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EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON GROWTH, YIELD AND QUALITY OF TOMATO (LYCOPERSICON ESCULENTUM MILL) cv. ARKA VARDAN

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ABSTRACT

A field experiment entitled "Effect of Integrated Nutrient Management on Growth, Yield and Quality of Tomato (*Lycopersicon esculentum* Mill.) cv. Arka Vardan" was conducted at Research Farm, Department of Horticulture Kulbhaskar ashram PG college prayagraj (U.P) during Rabi Session 2022-2023. The experiment consisted 8 treatment combinations *viz*.T1 ¯Control, T2– 100% RDF (100:50:50 NPK respectively), T3– Neem cake (50%) + Vermicompost (50%) + PSB + Azotobacter, T4 -Neem cake (50%) + Poultry manure (50%) + PSB + Azotobacter,), T5 -Neem cake (50%) + FYM (50%) + PSB + Azotobacter,, T6 -Neem cake (25%) +Vermicompost (25%) + FYM (25%) + Poultry manure (25%) + PSB + Azotobacter, T7– RDF 50% + 50% (Neem cake (12.5%) + Vermicompost (12.5%) + FYM (12.5%) +Poultry manure (12.5%)) + PSB + Azotobacter, T8 – RDF 75% + 25% (Neem cake (6.25%) +Vermicompost (6.25%) + FYM (6.25%) + Poultry manure (6.25%) + PSB + Azotobacter, which was laid out in randomized block design (RBD) with three replications. Observation were recorded on growth attributes viz., plant height and number of branches per plant at 20, 40, 60,80 DAT and at harvest (120DAT), number of leaves per plant at 20, 40, 60and 80 DAT and at harvest (120DAT), Leaf area at 20, 40, 60,80 DAT and at harvest (120DAT) and at harvest; phenological attributes viz., no. of flower cluster/plant, days to first flowering, days to 50% flowering and days to first fruit picking , No. of fruit/plant; yield attributes viz., fresh weight of fruit (g), dry weight of fruit(g), polar diameter(cm), equatorial diameter(cm), fresh weight of plant (g), dry weight of plant(g), fruit yield /plot (kg), fruityield /ha(q); quality attributes viz., shelf life, total soluble solids(°Brix) and acidity(%). The findings obtained from the study have been summarized as follows: The result revealed that application of recommended dose of fertilizers (RDF) along with bio fertilizers.

The findings of the experiment with respect to growth parameters revealed significant effect of various treatments. Highest number of branches per plant(1.72,3.53,6.32,14.80and 24.69), leaf Area (170.27, 207.97,288,335.27 and 359.26cm^2) , Number of cluster(28.40), Number of leaves(6.55,16.66,50.78,70.17 and 76.84) were observed in treatment T8. Highest plant heights (38.22,47.04,71.62,95.20 and 113.38cm), was observed in T2. While the minimum value of all these growth parameters was found under the treatment T1.

The findings of the experiment with respect to phenological parameters revealed significant effect of various Treatments. Minimum number of days to first flowering(42.39), number of days taken to 50% flowering (54.39), First picking of fruit(83) were observed in treatment T2 followed by T8. While the minimum value of all these growth parameters was found under the treatment T1.Highest polar diameter (cm) (5.32cm) was found under T8 followed by T7. While the lowest value under the treatment T1. Highest Equatorial diameter

(cm)(5.07cm) was found under T8 followed by T2. While the lowest value under the treatment T1. Highest fresh weight of plant (g)(164.53gm), dry weight of plant (g)(57.47gm) was found under T2 followed by T8. While the lowest values these parameters was found T1. The significantly maximum number of fruits per plant(43.33), fresh weight of fruit (g)(64.99gm), dry weight of fruit (g)(3.60gm), fruit yield per plot (kg)(19.62kg), fruit yield/ha. (q.) (269.22q); was found under T8 followed by T2. Whereas the minimum number of fruits per plant, fresh weight of fruit (g), dry weight fruit (g), fruit yield per plot (kg), fruit yield/ha. (q.); was found under T1.Quality parameters of the tomato denoted significant effect of various treatments. Maximum shelf life (days) (13.31 days) and total soluble solids (°Brix)(4.52^{0}brix) in tomato fruits were estimated with treatment T7 followed by T8 whereas the minimum value of all these quality parameter was found under the treatment T1. The significantly maximum acidity (%)(0.69%) was found under the treatment T8 followed by T7. While the minimum acidity (%) found under the treatment T1.In T8 recorded maximum net return of (Rs 156237/ha) with the highest cost benefit ratio(1.38) followed by T2 ,while the minimum net return,cost benefit ratio was estimated in T1.

Result of present study thus clearly indicated that different treatments significantly influenced the growth, yield , quality and maximum net return and cost benefit ratio of fruit and soil quality in tomato (Arka Vardan). It may be concluded from the findings of the present study that among the different treatments of tomato, T8 (RDF 75% + 25% [Neem cake (6.25%)+Vermicompost (6.25%) + FYM (6.25%) + Poultry manure (6.25%)] + PSB + Azotobacter,) recorded superior performance over other treatment for fruit quality and yield. Among the different treatments T2– 100% RDF (100:50:50 NPK respectively),showed highest growth viz., plant height, days to first flowering,days to 50% flowering ,days to first picking, fresh and dry weight of plant. Quality attributes like T.S.S., shelflife, were recorded in T7– RDF 50% + 50% [Neem cake (12.5%) + Vermicompost (12.5%) + FYM (12.5%) + Poultry manure (12.5%)] + PSB + Azotobacter.

Keywords : *INM, tomato, growth, yield*

INTRODUCTION

Tomato is the world's largest vegetable crop and known as protective food both because of its special nutritive value and also because of its wide spread production. Tomato is one of the most important vegetable crops cultivated for its fleshy fruits. Tomato is considered as important commercial and dietary vegetable crop.

Tomato (*Lycopersicon esculentum* Mill.)is one of the most important vegetable crops grown all over the world due to its wider adaptability to various agro-climate conditions.India ranks second in area and production of tomato in the world.

Cultivated tomato is generally accepted to have originated in the tropical America since all related species of tomato are native to the Andean region and form where it spread to other parts of the world in the 16thcentury and became popular in India within the last 9 decades. In England, It was populary known as'love of apple'. Tomato is a very remunerative crop for small and marginal farmers. There are various types of flavoring compounds found in tomato fruits, which enrich the taste. Tomato is used directly as raw vegetable in sandwiches, salad etc. and several processed products like paste, puree, soup, ketchup, drinks; whole peeled tomatoes, sauces and chutney are prepared on large scale. The pulp and juice are digestible, a promoter of gastric secretion and blood purifier. For tomato nutrition management is one of the most important factors which govern the tomato production. Tomato is a good source of vitamins,

viz, ascorbic acid and vitamins C,vitaminA,thiamin or vitamin B1 and riboflavin or vitaminB2 in that order.A100g edible portion of tomato contains 94.1gwater, 1gprotein,0.3gfat,4gcarbohydrates, 1,100 IU vitamin A, 0.2 mg vitamin B, mg nicotinic acid, 0.31 mg pantothenicacid, 23 mg vitamin C, 0.27 mg vitamin E, 390 mg citric acid, 268 mg potassium 27 mg phosphorous and 51mg chlorine.It also contains higher quantity of total sugar (2.54.5%),starch(0.6 1.2%)and minerals like potassium, calcium, sodium, magnesium, phosphorous, boron ,manganese , zinc, copper, iron, etc .Apartfromthese, it also contains organic acids such as citric, malic and acetic acids which are known as health acidsin fresh tomato fruit. The flavor of tomato fruits is controlled by various volatile compounds like ethanol and acetaldehyde.

Arka Vardan is a F1 hybrid between IHR550-3 X IHR932 Plants in determinate. Fruits arge (140g.) round with green shoulder, tolerant to cracking with thick flesh. Develops deep red colour on ripening Resistant to nematodes.

