do we irrigate 220 million hectares of land worldwide (Hoffman et al., 1990). The purpose of irrigation is to provide food and fiber for a growing global human population. Approximately one-third of the global harvest is from irrigated lands

(Postel, 1993). About 70% of the irrigated land is in developing countries and many populous nations are highly dependent on irrigated agricultural production. Most of the world's fruits and vegetables are grown with irrigation. Agricultural production would fluctuate much more with weather from year to year, requiring greater storage of reserves. The quantity, quality, and dependability of our food supply would decline.

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SUSTAINABLE AGRICULTURE TO ENSURING FOOD SECURITY

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Abstract

A sustainable agriculture is a system of agriculture that will last. It is an agriculture that maintains its productivity over the long run. Sustainable agriculture is both a philosophy and a system of farming. It has its roots in a set of values that reflects an awareness of both ecological and social realities. It involves design and management procedures that work with natural processes to conserve all resources, minimize waste and environmental damage, while maintaining or improving farm profitability.In practice such systems have tended to avoid the use of synthetically compounded fertilizers, pesticides, growth regulators, and livestock feed additives. These substances are rejected on the basis of their dependence on non-renewable resources, disruption potential within the environment, and their potential impacts on wildlife, livestock and human health. For example, synthetically compounded fertilizers and pesticides generally suppress biological activity in the soil. Some growth regulators and feed additives are implicated in retarding the decomposition of manure and are potential human health hazards. Instead, sustainable agriculture systems rely on crop rotations, crop residues, animal manures, legumes, green manures, off-farm organic wastes, appropriate mechanical cultivation, and mineral bearing rocks to maximize soil biological activity, and to maintain soil fertility and productivity. Natural, biological, and cultural controls are used to manage pests, weeds and diseases

Introduction

A sustainable agriculture is a system of agriculture that will last. It is an agriculture that maintains its productivity over the long run. Sustainable agriculture is both a philosophy and a system of farming. It has its roots in a set of values that reflects an awareness of both ecological and social realities. It involves design and management procedures that work with natural processes to conserve all resources, minimize waste and environmental damage, while maintaining or improving farm profitability. Working with natural soil processes is of particular importance. Sustainable agriculture systems are designed to take maximizes advantage of existing soil nutrient and water cycles, energy flows, and soil organisms for food production. As well, such systems aim to produce food that is nutritious, without being contaminated with products that might harm human health (McLeod P and Rashid, 2011). In simplest phrases, sustainable agriculture is the manufacturing of meals, fiber, or exceptional plant or animal merchandise using farming techniques that protect the environment, public health, human groups, and animal welfare. The phrase sustainable has grown to be very popular in recent years and it's far now used to explain loads of things (Roy-Bolduc and Hijri, 2011; Densilin DM, et al 2011).

Food security is a pressing problem in India and in the world. According to the Food and Agriculture

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Organization of the UN (FAO), it is estimated that over 190 million people go hungry every day in the country. Evidence for India's food challenge can be found in the fact that the yield per hectare of rice, one of India's principal crops, is 2177 kgs per hectare, lagging behind countries such as China and Brazil that have yield rates of 4263 kgs/hectare and 3265 kgs/hectare respectively. The cereal yield per hectare in the country is also 2,981 kgs per hectare, lagging far behind countries such as China, Japan and the US. The slow growth of agricultural production in India can be attributed to an inefficient rural transport system, lack of awareness about the treatment of crops, limited access to modern farming technology and the shrinking agricultural land due to urbanization. Add to that, an irregular monsoon and the fact that 63% of agricultural land is dependent on rainfall further increase

Sustainable agriculture techniques enable higher resource efficiency. They help produce greater agricultural output while using lesser land, water and energy, ensuring profitability for the farmer. These essentially include methods that, among other things, protect and enhance the crops and the soil, improve water absorption and use efficient seed treatments. While Indian farmers have traditionally followed these principles, new technology now makes them more effective. For example, for soil enhancement, certified biodegradable mulch films are now available. A mulch film is a layer of protective material applied to soil to conserve moisture and fertility. Most mulch films used in agriculture today are made of polyethylene (PE), which has the unwanted overhead of disposal. It is a labour intensive and time-consuming process to remove the PE mulch film after usage. If not done, it affects soil quality and hence, crop yield. An independently certified biodegradable mulch film, on the other hand, is directly absorbed by the microorganisms in the soil. It conserves the soil properties, eliminates soil contamination, and saves the labor cost that comes with PE mulch films. The other perpetual challenge for India's farms is the availability of water. Many food crops like rice and sugarcane have a high-water requirement. In a country like India, where majority of the agricultural land is rain-fed, low rainfall years can wreak havoc for crops and cause a slew of other problems - a surge in crop prices and a reduction in access to essential food items. Again, Indian farmers have long experience in water conservation that can now be enhanced through technology. Seeds can now be treated with enhancements that help them improve their root systems. This leads to more efficient water absorption. In addition to soil and water management, the third big factor, better seed treatment, can also significantly improve crop health and boost productivity. These solutions include application of fungicides and insecticides that protect the seed from unwanted fungi and parasites that can damage crops or hinder growth, and increase productivity. In addition to these, there are several general goals associated with sustainable agriculture, consisting of holding water, reducing the use of fertilizers and pesticides, and selling biodiversity in plants grown and the ecosystem. Sustainable agriculture additionally specializes in retaining monetary balance of farms and assisting farmers improve their techniques and satisfactory of existence (Tang, 2012).

Ensuring our food security

Since the dawn of civilizations agriculture is one sector that impacts and in turn is impacted the most by environment. Hence sustainability of the human race and this world depends a lot on the environmental friendliness of our agriculture.India is facing a food crisis thanks to the systematic destruction of farmlands and food production systems over the last five decades through uncontrolled use of chemical fertilisers, pesticides, mono-cropping and other intensive agricultural practices. Instead of looking at the real problem the government is favouring false solutions like genetically engineered (GE) food crops.

Ecological farming is the answer to the problems being faced by agriculture in our country today. It will also keep agriculture sustainable. This form of agriculture conserves our soil and water resources, protects our climate, enhances agro-diversity, ensures biodiversity, meets the demand for food and safeguards livelihoods. In short, it ensures that the environment thrives, the farm is productive, the farmer makes a net

profit and society has enough nutritious food.

India has a long history of agriculture. Over centuries, farmers in this country devised practices to keep our farms sustainable. Practices like mixed cropping, crop rotation, using organic manure and pest management kept our agriculture sustainable. But things changed for the worse with the onslaught of a chemical intensive model of agriculture, imposed through the so called Green Revolution in 1965.It was therefore not surprising when the International Assessment of Agricultural Science and Technology for Development [IAASTD], an initiative of the United Nations and World Bank, concluded that small-scale farmers and agro-ecological methods are the way forward if the current food crisis is to be solved. This initiative involved a three year review of all the agricultural technologies in the past 50 years by around 400 scientists across the world.

The IAASTD said that to meet the needs of local communities, indigenous and local knowledge need to be declared as important as formal science. This is a significant departure from the destructive chemical-dependent, one-size-fits-all model of industrial agriculture. The report also acknowledges that genetically engineered crops are highly controversial and will not play a substantial role in addressing the key problems of climate change, biodiversity loss, hunger and poverty.

Definitions of Sustainable Agriculture

Sustainable agriculture is farming in sustainable ways based on an understanding of ecosystem services, the study of relationships between organisms and their environment. It has been defined as "an integrated system of plant and animal production practices having a site-specific application that will last over the long term", for example:

1. Satisfy human food and fiber needs
2. Enhance environmental and the natural resource base upon which the agricultural economy depends
3. Make the most efficient use of non-renewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls
4. Sustain the economic viability of farm operations
5. Enhance the quality of life for farmers and society as a whole

"A sustainable agriculture does not deplete soils or people." Sustainable agriculture is a form of agriculture aimed at meeting the needs of the present generation without endangering the resource base of the future generations. In order to feed the burgeoning population more food has to be produced and this has to be done without degradation of the resource base. Expanding agriculture to ecologically fragile areas means greater threat to environment. Sustainable agriculture is a balanced management system of renewable resources including soil, wildlife, forests, crops, fish, livestock, plant genetic resources and ecosystems without degradation and to provide food, livelihood for current and future generations maintaining or improving productivity and ecosystem services of these resources. Sustainable agriculture system has to be economically viable both in the short and long term perspectives. Natural resources- not only provide food, fiber, fuel and fodder but also perform ecosystem services such as detoxification of noxious chemicals within soils, purification of waters, favourable weather and regulation of hydrological process within watersheds. Sustainable agriculture has to prevent land degradation and soil erosion.

It has to replenish nutrients and control weeds, pests and diseases through biological and cultural methods.Because agricultural systems are so diverse, based on farm size, location, crop being grown, socioeconomic background, among many other factors, and because the movement has become so widespread globally, sustainable agriculture has come to represent different things to different people. Nevertheless there are some common threads, concepts, and beliefs. In the most general terms, sustainable

agriculture describes systems in which the farmer reaches the goal of producing adequate yields and good profits following production practices that minimize any negative short-and longterm side effects on the environment and the well-being of the community. The major goals of this approach are thus to develop economically viable agro-ecosystems and to enhance the quality of the environment, so that farmlands will remain productive indefinitely.

Methods of Sustainable Agriculture

Two of the various possible practices of sustainable agriculture are crop rotation and soil modification, every designed to make targeted that vegetation being cultivated can acquire the important vitamins and minerals for healthful expand. Soil amendments would encompass utilizing locally to be had compost from neighborhood recycling facilities. These neighborhood recycling facilities aid produce the compost wished by way of the regional organic farms.

Crop rotation: Crop rotation is likely one of the most effective procedures of sustainable agriculture. Its rationale is to maintain away from the consequences that include planting the equal plants throughout the equal soil for years in a row (Mahapatra et al 2014). It allows deal with pest troubles, a0073 many pests choose distinctive crops. If the pests have a consistent ingredients give they may be able to widely broaden their population dimension.

Cover crops: Many farmers select to have crops planted in a discipline always and by no means depart it barren, this can purpose accidental results. By way of planting cowl plants, which include clover or oats, the farmer can achieve his desires of stopping soil erosion, suppressing the increase of weeds, and improving the great of the soil Using cowl vegetation also reduces the want for chemicals consisting of fertilizers.

Natural pest predators: So as to maintain powerful control over pests, it's far vital to view the farm as surroundings as opposed to a factory. Coping with your farm in order that it is able to harbor populations of these pest predators is an effective as well as a complicated method. The usage of chemical insecticides can result in the indiscriminate killing of pest predators (Chapman and Pratt, 1961).

Integrated pest management: This is an approach, which simply relies on organic instead of chemical techniques. IMP also emphasizes the importance of crop rotation to fight pest control. Once a pest problem is recognized, IPM will mean that chemical solutions will most effective be used as a closing resort. Alternatively the correct responses could be the use of sterile men, and bio control agents consisting of ladybirds

India – Policies for Sustainable Agriculture

The Indian government's policies have always emphasized food grain self-sufficiency, which has not necessarily coincided with agricultural sustainability. The growth of agricultural production and productivity, which had risen significantly during 1970s and 1980s, declined during 1990s. These slowdowns have worsened since 2000; both overall agricultural production and food grains production have shown negative growth rates in 2000-01 to 2002-03 periods (GoI, 2002). Decline in the growth rates of agricultural production and productivity is a serious issue considering the questions of food security, livelihood, and environment. As such, a critical examination of the approaches for sustainable agricultural development is necessary. This examination must be framed not only by India's ongoing need to ensure food self-sufficiency but also by the consequences of access to international markets.

Challenges Faced by Indian Agricultural Sector

As mentioned earlier, several major challenges are facing Indian agricultural sector, and the primary stakeholders affected by these challenges include the i) agri-producers, ii) agricultural consumers, iii) the government and iv) the environment. Each of these stakeholders can influence the level of impact these

challenges may have, for example the agricultural practices of producers can influence the level of food security. Similarly, governmental initiatives and policies play a vital role in providing food security.

The first key aspect to consider is that of food security

Food security can be defined as i) the access to nutritionally adequate food at affordable prices, ii) is culturally accepted, and iii) can be accessed through non-emergency means at all times (Ramabulana 2011). According to a 2011 Food and Agricultural Organization of the United Nations (FAO) report, 839 million people in developing countries are undernourished.

Climate Change

The second key aspect to consider is that of climate change. Although globally producers have succeeded in providing in the growing supply of food products, conventional agricultural practices are held responsible for various environmental problems such as decelerating soil fertility and the decline in biodiversity (Reddy 2010; Singh and Grover). In the recent past, the costs of current food production practices to the environment and whether these practices are sustainable have been questioned (Gregory and George 2011). However, the non-financial benefits of adopting more environmentally friendly production methods, such as positive environmental outcomes and health benefits to consumers, cannot easily be expressed in monetary terms. Scientists from the Universities of Yale and Columbia in the USA, in collaboration with the World Economic Forum, issue a biennial report that measures 132 countries' environmental performance indices (EPIs). These indicators indicate a country's environmental health and ecosystem vitality.

Biofuels

The third aspect to consider is that of biofuel production. Biofuels have been simultaneously upheld as a method to reduce the impact of the use of fossil fuels and as a risk to food security due to it being a potential competitor for agricultural land used to grow crops for food consumption (Gregory and George 2011).

Some Key Undesirable Side Effects of Modern Agriculture

1. Unsustainable irrigation programs throughout the world are resulting in an undesirable buildup of salinity and toxic mineral levels in one out of five hectares under irrigation. Thus, agricultural water, a nonrenewable resource whose use has tripled globally since 1950, has to be used more efficiently to minimize salinization problems.
2. Excessive soil erosion, in the range of fifteen to forty tons per hectare annually, results in the loss of productive farmland in many parts of the world. Forested areas, a refuge for wildlife and biodiversity (biological diversity), are then often turned into agricultural fields to compensate for the loss of the abandoned eroded areas.
3. The indiscriminate use of pesticides is affecting human health and wildlife populations, as first reported to the population at large in Rachel Carson's book Silent Spring (1962).
4. The increased concentration of farms into larger and larger farm holdings is reducing the number of small family farms, believed by many to represent the heart of rural communities and to be key stewards of the environment.
5. The trend toward larger farms and plantation-type monocultures is leading to a loss of global biodiversity. Biodiversity, many argue, may be a critical ecological feature that allows the continued survival of humans on earth.

Basic Elements of Sustainable Agriculture

Sustainable agriculture's benefit to farm and community economies is grounded in four well-

established economic development principles and a fifth, concern for the community:

Input Optimization: Sustainable production practices maximize on-farm resources. Internally derived inputs, such as family labor, intensive grazing systems, recycled nutrients, legume nitrogen, crop rotations, use of renewable solar energy, improved management of pests, soils and woodlands are a few examples of substituted resources. Studies have shown that these substitutions can be made while maintaining yields and often result in increased net farm earnings. These earnings can benefit the community by increasing local retail sales and providing a stronger tax base.

Diversification: To develop healthy soils and reduce purchased inputs, sustainable agriculture emphasizes diverse cropping and livestock systems. Diversification can lead to more stable farm income by lowering economic risk from climate, pests, and fluctuating agriculture markets. This helps to keep farmers on the land and helps buffer the local economy from the shock of a dramatic decline in a single commodity/industry.

Conservation of Natural Capital: It is standard accounting practice to depreciate capital assets. It has not been standard practice for farmers to depreciate natural capital that is depleted by farming methods that do not conserve resources. Nevertheless, the loss is real, eventually affecting yields, farm profitability, and sustainability. In sustainable agriculture, economic value is created by maintaining the productivity of land and water resources while enhancing human health and the environment.