MATERIALS AND METHODS

A field experiment entitled "Effect of Integrated Nutrient Management on Growth, Yield and Quality of Tomato (*Lycopersiconesculentum* Mill.) cv. Arka Vardan" was conducted at Research Farm, Department of Horticulture Kulbhaskar ashram PG college Prayagraj (U.P) during Rabi Session 2022-2023. The experiment consisted 8 treatment combinations *viz*.T1 – Control,T2–100% RDF (100 :50 :50 NPK respectively) ,T3- Neemcake (50%)+ Vermicompost (50%) + PSB + Azotobacter, T4 - Neem cake (50%) + Poultry manure (50%) + PSB +Azotobacter,), T5 -Neem cake (50%) + FYM (50%) + PSB + Azotobacter,, T6 - Neemcake(25%) +Vermicompost (25%) +FYM (25%) +Poultrymanure (25%) +PSB+Azotobacter,T7- RDF50% + 50% (Neemcake(12.5%) +Vermicompost(12.5%)+FYM (12.5%) +Poultry manure (12.5%)) + PSB+ Azotobacter, T8 – RDF 75% + 25%(Neem cake (6.25%) + Vermicompost (6.25%) + FYM (6.25%) + Poultry manure (6.25%) + PSB + Azotobacter, which was laid out in randomized block design (RBD) with three replications and the treatment factor is RDF (100 :50:50),FYM(25tn/ha),vermicompost (5tn/ha), paultry manure (3tn/ha), neem cake (2tn/ha), azotobactor (5kg/ha),PSB (5kg/ha).total number of plot-24,size of field- 24m x 11m,gross plot size-3.3m x 2.7m,net plot size-3m x 2.4m. pure,healthy and best quality seed obtained from IIHR Bengaluru,Karnatka. Observation were recorded on growth attributes viz.,plant height and number of branches per plant at 20, 40,60,80DAT and at harvest (120DAT) ,number of leaves per plant at 20,40,60 and 80 DAT and at harvest(120DAT), Leaf area at 20, 40, 60,80 DAT and at harvest (120DAT) and at harvest;phenological attributes viz., no. of flower cluster/plant, days to first flowering, days to 50% flowering and days to first fruit picking ,No.of fruit/plant; yield attributes viz.,fresh weight of fruit(g),dry weight of fruit(g),polar diameter (cm) ,equatorial diameter(cm), fresh weight of plant (g), dry weight of plant(g), fruit yield /plot (kg), fruit yield /ha (q) ;quality attributes viz.,shelf life,total soluble solids(°Brix) and acidity(%).The findings obtained from the study have been summarized as follows: The result revealed that application of recommended dose of fertilizers (RDF) along with biofertilizers. The significance of the treatment difference was judged by using critical difference (C.D.), which was calculated by using formula given by Panse and Sukhatme (1984).

RESULTS AND DISCUSSION

I. GROWTH PARAMETERS

The significantly maximum plant height 38.22, 47.04, 71.62, 95.20, 113.38 cm were recorded

in treatment T2 (100% RDF) at all DAT and at harvest), followed by T8 , While the minimum plant height (28.80, 36.30, 61, 82.34, 100.45cm) was observed in treatment T1 (control.) at all DAT and at harvesting respectively.The significantly maximum number of branches per plant i.e. 1.72, 3.53, 6.32, 14.80, and 24.69 were observed under the treatment T8 (RDF 75% + 25% [Neem cake (6.25%) +Vermicompost (6.25%)+FYM (6.25%) +Poultry manure (6.25%)] + PSB + Azotobacter). followed by T2,While minimum number of branches per plant was observed in case T1 (control) The data clearly indicated that the number of leaves per plant in tomato plants responded significantly to various treatments at all the growth stages (20, 40, 60, 80 and at harvest. The significantly maximum 6.55, 16.66, 50.78, 70.17 and 76.84 leaves per plant were found under the treatment T8 (RDF 75% + 25% [Neem cake (6.25%) +Vermicompost (6.25%) +FYM (6.25%) + Poultry manure (6.25%)] + PSB +Azotobacter) followed by T2, Whereas, the minimum leaves per plant was recorded in treatment T1 (control) at all DAT and at harvest respectively.The average leaf area per plant of various treatment of organic manure and bio fertilizers at 20, 40, 60, 80 DAT and at harvest.Treatment T8 (RDF 75% + 25% [Neem cake (6.25%) +Vermicompost (6.25%) + FYM (6.25%) + Poultry manure (6.25%)] + PSB + Azotobacter), was observed the significantly highest 170.27, 207.97, 288.00, 335.27 and 359.26cm^2 leaf area per plant and was superior over other treatments of organic manure and bio fertilizers at all DAT (20, 40, 60, 80) and at harvest followed by T2,Whereas, the lowest leaf area per plant was recorded under treatment T1 (control) at all DAT and at harvest respectively.

The significantly maximum number of flowersper plant was recorded in the treatment T8 (RDF 75% + 25% [Neem cake (6.25%) +Vermicompost (6.25%) +FYM (6.25%) +Poultry manure (6.25%)] + PSB+Azotobacter). valued 28.40 followed by T2 ,while minimum number of flower cluster was noted in treatment T1. The significantly minimum days taken into first flowering was recorded in the treatment T2 (100% RDF) valued 42.39 followed by T8,while The maximum days flowering per plant was recorded in treatment T1 .The minimum days taken to 50% flowering was recorded in the treatment T2 (100% RDF) valued 53.25 followed by t T8 while the maximum days flowering per plant was observed in treatment T1. The treatment T2 (100% RDF) resulted in the shortest period taken to first fruit picking in tomato valued 83.00 which is followed by T8 while the treatment T1 showed in the longest period taken to first fruit picking in tomato . The maximum fresh weight of plant was recorded in the treatment T2 (100% RDF) valued 168.23.g followed by T8 while the minimum fresh weight of plant was recorded in treatment T1 . Maximum dry weight of plant i.e.58.13 was observed T2 (100% RDF) followed by T8 and the minimum dry weight of plant was noted under T1

II. YIELD PARAMETERS:

Significantly highest polar diameter of fruit was measured under the T8 (RDF 75% + 25% [Neem cake (6.25%) + Vermicompost (6.25%) + FYM (6.25%) + Poultry manure (6.25%)] + PSB + Azotobacter) 5.32 cm which was followed by T7 while lowest polar diameter of fruit under T1. Highest equatorial diameter of fruit was measured under the T8 (RDF 75% + 25% [Neem cake (6.25%)+ Vermicompost (6.25%) + FYM (6.25%) +Poultry manure (6.25%)] + PSB + Azotobacter) i.e. 5.07cm which was followed by T2 while Lowest equatorial diameter of fruit was noted under T1. Highest fresh weight of fruit was found under the T8 (RDF 75% +

25% [Neem cake (6.25%) + Vermicompost (6.25%) + FYM (6.25%) +Poultry manure (6.25%)] + PSB + Azotobacter).valued 64.99 g which was followed by T2 both were found at par with each other. Minimum weight of fruit i.was noted under T1 . Highest dry weight of fruit was found under the T8 (RDF 75% + 25% [Neem cake (6.25%)+Vermicompost (6.25%) +FYM (6.25%) + Poultry manure (6.25%)] + PSB + Azotobacter) valued 3.96 g which was followed by treatment T2 while Minimum dry weight of fruit was noted under T1.The significantly the maximum yield was recorded treatment T8 (RDF 75% + 25%[Neem cake (6.25%) + Vermicompost (6.25%) + FYM (6.25%) + Poultry manure (6.25%)] +PSB + Azotobacter). Valued 19.62 kg. and followed by T2 ,While, the minimum fruit yield per plot was found in treatment T1.The significantly the maximum yield was recorded treatment T8 (RDF 75% + 25%[Neem cake (6.25%) +Vermicompost (6.25%) + FYM (6.25%) + Poultry manure (6.25%)] +PSB + Azotobacter). Valued 269.22 q/ha. And followed by T2 , While, the minimum fruit yield per plot was found in treatment T1. . Significantly maximum no. of fruit per plant was recorded under the treatments T8 (RDF 75% + 25% [Neem cake (6.25%) + Vermicompost (6.25%) +FYM (6.25%) +Poultry manure (6.25%)] + PSB + Azotobacter). value 43.33 Followed by T2, However, treatment T1 (control.) was recorded minimum No. of fruit per plant.

III. QUALITY PARAMETERS:

Shelf life of fruit was recorded maximum in the treatment T7– (RDF 50% +50% [Neemcake (12.5%)+Vermicompost (12.5%) + FYM (12.5%) +Poultry manure (12.5%)]+ PSB+ Azotobacter) valued 13.31 days and followed by T8 while the minimum number of days was to be observed in T1.The highest T.S.S. was observed in treatment T7– (RDF 50% + 50%[Neem cake (12.5%) +Vermicompost (12.5%) +FYM (12.5%)+Poultry manure (12.5%)] + PSB + Azotobacter) valued 4.52 (0brix) followed by T8, the lowest T.S.S. of was recorded in treatmentT1 . The highest Acidity was observed in treatment T8 (RDF 75% + 25% [Neem cake (6.25%) +Vermicompost(6.25%)+FYM (6.25%) +Poultry manure (6.25%)] + PSB + Azotobacter) valued 0.74 (%) followed by T7, the lowest Acidity of was recorded in treatment T1.