Capturing Value-Added: The marketing of crops and products grown is by far the weakest link in the farmers' role in the 'field to table' food system. To create and maintain a truly sustainable agriculture, farmers will have to develop ways of retaining a higher percentage of value-added on the farm. While individuals farmers can and do design, process and direct-market their own products, many other value-added strategies require more resources than one farmer can handle financially. Therefore, these value-added strategies will require the formation of a coop of local farmers and a collaborative relationship with the local community.

Community: The elements of sustainable agriculture are integral to all communities. If we are to support sustainable agriculture, we must recognize the rural/urban interconnection, the conflicts and tremendous opportunities. The positives of a sustainable farming system include shared commitment to profitability, food security, food safety, open space for water recharge, natural habitats for flora, fauna and recreation and a cooperative and supportive social and economic community infrastructure. Currently our urban communities are separated from farming communities not only in philosophy, but also in their mutual understanding, particularly in their knowledge of the entire food production and distribution system. Recognition of the role farming has played in stabilizing our community is critical or we shall continue to disintegrate our rural fabric and preferred standards of living. In other words, we must rekindle a sense of caring about the welfare of our neighbors in order for viable rural and urban communities to survive.

Approaches of Sustainable Agriculture

Many of the approaches in conventional agriculture (minimum tillage, chemical banding) would fall into the "efficiency" category. They demonstrate a reduction in resource use and associated negative environmental impact, and in many cases a reduction in input expenses for the farmer. They represent, however, only an initial step towards a truly sustainable system.

Efforts to substitute safe products and practices (botanical pesticides, biocontrol agents, imported manures, rock powders and mechanical weed control) are also gaining popularity. Despite the reduced negative environmental damage associated with them, they remain problematic. Botanical pesticides also kill beneficial organisms, the release of bio-controls does not address the question of why pest outbreaks occur dependence on imported fertilizer materials makes the system vulnerable to supply disruptions and excessive cultivation to control weeds is detrimental to the soil.The systems that focus on redesign of the farm are the most sophisticated, generally the most environmentally and economically sustainable, over the long term.

These farm systems recycle resources to the greatest extent possible, meaning that little is wasted, few pollutants are generated, and input costs are reduced substantially. For example, chicken and orchard operations have been successfully integrated. The manure is used as a fertilizer, the chickens eat pests that attack the fruit, the feed bill for the chickens is greatly reduced, and the eggs and/or meat can be consumed or sold. Three to seven year crop rotations can be designed that minimize tillage, use legumes and green manures to maintain soil fertility, prevent pest and disease outbreaks, and provide a diverse diet for livestock.

Pigs and goats can be used to renovate wooded lands in preparation for sheep pasture. The pigs and goats replace the petrochemical energy that would be consumed in machines, herbicides and fertilizers. All these practices involve redesigning the farm. As in conventional agricultural systems, the success of sustainable approaches is very dependent on the skills and attitudes of the producers. The degree to which different models of such farms are sustainable is very variable, and is dependent on the physical resources of the farmer, and the degree deficiencies in support farm, the talents and commitment of the support available. The current from government, universities, and agricultural professionals means that farmers must often rely on their own talents and commitment.

Plant Production Practices

Sustainable production practices involve a variety of approaches. Specific strategies must take into account topography, soil characteristics, climate, pests, local availability of inputs and the individual grower's goals. Despite the site-specific and individual nature of sustainable agriculture, several general principles can be applied to help growers select appropriate management practices:

Selection of site, species and variety

Preventive strategies, adopted early, can reduce inputs and help establish a sustainable production system. When possible, pest-resistant crops should be selected which are tolerant of existing soil or site conditions. When site selection is an option, factors such as soil type and depth, previous crop history, and location (e.g. climate, topography) should be taken into account before planting.

Diversity

Diversified farms are usually more economically and ecologically resilient. While monoculture farming has advantages in terms of efficiency and ease of management, the loss of the crop in any one year could put a farm out of business and/or seriously disrupt the stability of a community dependent on that crop. By growing a variety of crops, farmers spread economic risk and are less susceptible to the radical price fluctuations associated with changes in supply and demand.

Properly managed, diversity can also buffer a farm in a biological sense. For example, in annual cropping systems, crop rotation can be used to suppress weeds, pathogens and insect pests. Also, cover crops can have stabilizing effects on the agroecosystem by holding soil and nutrients in place, conserving soil moisture with mowed or standing dead mulches, and by increasing the water infiltration rate and soil water holding capacity. Cover crops in orchards and vineyards can buffer the system against pest infestations by increasing beneficial arthropod populations and can therefore reduce the need for chemical inputs. Using a variety of cover crops is also important in order to protect against the failure of a particular species to grow and to attract and sustain a wide range of beneficial arthropods.

Optimum diversity may be obtained by integrating both crops and livestock in the same farming operation. This was the common practice for centuries until the mid-1900s when technology, government policy and economics compelled farms to become more specialized. Mixed crop and livestock operations have several advantages. First, growing row crops only on more level land and pasture or forages on steeper

slopes will reduce soil erosion. Second, pasture and forage crops in rotation enhance soil quality and reduce erosion; livestock manure, in turn, contributes to soil fertility. Third, livestock can buffer the negative impacts of low rainfall periods by consuming crop residue that in "plant only" systems would have been considered crop failures. Finally, feeding and marketing are flexible in animal production systems. This can help cushion farmers against trade and price fluctuations and, in conjunction with cropping operations, make more efficient use of farm labor.

Soil management

A common philosophy among sustainable agriculture practitioners is that a "healthy" soil is a key component of sustainability; that is, a healthy soil will produce healthy crop plants that have optimum vigor and are less susceptible to pests. While many crops have key pests that attack even the healthiest of plants, proper soil, water and nutrient management can help prevent some pest problems brought on by crop stress or nutrient imbalance. Furthermore, crop management systems that impair soil quality often result in greater inputs of water, nutrients, pesticides, and/or energy for tillage to maintain yields.

In sustainable systems, the soil is viewed as a fragile and living medium that must be protected and nurtured to ensure its long-term productivity and stability. Methods to protect and enhance the productivity of the soil include:

1. Using cover crops, compost and/or manures
2. Reducing tillage
3. Avoiding traffic on wet soils
4. Maintaining soil cover with plants and/or mulches

Efficient use of inputs

Many inputs and practices used by conventional farmers are also used in sustainable agriculture. Sustainable farmers, however, maximize reliance on natural, renewable, and on-farm inputs. Equally important are the environmental, social, and economic impacts of a particular strategy. Converting to sustainable practices does not mean simple input substitution. Frequently, it substitutes enhanced management and scientific knowledge for conventional inputs, especially chemical inputs that harm the environment on farms and in rural communities. The goal is to develop efficient, biological systems which do not need high levels of material inputs. Growers frequently ask if synthetic chemicals are appropriate in a sustainable farming system. Sustainable approaches are those that are the least toxic and least energy intensive, and yet maintain productivity and profitability. Preventive strategies and other alternatives should be employed before using chemical inputs from any source. However, there may be situations where the use of synthetic chemicals would be more "sustainable" than a strictly nonchemical approach or an approach using toxic "organic" chemicals. For example, one grape grower switched from tillage to a few applications of a broad spectrum contact herbicide in the vine row. This approach may use less energy and may compact the soil less than numerous passes with a cultivator or mower.

Consideration of farmer goals and lifestyle choices

Management decisions should reflect not only environmental and broad social considerations, but also individual goals and lifestyle choices. For example, adoption of some technologies or practices that promise profitability may also require such intensive management that one's lifestyle actually deteriorates. Management decisions that promote sustainability, nourish the environment, the community and the individual.

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NOVEL VALUE-ADDED PRODUCTS FROM FRUIT AND VEGETABLE WASTES

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The huge quantity of fruit and vegetable wastes and by-products produced throughout the world, both in the organized and un-organized sectors, can be effectively utilized as livestock feed. These resources, i.e. peels, pomace and seeds etc. are rich sources of bioactive compounds, which can be extracted and utilized in food, cosmetic, pharmaceutical, and biofuel industries. Some of such novel value-added products and their utilities are discussed below.

Essential oils. The citrus peels are a potential source of essential oil (EO) and yield 0.5 to 3.0 kg oil/tonnes of fruit (Sattar and Mahmud, 1986). Citrus EO is widely used in alcoholic beverages, confectioneries, soft drinks, perfumes, soaps, cosmetics and household products owing to its aromatic flavor. It also serves as a masking agent in pharmaceutical products (Njoroge et al., 2005). It improves the shelf-life and the safety of fresh fruits (Lanciotti et al., 2004), skim milk and low-fat milk (Dabbah, Edwards and Moats, 1970) and exhibits broad spectrum antibacterial activity (Javed et al., 2011). Oils from both sweet and bitter oranges are used in tea formulations and as an ingredient in stomachic, carminative and laxative preparations. Lemon EO contains D-limonene, which improves the immunity, counters occasional feelings of depression, promotes clarity of thought and purpose, energizes and stimulates the mind and body, opens and releases emotional blocks and supports skin health and reduces the appearance of wrinkles (Sharon Falsetto, 2008). Dried bitter orange oil is used in treating prolapse of the uterus and rectum, diarrhea and piles.

Polyphenolic compounds. The concentration of total phenolic compounds in the peels, pulp/pomace and seeds of citrus fruits, apples, peaches, pears, yellow and white flesh nectarines, banana, pomegranate, mulberry, blackberry, tomatoes and sugar beet etc. is more than twice the amount present in edible tissue. Apple and grape pomace are rich in proanthocyanidins and flavonoids, banana in catechin and gallocatechin, carrot pomace in hydroxycinnamic derivatives like chlorogenic acid and dicaffeoylquinic acids (Zhang and Hamauzu, 2004), mango seed kernels (Puravankara, Boghra and Sharma, 2000) and mango peels (Larrauri, Ruperez and Saura-Calixto, 1996) in gallic and ellagic acids. Babbar et al. (2011) reported that kinnow peel, litchi pericarp, litchi seeds and grape seeds can serve as potential sources of antioxidants for use in food and pharmaceutical industries. The beet root pomace is a rich source of flavonoids (Čanadanović et al., 2011). The phenolic portion of the beet root peel depicts l-tryptophane, p-coumaric and ferulic acids, as well as cyclodopa glucoside derivatives (Kujala, Loponen and Pihlaja, 2001). The polyphenolic compounds exhibit anti-cancer, anti-microbial (pathogens), anti-oxidative and immune-modulatory effects in vertebrates. The peel and pulp of guava fruits could be used as a source of antioxidant dietary fibre (Jimenez-Escrig et al., 2001). Polyphenols reduce incidence of cardiovascular diseases and are thought to inhibit oxidation of LDL (Rice-Evans, 2001). Polyphenols can reduce the systolic pressure and the level of plasma cholesterol in humans and animals, inhibit platelet aggregation and prevent thrombosis (Lurton, 2003). The terpenoid and flavonoids in banana foliage exhibit anthelmintic properties (Marie-Magdeleine et al., 2010).

Edible oils. The fat in mango seed kernel is a promising source of edible oil and its fatty acid and triglyceride profiles are similar to those of cocoa butter. Guava (Psidium guajava L., Myrtaceae) seeds, usually discarded

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during processing of juice and pulp, contain 5–13 percent oil rich in essential fatty acids (Adsule and Kadam, 1995). The passion fruit seed oil is rich in unsaturated fatty acids (87.6 percent), mainly linoleic (73.1 percent) and oleic (13.8 percent) acids (Cassia Roberta Malacrida and Neuza Jorge, 2012). The oil has free radical scavenging activity.

Pigments. Tomato peel is a rich source of carotenoids such as lycopene (Knoblich, Anderson and Latshaw, 2005). It may be beneficial in curing cancer, coronary heart disease and other chronic conditions. The addition of tomato peel to meat products can result in a healthier product due to both the lycopene and fibre present in this by-product of tomato processing. Carrot pomace is also a good source of carotenoids (Zhang and Hamauzu, 2004). Anthocyanin pigments in banana bracts (leaves below calyx) and beet root pulp were evaluated for their potential application as natural food colorants. The beet root pomace contains 11−23 mg β-xanthins/g of dry extract (Čanadanović et al., 2011). Beet root peel is a potential source of valuable water-soluble nitrogenous pigments, called betalains, which comprise two main groups, the red betacyanins and the yellow betaxanthins. They are free radical scavengers and prevent active oxygen-induced and free radical-mediated oxidation of biological molecules (Pedreno and Escribano, 2001). Betalains have been extensively used as natural colorants in the modern food industry (Azeredo, 2009).

Food additives. Carrot pomace can be used in bread (Osawa et al., 1994), cake, dressing and pickles (Osawa et al., 1995), and in functional drinks (Henn and Kunz, 1996); and onion pomace in snacks (Kee, Ryu and Park, 2000). In the food industry, synthetic antioxidants, such as butylated hydroxyanizole (BHA) and butylated hydroxytoluene (BHT), have long been widely used as antioxidant additives to preserve and stabilise the freshness, nutritive value, flavour and colour of foods. However, Schilderman et al. (1995) revealed that BHT could be toxic, especially at high doses. Therefore, interest in the substitution of synthetic food antioxidants by natural ones has increased over the recent years. The antioxidant compounds from waste products of the food industry could be used for protecting the oxidative damage in living systems by scavenging oxygen free radicals, and also for increasing the stability of foods by preventing lipid peroxidation (Makris, Boskou and Andrikopoulos, 2007).

Anti-carcinogenic compounds. Brassica extracts are reported to possess anticarcinogenic properties, which have mainly been ascribed to the hydrolytic products rather than to the intact glucosinolates (GLSs). The hydrolysis of GLSs by the myrosinase leads to the production of bioactive compounds such as isothiocyanates, nitriles, thiocyanates, epithionitriles, and oxazolidines. Glucosinolate hydrolysis products from glucoiberin, sinigrin and progoitrin have also been reported to possess anticancer effects (Cartea and Velasco, 2008).

Dietary fibre. Fruit and vegetable wastes/by-products such as apple, pear, orange, peach, blackcurrant, cherry, artichoke, asparagus, onion and carrot pomace, mango peels and cauliflower trimmings are used as sources of dietary fibre supplements (gelling and thickening agents) in refined food. These compounds increase the bulk of the food and help prevent constipation by reducing gastro-intestinal transit time (Schwartz et al., 1988). They also bind to toxins in the food which helps to protect the mucus membrane of the gut and thus reduces colon cancer risk. Furthermore, dietary fibres bind to bile salts and decrease their re-absorption, thus helping to lower serum low density lipoproteins (LDL) cholesterol levels (Fernandez et al., 1994). The typical inclusion levels of fruit and vegetable by-products varies between 2−15 percent. The vegetable materials were found to maintain antioxidant activity after extrusion, retarding product oxidation.

Enzymes. Plant food residues including trimmings and peels might contain a range of enzymes capable of having a wide range of applications. Proteolytic enzyme bromelain may be extracted from the mature pineapple and papain from latex of papaya fruit. Banana waste can be used for the biotechnological production of α-amylase (Krishna and Chandrasekaran, 1996), hemicellulase (Medeiros et al., 2000) and cellulase (Krishna, 1999). Dried kinnow pulp supplemented with wheat bran in the ratio of 4:1 resulted in the highest filter paper cellulase (FPase) activity (Oberoi et al., 2010). Agha et al. (2009) investigated the use of a crude peroxidase preparation from onion solid by-products. Gassara et al. (2011) used apple pomace for production of lignin and manganese peroxidase and laccase production by Phanerocheate chrysosporium.

Sapota peels and citrus peels can be used as substrate for the production of pectinase (Sabika Akbar and Gyana Prasuna, 2012). Mango peels can be used for the production of cellulase (Saravanan, Muthuvelayudham and Viruthagiri, 2012).

Citric acid. It is used mainly in foods and pharmaceuticals. Most of the citric acid is manufactured mainly through solid-state fermentation (SSF) of starch/molasses exclusively by Aspergillus niger (Dhillon et al., 2011). Recently molasses, fruit and vegetable pomace and cassava bagasse etc. have been used as a substrate for citric acid production (Kuforiji, Kuboye and Odunfa, 2010). Hang (1987) used apple pomace as substrate for citric acid production.

Bio-ethanol. These resources can either be used directly as an untreated material for microbial growth or be used by appropriate treatment with enzymes for bioenergy production. The products generated from perishable wastes can be in liquid or gaseous forms of biofuels. Amongst various wastes used for ethanol production, potato peels (Arapoglou et al., 2010), apple pomace, waste apples (Tahir and Sarwar, 2012), banana peel, banana waste (Tewari, Marwaha and Rupal, 1986; Oberoi et al., 2011a), beet waste, beet pomace (Dhabekar and Chandak, 2010), Kinnow mandarin (Citrus reticulata) waste (Oberoi et al., 2011b) and peels (Sandhu et al., 2012) and peach wastes have shown encouraging results. Pineapple pulp contains substantial amounts of sucrose, starch and hemicellulose, and may therefore be used for ethanol production (Nigam, 2000).

Methane mitigation potential. Mangosteen (Garcinia mangostan) peel containing 16 percent condensed tannins and 10 percent crude saponins on DM basis were supplemented at the rate of 100 g DM/day with 3 percent sunflower oil (SFO) and 3 percent coconut oil (CO) in a rice straw and ruzi grass (Brachiaria ruziziensis) based diet fed to dairy cattle. It improved rumen ecology, especially increased bacterial population and reduced protozoa without any significant effect on fungal zoospores population. Methane production in the rumen was reduced significantly when MSP, sunflower oil and coconut oil were supplemented. The milk yield and milk composition were not affected significantly ($P>0.05$) by supplementing the diet with MSP, SFO and CO (Suchitra and Wanapat, 2008). Methane production was reduced with mangosteen peel after 21 h incubation from 11.4 to 5.5 ml/g substrate while the reduction with calcium nitrate versus urea was from 15.2 to 7.4 ml/g of substrate, a drop of 51 percent in both the cases. Lamba, Wadhwa and Bakshi (2012) also revealed that the methane production potential of cotton seed cake, corn gluten meal and tomato pomace was significantly lower than conventional (mustard cake, groundnut cake, soybean meal etc) and non-conventional (spent brewer's grains and maize oil cake) protein supplements.

Bio-gas. About 30 percent of the total production of Chinese cabbage is discarded as waste. According to Liu, Wang and Chen (2009) mesophilic fermentation condition was more suitable compared with thermophilic condition for biogas production from cabbage leaves. Gunaseelan (2004) obtained a methane yield of 309 and 291 mL/g volatile solids (VS) from cabbage leaves and stems respectively. It is well established that mixture of substrates containing both N and C rich substrates should be used in proper proportion for optimum bio-methane production. The higher specific methane yield of 686 Nm3 /tonnes VS (Ponsa, Gea and Sanchez, 2011) is achieved by co-digesting organic fraction of municipal solid waste (OFMSW) and vegetable oil (83:17 on DM basis). This is followed by co-digesting OFMSW and animal fat (83:17 on DM basis), and cow manure with fruit and vegetable waste (50:50 on DM basis) giving a methane yield of 508 (Ponsa, Gea and Sanchez, 2011) and 450 (Callaghan et al., 2002) Nm3/ tonnes VS, respectively.

Single cell protein. Single cell proteins can be produced from dried and pectin extracted apple pomace by using Trichoderma viride and Aspergillus niger. The grape waste and pressed apple pulp have also been used as a substrate for Aspergillus niger to generate crude protein and cellulose. Pineapple waste for production of single cell protein production has also been utilized. Citrus peel juice has also been used to generate single cell protein using Fusarium. Potato peels supplemented with ammonium chloride have also been used for the production of protein by using a non-toxic fungi pleurotus ostreatus. Similarly, waste from orange, sugarcane and grape processing industry have also been utilized for the production of single cell protein (Gautam and Guleria, 2007).

Fermented edible products. A number of beverages such as cider, beer, wine and brandy, and vinegar can be obtained from the fermentation of fruit wastes. Apple pomace has been utilized for the production of cider. The possibility of making brandy from dried culled and surplus apples, grapes, oranges and other fruits has also been explored. Vinegar can also be prepared from fruit wastes. The fruit waste is initially subjected to alcoholic fermentation by acetic acid fermentation by Acetobacter bacteria, which produce acetic acid. Vinegar production by fermenting waste from pineapple juice and orange peel juice has been reported. Apple pomace extract can also be mixed with molasses in the ratio of 2:1 for producing vinegar (Gautam and Guleria, 2007).

Compost. Vegetable and fruit wastes can be composted and used to replace a significant part of the mineral nitrogen fertilisation with nitrogen recovery of 6−22 percent. The plots fertilised according to the nitrogen recommendations had comparable yields, whether this had been provided (partially) through VFG-compost or not. Long-term VFG applications resulted in a carbon accumulation in the top soil, mainly due to increase of the more resistant carbon fractions. The long-term compost applications improved the nitrogen status of the soil over the years (Tits et al., 2012

Bio-degradable plastic. Potato or cornstarch waste is hydrolyzed to glucose by high-temperature α amylase to solubilize the starch, and by glucoamylase to break it down into glucose. The glucose is fermented to lactic acid by Lactobacillus. Lactic acid with equal amounts of hydroxyl and carboxyl groups can self-condense to form linear thermoplastic polyester poly-lactic acid (PLA), a biodegradable plastic. It can be used as timed release coatings for fertilizers, pesticides, and agricultural mulch films, which degrade in the soil (Anon, 1990a, b; Studt, 1990; Keeler, 1991).

Miscellaneous products. Neohesperidin and naringin from bitter orange peel can serve as starting materials for the production of sweeteners. The orange peels can be used as low-cost and eco-friendly adsorbents for removing dyes from waste water (Fat'hi and Zolfi, 2012). Certain compounds in passion fruit peel has bronchodilator effect and can help relieve bronchospasm in asthma patients. Oral administration of the purple passion fruit peel extract is considered to reduce wheeze and cough and improves shortness of breath in adults with asthma. Banana leaves can be used for the cultivation of Volvariella volvacea, an edible mushroom (Belewu and Belewu, 2005). The spent banana leaves containing low ADL, NDF and ADF content; and enriched with microbial protein can provide sustainable feed for ruminants, confirming the earlier report on the cultivation of Volvariella volvacea on rice straw and utilization of spent rice straw as livestock feed (Langar and Bakshi, 1986).

Conclusion

Fruit and vegetable wastes like baby corn husk, cauliflower and cabbage leaves, pea pods, sarson saag waste, culled snow peas and tomato pomace; citrus, carrot and bottle gourd pulp; banana and mango peels etc. are a rich source of nutrients and these can be fed either as such, after drying or ensiling with cereal straws, without effecting the palatability, nutrient utilization, health or performance of livestock. These can also be used for the production of value-added products like essential oils, polyphenols, anti-carcinogenic compounds, edible oil, pigments, enzymes, bio-ethanol, bio-methane, bio-degradable plastic, single cell proteins etc. The effective and efficient utilization of fruit and vegetable wastes will reduce the cost of animal feeding thereby increasing farmers' profits, generate an array of value-added products and help in waste management and reduction of environmental pollution.

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ANTIOXIDANT: A ANTIAGING BIOMOLICULE

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An antioxidant is a molecule that inhibits the oxidation of other molecules. Oxidation is a chemical reaction that can produce free radicals, leading to chain reactions that may damage cells. Antioxidants such as ascorbic acid(vitamin C) terminate these chain reactions. The term "antioxidant" is mainly used for two different groups of substances: industrial chemicals which are added to products to prevent oxidation, and natural chemicals found in foods and body tissue which are said to have beneficial health effects. To balance the oxidative state, plants and animals maintain complex systems of overlapping antioxidants, such as glutathione and enzymes (e.g., catalase and superoxide dismutase) produced internally or the dietary antioxidants: vitamin A, vitamin C, and vitamin E.

Antioxidant dietary supplements do not improve health nor are they effective in preventing diseases as shown by randomized clinical trials including supplements of beta-carotene, vitamin A, and vitamin E singly or in different combinations having no effect on mortality rate or cancer risk. Supplementation with selenium or vitamin E does not reduce the risk of cardiovascular disease. Oxidative stress can be considered as either a cause or consequence of some diseases, an area of research stimulating drug development for antioxidant compounds for use as potential therapies. Industrial antioxidants have diverse uses, for example as preservatives in food and cosmetics and as oxidation inhibitors in fuels.

Health effect

Although certain levels of antioxidant vitamins in the diet are required for good health, there is considerable debate on whether antioxidant-rich foods or supplements have anti-disease activity. Moreover, if they are actually beneficial, it is unknown which antioxidant(s) are needed from the diet and in what amounts beyond typical dietary intake. Some authors dispute the hypothesis that antioxidant vitamins could prevent chronic diseases while others maintain such a possibility is unproved and misguided from the beginning. Polyphones, which often have antioxidant properties in vitro, are not necessarily antioxidants in vivo due to extensive metabolism. In many polyphenols, the catechol group acts as electron acceptor and is therefore responsible for the antioxidant activity.However, this catechol group undergoes extensive metabolism upon uptake in the human body, for example by catechol-O-methyl transferase, and is therefore no longer able to act as electron acceptor. Many polyphenols may have non-antioxidant roles in minute concentrations that affect cell-to-cell signaling, receptor sensitivity, inflammatory enzyme activity or gene regulation.

Although dietary antioxidants have been investigated for potential effects on neurodegenerative diseases such as Alzheimer's disease, Parkinson's disease, and amyotrophic lateral sclerosis these studies have been inconclusive.

Foods	Reducing acid present
Cocoa bean and chocolate, spinach, turnip and rhubarb.	Oxalic acid
Whole grains, maize, legumes.	Phytic acid
Tea, beans, cabbage.	Tannins

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Vitamin C

Ascorbic acid or "vitamin C" is a monosaccharide oxidation-reduction (redox) catalyst found in both animals and plants. As one of the enzymes needed to make ascorbic acid has been lost by mutation during primate evolution, humans must obtain it from the diet; it is therefore a vitamin. Most other animals are able to produce this compound in their bodies and do not require it in their diets. Ascorbic acid is required for the conversion of the procollagen to collagen by oxidizing proline residues to hydroxyproline. In other cells, it is maintained in its reduced form by reaction with glutathione, which can be catalysed by protein disulfide isomerase and glutaredoxins] Ascorbic acid is a redox catalyst which can reduce, and thereby neutralize, reactive oxygen species such as hydrogen peroxide. In addition to its direct antioxidant effects, ascorbic acid is also a substrate for the redox enzyme ascorbate peroxidase, a function that is particularly important in stress resistance in plants Ascorbic acid is present at high levels in all parts of plants and can reach concentrations of 20 millimolarin chloroplasts.

Vitamin E

Vitamin E is the collective name for a set of eight related tocopherols and tocotrienols, which are fat-soluble vitamins with antioxidant properties. Of these, α-tocopherol has been most studied as it has the highest bioavailability, with the body preferentially absorbing and metabolising this form.

It has been claimed that the α-tocopherol form is the most important lipid-soluble antioxidant, and that it protects membranes from oxidation by reacting with lipid radicals produced in the lipid peroxidation chain reaction. This removes the free radical intermediates and prevents the propagation reaction from continuing. This reaction produces oxidised α-tocopheroxyl radicals that can be recycled back to the active reduced form through reduction by other antioxidants, such as ascorbate, retinol or ubiquinol This is in line with findings showing that α-tocopherol, but not water-soluble antioxidants, efficiently protects glutathione peroxidase 4 (GPX4)-deficient cells from cell death. GPx4 is the only known enzyme that efficiently reduces lipid-hydroperoxides within biological membranes.

However, the roles and importance of the various forms of vitamin E are presently unclear, and it has even been suggested that the most important function of α-tocopherol is as a signaling molecule, with this molecule having no significant role in antioxidant metabolism. The functions of the other forms of vitamin E are even less well understood, although γ-tocopherol is a nucleophile that may react with electrophilicmutagens, and tocotrienols may be important in protecting neurons from damage.

Uses in technology

Food preservatives

Antioxidants are used as food additives to help guard against food deterioration. Exposure to oxygen and sunlight are the two main factors in the oxidation of food, so food is preserved by keeping in the dark and sealing it in containers or even coating it in wax, as with cucumbers. However, as oxygen is also important for plant respiration, storing plant materials in anaerobicconditions produces unpleasant flavors and unappealing colors. Consequently, packaging of fresh fruits and vegetables contains an ~8% oxygen atmosphere. Antioxidants are an especially important class of preservatives as, unlike bacterial or fungal spoilage, oxidation reactions still occur relatively rapidly in frozen or refrigerated food. These preservatives include natural antioxidants such as ascorbic acid (AA, E300) and tocopherols (E306), as well as synthetic antioxidants such as propyl gallate (PG, E310), tertiary butylhydroquinone(TBHQ), butylated hydroxyanisole (BHA, E320) and butylated hydroxytoluene (BHT, E321).

Levels in food

Antioxidant vitamins are found in vegetables, fruits, eggs, legumes and nuts. Vitamins A, C, and E can be destroyed by long-term storage or prolonged cooking.The effects of cooking and food processing are complex, as these processes can also increase the bioavailability of antioxidants, such as some carotenoids in vegetables. Processed food contains fewer antioxidant vitamins than fresh and uncooked foods, as preparation exposes food to heat and oxygen.

Antioxidant vitamins	Foods containing high levels of antioxidant vitamins
Vitamin C (ascorbic acid)	Fresh or frozen fruits and vegetables
Vitamin E (tocopherols, tocotrienols)	Vegetable oils, nuts, and seeds
Carotenoids(carotenes as provitamin A)	Fruit, vegetables and eggs

Other antioxidants are not obtained from the diet, but instead are made in the body. For example, ubiquinol (coenzyme Q) is poorly absorbed from the gut and is made through the mevalonate pathway. Another example is glutathione, which is made from amino acids. As any glutathione in the gut is broken down to free cysteine, glycine and glutamic acid before being absorbed, even large oral intake has little effect on the concentration of glutathione in the body . Although large amounts of sulfur-containing amino acids such as acetylcysteinecan increase glutathione, no evidence exists that eating high levels of these glutathione precursors is beneficial for healthy adults.

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ETHICS AND VALUES IN HIGHER EDUCATION

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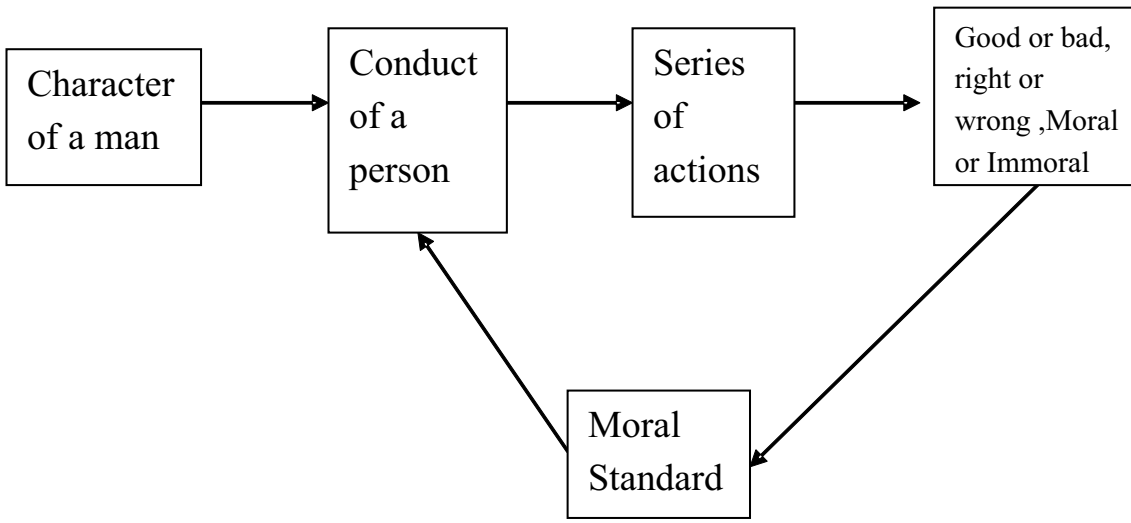
A man's ethical behaviour should be based effectually on sympathy, education, and social ties and needs; no religious basis is necessary. Man would indeed be in a poor way if he had to be restrained by fear of punishment and hope of reward after death.