Table - 1 : Value of Different Parameters in Different Treatments

Treatments	Plant height (cm)					Number of branches/plant				
	20DAT	40DAT	60DAT	80DAT	12ODAT	20DAT	40DAT	60DAT	80DAT	120DAT
T1	28.80	36.30	61.00	82.34	100.45	1.15	2.97	5.22	10.10	13.28
T2	38.22	47.04	71.62	95.20	113.38	1.64	3.42	6.04	13.68	21.92
T3	31.22	38.72	64.80	87.92	104.38	1.59	3.07	5.35	11.27	17.43
T4	31.30	39.22	62.89	87.25	102.45	1.16	2.92	5.25	10.37	15.05
T5	33.42	40.18	66.25	90.43	106.44	1.22	2.99	5.12	11.37	17.95
T6	34.62	41.95	69.37	91.29	109.39	1.54	3.23	5.97	12.22	19.00
T7	34.82	42.68	69.50	92.15	109.59	1.44	3.33	6.07	13.97	20.88
T8	35.72	46.03	70.26	93.11	110.47	1.72	3.53	6.32	14.80	24.69
MSE	0.393					0.911				
CD (5%)	1.294					2.648				

Table - 2 : Effect of INM on Leaves / Plant and Leaf Area per Plant of Tomato

Treatments	Number of leaves/plant					Leaf area per plant (cm^2)				
	20DAT	40DAT	60DAT	80DAT	120DAT	20DAT	40DAT	60DAT	80DAT	120DAT
T1	5.19	13.72	36.22	56.12	63.65	67.26	87.32	129.38	149.97	158.33
T2	6.35	15.10	49.00	67.75	76.76	165.27	199.97	276.32	326.15	335.30
T3	5.22	14.07	36.42	59.92	70.32	105.35	148.50	180.15	223.37	243.00
T4	5.15	13.92	36.34	58.75	68.29	88.15	109.26	164.27	174.15	185.37
T5	5.85	15.00	40.00	63.00	71.00	122.12	129.00	196.37	260.00	258.43
T6	5.75	14.65	41.84	64.95	72.35	137.38	163.14	238.31	285.25	298.00
T7	6.00	15.36	48.30	65.34	73.94	152.07	185.12	257.00	315.12	318.51
T8	6.55	16.66	50.78	70.17	76.84	170.27	207.97	288.00	335.27	359.26
MSE	**1.176**					**7.660**				
CD (5%)	**3.426**					**22.312**				

Table - 3 : Effect of INM on Yield Parameter of Tomato

Treatments	No. of flower cluster/plant	Days to first flowering	Days to 50% flowering	Days to first fruit picking	Number of fruit per plant	Fresh weight of plant(g)	Dry weight of plant(g)	Polar diameter(cm)
T1	21.24	46.13	57.12	86.25	40.12	116.03	43.28	4.26
T2	27.72	42.39	53.25	83.00	43.15	168.23	58.13	5.21
T3	23.65	45.00	56.32	85.68	40.97	137.69	50.04	4.44
T4	21.87	45.40	57.00	86.19	41.00	123.12	46.04	4.37
T5	25.91	44.35	55.22	84.32	42.45	144.00	53.05	5.00
T6	26.91	44.67	56.25	85.74	42.25	128.78	47.20	5.11
T7	27.42	43.74	55.29	84.77	42.00	154.46	54.27	5.23
T8	28.40	42.67	54.39	84.00	43.33	164.53	57.47	5.32
MSE	**1.7961**	**0.932**	**0.6827**	**0.5576**	**0.8026**	**12.126**	**3.5477**	**0.266**
CD (5%)	**5.3883**	**2.805**	**2.0475**	**1.6725**	**2.4075**	**36.375**	**10.6425**	**0.795**

IV. COMPERATIVE ECONOMICS OF THE TREATMENTS:

The maximum fruit yield of 269.22 q/ha. Was recorded in treatment T8 (RDF 75% + 25% [Neem cake (6.25%)+Vermicompost (6.25%) +FYM (6.25%) + Poultry manure (6.25%)] +PSB + Azotobacter). which recorded the maximum net return of (Rs 156237/ha.) with the highest cost benefit ratio (1.38) followed by T2 while ,the minimum cost benefit ratio was estimated in the treatment T1

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Table - 3 : Effect of INM on Quality Parameter of Tomato

Treatment	Equatorial Diameter(cm)	Fresh weight of fruit(g)	Dry weight of fruit (g)	Fruit yield (kg/plot)	Fruit yield(q/ha)	Shelf life	T.S.S (^{0}brix)	Acidity(%)	B:C
T1	4.29	50.76	2.59	12.82	174.82	11.22	3.87	0.55	0.75
T2	4.96	61.76	3.60	17.65	242.00	13.09	4.34	0.62	1.25
T3	4.39	51.99	2.92	14.00	230.24	12.18	3.97	0.58	0.83
T4	4.33	51.17	2.84	13.00	232.42	12.19	3.92	0.57	0.86
T5	4.46	56.46	3.00	14.89	235.69	12.24	3.99	0.60	0.97
T6	4.69	53.74	2.99	16.99	238.47	12.45	4.17	0.64	0.91
T7	4.85	58.52	3.17	17.85	239.17	13.31	4.52	0.69	1.04
T8	5.07	64.99	3.96	19.62	269.22	13.25	4.47	0.74	1.38
MSE	**0.196**	**3.5619**	**0.3426**	**1.758**	**23.656**	**0.5076**	**0.1561**	**0.477**	
CD (5%)	**0.585**	**10.6854**	**1.0275**	**5.268**	**70.962**	**1.5225**	**0.4683**	**0.1782**	

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AN ECONOMIC ANALYSIS OF GRAM CULTIVATION IN PRAYAGRAJ DISTRICT OF UTTAR PRADESH

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ABSTRACT

Pulses are important with the view of their food and nutritional security and also income and employment generation ability. India has secured first rank in pulses production with 36 percent and 26 percent of the world area and production. In India Uttar Pradesh has 5th position in pulses production with 8 percent area and 10 percent production. The present study has focused on economic analysis of gram cultivation in Prayagraj district UP. A list of villages under Saidabad Block were prepared on the basis of area under pulses crop, 5 villages were selected as per proportionate randomly sampling, from the list. Total 120 respondents were selected from 5 villages under study to achieve the objective. Simple tabular analysis and cost concepts was done to find out the result. It was found that the Gram cultivation is profitable at all categories of farm. The total cost of cultivation and gross income per acre were positively related to the size of farms, were as negative trend of net income with the size of farms. The overall average cost of cultivation was found Rs. 17606.37 per acre and the per acre net income was Rs. 16486.67 per acre.

Keywords : *Cost of cultivation, net income, cost concepts, pulses production*

INTRODUCTION

Pulses provide nutritional security to the Indian population and play a positive role in achieving the objection of sustainable development. It is the second important constituent of Indian diet after cereals. As an important source of protein provider to human nutrition. The total world acreage under pulses, as recorded during 2020 is about 931.83 lakh ha with production at 898.21 lakh tonnes with a productivity of 964 kg/ha. India has secured ranks first in area and production with 36 percent and 26 percent of the world area and production respectively with a view that it takes reasonably a larger share at global level. However, in case of productivity Canada stood first with 2212 kg/ha. It is also evident that India's productivity at 704 kg/ha is far below the world average productivity of 964 kg/ha Pulses are rich in proteins. Pulses are rich in lysine and they are therefore of good supplementary source to the cereal diets. As per 201-22 ministry survey report, Bengal gram has covered 11.20 million hectare area with 13.98 million tonnes production in India.

MATERIALS AND METHODS

1. Sampling technique:

The proportionate random sampling technique was used for the selection of district, block, villages and respondents.

2. Selection of district:

Prayagraj district of Uttar Pradesh was selected purposively seeing the convenience of investigator.

3. selection of block:

A list of all 23 block of Prayagraj district was prepared and one block namely Saidabad was selected purposively for the study.

4. Selection of village

A list of all the villages falling under Saidabad block was prepared and five villages was selected randomly from the list ……

5. Selection of respondents:

A separate list of all the gram crop growers of from five villages were prepared along with their size of holding, and were grouped into two categories; Marginal (below 2.5 acre) and Small (>2.5 acre). From the list, 120 respondents were selected for the study.