By – Albert Einstein

Meaning of Ethics-

Derived from a Greek word 'Ethicos' meaning **character** or **Manners,** science of character of a person expressed as right or wrong conduct or action. Set of moral principles prescribing code, explains what is good right, or bad and wrong.



Rushworth Kidder *states that "standard definitions of ethics have typically included such phrases as 'the science of the ideal human character' or 'the science of moral duty"*

Cambridge Dictionary of Philosophy *states that the word "ethics" is "commonly used interchangeably with 'morality and sometimes it is used more narrowly to mean the moral principles of a particular tradition, group or individual."*

Linda Elder *define ethics as "a set of concepts and principles that guide us in determining what behavior helps or harms sentient creatures"*

Objectives of Ethics-

Studies human behavior and makes evaluate assessment about them as moral or immoral .Establishes moral standards and norms of behavior. Makes judgement upon human behavior based on these standards and norms. Prescribed moral behavior and makes recommendations about hoe to or how not to behave .Expresses

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an opinion or attitude about human conduct in general.

Differences between ethics, values and morals-

Ethics is a branch of moral philosophy. Among others, it involves defending and recommending concepts of right and wrong conduct. In discussion however, ethics can become eclipsed by comingling concepts of values and morals. They all provide behavioral rules.

Values are rule from which we make our personal decisions about what is right and what is wrong, good or bad. Values help direct us to what is more important and past hat is less important. This helps guide us when making decisions.

Morals tend to be broad yet are more far reaching because of their strong link to good and bad. We judge others by their morals rather than their values.

Professional Ethics-

As Dr. Mary Ann Cutter explains, ethics can be applied to almost everything. Biologist have learned an extraordinary amount about the genetic code that shapes mice and men. The ethics of these professionals guide them in how to use these new genetic technologies and the information that comes from it. In addition to cloning animals and sequencing the human genome, amazing revelations have been presented. So while we are gaining information everyday – the genetic footprints breast cancer and Alzheimer's disease, what we know about the genome still pales in comparison to what we do not yet know and the implications what lies in between.

Ethics and ethical behavior are no less prevalent or important in education-

Educators, parents and community partners who have and continue to step up and selflessly gives their time and or funds to improve education. Steroids, hormones makes veggies, fruits harmful (Oxytocin).CBI has recovered images of 65 hard disk from the Electronic -In- Motion Weigh Bridge (EIMWBs) locations, which allegedly manipulated to under- weigh the freight canons, thereby benefitting private companies.

Pivotal issues that affect students, parents and educators on a daily basis :-

Should teachers and students be friends? Teachers are better able to structure their content and presentation methods when they have an understanding of their individual students and the way they live. For some teachers, this means being available to them as often as possible and sharing experiences. Moments that diminish the perception gap where students see teachers as out of touch with their world, promotes friendship.

Pivotal issues that affect students, parents and educators on a daily basis :-

Right to Education: does it really pertain to everyone, equally?

Historically, formal education was reserved for the privileged. Today it is universally recognized as a basic human right. Shortly after its birth in 1945, the United Nations created The Universal Declarations of Human Rights (UDHR).Originally adopted by 58 countries in 1948, the number grew to 170 countries by 1993. Charles Murray discussed the murky link between income and parent IQ on standardized tests outcomes, specifically the SAT college entrance exam. The richer the parents, the higher the children's SAT scores. Some view the SAT simly as another weapon in the inequality war.

Pivotal issues that affect students, parents and educators on a daily basis :-

Awareness. We all need to be reminded from time to time to sleep back and think about our decisions. As parents and educators, we all have ethical behaviors that society expects from us. It is up to us to uphold them. As I say to my students, the sign of a truly ethical person is one who des the right thing, in whatever capacity, even when no one is looking.

Common Unethical Acts…

- Lying and withholding needed information
- Abusive or intimidating behavior

- Discrimination and sexual harassment
- Stealing
- Breaking environment and safety laws
- Falsifying records
- Drug or alcohol abuse
- Giving or accepting bribes

Why ethical behavior is important?

Education is a subsystem of society it empowers all stakeholders concerned. Reduction in cost of friction with social environment . Important for organizations leaders because they influence the ethical climate for the rest.

Encouraging Ethical conduct:-

- **Ethics Training**
- **Whistle – blowing**
- **Ethical Advocate**
- **Code of Ethics**

Ethics Training - Key features of effective ethics training programs

- Institutional support.
  - Open discussion.
  - A clear focus on ethical issues.
  - A mechanism for anonymously reporting ethical violations.
  - Integration of ethics into the institution.
  - Reward ethical conduct.

Whistle Blowing – The reporting of perceived unethical matters. Reducing the fear of retaliation against whistleblowers.

- Anonymous hotlines and web sites
- Personal , confidential guidance

- ***Ethical Advocate*** –
  - An ethics specialist who plays a role of critical questioner in top- management's decision- making.
  - Serves as the board of director's social conscience.
  - Helps prevent groupthink and blind conformity

Code of ethics – Published statement of moral expectations for employee conduct. Requirements for an effective ethics code.

- Must describe specific practices as unethical (eg., kickbacks, payoffs, gifts, falsification of records, and misleading educational claims)
- Must be firmly support and fairly enforced by top management.

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GANGATIRI COW- AN EMERGING BREED OF EASTERN U.P.

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In India with the expansion in dairy industry it becomes necessary for its future glory to find out Indigenous cows breeds in different zone of our country. Therefore, our scientist started to see the most popular Gangatiri cow, which is mostly found in eastern zone of U.P. especially in Ganga watershed areas of Allahabad, Mirzapur, Varanasi & Baliya, Ganga river and nearby to its nearer area. Indigenous breeds of cows which were producing more milk either killed due ill treatment by their master or bad or poor management. Their milk production reduced gradually and they became poor to poorer, thus these breeds slowly and slowly became worthless and came to the danger zone. Gangatiri is an indigenous cattle breed of India and has been recognized as a separate breed by NBAGR-ICAR (Accession no. 03039). This is an important dual purpose breed of North India. Average daily milk yields of Gangatiri cow ranged between 4-6 liter per day. The lactation length is of 150-250 days. Inter calving period varies between 14-24 month. Coat color of Gangatiri cow is dull white. Muzzle is black, Hump and dewlap are medium.

Causes of its disappear: There are few most important causes as follow:

1. Less importance to this breed in comparison to hybrids due to their more milk production.
2. Lack of proper feed and poor management.
3. Shortening of Pasturelands.
4. Carelessness of Government and giving more facilities to the breeder's for hybrid cows or especially to some milk producing breeds.
5. Mechanized farming.
6. Shortage of knowledge Deshi or Indian cow's milk properties and contents and their values in nutrition.
7. Low market value of cow's or low market demand.
8. Other social causes like people those have hybrid cows regarded more prosperous than those who have Deshi or Gangatiri cows in the common family.

Such original breeds of cows gradually disappearing. So our Indian dairy experts paid their attention to revive them again in eastern zone of U.P. With regard to improve the production and development of this breed in the form or shape of a productive one and to get better results in the field of dairy as one the most popular breed among Indigenous cows. To get its previous glory as it is said that four side developments is necessary. Its milk has been analyzed and found that it is more useful for users and contains more nutrients than the hybrid breeds. The maintenance of this breed is easy in comparison with European/ exotic cows and thus following suggestions/advices have been made:

1) **(a)** It is most important fact that like our residence live-stock also requires safe place for their living. So it is must to keep keen concept that our cow sheds must be safe airy as well as enough space as required for animals.

(b) Cow shed should be neat and clean since if a fine particle of dust is mixed in milk may cause harm or several diseases.

2) Proper feeding and feed management: As feeds and forages are a source of nutrients for body building, therefore, for fulfillment of this situation animal should be provided dry and green fodders along with concentrate ration as per the body weight of animal and their milk production.

(a) Feed must be given timely and regularly at an equal interval.

(b) Animals must be provided fresh and clean water regularly for 24 hrs.

(c) Besides the feed and water, feed supplements and deworming at proper time is compulsory for their better performance. To meet sufficient nutrition for good health and body maintenance calcium, phosphorus and other micro-nutrient must be given additionally.

(d) Proper checking or care of animal health (Vaccination and treatment), cleaning or washing not only of animals but also their living place or shed too should be done on regular basis.

(e) Proper care in rain, winter and summer season is required.

(f) Proper care during the pregnancy and keeping proper record is necessary for a good breeders or milk men.

(g) Prescribed ration should be given as below:

(i) Dry matter content at the rate of 2.5kg/100 kg body weight

(ii) Straw contains dry matter 90% in summer where 85% in rainy & winter season because of atmospheric moisture content.

(iii) 90% dry matter should be in concentrate like wheat bran, oil cakes and other component like maize, bajara etc.

(iv) 50% dry content should be in Jowar or green maize fodder and 10% in green grasses and Berseem.

(H) Concentrate per animal for 24 hr is as per advice as bellow:

(i) Dry matter must be calculated on body weight basis as 2.5kg/100kg.

ii) The amount of dry matter supplied through concentrate be subtracted from the total amount of required dry matter.

iii) Rest dry matter should be given equally by green fodder and dry fodder.

(ii) Green fodder and dry fodder ratio must not exceed 3:1

For dry cow in general condition 1 kg/day for body maintenance.

(ii) Milch animal (Cow) 1 kg per 3 kg milk production along-with 1-1.5kg for life maintenance.

(iii) After 5 months pregnancy 1.2 kg concentrate along with maintenance ration should be given.

(E) It must be kept in mind that cow must be provided a rest of sixty days before calving; therefore, cow's milk must not be taken during the period.

(IV) Common salt and bone meal must be provided 40 gm per day per animal as usual.

If we follow all the above all advices definitely Gangatiri Cow would be better profitable and advantageous than hybrid cow and thus we would be proud on our own indigenous cows.

Advantages of Gangatiri Cows

- **i.** Its milk has more nutritive values.
- **ii.** Fat percent in Gangatiri breed is more than hybrid cow. Only 3.5 to 4% fat is found in hybrid cows whereas 4.5 to 5.5% fat is found in milk of Gangatiri cows.
- **iii.** Gangatiri cows are more tolerant then other breeds of cows in eastern atmosphere and do not require extra care for winter or summer season.
- **iv.** These are cheaper than hybrid cows, therefore, can be buy easily by all farmers.
- **v.** Hybrid cows are costly and expensive too in dairy business at every way.
- **vi.** Hybrid cow require 1kg concentrate at 2.5 liter milk production and have less fat percent in milk so its sell price goes down, reducing income and increases the cost of production.

Picture: Gangatiri Cow

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COMPLETE FEED TECHNOLOGY: A FEEDING STRATEGY FOR LIVESTOCK

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Abstract

Livestock play a central role in the natural resource-based livelihood in developing countries. However, nutritional adequacy for livestock is at currently referred one of the most burning global problems of agricultural countries. The growing feed shortage in the region is pushing the feed cost higher and higher, so that most of the resource poor small holders, who constitute majority of the livestock farmers in the tropical region, are unable to supply good quality of feeds and balanced nutrients to their animals. To minimize feed cost and labour, and to maximize production is the need of time. In such circumstances, the extensive use of crop residues in livestock feeding seems to be indispensible to meet the nutritional need of livestock. In this direction so far, Complete Feed Block Technology, an economically viable technique has been developed. This technology could be an effective way of feeding livestock to improve and sustain animal productivity. Complete Feed Block Technology has the potential to provide ready to eat complete ruminant diet during scarcity period, which are further aggravated by natural calamities like recurrent drought and flood.

Introduction

Livestock form an integral part of agriculture sector and encompass a great impact on the national economy. Among the multiple roles of the livestock industry, nutritional security, income generation and employment are the most important.

A successful livestock production largely depends on continuous supply of adequate, balanced and economic feeding. Balanced feeding of dairy animals can play a pivot role in a successful dairy development programme worldwide. To maximize profitability from the animals, one need to ensure that these animals must receive the acquired quantity of protein, energy, minerals and vitamins preferably from locally available feed resources. Dairy animals in India and other tropical countries are fed mainly on by products of various food crops, oil seeds and locally grown fodder. Effective utilization of available feed resources is the key for economical livestock rearing.

In India, there is an acute shortage of quality fodders and unbalanced feeding practice that afflicts the livestock industry. The main cause of this scarcity is the changing scenario of land use for non agricultural uses, shrinking of community grazing lands, handling, transportation and storage of crop residues are the major problem in feeding of livestock. During these scarcity periods, there is need for easily available feed that can meet nutritional requirements at low cost and is easy to transport. In this direction, many technologies have been developed so far, but for several reasons, that have not been adopted (1). The complete feed system is one of the latest developments in this context to exploit the potential of locally available animal feed resources in the best possible way (2, 3).

Complete feed technology may play an important role in maintaining an optimum nutritional status of animals. It helps in developing low cost feed formulations, better nutrient utilization due to proportionate intake of roughage dry matter and concentrate, avoiding refusal of unpalatable portion of plant residues that

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enables use of locally available ingredients in an efficient manner (4). Complete feed block supplementation will reduce the concentrate wastage and will increase concentrate consumption time, which will be beneficial for rumen microbial ecosystem. Complete feed with the use of fibrous crop residue is an effective way 0f feeding livestock to increase the intake and to improve feed utilization and animal production performance (3). Complete feed block have two main components, Major and Minor. The major components are roughage and concentrate, added in different ratios, while the minor components are micronutrients and feed additives (5).

***Roughage Part:** The roughage part is generally the crop residues such as wheat, ragi or paddy straw, sorghum stalk, sugarcane tops, maize Stover. Feed block based on tree leaves and dries forest grasses have also been used in certain part of India to fed bovine (6).

*Concentrate part: The proportion of the straw and concentrate in the block varies with the type of animal to which it is to be fed. The ingredients of the concentrate mixture are: oil cakes/meals as protein sources; molasses, grains, grain by products as energy sources; and supplement such as bypass protein or bypass fat (5).

***Micronutrients and feed additives:** These are vitamins, minerals, bentonite, probiotics, enzymes, antioxidants, immune-protective agents, antitoxins and herbal extracts, among others.

Thus a complete Feed Block can be defined as a system of feeding all ingredients including roughages, processed and mixed uniformly, to be made available to the animal. It has also been defined as an intimate mixture of processed ingredients presented in a form which precludes selection and which is designed to be the sole source of feed. Complete diet system has been introduced with the aim of supplying the feeding animals (7).