6. Period of study

The data was pertained to the agricultural year 2022-23

7. Analytical tools:

Suitable statistical tools were applied to analyse the data for estimating the result.

8. Tabular Analysis:

For tabular analysis of data, percentages, arithmetic mean, & weighted mean were used.

Weighted average $= \sum W_i X_i / \sum W_i$

Where,

W.A= weighted average of X_i

X_i = variable .

(b)- Arithmetic mean= $\sum X_i / N$

Where,

I= 1……..n

Xi=value of variable

N= number of observation

Cost Concept:

Costs include following certain concepts. The cost concepts and the items of cost included under each concept are given below:

Cost A_1:

This cost includes approximates and actual expenditure incurred in cash and kind.

1. Value of hired/owned human, bullocks, machinery and implements labour.
2. Value of seed (both farm produced and purchased)
3. Value of manure (owned and purchased)
4. Value of insecticides, pesticides and chemical fertilizer.
5. Depreciation on implements and farm building.
6. Irrigation charges.
7. Land revenue, assets and other taxes.
8. Interest on working capital.

Cost A_2: Cost A_1+rent paid for leased in land.

Cost B_1: Cost A_2+interest on value of owned fixed capital assets (Excluding Land)

Cost B_2: Cost B_1+ rental value of owned land (net land revenue) and rent paid for leased in land.

Cost C_1: Cost B_1+ imputed value of family labour.

Cost C_2: Cost B_2 + imputed value of family labour.

Cost C_3: Cost C_2+10% of C_2(Managerial cost)

Income concepts:

Gross income:

Value of farm output (main product and by product) whether sold or utilize by the farm family.

Net income:

It is the difference between gross income and

total cost, i.e.

Family labour income:

Gross income – cost B_2.

Farm investment income:

Net income + rental value of owned land + interest on owned fixed capital.

Or

Farm business income- imputed value of family labour.

Farm business income:

Gross income- cost A_1 or cost A_2 in case of land leased in farm.

RESULTS AND DISCUSSION

(a). Per acre costs of cultivation of gram crop:

Per acre costs incurred on the various input factors in gram cultivation was worked out and are given in Table 1. The Table 1 shows that thecosts of cultivation was highest on small farms Rs. 17862.17 followed by marginal farms Rs. 17452.91 respectively. The overall average costs of cultivation was observed Rs. 17606.37 on sample farms.

The major component of the cost were total human labour 19.30 percent followed by tractor/machinery charges 16.46 percent, rental value of land 16.04 percent, interest on fixed capital 12.67, seed 12.66 percent manure and fertilizers 5.21 percent, irrigation 4.01 percent, plant protection 3.61 percent, interest on working capital 0.91 percent respectively. Per acre cost of cultivation was found positive trend with farm size.

(b). Per acre costs and income from the cultivation of gram crop:

Table 2 revealed that on an average cost A_1/A_2, cost B_1, cost B_2, cost C_1, cost C_2, and cost C_3 came to Rs. 88868.50, Rs. 10793.70, Rs. 13593.70, Rs. 13205.91, Rs. 16005.62 and Rs. 17606.37 respectively. On an average gross income was recorded Rs. 34093.05 and net income came to Rs.16486.67. On small farms gross income was highest which was recorded Rs. 34256.5, and lowest on marginal farms i. e. Rs. 33995.

The net income was highest on marginal farms Rs. 16542.09 followed by small farms Rs. 16394.33. ON an average net income, family labour income, farm business income and farm investment income were observed to be Rs. 16486.67, Rs. 20499.35, Rs. 25224.55 and Rs. 22812.45, respectively. Family labour income was highest on marginal farms Rs. 20760.88 followed by small farms Rs. 20063.47 and farm business income was highest on marginal farms Rs. 25773.35 followed by small farms Rs. 24309.9 and farm investment income was highest on marginal farms Rs. 23141.18 followed by small farms Rs. 22264.59. On an average cost of production per quintal and yield per acre were estimated to Rs. 2700.82 per quintal and 6.51 quintal respectively.

On an average input output ratio regarding costs C_3, C_2, C_1, B_2, B_1 and A_1/A_2 were recorded 1:1.92, 1:2.12, 1:2.57, 1:2.50, 1:3.15 and 1:3.87 respectively. On the basis of cost C_3 input output ratio was highest on marginal farms 1:1.94 followed by small farms 1:1.91. It may be concluded that the costs of cultivation on different size group of farm decrease with an increase in farm size.

CONCLUSION

In case of gram highest cost of cultivation was observed under small size of sample farms mainly due to higher cost of labour,followed by cost of tractor and machinery. Overall average, cost of cultivation was worked out to be Rs. 17606.37 maximum cost incurred in the gram crop was average total human labour 19.72 percent, tractor and machinery 16.54 percent and rental and rental value of land average share of 15.90 percent.

Per acre gross income was observed maximum under small farms Rs. 34256.5 followed by marginal

Table - 1 : Per acre costs of different inputs used in gram cultivation (Rs.)

S.No.	Particulars	Size group of farms		
		Marginal	Small	Overall average
1.	**Total Human Labour**	**3368.67 (19.30)**	**3648.34 (20.42)**	**3473.53 (19.72)**
	Family Labour	2632.17 (15.08)	2045.31 (11.45)	2412 (13.70)
	Hired Labour	736.50 (4.22)	1603.03 (8.97)	1061.44 (6.02)
2.	Seed	2210.80 (12.66)	2510.32 (14.05)	2323.12 (13.19)
3.	Manure and Fertilizer	910.23 (5.21)	1220.21 (6.83)	1026.46 (5.83)
4.	Irrigation	700.00 (4.01)	750.00 (4.19)	718.75 (4.08)
5.	Tractor/Machinery charges	2873.32 (16.46)	2980.31 (16.68)	2913.43 (16.54)
6.	Plant protection	630.40 (3.61)	705.51 (3.94)	658.56 (3.74)
7.	**Total working capital**	**10693.42 (61.27)**	**11814.69 (66.14)**	**11113.88 (63.12)**
8.	Interest on working capital	160.40 (0.91)	177.22 (0.99)	166.70 (0.94)
9.	Rental value of land	2800.00 (16.04)	2800.00 (15.67)	2800.00 (15.90)
10.	Interest on fixed capital	2212.47 (12.67)	1446.43 (8.09)	1925.20 (10.93)
11.	**Sub total**	**15866.29 (90.90)**	**16238.34 (90.90)**	**16005.80 (90.90)**
12.	Managerial Cost @ 10% of sub total	1586.63 (9.09)	1623.83 (9.09)	1600.56 (9.09)
Grand Total		**17452.91 (100)**	**17862.17 (100)**	**17606.37 (100)**

(Figures in parenthesis indicate percentage to the total cost)

farms Rs. 33995. The gross income per acre was highest on small farms due to intensive cultivation & more use human labour and number of plant protection on these farms for high productivity. Productivity on these farms was associated with better management by farmers, timely cultural operations through family labours. On an average, gross income came to Rs. 34093.05 whereas net income was Rs. 16486.67 per acre. An overall average farm business income and family labour income were worked out to be Rs. 25224.55, Rs.20499.35 per acre respectively. Cost of production per quintal of gram was computed to be Rs. 2685.06 and Rs. 2727.04 on marginal and small farms. Input- output ratio related to cost C_3 was highest on marginal farms (1:1.94) followed by small farms (1:1.91).

Suggestions:

Different government departments like department of agriculture, plant protection and irrigation should assure the timely and adequate supply of the inputs and irrigation water.

1. Government should also ensure that the quality inputs are supplied to the farmers by different private agencies.
2. Agencies involved in disseminating the improved scientific techniques should organize more practical training programmers in order to increase the knowledge and skill of pulses growers.
3. Awareness among the farmers should be

Table - 2 : Per acre costs concepts for gram cultivation (Rs.)

S.No.	Particulars	Size group of farms		
		Marginal	Small	Overall average
1.	Cost A_1/A_2	8221.65	9946.6	8868.50
2.	Cost B_1	10434.12	11393.03	10793.70
3.	Cost B_2	13234.12	14193.03	13593.70
4.	Cost C_1	13066.47	13438.34	13205.91
5.	Cost C_2	15866.29	16238.34	16005.62
6.	Cost C_3	**17452.91**	**17862.17**	**17606.37**
7.	Yield q/acre	6.50	6.55	6.51
8.	Gross income	**33995**	**34256.5**	**34093.05**
9.	Net return over cost C_3	16542.09	16394.33	16486.67
10.	Family labour income	20760.88	20063.47	20499.35
11.	Farm business income	25773.35	24309.90	25224.55
12.	Farm investment income	23141.18	22264.59	22812.45
13.	Cost of production (Rs./q)	2685.06	2727.04	2700.82

S.No.	Particulars		Size group of farms	
		Marginal	Small	Overall average
14.	Input- output ratio			
a.	On the basis of cost A_1/A_2	1:4.13	1:3.44	1:3.87
b.	On the basis of cost B_1	1:3.25	1:3.00	1:3.15
c.	On the basis of cost B_2	1:2.56	1:2.41	1:2.50
d.	On the basis of cost C_1	1:2.60	1:2.54	1:2.57
e.	On the basis of cost C_2	1:2.14	1:2.10	1:2.12
f.	On the basis of cost C_3	1:1.94	1:1.91	1:1.92

developed to have the market information which may help for efficient disposal of marketable surplus.

4. For any agricultural knowledge and new technology farmers should call "KISAN CALL CENTER" Number 18001801551 and IFFCO call center 534351.
5. Farmer should also get knowledge on different mobile apps like AgriKheti, IFFCO Kisan, Khetibari, Agri market, Krishigyan and E Naam. Telivision programme like KisanBhartiabd AIR News programme etc.
6. Improved insects pest management practices should be applied for better production of pulses.

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AN ECONOMIC ANALYSIS OF PRODUCTION OF TOMATO CROP IN JAUNPUR DISTRICT OF UTTAR PRADESH

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ABSTRACT

The present study was conducted with a view to examine the cost and returns of Tomato production, input-output relationship as well as various measures of farm profits in Tomato crop on different size group of farms. A case study of Khutahan block of Jaunpur district has been carried out in 2017.A sample size of 60 farmers was selected using multi-stage random-cum-purposive sampling technique through personal interview by survey method. Percentage, simple and weighted menu was used as statistical measure. Cost of production work out to per quintal be Rs182.29 and overall average of input-output ratio comes to 1:5.48on the basis of cost C3. The return per rupee of investment was higher on the small size group of farm. The per hectare total cost of cultivation worked out to be Rs52298.08, gross-return and realized were Rs2,81,250 and net returns were Rs2,29,980.35 and overall average of input-output ratio comes to 1:5.48 on the basis of cost C3. The study concludes that the higher cost on input factors needed for product of Tomato crop. There is a big opportunity to increase the income and employment by shifting the area under Tomato crop from cereals and other crops. The study suggested that there is need to increase the use of modern technology for increasing Tomato production and farm income with the help of research and development programmers by govt. agencies for effective achievement of the goal.

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Keywords : *Tomato, economic, vegetable.*

INTRODUCTION

Tomato is one of the most important vegetable crop of cultivated for its freshly fruit of solanumhycopersicum which belong to family solanaceae. Tomato is grown and consumed by the people around the world. They are nutritious fibre, vegetable that provide good quantities of vitamin A and C. Tomato are used in many cooking recipes or as a fresh item in combination with salad. In our countries, large quantities of Tomato are utilized to produce soup, juice, ketchup, puree, paste and powder. It contains 98% moisture, 0.9% protein, 0.2% fat, 0.8% 3.4% carbohydrate and rich source of Vitamin C. Tomato can be preserved and available in the market round the year. Tomato is also a popular choice by people who wish to grown fruit and vegetable in their own garden and commercial purposes has the highest economic importance.

Keeping in view the important role played by Tomato in agricultural economy of the country, an attempt was made to study the profitability of production of Tomato crop in Jaunpur district of Uttar Pradesh.

MATERIALS AND METHODS

The sampling design consists of multi-stage random sampling. The random-cum-purposive sampling technique was used to select the block villages and farmers, Jaunpur district of Uttar Pradesh was purposively selected to represent a case study dealing with the convenience of investigator. The study details were draw out total 60 sample farms on the data collected by survey method from randomly selected 60 Tomato growers from four villages in Khutahan block arranged in descending order of the proportion of area under Tomato to gross area sown. Tomato is one of the most important cash crops of the world with 2nd ranking in the area as well as in the production. Tomato is an important vegetable crop of Uttar Pradesh and influences the condition of farmers of Eastern U.P. contributes major share of Tomato production. The study details were drawn out total 60 sample farms. Fifteen cultivators from each selected villages were randomly selected according to their proportion in various strata of population viz: Marginal (>1ha), Small (1-2ha), Medium (2-3ha), and Large (<3ha). The study period pertain to Agricultural year 2017. The primary data were collected by survey method through personal interview with use of restructure and pretested schedule while secondary data were collected from JilaVikasBhavan, Agricultural development office, Block Head Quarter, Books and Internet etc. The method and technique of tabular analysis percentage simple and weighted average were used. The formula used to estimate the average is: $WA = \frac{\sum W_1 X_1}{\sum W_1}$

Where,

WA- Weighted average

X_1 - Variable

W_1- Weight of 'X'

Above simplest and important measures of average which have been used into statistical analysis.

RESULTS AND DISCUSSION

The finding obtained from the present study is presented below under following head:

Per Hectare cost in the production of Tomato-

1. **Production-**The cultivators of Jaunpur are well known for Tomato cultivation from generations. The main crop rotation prevalent in the area is Tomato crop is a capital intensive crop requiring assured irrigation facilities and pant protection measure facilities in one hand and good fertile soil on the other.
2. **Cost Structure-**The cost of production include the cost of inputs like seeds, fertilizers , irrigation, plant protection measures, human labour and bullock labour/tractor power , rental value of owned land at prevailing market rate and overhead cost comprising of interest on working capital, interest on owned sized capital, depreciation, etc. The estimates of average cost on various inputs in Tomato production on sample holdings are shown in Table 1.

Per Hectare Cost in the production of Tomato-

This table indicate that on an average the total cost of cultivation of Tomato per hectare was highest on Marginal farm (Rs56071.07) followed by Small farm (Rs54400.03), Large farm (Rs51120.77) and Medium farm (Rs47929.50) among all the input items. Cost of total human labour (family -hired) contribute the highest, being 35.65% followed by

Table - 1 : Per Hectare Costs in the Production of Tomato

Sr. No.	Item	Size of Groups									
		Marginal		Small		Medium		Large		Overall	
		In Rs.	%age	In Rs.	%age	In Rs.	%age	In Rs.	%age	In Rs.	%age
(A)	Variable cost										
1.	Family Labour	23143.90	41.28	16207.20	29.79	9000.20	18.78	8886.95	17.38	14309.30	27.36
2.	Hired Labour	2124.88	3.78	3981.10	7.32	5150.40	10.74	5095.92	9.97	4088.07	7.82
3.	Total Human Labour	25268.78	43.06	20188.30	37.11	24150.60	29.52	14981.82	27.35	18647.37	35.65
4.	Bullock Labour	1221.55	2.18	756.90	1.39	193.80	0.40	185.40	0.36	589.41	1.13
5.	Tractor Charges	851.42	1.52	1369.92	2.52	1825.20	3.81	2081.70	4.07	1532.08	2.93
6.	Seed Cost	5472.45	9.76	4862.90	8.94	5106.42	10.65	5899.85	11.54	5335.40	2.93
7.	Manure and Fertiliser	5082.55	9.06	5906.80	10.86	4682.75	9.77	7173.70	17.38	5711.45	10.92
8.	Plant Protection Measures	1244.80	2.22	3658.90	6.73	3590.70	7.49	5008.60	9.97	3375.75	6.45
9.	Irrigation Charges	1477.95	2.64	1064.15	1.96	975.20	2.03	898.90	27.35	1104.05	2.11
(B).	Overhead Cost										
10.	Interest on working capital	1218.59	2.17	1134.24	2.08	915.74	1.91	1086.90	0.36	1088.86	2.08
11.	Depreciation	573.33	1.02	873.33	1.61	750.88	1.57	915.23	4.07	778.19	1.49
12.	Rental value of owned land	6000.00	10.70	6000.00	11.03	6000.00	12.52	6000.00	11.74	6000.00	11.47
13.	Interest on owned fixed capital	2562.20	4.57	3639.13	6.69	5080.98	10.60	2241.33	4.38	3380.91	6.46
	Sub Total	50973.70	90.91	49454.57	90.91	43572.27	90.91	46473.43	90.91	47543.75	90.91
	Managerial cost @ 10% on A+B	5097.37	9.09	4945.46	9.09	4357.23	9.09	4647.34	9.09	4754.35	9.09
	Grand Total	56071.07	100	54400.03	100	47929.50	100	51120.77	100	52298.09	100

manures and fertilizers 10.92%per cent , seed 10.20% , plant protection measures 6.45%, Tractor charges 2.93% and irrigation charges 2.11%. The overall overhead cost maximum 11.47% n rental value of land, followed by interest on owned fixed capital cost 2.08% and depreciation charges was 1.49%. The overall average total cost of cultivation incurred Rs52298.09. Per hectare cost of input factors on the basis of cost concept have been given in Table No- 2. It is observed that overall on an average the cost of cultivation per hectare of Tomato came to Rs22825.07 on cost A_1 & A_2, Rs26206 on cost B_1, Rs32206.00 on cost B_2, Rs40515.30 on cost C_1, Rs46515.30 on cost C_2 and Rs51269.65 on cost C_3respectively.