Benefits of Complete Feed Block Technology:

1. Simple and efficient technique for long term conservation of crop residues and agricultural products.
2. Reduced use of conventional concentrate feed, thereby feeding cost would be alleviated.
3. Allow a synchronous and fractional supply of essential nutrients for ruminants fed on low quality roughage.
4. The feeding of complete feed stabilizes rumen fermentation, minimizes fermentation loss and ensures better ammonia utilization. (8)
5. Complete feed block may be used in dry season or winter season to ruminants when their diet is high in fibre.
6. Feeding complete diet provides scope for incorporation of nutritious non-conventional feed resources in concentrate or roughage component by avoiding selective eating of palatable components by animals, which is helpful in feeding balanced ration to livestock. This reduces the feed wastage (7, 9-13).
7. Feeding of complete feed blocks has appositive effect on production as well as reproduction of the animals. It was reported that the growth rate of calves could increase by 25-35% (14).There could also be some increase in fat content of milk.
8. The optimum supply of nutrients and micro-nutrients through complete feed blocks also has a positive impact on the maintenance of good animal health (15).
9. Lesser storage space is required to store the bulky feed especially straw.
10. Easy in transport. Since the feed blocks occupy approximately one third lesser space and volume than the original components in the uncompressed state, more fed (by weight) can be accommodated and transported within the same space.
11. Reduce Environmental pollution. In many part of the world, straw is also burnt in the field after harvesting of the grains causing the emission of green house gases. By converting the residual straw into densified forage or feed blocks not only this valuable feed resources could be effectively used,

but the emission of green house gases could also be avoided. Also there is less dust pollution when the feed is transported as blocks rather than as loose straw.

Conclusion

Thus complete feed in block form may overcome several problems and will transport feed resources to deficit region or area of natural clamities, cost effectively and can form a part of "scarcity feed banks" for economic and viable livestock production programme for small and marginal farmers, landless labourers and other weaker sections of the society. However, lots of efforts are still needed to be taken for extending the concept extensively to the field.

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STUDIES ON FUNGAL DISEASES OF CUCURBITACEOUS CROPS GROWN IN INDIA

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Introduction

"Cucurbits" is a term coined by Liberty Hyde Bailey for cultivated species of the family Cucurbitace.Cucurbts from an important and a large group of vegetables grown extensively throughout India and other tropical as well as other sub – tropical region of the word. Historically, cucurbits have been important to mankind, especially as a food source. There is great diversity among consumed cucurbitaceous crops and production regions around the world (Robinson and Decker-Walters, 1997). Cucurbit crops continue to be developed and produced for market niches worldwide (Schaefer, H., and Renner, S. S. 2011). The family Cucurbitaceae comprises about parts 117 genera and 825species in warmers of the world. In India, the family

Cucurbitaceae is represented by 36 genera and 100 species (Chakravarty, 1982). The Cucurbitaceae have an important cultural and economic role among many societies. Some species are among the plants first domesticated by humans and several are stable crops (Jeffrey, 1990). All parts of cucurbits (leaves, shoots, roots, flowers, seeds and fruits) can be used in the preparation of pickles, curries and salads (Upaganlawar and Balaraman, 2009).Archaeological records of the New World suggest that *Cucurbita* was one of the first plant to be domesticated (NEE, 1990). The word "pumpkin" is derived from the Latin word *pepo* which is a botanical term for fruit with a hard rind and fleshy interior.

The commonly used scientific name for pumpkins is *Cucurbita pepo*. Major fruit rots of cucurbits are black rot, Fusarium rot, *Phytophthora* rot, *Sclerotinia*rot.Cucurbits crop can be infected by fungal, bacterial and viral pathogens from the time of fruit setuntil harvest. Also, some diseases may develop in cucurbits during transit and in storage. Cucurbits crop can be infected by the followingPathogens *Choanephora* fruit rot-*Choanephora cucurbitarum,*Scab-*Cladosporium cucumericum*, Anthracnose-*Colletotrichum orbiculare,,* Black rot-, *Didymella bryoniae,Fusarium rot- Fusarium spp, Phytophthora* fruit rot,-*Phytophthora capsici,Plectosporium* blight- *Plectosporium tabacinum,Pythium* fruit rot- *Pythium* spp, southern blight- *Sclerotium rolfsii,Sclerotinia* rot-*Sclerotinia sclerotiorum*,Septoria Spot - *Septoria cucurbitacearum,* Black rot was first reported in Europe and US in 1891. *Didymella bryoniae* survives between the growing seasons on diseased vines, crop debris, and seed.*Fusarium* crown and fruit rot of cucurbits was first described in detail in South Africa in 1932. In India over 20 cucurbit species are grown for vegetable purposes. The list of cucurbits cultivated in Uttar Pradesh is given in Table (1). A brief account of medicinal properties of cucurbits is described by (Robinson and Decker- Walters 1999, and Seshadri and More,2009).*Phytophthora capsici* was first described in New Mexico in 1922.*Alternaria* leaf blight is a common disease on cantaloupe and of less importance on cucumber, watermelon and squash. Symptoms first appear on the upper leaf surface as small,

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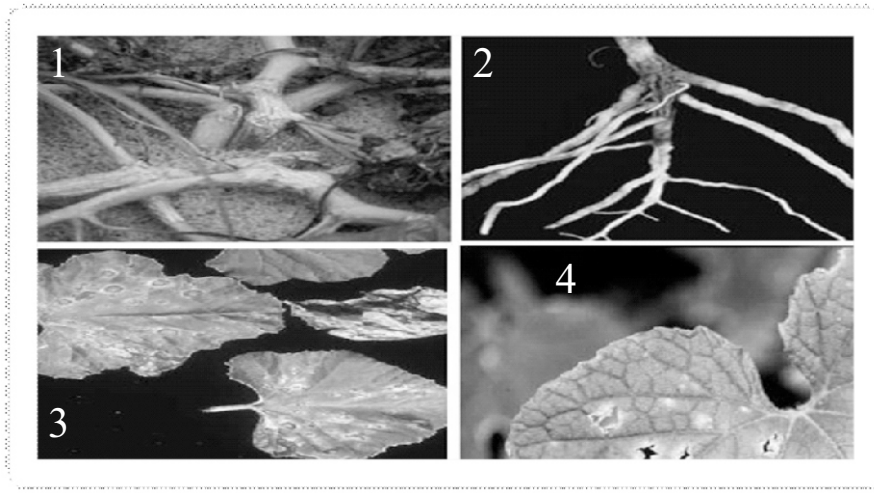

Figure-(A) Cucurbits diseases (1) Gummy stem blight (2) Damping off Cucumber (3) *Alternaria* leaf blight (4) *Anthracnose*

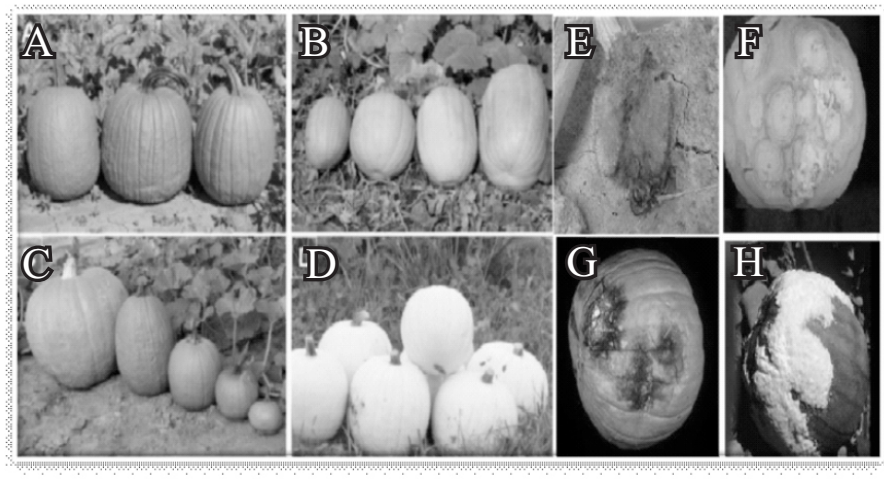

Figure- (B), (A) Pumpkin (B) Processing pumpkins (C) Different pumpkin cultivars (D) White pumpkins (E) Infected pumpkins *Choanephora* fruit rot (F)*Anthracnose (Colletotrichum orbiculare*) (G) Black rot (*Didymella bryoniae*) (H) *Phythium* rot *(Phythium spp*.)

circular, tan spots with white centers. These spots enlarge, turn light brown and form a slight depression. Small leaf veins with in thespots darken, resulting in anetted appearance.*Colletotrichum orbiculare* can be associated with seed and infected crop debris.Spread of this fungus can occur by splashing rain, overhead irrigation, insects, field workers and equipment. Disease development is favored by warm, humid weather. Optimum temperature for disease development is 24°C (75°F). Late infection of the crop may result in fruit becoming unmarketable during storage, shipment or display.*Fusarium* wilt of muskmelonsis an important disease world-wide(Martyn, R. D., 1996.)Damping off of seedlings typically occurs in soils that remain saturated for extended periods, especially low lying areas of a field.The gummy stem blight fungus is both seed- and soil-borne. The pathogen may be carried in or on infested seed. In the absence of host plants, the fungus can over winter for a year and a half or more on infected crop residue. The center of diversity of bitter gourd is the Old World tropics with its highest diversity in India, China, and Southeast Asia (Esquinas-Alcazar and Gulick, 1983)

Major Cucurbits crops grown in India. (Table-1)

S.N	Cucurbits name	Botanical name	Native Place
1.	Pumpkin	*Cucurbita moschata*	Peru and Mexico
2.	Cucumber	*Cucumis sativus*	India
3.	Bitter gourd	*Momordica charantia*	Indo-Burma
4.	Bottle gourd	*Lagenaria siceraria*	Ethopia
5.	Ridge gourd	*Luffa acutangula*	India
6.	Watermelon	*Citrullus lanatus*	Tropical Africa
7.	Long melon	*Cucumis melo*	Tropical Africa
8.	Sponge gourd	*Luffa cylindrica*	India
9.	Ivy or scarlet gourd	*Coccinia cordifolia*	India
10	Pointed gourd	*Trichosanthes dioica*	India
11.	Summer Squash	*Cucurbita pepo*	Peru and Mexico
12.	Winter Squash	*Cucurbita maxima*	Peru and Mexico
13	Ash gourd	*Binincasa hispida*	Asia
14.	Chow-chow	*Sechium edule*	Africa

Study Area

This research study was carried out in the period between 26 February 2017 to 22 July 2017 in the Bhargva Agricultural Botany laboratory of the Department of Botany, University of Allahabad, Allahabad, U.P. India.Allahabad district is situated between 24° 47' N and 25° 47' N latitudes and between 81° 19'E and 82° 21'E longitudes. It covers an area of 5246 km^2

Survey & Collection of Cucurbits

Five infected cucurbit vegetables Viz.,Cucumber(*Cucumis sativus*),Long-melon (*Cucumis melo*),Water-melon (*Citrullus lanatus*),Pumpkin (*Cucurbita moschata*) andBitter-gourd (*Momordica charantia*) were collected from Allahabad district in Uttar Pradesh.

Isolation and Identification of Cucurbits fungi

The infected tissues of the collected samples were transferred individually to Petri dishes containing 20 ml of Oatmeal agar medium. Incubate the dishes at 30ºC for 5 days then dishes were examined and identified.The pure cultures of isolated fungal strains were maintained in PDA slants with streptomycin at 28°Cduring the study (Aneja, 2004).Fungi were identified by means of keys of (Barnett &Hunter, 1999).

Pathogenicity test

Some of isolated fungi were used to confirm their pathogenicity test in their respective hosts. Some fresh healthy samples were brought in to the laboratory and surface sterilized with 0.1% $HgCl_2$.For inoculations corkborersof (2mm) diameter were used. They were sterilized by placing in spirit lamp flame, dipping in alcohol and shaking off the excess alcohol by flaming (Granger & Horne, 1924). The inoculated samples and their respective controls were kept under sterile conditions at room temperature under bell jars. The artificially inoculated samples were examined daily and the extent of damage was recorded. The pathogens were re-isolated and disease symptoms were clearly evident, the culture and symptoms signs were compared with original.

Results and Discussion

The results were obtained, out of ten species, three species of fusarium were most incidence species. Two species of Phythium & phytopthora were recovered from different cucurbits table (1). There were three other fungal species namely; *Didymella bryoniae, Rhizopus nigricans, Plectosporium tabacinum* has been recovered from different cucurbits Table (2).

Table (2) : Fungalgenera and species which were recovered from various Cucurbits sample collected from Allahabad district in U.P India.

S. N.	Fungal species	Cucurbits Crops name				
		Cucumber	Long melon	Water melon	Pumpkin	Bitter gourd
1.	***F.oxysporum sp. cucumerinum***	+	_	_	_	_
2	***F.oxysporum sp. melonis***	_	+	_	_	_
3	***F.oxysporum sp. niveum***	_	_	+	_	_
4	***P.aphanidermatum***	+	_	+	+	_
5	***Phythium spp***	+	_	+	+	_
6.	***P. capsici***	+	+	+	+	_
7.	***P. melonis***	_	+	_	_	_
8.	***Didymella bryoniae***	+	_	_	+	+
9.	***Rhizopus nigricans***	_	_	_	_	+
10	***Plectosporium tabacinum,***	+	_	+	+	_

It was noticed that *F. oxysporum cucumerinum*infects only cucumber and it showed negative response on long melon, watermelon, pumpkin, bitter gourd in table (2). This type similar study has been also done by (bajpai *et al.,*2016).*F.oxysporum melonis* infects only longmelon but it showed negative response on cucumber, watermelon, pumpkin, bitter gourd.*F.oxysporum niveum* infects watermelon and it showed negative response on cucumber, long melon, pumpkin, bitter gourd.*P.aphanidermatum* infectscucumber, watermelon, pumpkin but it showed negative response on long melon, bitter gourd.*Phythium spp* infects cucumber, watermelon, pumpkin but it showed negative response on longmelon, bitter gourd.*Phytopthora capsici*infects cucumber, longmelon, watermelon, pumpkin but it showed negative response on bitter gourd.*Phytopthora melonis*infects only long melon but it showed negative response on cucumber, watermelon, pumpkin, bittergourd.*D.bryoniae* infects cucumber, pumpkin, bittergourd it showed negative response on longmelon, watermelon. *Rhizopus nigricans* infects bitter gourd but it showed negative response on cucumber, longmelon, watermelon, pumpkin.

Conclusion

The total number of 6 fungal genera and 10 species of fungi were recovered from five cucurbits vegetables. The studyresulted in the maximum fungal genera and species were recorded in cucumber followed by watermelon,pumpkin. Minimum fungal genera and species were recorded in long melon bitter gourd.

Acknowledgement

We are thankful to our sincere supervisor Prof. D.N Shukla (D.Sc.). Department of Botany University of Allahabad, Allahabad (U.P), India. for providing necessary Laboratory facilities and guidance for the research.

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STONE CRUSHER POLLUTION AND ITS MANAGEMENT

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Abstract

Stone crusher industries are the major cause of air pollution. These are the main source of fine particulate matter. Because of the presence of high amount of air pollutants in the ambient air, the health of the population is getting adversely affected. Higher concentration of particulate matter above the permissible limit causes various respiratory diseases, (acute bronchitis, silicosis, lungs diseases and asthma), skin disease, eye irritations, and heart diseases in human being. It prevents plant growth and also disturbs the ecological balance. Proper management of stone crusher industrial pollution is need of hour. The main aim of study is to create awareness on a clean environment and minimize occupational health hazard to stone crusher workers.