Measure of cost and return per hectare from the production of Tomato-

The per hectare average yield cost of production per quintal, gross-returns, net-returns and input-output ratio in Tomato production on the sample holdings on the basis of cost concept have been given in Table 2.The average yield of Tomato came to Rs281.25qt/ha. The overall average gross income was worked out to Rs2, 81,250 per hectare on an average overall net income to Rs2, 29,980.35 which was highest on small farm Rs3,12,473.30 followed by marginal Rs2,44,502.26, medium Rs2,33,121.38 and large farm Rs1,42,793.46

Table - 2 : Measure of cost and return per hectare from the production of Tomato-

Sr. No.	Item	Size of Groups				
		Marginal	Small	Medium	Large	Overall
1.	Cost A_1 & A_2	18694.27	22734.91	22440.21	27430.97	22825.07
2.	Cost B_1	21256.47	26374.04	27521.19	29672.30	26206.00
3.	Cost B_2	27256.47	32374.04	33521.19	35672.30	32206.00
4.	Cost C_1	44400.37	42581.24	36521.39	38559.20	40515.30
5.	Cost C_2	50400.37	48581.24	42521.39	44559.20	46515.30
6.	Cost C_3	55497.74	53526.70	46878.62	49206.54	51269.65
7.	Yield qt./ha	300 qt (@Rs.1000/qt)	305qt (@Rs1000/qt)	280qt. (@Rs1000/qt)	240qt (@Rs1000/qt)	281.25qt (@Rs1000/qt)
8.	Gross Income	300000	366000	280000	192000	281250
9.	Net Income	244502.26	312473.30	233121.38	142793.46	229980.35
10.	Cost of production	184.99	175.49	167.42	205.02	182.29
11.	Family Labour Income	272743.53	333625.96	246478.81	156327.70	249044.00
12.	Farm Business Income	281305.73	343265.09	257559.79	164569.03	258424.93
13.	Input- Output ratio					
14.	On the basis of Cost C_3	1:5.40	1:6.84	1:5.97	1:3.90	1:5.48
15.	On the basis of Cost C_2	1:5.95	1:7.53	1:6.58	1:4.31	1:6.05
16.	On the basis of Cost C_1	1:6.76	1:8.59	1:7.66	1:4.98	1:6.94
17.	On the basis of Cost B_2	1:11.01	1:11.30	1:8.35	1:5.38	1:8.73
18.	On the basis of Cost B_1" basis	1:14.11	1:13.87	1:10.17	1:6.47	1:10.73

respectively. Also overall on an average income like family labour income, farm business income were work out to be Rs2, 49,044.00 and Rs2, 58,424.93 respectively. Cost of production Rs/qt was calculated farm overall average came to be Rs182.29. Higher cost of production observed on large farms that i.e. Rs205.02followed by marginal Rs184.99, Small farms Rs175.49 and Medium farm Rs167.42respectively. The average input-output ratio at cost A_1& A_2 was 1:12.32, cost B_1 was 1:10.73, cost B_2 was 1:8.73, cost C_1 was 1:6.94, cost C_2 was 1:6.05 and cost C_3 was 1:5.48 respectively. The overall average of input-output ratio on the basis of cost C_3 was observed 1:5.48. Its analysis was 1:540, 1:6.84, 1:5.97 and 1:3.90 on Marginal, Small, and Medium and Large size of farms.

CONCLUSIONS

On the basis of foregoing discussion it may be concluded that better production of the Tomato crop may not provide better return to the growers unless it is properly marketed. During the cost of investigation it was observed that there was various problems in production of Tomato are as follows –

(I).Due to lack of knowledge the Tomato growers is facing the problem

In method of Sowing, fertilizers application, insecticides & pesticides

(II).The farmers faced main problem of disease of plant and plant

Protection measure in study area due to which they do not get inputs at

Reasonablerate.

This enhances the cost of inputs. The overall average cost of Tomato production was Rs51269.65 per hectare and also the per quintal cost of Tomato overall farm was estimated Rs182.29/qtl. The overall average of input-output ratio on the basis of cost C_3 was observed 1:5.48.The return per rupee of investment was higher on the small size group of farms. The major portions of the farmers produce was sold at a lower price in the post-harvest period due to non- storability and immediate cash requirements. The procedures fail to hold their produce and dispose immediately after harvest, which tends the price, came

down during post-harvest period. The results of the study indicate that to reduce the post-harvest losses, the Tomato growers should be encouraged to sell their produce. The analysis indicate that adequate input facilities and timely supply of cheaper credit by the financing agencies to the producers, processors and traders would help in increasing the productivity as well as efficiency in the marketing of the produce. The processing unit based on Tomato can play a significant role in fetching reasonable prices if are utilize to produce soup, juice, ketchup, puree, paste and powder are prepared rather than selling the Tomato as such in the market. It is therefore very essential to establish processing units in rural areas. The govt. should establish processing unit and adequate refrigerated storage facilities at village level for the purpose of production and marketing of Tomato to benefits both producers and consumers. The study suggested that there is need to increase the irrigation facilities, use of hybrid seed in increased area under high yielding varieties and advice the procedures to use recommended doses of plant protection measure and fertilizers and also use of modern production technology for increasing Tomato production and farm income.

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COMPARATIVE STUDY ON AVAILABILITY AND DELIVERY OF ANIMAL HEALTH CARE SERVICES IN DEVELOPING COUNTRY: STATUS OF ANIMAL HEALTH SERVICES IN GUJARAT

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ABSTRACT

The study was based on both, primary and secondary data. Primary data was collected from the 200 sample farmers, whereas time series data pertaining to last 22 years data from 1993-94 to 2014-15, for a large number of variables were collected to study the delivery and availability of health services. Mainly tabular approach was used to analyse and present the results. The study found that there was a great regional variation in the delivery of animal health care services as well as artificial insemination services. The regional differences was found to be very large, for example in Central Gujarat the livestock density as well as livestock population per veterinary institution was increasing at a rate of more than 20 per cent and 17 per cent respectively, whereas veterinary institution was increasing at a rate of 1.9 per cent, which was very low as compared to other regions of Gujarat. Livestock population density as well as livestock per veterinary institution was observed to be very high in Central Gujarat followed by North Gujarat. The average number of livestock population per veterinary doctor per annum was more than 14 thousand and on the other hand the regional allocation of livestock population per veterinary doctors shows that in each region the doctors were overburdened except in South Gujarat. The health clinics were found to be overburdened with lack of sufficient staff that can treat the animal timely. Though area wise and share of livestock population, Kachha and Saurashtra region is the largest region of Gujarat, still the veterinary infrastructure status was poor as compared to other regions. The study also shows that in some regions cooperatives were providing better health care services than government agencies.

Keywords : *Animal health services, livestock population, cooperatives, regional distribution, livestock, veterinary institution.*

INTRODUCTION

Animal husbandry plays an important role in the growth and development of agriculture sector in an economy as animal husbandry sector has emerged as an important sector for ensuring more inclusive and sustainable agriculture growth. Evidences from *National Sample Survey Office's 70th round* proved that more than 23 per cent of households with very small chunk of land (less than 0.01 hectare) reported animal husbandry as their principal source of Income. Being an important contributor of farmer's livelihood security, the sector has been considered as one of the budding sector

which has the potential to mollify poverty and unemployment in rural areas. Animal husbandry activities provide between 15 to 40 per cent of household income to nearly 70 per cent of rural *households (Birthal et al., 2007).*

The momentum of National Dairy Plan (NDP) is to increase the productivity of dairy animals through multipronged strategies of improving genetics, widening AI coverage and promoting scientific feeding practices which may not give the desired result if not collocate with better health care and augmented by appropriate disease control programmes. The animal health institutions of our country working relentlessly for decades that is why we are mostly self-sufficient in vaccines and therapeutics for most of the diseases. In addition to the progress made so far has been encouraging, in order to upraise the animal health delivery mechanisms in our country to international standards, still a lot more needs to be done. For this, putting in place better systems and standards would be the starting point. This would implicit a profusion of activities to be done, foremost being upgrading the veterinary infrastructure, in terms of veterinary institutions - hospitals, colleges, diagnostic laboratories and vaccine production units etc, and quality of the services they deliver, so that it ultimately culminates in good quality veterinary health services being provided at affordable charges at the farmer's doorstep.

Different states have taken different approaches to the provision and delivery of support services to the livestock sector, but in general it is the dairy sector which has received most of the support in the name of animal husbandry development. The diversified nature of livestock in India with species, production system, agro-ecological conditions and social hierarchy it seems implausible that one size fits all approach is appropriate. The description of delivery of different livestock services in Gujarat are discussed below. This study represents some clumsy conjectures and metaphor of animal health service delivery pattern, status and coverage across various types of providers.

In the light of the aforementioned issues this study has been targeted to explore key issues related to availability and delivery of animal health services to the farmers. More specifically, the research attempts to (i) to examine the availability and delivery pattern of animal health care services in Gujarat, (ii) to study the status and growth pattern of animal health services in Gujarat.

MATERIALS AND METHODS

The study has been conducted in the state of Gujarat at macro level and Gujarat was selected purposively keeping in view the dairy development and multi-agencies involved in providing the animal husbandry support services. At macro level, status of the animal health services was estimated for the state as a whole. The study was based on both, primary and secondary data. Primary data was collected from the 200 farmers. To select a sample of 200 farmers, a multi-stage simple random sampling technique was used. Two categories of animal husbandry services namely health and breeding services were considered in the study. Before doing any analysis, status, growth and use pattern of these livestock services were worked out to draw any inference. Time series data was used to study the changes in status and growth rate of each activity in a category of services. The purpose of this analysis was to find out change in status of animal husbandry services. Mainly tabular approach was used to analyse and present the results. In the following sections, animal husbandry services are described followed by defining the different concepts used in the study.

Animal health services:

It includes veterinary hospitals, veterinary doctors and para veterinarians, dispensaries, aid centres, livestock density etc. The aspects studied in this category were density of these institutions per thousand square kilometres of the geographical area and the number of animals served by each institution or a doctor. All the 26 districts were covered to study the status and growth of livestock infrastructure as well as support services in Gujarat. District level data pertaining to last 22 years data from 1993-94 to 2014-15, for a large number of variables were collected to carry out the first and few part of the second objective of the study. These data base were also used to build a comparative framework in different region of Gujarat viz. North, Central, South and Kuchha & Saurashtra regions of Gujarat.

Animal breeding services:

It includes number of artificial insemination centres under different agencies including government, cooperatives and private. The aspects studied in this category were density of these A.I. centres per thousand square kilometres of the geographical area and the number of animals served by each institution. All the 26 districts were covered to study the status and growth of A.I. centres under different service providing agency in Gujarat. District level data pertaining to last 22 years data from 1993-94 to 2014-15, were collected to carry out the first and few part of the second objective of the study. After gathering all these data from various sources, annual growth rates were calculated by using given below formula:

The annual growth rates of various aspects of these services were estimated by using the following formula having exponential relationship with time.

$Z_t = Z_0(1+r)^t$, where Z = value of the t^{th} year; t = Time in years and Z_0 = previous value of variable

$\text{Log } Z_t = \text{Log } Z_0 + t \log (1+r)$

Compound growth rate "r' = [(Antilog of log (1+r))–1] x 100

RESULTS AND DISCUSSION

Status and growth of animal husbandry support services

It was found that from last 25 years (1993-94 to 2014-15) the increase in the average number of veterinary institution on per thousand square kilometre of area was very slow in all the regions of Gujarat. For example in early 90's there were 5 veterinary institution in Gujarat, which increased up to 7 veterinary institution on per thousand square kilometre of area during 2010-11 to 2014-15 (Table 1.1). The regional difference was very wide, for example in Kachha and Saurashtra region, there was only 3 veterinary institution per thousand square kilometres of area in early 90's, which increase up to 5 veterinary institution during 2014-15. There were only 7 veterinary institutions on per 1000 square kilometre of area. The average livestock population density on per square kilometre of area was 109 thousand in early 90's, which increase to 127 thousand livestock during the period of 2011 to 2015 (Table 1.1).

On an average the livestock population on per veterinary institution was 18.9 thousand in early 90's, which increases to 20.6 thousand during the period of 2011-15. It was observed that in all the regions of Gujarat, the number of livestock population on per veterinary institution as well as livestock density was increasing more rapidly than the veterinary infrastructure except in Kachha and Saurashtra region, where livestock density as well as livestock on per veterinary institution was decreasing over the years.(Table 1.1 and Fig. 1.1). The 19^{th} Livestock census finding also says that in Gujarat, the livestock population has increased by 15.3 per cent. This growing livestock density as well

Table - 1.1 : Status and Growth of Veterinary Infrastructure in Gujarat (1993-94 to 2014-15)

Region	Particulars	Units	Quinquennial Averages				
			1993-1997	1997-2001	2001-2006	2006-2011	2011-2015
Central Gujarat	Density of Vet. Institutions	No./ '000 Sq. Km.	11	18.8	23.9	23.7	24
	Livestock Population Density	No./ Sq. Km.	113	181	213	241	246
	Livestock Population per Vet. Institution	'000 No.	10	10	9	10	11
Kachha& Saurashtra	Density of Vet. Institutions	No./ '000 Sq. Km.	3	3	3	4	4
	Livestock Population Density	No./ Sq. Km.	75	115	175	176	178
	Livestock Population per Vet. Institution	'000 No.	23.6	34.1	21.4	20.2	19.5
North Gujarat	Density of Vet. Institutions	No./ '000 Sq. Km.	8	8	8	9	10
	Livestock Population Density	No./ Sq. Km.	139	140	175	195	198
	Livestock Population per Vet. Institution	'000 No.	17.09	17.57	22.87	22.6	20.8
South Gujarat	Density of Vet. Institutions	No./ '000 Sq. Km.	9	8	9	11	11
	Livestock Population Density	No./ Sq. Km.	85	109	114	114	112
	Livestock Population per Vet. Institution	'000 No.	9.1	12.8	14.9	12.4	10.1
Gujarat	Density of Vet. Institutions	No./ '000 Sq. Km.	5	6	6	6	7
	Livestock Population Density	No./ Sq. Km.	109	102	117	125	127
	Livestock Population per Vet. Institution	'000 No.	18.9	18	21.3	20	20.60

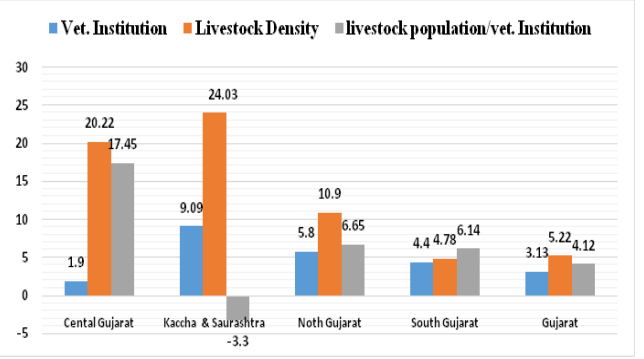
All the districts has been covered.

Sources: Bulletin of Animal Husbandry and Dairying in Gujarat (1990-91 to 2016-17), Dairying in Gujarat, National Dairy Development Board Report, 2013.

as livestock burden per veterinary institution pushing the demand for more veterinary institution, hospitals, and polyclinics.

The regional differences was found to be very large, for example in Central Gujarat the livestock density as well as livestock population per veterinary institution was increasing at a rate of more than 20 per cent and 17 per cent respectively, whereas veterinary institution was increasing at a rate of 1.9 per cent, which was very low as compared to other regions of Gujarat (Fig.1.1). Livestock population density as well as livestock per veterinary institution was observed to be very high in Central Gujarat followed by North Gujarat (Table1.1)

Fig. - 1.1 : Growth Rate of Veterinary Infrastructure in Gujarat (1993-94 to 2014-15)



Artificial insemination (AI.) services were provided by three types of agencies, namely government, cooperatives and private and all these three agencies were having their own AI. centres in Gujarat.