Introduction

Stone crushing Industry is an important industrial sector in the country engaged in producing crushed stone of various sizes depending upon the requirement which acts as raw material for various construction activities such as construction of roads, highways, bridges, buildings, canals etc. It is estimated that there are over 12,000 stone crusher units in India **(CPCB, 2009)**. The number is expected to grow further keeping in view the future plans for development of infrastructure of roads, canals and buildings that are required for overall development of the country. In India, the Stone Crushing Industry sector is estimated to have an annual turnover of Rs. 5000 crore (equivalent to over US$ 1 billion) and is therefore an economically important sector. The sector is estimated to be providing direct employment to over 500,000 people engaged in various activities such as mining, crushing, transportation of mined stones and crushed products etc. Most of these personnel are from rural and economically backward areas where employment opportunities are limited and therefore it carries greater significance in terms of social importance in rural areas. It is a source of earning for uneducated poor unskilled rural people **(National Productivity Council, 1995)**. The rapid and necessary development of large urban areas ('megacities'), especially in developing countries, causes and will cause serious air-quality issues **(Valerie *et al.*, 2007**). The release of different pollutants into the environment has increased noticeably as a result of industrialization and thereby lowered the quality of the environment to alarming levels **(Aziz, 1999)**.

These stone crushers though socio-economically an important sector, gives rise to substantial quantity of fine fugitive dust emission which create health hazards to the workers as well as surrounding population by way of causing respiratory diseases. Exposure to respirable dust coming out from stone crushing units may create adverse health effects, chief among them being pneumoconiosis ( ).The dust also adversely affects visibility, reduces growth of vegetation and hampers aesthetics of the area. The ill effects on health are severe with the fetus, children, elders and cardiovascular and angina pectoris patients (**Balashanmugam et al., 2012)**.

Management Of Stone Crusher Pollution

In order to control environment pollution, the following ways will be useful to reduce the impact of

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Stone crusher pollution. All stone crushers should provide the following dust containment equipment/ system:

i. Closed metal sheet enclosures at dust emitting points i.e. the crushers including their discharge points, screens, and the transfer points of belt conveyers, with arrangements of a door with opening and closing facility for cleaning and maintenance and flexible covers at entrance and exit of the belt conveyors. All opening provided for ventilation in the enclosures should be covered by canvas bag-filter to arrest the escaping dust.

ii. Covering of all belt conveyers.

iii. Silos with telescopic discharge chute for collecting, storing and delivering/truck-loading the product, 'stone dust' and the reject, 'fine dust'.

iv. A minimum 12 ft high metal sheet barricading or boundary wall should be provided by all stone crushers to avoid effects of dust such as respiratory diseases

v. Dust suppression by scientifically designed water sprinkling system on raw material/products at the equipments and transfer points should be adopted as an auxiliary air pollution control measure.

vi. The roads inside the stone crusher premises should be metalled and the stone crusher premises should be cleaned regularly to avoid re-entrainment of settled dust. Regular wetting of the ground within the premises be adopted as an auxiliary air pollution abatement measure.

vii. Organization of health checkup camps for the checking of stone crusher workers.

viii. All appropriate environmental management measures detailed in this report, together with any other environment management commitments should be implemented.

The above 'equipment specifications' should be primarily and compulsorily enforced on all stone crushers. SPM standard as prescribed in Environmental (Protection) Act, 1986 must be complied by every individual stone crusher.

Suggestions to the Industry

- Suction device with water spray at the aggregate crusher.
- Additional water sprays arrangements at different parts of the crusher units.
- Water spray may be provided on muddy roads to avoid dust.
- Ear mufflers and mouth masks for the workers.
- The worker's training to use the ear plugs.
- Creating awareness of safe ear cleaning procedures.
- Special training on safety for workers.
- Government must admit that child labour exists on a large scale in the mines.
- An enquiry must be commissioned immediately by the Governments of India and on the magnitude of the exploitation of children in the mine and violation of children's rights in the area.
- Legal action by the Department of Labor under the Child Labor (Prohibition and Regulation) Act, 1986, The Mines Act, 1952 and The Bonded Labor System Abolition Act, 1976 must be immediately taken against the employers.

Conclusion

It may be concluded that joint efforts of government, non-government organization and the general public approach are very essential abatement of stone crusher pollution. So, it is very necessary to control and reduce air pollution as much as possible so that we can preserve aesthetic beauty of nature and purity of environment not only for ourselves but also for our coming generations.

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LIGNOCELLULOLYTIC BIO-AGENTS IN DECOMPOSITION OF AGRO-WASTE TO PRODUCE VALUE ADDED BIOFERTILIZER

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Lignin and cellulose containing agro waste substrates or plant biomass are decomposed by beneficial bio-agents such as bacteria (*Bacillus subtilis*, *Pseudomonas fluorescens*), fungi (*Trichoderma spp*, *Pleurotus ostreatus*, *Polyporus ostriformis, Aspergillus spp.*).These bacteria and fungi as specific bio-agents are known to play an important role in decomposition of lignin or cellulose based organic materials. Cellulose degrading micro-organisms hasten bio-degradation of crop residues viz. straw, leaves, trash etc. and such microbial cultures have been used for composting of plant biomass but still time taken process to prepare bio-fertilizers or organic fertilizers. The decomposition process of agro-wastes means organic disposal through natural succession of micro-flora. The idea of mass multiplication, manipulating and controlling the soil micro-flora through microbial inoculants ,organic amendments, cultural and management practices to create a more favorable soil involvement for optimum crop production and protection has been continuously in practice (Lynch *et al*., 1991).Some bacteria and fungi are able to promote plant growth upon root colonization and functionally designated as plant growth promoting rhizo-bacteria (PGPR) and plant growth promoting fungi (PGPF) which regarded as non- pathogenic soil inhabiting saprophytes. These PGPR and PGPF have been reported as beneficial micro-organisms to several economically important agricultural, horticultural and ornamental crop plants not only promoting their growth but also protecting them against diseases. One of the primary functions of filamentous fungi in soil is degrade organic matter and help in soil aggregation. Besides these properties, certain species of *Trichoderma*, *Alternaria*, *Aspergillus*, *Cladosporium*, *Dematium*, *Gliocladium*, *Helminthosporium*, *Humicola* and *Metarhizium* produce substances similar to humic acid and hence, may be important in the maintenance of soil organic matter in rhizo-sphere region. Finally, such useful micro-organisms degrade agro-waste materials through decomposition process also enhance nutrient uptake, growth and induce host resistance in plants.

Agro- waste in the form of crop residues and organic materials is generated in large quantities and constitutes abundant biomass in agriculture. These materials are under-utilized as a source of renewable biomass. Approximately 700 million tons crop residue is available in India. Uttar Pradesh produces highest amount of crop residues among all states. The most widely uses of crop residues are roof material, animal feed, fuel and packing materials. The rest plant biomass is disposed by burning and land-filling. The later process is easier and cheaper but non-scientific which increases air pollution, soil erosion and decreases soil health. Moreover, it also causes respiratory problems and increases fog incidents even in distant cities. Incorporation of untreated agro-wastes in soil decreases crop yield due to production of microbial toxins, allelo-chemicals and immobilization of available nutrients. Crop residues like paddy straw increases the Methane gas (CH4) emission especially in irrigated soils or lowlands and burning of wheat straw or other organic materials which is responsible for continuous increase in global warning.

Plant biomass is the most abundant renewable source of beneficial micro-organisms on earth and thus, also considered as attractive source of bio-energy and bio-chemical based product. It mainly consists of lignin,

cellulose and hemi-cellulose. The more complex the substance, the more extensive and comprehensive enzyme system is required. For optimizing the use of plant biomass through refining and lignin degradation has become a key target of last few years. Decomposition of agro-wastes through lignin-cellulose degrading micro-organisms is easier to manage and it recycled material when applied to the soil improves soil fertility and plant health. Beneficial micro-organisms such as bacteria and fungi are most extensively used bio-agents for decomposition of lignin and cellulose based plant biomass but still time taken for composting is too long. The time constraints can be overcome by using some lignin degrading micro-organisms in combination with cellulose degrading micro-organisms.

Crop residues enhance soil organic matter. The soil organic matter (SOM) provides substratum for micro, meso and macro soil-biota. The SOM also enhances antagonists which suppress soil-borne pathogens. Soil predators reduce soil pests. Slow mineralization of C and N activates genes that promote disease tolerance and crop diversity as well as low free N content in foliage. Mutualists enhance Nitrogen fixation, Phosphorus uptake, water use efficiency etc and certain invertebrates (*Collembola* and detritivores) serves as alternate food to natural enemies in times of pest scarcity. Plant root- microbe interactions arise from specific interaction between groups of bacteria and fungi that are adapted to live in the rhizosphere. The plant growth promoting rhizo-bacteria and fungi are also adapted to exploit this niche and proliferate in the rhizosphere. These organisms often act synergistically in combination with arbuscular mycorrhizal fungi (AMF). Of particular importance in plant health and soil fertility are the PGPR and PGPF. Their effects are mediated through a variety of mechanisms. Some rely on interaction with potential phyto-pathogens such that bio-protection results (Azc-n-Aguilar and Barea, 1996). Others produce compounds that directly stimulate plant growth such as vitamins or plant hormones (Barea, 1997, 2000). Others, such as the fungus *Trichoderma* may stimulate plant growth in more than one way (Ousley *et al*., 1994).The most well known beneficial effect of micro-organisms on crop plants are two ways firstly, direct effects on plant growth promotion (PGPM) and secondly, bio-control agents(BCA) that indirectly assist with plant productivity through the control of plant pathogens. In addition to their primary effects on plant productivity and health, respectively, recent work has shown that these beneficial micro-organisms possess secondary i.e. most recently discovered effects that may bestow them increased interest of growers (Whipps, 2004; Vassilev *et al*. 2006). More specifically, PGPMs have shown activities related to bio-control of soil-borne pathogens. Conversely, bio-control agents (BCA) have demonstrated properties that directly promote plant growth. Some BCAs exhibit predatory behaviour under nutrient –limited conditions. However, such activity generally is not expressed under typical growing conditions. For example, some *Trichoderma spp.* produces a range of enzymes that are directed against cell wall of fungi. However, when fresh bark is used in compost, *Trichoderma spp*. do not directly attack the plant pathogen Rhizoctonia solani, but in decomposing bark, the concentration of readily available cellulose decreases and this activates the chitinase genes of *Trichoderma spp.,* which in turn produce chitinase to parasitize *R. solani.* In general, the rhizosphere has an extremely complex microbial community including saprophytes, epiphytes, endophytes, pathogens and beneficial micro-organisms. Naturally, these microbial communities tend to live in relative harmony when all populations generally balance each other out in their quest for food and space. This review will focus on recent study of lignin and/or cellulose containing agro-wastes materials management through beneficial bio-agents.

Potential mode of action of PGPMs and BCAs with primary and secondary beneficial effects on plants showed that soil micro-organisms are paramount in the biogeochemical cycling of both inorganic and organic nutrients in the soil and maintenance of soil quality. In particular, microbial activity in the rhizosphere is a major factor that determines the availability of nutrients to plants and has a significant influence on plant health and productivity. An understanding of the basic principles of rhizosphere microbial ecology including the function and diversity of the micro-organisms that reside there, is necessary before soil microbial technologies can be applied (Bolton *et al*., 1992).Soil-plant-microbes interactions are complex and there are many ways in which the outcomes can influence plant health and productivity(Kennedy,1998).

Bio-fertilizers or bio-manures are an eco-friendly substitute of harmful chemical fertilizers. They enrich the overall quality of soil through transformation of organic matter into essential nutrients that can make

plants healthy and productive. They are usually prepared as carrier based inoculants containing effective micro-organisms. Several kinds of agro-waste materials are considered as a good carrier for the inoculants. The bio-degradation of such substrates or organic materials in to simple sugars provides energy source for hetero- trophic micro-organisms such as phosphorus solublizing and nitrogen fixing bacteria. The beneficial inoculants are bacteria (*Bacillus spp*. & *Pseudomonas spp*. etc.), fungi (*Trichoderma spp*., *Aspergillus niger AN- 23* etc), cyno-bacteria (Blue green algae) and vascular arbuscular mycorhizae (*Glomus spp*.). These microbes have various abilities which could be exploited for better farming practices. Some of them help in combat diseases while some have the ability to degrade soil complex compounds into simpler forms which are utilized by plants for their growth. The above inoculants are extremely beneficial in enriching the soil by producing organic nutrients and also convert insoluble to soluble form for increasing plant yield and enhance safe and healthy environment. It is necessary to produce useful bio-agents as bio-activators under suitable conditions prior to use on commercial level. Mass multiplication techniques of the lignin and cellulose degrading inoculants on low cost substrates, long time survival and feasible delivery system are important part of biological research and development. The potential inoculants can be utilized for integrated pest management tool as well as to increase degradation process of agricultural wastes which will be an instant organic source with anti-mycotic or anti-fungal potential and help in reducing the soil-borne diseases in crop plants and cumbersome burning of crop residues that enhance safe and healthy environment.

Generally, almost all commercial crop plants are attacked by various soil-borne and foliar pathogenic fungi resulting billions of dollar in cumulative losses. Currently, the most widely used control measure for suppressing these diseases are the use of toxic fungicides. However, problems encountered such as development of pathogenic resistance to fungicides and inability to seed- development of an important and alternate approach in this direction. The use of beneficial micro-organisms for the control of plant pathogens is known as biological control. It is accepted as a suitable and eco-friendly alternative or a supplemental way of reducing the use of chemicals in plant disease management. Generally, bio-formulations are considered to be ideal for pest management because of this specificity to pests and also their lack of toxicity to humans or natural enemies of many crop pests. Natural crop pests including pathogenic fungi, bacteria, viruses, entomo-pathogenic nematodes (EPNs) and harmful insect-pests are chiefly controlled by imported expensive chemicals which are the main cause of environmental pollution, have detrimental effect on human health and cause death of not only pests but many useful insects too.

North Indian states including Uttar Pradesh are generated maximum agro-waste or crop residue from mainly three crops viz. paddy, wheat and oilseeds. On an average, these crop residues or wastes contain approximately 0.5% N, 0.2% P2O5 and 0.15%K2O. Assuring that half of the crop residues are utilized as cattle feed and fuel. The nutrient potential of the remaining residue is 6.5 million tonnes NPK annually, which account for 30% of total NPK consumption in the country. Hence, re-cycling of these waste materials is not only ecological necessity but in the state or country it is economic compulsion. Composting of agro-wastes or crop residues through action of ligno-cellulolytic micro-organisms is easier to manage and it re-cycles the agricultural waste material with high economic efficiency. The re-cycled material when applied to soil, it improves soil fertility and plant health as well as rhizo-sphere environment.

Composting is the biological degradation and stabilization of organic substrates under conditions that allow development of thermo-philic temperature as a result of biologically produced heat. During this process, meso-philic populations build up initially by the utilization of simple nutrients which raises the temperature of the piles. Thermo-philic micro-organisms proliferate in the second phase. The final product is stable, free of pathogens and viable seeds and can be beneficially applied to land or soil. The decomposition process of agro-wastes has been used as a means of organic disposal through natural succession of micro-flora. The specific bacteria and fungi are known to play important role in composting of lignin-cellulose based organic materials. Cellulose degrading micro-organisms hasten bio-degradation of crop residues such a straw, leaves trash etc. and such microbial cultures have been used for composting of plant residues but still time taken process to prepare organic bio-fertilizers.

Future Strategy:

In India, approximately 700 million tonnes organic waste is generated annually in India leading to challenges for its safe disposal with the waste being usually burned or land filled (Bhiday, 1994; Nagavallemma *et al*, 2006 and Zeinhom *et al*. 2010). However, there are several natural occurring micro-organisms that are able to convert organic- wastes into valuable resources such as plant nutrients and reduce C: N ratio to support soil productivity. These microbes are also important to maintain nutrient flow from one system to another system and minimum ecological imbalance (Novinsak *et al*.2008; Umsakul *et al*. 2010).

A preferred and environmentally sound method of agro-waste decomposition is composting which changes organic waste into bio-manure or organic fertilizer and soil conditioner through biological processes (Alexander, 1999 and Gautam *et al*., 2010).The high organic C content and biological activity of compost make it effective for applications such as soil erosion control and re-vegetation(Anastasi *et al*., 2005). The composting process involves 3 phases and uses diverse micro-flora such as bacteria, fungi and mesophilic (*Steptomyces rectus*) and thermophilic actinomycetes (*Actinobifida chromogena*), *Thermomonospora fusca,* Microbispora (*Thermopolyspora*, *Thermobispora*, *Thermomonospora curvata* (Thermoactinomyces spp.) eventually converting organic waste to humus(Buyuksonmer *et al*. 2000; Pedro *et al*., 2003; Schloss *et al*., 2003 , Zeng *et al*., 2011).During the first phase , there is an increase CO2 along with temperature. The substrate is reduced due to degradation of sugar and protein by the action of mesophilic organisms (Hellmenn *et al*., 1997; Schloss *et al*., 2003; Novinsak *et al*., 2008; Zeng *et al*., 2011). The second phase leads to an increase of temperature in the compost piles from 15*c to approximately 70*c and the mesophiles are replaced by thermophiles (Pedro et al., 2003; Schloss *et al*., 2003). Large numbers of pathogenic individuals are degraded during the time of composting (Novinsak *et al*., 2008). The third phase begins with the decrease of temperature of the compost pile.

The use of microbial products as bio-fertilizing agents are not considered harmful to ecological processes (Rodrigues and Frega, 1999). Beneficial effects of the microbial inoculation as bio-fertilizer to many crop plants have been described by earlier scientists (Antoun *et al*., 1998; Chabot *et al*., 1998; Pal, 1998; Peix *et al*., 2001 a & b; Sarawgi *et al*., 1999 and Tomar *et al*., 1996).

Farmers and extension functionaries are target people. Large scale production of value added bio-fertilizers at cheaper cost is a better substitute of costly fertilizers and harmful chemicals. Utilization of available organic wastes in the form of bio-fertilizers or bio-manures will be a direct benefit to the society by reducing environmental pollution which in turn provides a safe and healthy atmosphere.

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ROLE OF SCIENCE AND TECHNOLOGY IN GLOBAL FOOD SECURITY

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Abstract

Food security exists when all people, at all times, have social, physical and economic access to safe, sufficient and nutritious food which meets their nutritional needs and food preferences for an vigorous and healthy life. Science and technology can make a major contribution in food security by providing practical solutions. Important areas for focus include: crop protection through integrated pest management, crop improvement through genomic techniques, soil management, conservation agriculture and nanotechnology.

Introduction:

Food security is generally framed in four dimensions: access to food, food availability, food stability and utilization and use of food. These dimensions build the largely framework of the definition established by the Food and Agriculture Organization of the United Nations (FAO): *"*Food security exists when all people, at all times, have social, physical and economic access to safe, sufficient and nutritious food which meets their nutritional needs and food preferences for an vigorous and healthy life"[1]. The FAO estimated that the number of starved people in the world increased by 75 million in 2000, mainly attributed to high food prices. This brought the proportion of people in the world without access to sufficient food back to the levels of a decade ago[2].

The global challenges of food security and high food prices, mainly of major cereal crops, have severe impacts in countries considering the region is the largest cereal importer in the world. The great weakness of food security in countries, due to their rapidly growing populations, highlights the dire need in the region to focus on agriculture development. Supporting innovative research will arm the countries to increase their productivity and sustainably develop their rural economy. Today, the advances made in agricultural research and technology development can help release the potential of production systems in dry areas even with scarce natural resources – making it entirely possible for countries to significantly increase their food self-sufficiency.

Science and technology for food security:

A number of technologies can play a role in addressing concerns related to the four dimensions of food security

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Food security	Challenges	Examples of science and technology
Food availability	Biotic stresses	Disease or pest resistant crops
	Abiotic stresses	Heat, drought and salinity Tolerant varieties
	Improving crop productivity	Conventional breeding Tissue culture Marker-assisted breeding Advanced genetic engineering
	Lack of water availability	Water storage technologies (subsurface water technologies aquifers, ponds, tanks, low cost plastic water tanks, natural wetlands, reservoirs) Rainwater harvesting mechanisms Wastewater reuse Conservation agri culture
	Soil	Synthetic and organic fertilizers Zero or conservation tillage
	Farming in urban environments	Indoor farming Vertical farming Aquaponics Low-cost greenhouses
Food access	Post-harvest loss (storage, refrigeration and transport)	Fruit preservation technologies Nanotechnology Improved genetic varieties Innovative packaging Low-cost solar dryers Vacuum sealing
Food utilization and use	Lack of nutritious foods especially staple crops	High-nutrient staple crops
Food stability	Lack of financial mechanisms to ensure income	Index-based insurance

Solutions From Science And Technology

1. **Crop protection:** Crops are attacked by a great variety of pests, diseases and weeds. A key challenge to the protection of current production is the emergence of new pests and diseases, in addition to the spread of current diseases[5]. The well-managed use of conventional pesticides must continue to play a key role. However, there are also opportunities for greater use of integrated Pest Management (IPM) is an environmentally friendly approach to pest control that combines an extensive range of organic techniques to control and prevent the growth and spread of pest populations. It emphasizes the use of cultural and biological interventions and supports the targeted use of pesticides only when alternative methods have been exhausted; costs are not excessive and there is no threat to existing agro-ecosystems.

2. Crop improvement: As the global population is increasing, the capabilities of crop plants remains the most cost-effective and powerful means of achieving food security, particularly in dry areas. Crop

improvement through breeding has been key to success of agriculture. This entails robust ongoing research on plant genetics and crop improvement to increase yield potential along with crop protection through desirable traits for resistance/tolerance to abiotic (e.g. drought, extreme temperatures, salinity). Research to develop improved crops that are appropriate for local conditions is vital to their widespread adoption, and schemes to promote greater participation of local farmers in research have accelerated both development and adoption[6,7]. New genomic techniques, such as marker assisted breeding, allow greater selectivity and reduce the element of chance in plant breeding. These techniques have been used to promote a range of qualities such as submergence tolerance in rice and increased resistance to pests and diseases[3].

Transgenic modification confers a number of benefits, including tolerance to biotic stresses (insects and disease),abiotic stresses (drought), improved nutrition, taste and appearance, herbicide tolerance and reduced use of synthetic fertilizers. Given the challenges of increasing water scarcity and land degradation, such technologies potentially increase productivity per area unit or plant.

3. Soil management: Genetically improved varieties capacity to increase their yields if constraints such as low soil fertility is overcome. Synthetic fertilizers have been used to increase agricultural yields for decades but their capital intensity, dependence on natural gas particularly in the case of nitrogen and a large ecological path make them unsustainable. Over use of fertilizer and water cause environmental damage and represent an economic waste for smallholder farmers.

4. **Nanotechnology:** The combination use of nanoemulsions and pesticides can be applied more easily and safely. Smart, nanotechnology-based, sensors, applied to the field, may in future allow early detection of disease and monitoring of soil conditions to improve application of water, fertilizers and pesticides[4]. However, as with any new technology, the potential risks must be investigated and weighed against the benefits.

5. ***conservation agriculture:*** *Conservation agriculture* is a set of soil management practices that minimize the disruption of the soil's structure, composition and natural biodiversity. It has proven potential to improve crop yields, while improving the long-term environmental and financial sustainability of farming.

Conclusion: Food security through the twenty-first century is reachable, but must be tackled consistently with other global challenges. Existing science and technology tools offer to increase agricultural production but sustainable management of natural resources must be the cornerstone of agricultural practices in the fragile agro-ecosystems.

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MILK BYPRODUCT UTILIZATION

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Byproduct Utilisation (Milk)

Lassi: The term is also used to indicate the leftovers from whole milk curd after churning it for Desi butter. This is almost entirely a product of rural butter/ghee making process, and is mostly consumed by the farmer as a beverage. In the Southern States like Tamil Nadu and Andhra, this diluted byproduct of the butter industry is sold either to substitute the requirements of curd by the less well-to-do sections of the community, or to serve as a welcome beverage, specially when salted.

It is heartening to note that some of the major dairies have now introduced production and sale of flavoured butter milk (from sub-standard receipts) as an economically feasible means of disposing poor quality receipts from the farmer, or late returns from the consumer supplies. At any rate, there is reason to believe that practically all but a negligible portion of this nutritious product containing anything from 1-3% proteins and equivalent quantities of milk, sugar and growing lactic acid bacteria is satsifactorily utilised.

Skimmed Milk: All skimmed milk of fresh quality produced during cream separation in the organised sector is exploited for production of skimmed milk powder for use as a constituent for reconstitution and recombination in the production of fluid milk during lean months. How-ever, so far hardly 7-10 percent of the entire milk production is handled by the organised sector. The skimmed milk left over in rural areas is almost entirely converted into non-edible industrial casein of inferior quality suitable for glazing, glue making, etc. In the north-eastern parts of the country, some quantities of skimmed milk are converted into channa (an edible proteinous product used in the milk-based confections). Here again, the protein part of skimmed milk finds edible use, while the watery whey with considerable quantities of solids is drained off. There is reason to believe that whereas approximately 1,400 million kg, of skimmed milk is available, nearly 60% is uneconomically utilised.

Whey: In countries advanced in dairying, it is this byproduct that is receiving increasing attention. In the first instance, the whey proteins, milk sugar, minerals and water soluble vitamins which escape into the skimmed milk are considered as valuable nutritional constituents. Secondly, when this product is let out into the ponds, rivers or lakes, there results a consequent purification of atmospheric pollution and elimination of dissolved oxygen of the water leading to depletion or even death of aquatic life.

Laboratory, semi-commercial and large scale methods have been evolved to isolate the whey proteins by electro-osmosis, ultra centrifugation procedures developed for seperating the lactose from whey. Also procedures have been evolved to dry whey with minimum damage to the whey proteins. Cold precipitation techniques have been evolved to separate out the whey proteins for subsequent drying, and use as protein enriched foods by processes such as electro-osmosis, ultrafiltration, ion exchange, etc. Such methods have also been tried out in the types of whey available in our country, and the usefulness of the isolated whey proteins in improving the biological value of baby foods, preparation of milk biscuits, egg-substitutes, etc. has been accepted beyond question. For exploitation on a cottage industry scale, procedures have been standardised to process and bottle clear whey with sugar and citric acid to produce highly palatable beverages

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providing thirst quenching and nutritive attributes. It is also possible to ferment whey for the production of alcoholic beverages.

Ghee Residue: The estimated quantity of the ghee residue available is around 4.5 million kg per annum. The product contains approximately 30-40 percent fat and about 40-50 percent moisture, the rest being pro-teins and salts. However, the proteins in ghee residue are fully denatured. When parally defatted to remove loose fat, and subsequently processed by cooking in steam/water, the material serves as an excellent base for toffers. Experiments conducted in National laboratories have established its use for edible purposes.

However, here again the collection of rural produced raw material is the crux of the problem acting as a limiting factor for its use.

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PRIVATE SECTOR'S IMPORTANCE IN FOOD SECURITY

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Introduction

Food security is all about achieving a reliable access to adequate, affordable and nutritious food Supplies sufficient to avoid chronic hunger, crisis hunger and stunted development. Once basic caloric needs are met, a second stage of food concerns surfaces around safety and healthfulness. This safety dimension involves securing food supplies free from contamination, adulteration or food-borne diseases and healthy foods that reduce the influence of diet-based diseases and promote well-being.

While talking about the country India where more than a-third of its population is estimated to be absolutely poor, and as many as one half of its children have suffered from malnourishment over the last three decades. Several important issues have emerged in the context of food security in India. These have been (a) the liberalization of the economy and its impact on agriculture and food security; (b) the establishment of the WTO and the agreement on Agriculture; (c) climate change and its impact on food production and prices; (d) the prevalence of hunger and poverty coexisting with high levels of food stocks; (e) the introduction of the targeted Public Distribution System (f) the „Right to Food" campaign; and (g) the National Food Security Bill. These important issues have posed severe challenges for food security in the country. The Food and Agricultural Organization (FAO) states that food security emerges when all people at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. Food security has three important and closely related components, which are availability of food, access to food, and absorption of food. Food security is thus a multi-dimensional concept and extends beyond the production availability, and demand for food. There has been a definite and significant paradigm shift in the concept of food security from mere macro level availability and stability to micro level household food insecurity, and also from an assessment of energy intake to measures and indicators of malnutrition.

A brief Overview of Food Security in India

The era of green revolution (1960s) was a historic watershed that transformed the Food security situation in India. It tripled food grain production over the next three or four decades and consequently reduced by over 50 percent both the levels of food insecurity and poverty in the country, this was achieved in spite of the increase in population during the period, which almost doubled. The country succeeded in the laudable task of becoming a food self-sufficient nation, at least at the macro level. The per capita dietary energy supply increased significantly from 2370 kcal/day in the early1990s to about 2440 kcal/day in 2001-03 and to 2550 kcal/day in 2006-08. The prevalence of undernourishment in the total population also decreased from 25 to 20 per cent during the period of 1990 to 2000, and as many as 58 million individuals were estimated to have come out of the poverty trap. The absolute number of poor Persons came down from 317 million to 259 million with other livelihood indicators such as the literacy rate and longevity increasing substantially. The life expectancy at birth for males and females respectively, in 2005-06 was 63 and 66 years respectively as compared to that in 1986-91, which was as low as 58 and 59 years for males and females respectively (Agricultural Statistics at a Glance; 2007).

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The achievement of macro level food security and the discernable improvement in per capita consumption is not enough; the country is still home to a-fifth of the world's undernourished population. This given situation has been ascribed to high and increasing population pressure with nearly 16 million people being added annually to the already large population exceeding 1.2 billion. This situation of hunger and malnutrition is also equally on account of serious problems related to the distribution and economic access to food, which adversely affect household and individual level food insecurities. According to the FAO‟s latest food security report, micronutrient and vitamin A deficiency were the prime determinants to child health and nutrition in India. It is reported that nearly 57 percent of pre-school children suffered from vitamin A deficiency, a significantly higher level as compared to even Sub Saharan Africa. The infant mortality rate in India (for infants under one year) was as high as 56 in 2005. The NFHS-3 reported that 19 percent of India's children were wasted, 38 percent stunted, and 46 percent were underweight, figures that are disturbing and far from satisfactory. The extent and nature of food insecurity can be broadly categorized into (1) Chronic Food Insecurity (2) Nutritional Insecurity (3) Food Insecurity caused by lack of Food Absorption, and(4) Transitory Food Insecurity. There are several factors, both on the supply side, as well as the demand side that may cause chronic food insecurity. The most important supply side determinants of food insecurity are (a) the level of domestic food production, (b) the imports of food and (c) the distribution of food (PDS). The determinants on the demand side are (i) the growth of population (ii) the purchasing power; (iii) product prices/subsidies and (iv) the extent and effectiveness of supportive social programmes and schemes such as the ICDS, the Mid Day Meal scheme, Food for Work Programmes, and Rural Wage Employment Programmes. . (Agricultural Statistics at a Glance; 2007).

Private Sector Coping the Global Food Security Challenge

Food security is an urgent global issue. The reasons behind food insecurity are numerous, complex and multifaceted. Persistent poverty and undernourishment, combined with political and socio-economic challenges, are the major underpinnings of food insecurity globally. Other major contributing factors include production shortfalls, agricultural impact on the environment, global climate change, water scarcity, natural disasters, rapid population growth, changing consumption trends and price volatility. All these and other challenges only heighten the concern for the future of food access and security over the coming decades. The good news is many leading companies are on the forefront of helping solve the global food security crisis. In 2008, for example, General Mills launched Partners in Food Solutions, a consortium of leading global food companies, including Royal DSM and Cargill, and in partnership with Techno Serve and the for International Development. The consortium aims to help strengthen the capacity of hundreds of food companies in several African nations — including Ethiopia, Kenya, Malawi, Tanzania and Zambia — impacting 550,000 small-holder farmers. It encourages other companies with additional capabilities to join to broaden its reach to continue to improve the food value chain in Africa. Additionally, six coffee industry leaders — Starbucks, Keurig Green Mountain, S&D Coffee, Farmer Brothers, Counter Culture Coffee and Sustainable Harvest Coffee Importers — have launched the Coffee Lands Food Security Coalition, which aims to combat seasonal hunger among coffee-farming families in coffee-producing regions. A three-year program, “Empowering Food Secure Communities,” was established in partnership with the global humanitarian organization Mercy Corps and Nicaraguan organization Association “Aldea Global” Jinotega. The program targets 150 women and their families to improve business and farming techniques to support food security and improve livelihoods in coffee-growing communities.

In 2010, Wal-Mart and the Wal-Mart Foundation launched “Fighting Hunger Together,” a $2 billion cash and in-kind commitment through 2015 to combat hunger in the U.S in partnership with hunger relief organizations and food banks. Goals include donating more than 1.1 billion pounds of food valued at $1.75 billion, award $250 million in grants to hunger relief organizations, mobilize Wal-Mart customers and employees to contribute their time and expertise to fight hunger, and partner with other companies, foundations, government and food manufacturers. In addition, Wal-Mart is collaborating with USAID through the government's Feed the Future initiative, which aims to support rural small-holder farmers in

Central America, connect them to Wal-Mart's international and regional supply chains, and improve nutrition for customers through greater access to more diverse local produce. Part of the Feed the Future initiative, the New Alliance for Food Security and Nutrition is a broader collaborative effort that brings together the private sector, donors and the investment community to drive sustainable agriculture in Africa and lift 50 million people out of poverty by 2022.

In 2012, DuPont set food security goals for 2020, including committing $10 billion to R&D and introducing 4,000 new products focused on producing more food, reducing waste, bolstering food availability and shelf life, and enhancing food and agriculture sustainability; educating 2 million youth; and improve the livelihoods of at least 3 million farmers and their communities. DuPont also launched the Global Food Security Index, developed by the Economist Intelligence Unit, a comprehensive tool to measure the drivers of food security affordability, availability, quality and safety in more than 100 countries. (Economic Times)

Agriculture and Private Sector

Indian agriculture has witnessed significant transformation over the past few decades. The changes range from new entrants into the sector to new and improved technologies, to farming becoming more mechanized, to weather, soil and environmental changes, to new markets and demand, and most importantly to agriculture evolving from just a way of life to a full-fledged business agribusiness. These changes have unfortunately not been accompanied by changes on the institutional and policy front. Even in instances where amendments have been introduced on the policy front they have not necessarily been accompanied by changes on the organizational and institutional fronts. This disconnect has limited the growth potential of this vital sector. The state research and extension systems are not sufficiently robust and the lack of regional strategic thrust as well as field-level operational flexibility has restricted the potential of the Indian agricultural growth story. There is an overlapping of the roles and responsibilities of the central and state institutions. On the legislative, constitutional, policy and financing/funding front, the Centre seems to play a dominating role and is the main decision-making authority in terms of agricultural policies, programmes and schemes which are designed primarily to have direct or indirect impact on state agriculture. There also exists the challenge of delays in the process of budgetary allocation from the central level to the different state-level bodies, agencies and the farmers. Policy dialogue between the Centre and states has also not been efficient enough.

The need to develop a long-term strategy that would reduce the vulnerability of the farming community and accelerate agricultural growth is thus imperative. What is required are institutional reforms and technological breakthroughs, which trigger agricultural transformation. It is here that the central and state governments play a key role through national and state research systems as the future and success of the agricultural sector in India depends on how the Centre and states function with respect to each other, and how they facilitate the sector across the country. The panchayati raj institutions also need to be re-integrated fully into the agricultural system for sustainable and equitable growth. The hitherto problem of non-involvement of farmers in the planning process will be addressed by involving the panchayati system in the process of agriculture planning by introducing the three-tier system. This again would require certain institutional and policy reforms along with facilitating mechanisms that would ensure a smooth participative system. All of the above would require focused and strategically designed institutional reforms that would facilitate the movement towards a robust agricultural sector jointly driven by the public and private sector. An in-depth analysis of the situation, and the required institutional and legal structure reforms that emerge there from could also involve a review of the redundant aspects in the constitutional framework to enable some of the changes. The need of the hour is an in-depth analysis and review of the current system, identification of the problem areas and the subsequent formulation of institutional and policy reforms that would ensure an efficient governance mechanism to facilitate the new/ reformed system a system that allows for a smooth functioning of the Centre, states and private sector players in a combined effort to boost Indian agriculture.

A well developed food value chain is essential for the development and success of the Indian

agribusiness sector. This, however, requires the identification and implementation of appropriate projects and interventions. Lack of Agri infrastructural facilities can severely affect, and in fact nullify, the gains in value and efficiency in the agricultural sector. These bottlenecks need to be dealt with and removed in a focused manner. This can be done by facilitating and extending Public Private Partnership (PPP) principles from the infrastructure sector to the agribusiness sector.

While the government plays a paramount role in the food and agriculture sector through legislation, policy guidelines, support pricing, subsidies, agri-extension services along with providing various essential inputs like fertilizer, water and energy (very often at concessional rates), the importance of the private sector is being increasingly recognized in terms of the additional investments that it can mobilize as well as its greater efficiencies, which ensure superior service delivery to the end consumer with the objective of maximizing service to the common man at an affordable price. PPP has thus been recognized as an important facilitator of and a probable mechanism to facilitate and foster the participation of the private sector along with the government, both central and state, in order to achieve social objectives as well as ensure the marketability and profitability of the agricultural sector both in terms of technology and final output. Given that PPP is a relatively new approach in India, focus first needs to be directed to the policy and governance front in order to create an enabling environment for successful implementation of PPP Projects.

Financial institutions (FIs) play a key role in the agri-business sector, primarily on the credit front due to the priority sector lending requirement. However, the link between FIs and agri-business does not end with just credit to the farmers. FIs should be an integral component of the agri-system and finance should be available at each and every stage of the value chain in order to make the agri-system sustainable. Government should refrain from direct participation but should facilitate this integrating process by creating appropriate institutional mechanisms and policy frameworks. Decisions like farmer loan waivers do not in any way help farmers meet their credit needs. The government should aim at reducing the dependence of farmers on subsidies and loan waivers but help in capacity building and training programmes such that the farmers can assess their credit needs on the basis of which they are able to take informed and calculated choices and decisions.

Banks and FIs must consider setting up focused groups within the organization that cater specifically to advisory on the policy and governance front. This would act as a huge enabler for integrating the financial sector with agriculture. The possibility of tie-ups with international training organizations in order to provide farmers training to carry out hi-tech and high-value farming need to be explored. It is only when all the concerned stakeholders come together under the common umbrella of enhancing agricultural growth that we will be able to identify specific focus areas where institutional reforms are needed and comprehend the nature of these reforms. There are a variety of challenges that need to be addressed in the agricultural sector. These need to be identified, worked upon along with formulating appropriate institutional and policy reforms as well as appropriate regulatory and governance mechanisms (Dreze, J. and A. Sen,)

Role of Private Sector in Food Security in India

Agriculture is the back bone of most of the developing nations including Malawi for income, growth, food, fuel and medicine. It impacts on health and nutrition on the other hand, health and nutrition impacts on agricultural production and productivity. This is a clear indication that agriculture, health and nutrition are interlinked and sectors involved in these three areas need take into account his relationship from policy to implementation.

The private sector plays different roles from production, processing, marketing and consumption. In production, private sector is involved in research and development of different inputs required for production, such as seed, fertilizers, farming technologies, contract farming, extension services, information, and communication technologies (ICT) and transportation. The sector has a critical role in marketing and post harvest management, processing, value addition to the products, marketing based on research, distribution based on need and demand. The sector is also directly involved with consumers of agricultural products, process and package products based on consumers preferences and needs, follow global and national food

standards and resolutions such as on infant feeding affecting milks and complementary foods, ICT on availability of agricultural products and services that support agriculture, healthier diets and life styles. Private sector is also strong in capacity building in all areas of agriculture, linking farmers (producers) to retailers or processors to consumers and vice versa.

The private sector translates global and national policies into action for marketing purposes and deliberate move to deal with a health and nutrition problem. For example, biotechnology bio fortification, food fortification, and general food processing for different target groups, the sector is contributing to solutions for availability and access to diversified food products and macro and micronutrient deficiencies and access to medicines for prevention and treatment of health problems. The sector is committed to implement global, regional and national policies and strategies if made aware such as the Code of marketing breast milk substitutes and subsequent resolutions, the WHO global strategy on diet, physical activity and health, Codex alimentations, agriculture, nutrition and health policies and regulations. In the processing industry, occupational health regulations and procedures are implemented for the health considerations of the staff and products. The sector has the capacity to inform and educate the public on this linkage. However effective promotion and implementation of interventions towards this linkage depends on policies and standards prevailing in each country and monitoring mechanisms however there are challenges in monitoring and reinforcement of these policies and programmes. Most of the times the private sector involved in this linkage have a nutrition and or health objective to be achieved although in other cases it may be secondary, the primary objective might be value addition to increase demand for the product. For example Valid Nutrition.

Objectives of strategies

To make highly nutritious "ready-to-use food" products for prevention and treatment of malnutrition more accessible and affordable for those that need them most. To prevent contagious diseases from agricultural products and people visiting and working within the factory.

Strategies: Use of current nutritional needs and requirements started with severe acute malnutrition(SAM) greatest need, currently working on moderate acute and chronic malnutrition using global and national policies and standards, Research and development on use of locally available and acceptable foods (development of recipes, acceptability trials and efficacy trials) before release, of the formulation.

Ingredients for RUTF are peanut paste or chick pea/ sesame and soon Malawi will start using Soybean, maize sorghum combination, milk, sugar, cooking oil, vitamins and minerals. Sourcing of these ingredients can be a challenge- in terms of availability and quality. VN works directly with organized farmers groups such as NASFAM and Exagris to ensure the right paste and quality is procured at the same producers get information and surety on market and prices of their products. Partners with the public sector to ensure that distribution, access and utilization is based on needs.

VN working with NASFAM and Exagris and processors of peanut paste is helping to have peanuts and its paste with acceptable levels of aflatoxin, there is testing of paste before and after production for aflatoxin, strict routine biochemical and microbial testing, implementation of personal hygiene and occupational health regulations to prevent contamination and transfer of infections.

Food security, both at the national and household levels, has been the focus of agricultural development in India ever since the mid-sixties when import dependence for cereals had gone up to 16 percent. The new approach intended at maximizing the production of cereals and involved building a foundation of food security on three key elements including provision of an improved agricultural technology package to the farmers, delivery of modern farm inputs, technical know-how and institutional credit to the farmer. The performance of agriculture, however, has not been satisfactory. The share of agriculture in the Gross Domestic Product (GDP) has registered a steady decline from 36.4 percent in 1982-83 to 13.7 percent in 2015-16. But agricultural sector continues to support more than half a billion people providing employment to 52 percent of the workforce (Radhakrishna and Ray, 2014).

Strategies for improving in Food Security

The following are the measures to be taken for improve food security for growing population through higher food production.

1. Literacy & Education: - Role of education in improving farm efficiency and technology adoption has been well established. As agriculture transformed from subsistence to commercial level, farmers seek information on a wide range of issues to acquire knowledge or upgrade their skills and entrepreneurial ability. Literacy emerges as an important source of growth in adoption of technology, and use of modern inputs like fertilizers and machines. An educated workforce makes it easier to train and acquire new skills and technologies required for productivity growth. Thus, contribution of literacy will be substantial on yield growth and domestic supply of food.

2. Diversification: - Food availability is a necessary condition for food security. India is more or less self sufficient in cereals but has deficit in pulses and oilseeds. Due to changes in consumption patterns, demand for fruits, vegetables, dairy, meat, poultry, and fishery products has been increasing. There is a need to increase crop diversification and improve allied activities to produce such crops and produces in which we are deficient.

3. Coping climate change:- Food security in India can be achieved by paying higher attention to issues such as climate change, limiting global warming, including the promotion of climate-smart agricultural production systems and land use policies at a scale to help adapt and mitigate ill effects of climate change.

4. Water management Integration:- India needs to produce more crop per unit of land and water resources. Alarming rates of groundwater depletions and increasing environmental and social problems pose acute threats to mankind. Improved management of irrigation water is essential in enhancing production and productivity, food security and poverty alleviation. Agriculture is the biggest user of water accounting for over 80 percent of the water withdrawals. There are pressures for diverting water from agriculture to other sectors. It has been projected that availability of water for agriculture use in India may be reduced by 21 percent by 2020, resulting in drop of yields, especially rice, leading to price rise and threat to food security of the poor. The needs of other sectors for water cannot be ignored. As a result, it is necessary that an integrated water use policy is formulated and judiciously implemented. Modern methods of irrigation like sprinkler, drip irrigation, fustigation, among other water efficient tools need to be adopted on larger scale.

5. Integrated nutrient management:- Attention needs to be given to balanced use of nutrients. Phosphorus deficiency is the most wide spread soil fertility problem in both irrigated and non-irrigated rained areas. To improve the efficiency of fertilizer-use, what really needed is enhanced location-specific research on efficient fertilizer practices, improvement in soil testing services, development of improved fertilizer supply and distribution systems and development of physical and institutional infrastructure.

6. Improved varieties: - In several regions, farmers are not able to get information about the availability of new and improved varieties and some are not having access to quality seeds of these varieties, resulting in lesser yields. This situation has to be corrected by developing a national-level network to monitor and coordinate the activities with the various State government functionaries working in the area of crop production

7. Improved technology adoption:- Adoption of technologies like integrated nutrient management, integrated pest management and integrated weed management need to be made available for adoption to ensure higher production and sustainability of production base.

8. Awareness on population growth :- The awareness of the pressures of increasing population growth and consumption patterns on ecosystem functioning should be created to sensitize farmers on adoption of sustainable crop cultivation and management practices.

9. Focus on small farmers:- Increase in food production in the country does not necessarily ensure food security, if the poor do not have the buying power. Therefore, participation of small farmers in food production is essential to achieve food security. Most of them being illiterate and having failed earlier either in

adopting new technologies or repaying the loan provided under various development schemes. They need support not only to procure inputs but also to gain confidence.

The strategy to enhance the food production should address the problems of such small landholding farmers, who constitute over 83 percent of farmers in the country. They own less than two hectare of land per family, mostly marginal and non-irrigated. They have been practicing low-external input farming and the crop yields have been substantially low. However, their contribution to the national food production is considerable and meets a significant part of their food needs.

10. Agricultural research education:- The agricultural education in India is facing one of the biggest challenges. It has to identify its role in equipping the human resources for enhanced agricultural productivity and sustainable use of natural resources. Agricultural colleges and universities were initially assigned to disseminate scientific knowledge and skills to the farming community and to train them to use such skills for better output. As a backup for such a mission, agricultural research was encouraged to focus on scientific knowledge to suit to the realities of rural societies.

However, these initiatives could not keep pace with the fast changing scientific and technical improvements and gradually failed in their objective to cultivate the most modern skills and attitudes to both agricultural students and farmers. Therefore, updation of the curricula of agricultural education has become imperative. This is very relevant to teaching, research and extension functions of the university as they form the inter-related, theoretical and practical basis of modern agricultural education in India.

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