Table - 1.2 : Status of AI. Infrastructure under Different Service Providers in Gujarat (1993-94 to 2014-15)

Items/Years		Types of Agency	1993- 97	1997-01	2001-06	2006-11	2011-15
Central Gujarat	A.I. Centres(No./'000, Sq. Km.)	Govt.	8	9	9	12	18
		Coop.	6	32	52	64	73
		Private	2	3	1	1	0
	Livestock Population /A. I. Centre (000, No.)		7.9	4.2	3.2	3	2.6
Kachha & Saurashtra	No. A.I. Centres (000, Sq. Km.)	Govt.	2	4	4	5	7
		Coop.	0	0	0	1	3
		Private	1	2	2	3	5
	No. of Livestock Population /A. I. Centre (000, No.)		27.5	21.9	11.6	9.2	6.3
North Gujarat	No. A.I. Centres/000, Sq. Km.	Govt.	10	12	12	15	24
		Coop.	10	19	29	41	52
		Private	1	2	2	3	3
	No. of Livestock Population /A. I. Centre (000, No.)		6.4	4.3	3.9	3.2	2.5
South Gujarat	No. A.I. Centres (000, Sq. Km.)	Govt.	12	14	15	18	24
		Coop.	9	11	17	24	31
		Private	1	3	6	4	4
	No. of Livestock Population /A. I. Centre (000, No.)		3.8	3.9	3.1	3.2	1.9
Gujarat	No. A.I. Centres(000, Sq. Km.)	Govt.	6	7	7	9	13
		Coop.	4	9	14	19	24
		Private	1	2	3	4	4
	No. of Livestock Population /A. I. Centre (000, No.)		10.8	5.7	4.7	3.9	3.1

All the districts has been covered.

Sources: Bulletin of Animal Husbandry and Dairying in Gujarat (1990-91 to 2016-17), Dairying in Gujarat, National Dairy Development Board Report, 2013.

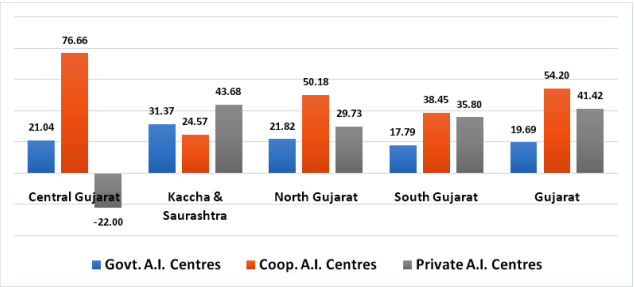
It was found that in early 90's the number of AI. centers per 000, square kilometre under cooperatives department was less than the government department, but after mid 90's the cooperatives AI. centres were increased more than 10 times in all the regions of Gujarat except in Kachha and Saurashra, where the coverage of cooperatives was very negligible or very low (Table 1.2). In Kachha and Saursahtra region the cooperatives were working as milk collection as well as processing unit, but from last five years (2010-11), they had also entered in the fields of livestock service providers.

The findings of the study show that there were good network of AI. infrastructure in Gujarat. It was observed that the number of AI. centres under private agency were also prevailing in Kachha and Saurashtra as well as South Gujarat regions, as in these both region the coverage of cooperatives was not that much strong, as it was in North and central Gujarat regions and due to which, private AI. centres were also prevailing in good numbers. On an average in overall Gujarat, there were six AI. centres per thousand square kilometre of area in early 90's, which increase up to 13 AI. centres/000, square kilometre of area during 2011-15 under government

departments. The number of AI. centres had increase from 4 AI. to 24 AI. centres /000, square kilometre of area in last 22 years (1993-94 to 2014-15) under cooperative society. It was found that after every five years, the number of livestock population per AI. centres was decreasing, because these AI. centres were increasing at a growth rate more than 19 per cent in government department, more than 54 per cent in cooperative society and more than 41 per cent in Private provides (Table 1.2 and Fig 1.2).

Maximum number of AI. centres/000, square kilometre of area under cooperative society was found in Central Gujarat followed by North Gujarat. Though the number of private AI. centres were very less as compared to government and cooperatives but the rate of growth under private AI. centres was much higher than the government and cooperatives society. For example in North Gujarat as well as in Kachha and Saurashtrra regions the growth rate for private agency was more than 20 per cent per annum, and even at overall level in Gujarat the growth rate of private AI. centres was higher than cooperatives and government agency (Fig.1.2). It was observed that there was good and sufficient number of AI. centres/000, square kilometre of area, so the burden of livestock population on per AI. centres was very much less as compared to veterinary hospitals, which was very less in numbers, as we had discussed earlier (Table 1.2).

Fig. - 1.2 : Growth of AI. Centres under Different Agencies in Gujarat (1993-94 to 2014-15)



**For Kachha and Saurashtra growth rate under cooperative agency is for the years 2010-11 to 2015-16.*

The regional distribution of AI. centres was very uneven. Most of the AI. centres were concentrated in the North and South Gujarat regions. Within the state, the distribution of AL, as well as veterinary institution was highly skewed. In general, the districts and the regions with better infrastructure have better coverage of AI. centres as well as veterinary institutions. For example Central, North and South Gujarat regions was well developed in infrastructure as well as in agriculture also, and this might be one reason that due to better infrastructure in these regions the coverage of AI. centres and veterinary institutions was better than the Kachha and Suarashtra region (Table 1.1 and 1.2).

The current year (2014-15) data shows that in Gujarat there were 1886 veterinary doctors (including government and cooperatives both), out of which, 889 doctors were from cooperative department and 997 were from government department (Table 1.3).

The regional distribution of doctors shows that in some regions the number of cooperatives resource person was more than the government agency, like in Central and North Gujarat regions, the number of veterinary doctors under cooperatives was 205 and 452 respectively, whereas under government department, 202 and 244 doctors were there in Central and North Gujarat, respectively (Table 1.3).

The average number of livestock population per veterinary doctor per annum was more than 14 thousand and on the other hand the regional allocation of livestock population per veterinary doctors shows that in each region the doctors were overburdened except in South Gujarat. The coverage of veterinary doctors on per thousand square kilometres of area shows that on an average there were 10 veterinary doctors/000, square kilometre of area (including government and

Table - 1.3 : Status of Veterinary Doctors under Different Service Providing Agencies (2015-16)

Particulars/ agencies	Geographical Regions				Gujarat
	Central	Kuccha & Saurashtra	North	South	
Veterinary Doctors (Number)					
Govt.	202	344	244	207	997
Coop.	205	35	452	197	889
Total	407	379	696	404	1886
Livestock population served by a doctor ('000 No.)					
Govt.	35.8	27.3	31.5	12.2	27.4
Coop.	35.3	26.9	17.3	12.8	30.8
Total	17.8	24.8	11.1	6.2	14.4
Density of veterinary doctor ('000/ Sq. Km.)	15	3	19	17	10

All the districts has been covered.

Sources: Bulletin of Animal Husbandry and Dairying in Gujarat, 2016-17.

cooperatives both). The regional distribution of doctors among different regions observed that maximum number of doctors were concentrated in South, North and Central Gujarat, whereas in Kachha and Saurashtra there were only 3 doctors/000, square kilometre of area, which was observed to be very less (Table 1.3).

RESULTS AND DISCUSSION

The analysis of this study emphasizes the need for re-examining government's current strategy for delivery of animal health services. Animal husbandry can be a source of poverty alleviating growth because the demand for livestock products is growing rapidly in domestic as well as in global market. In absence of good access to markets, demand for animal husbandry services is likely to remain low necessitating the government presence in service delivery in many areas. That has the effect of locking up the resources required for providing much needed disease control and surveillance and market access infrastructure for this sector. Though Gujarat is having a good network of dairy cooperatives, which are also providing animal health and breeding services to the farmers' door steps, still there was a great disparity and gap in delivering of animal health services among the regions. The health clinics were found to be overburdened with lack of sufficient staff that can treat the animal timely. Though area wise and share of livestock population, Kachha and Saurashtra region is the largest region of Gujarat, still the veterinary infrastructure status was poor as compared to other regions.

As per the NDDB (National Dairy Development Board) report there should be at least one veterinary hospital between two blocks, but the data shows that in each region there were very less number of veterinary institution in Gujarat. It was observed that in all the regions of Gujarat, the number of livestock population on per veterinary institution as well as livestock density was increasing more rapidly than the veterinary infrastructure except in Kachha and Saurashtra region, where livestock density as well as livestock on per veterinary institution was decreasing over the years. The 19th Livestock census finding also says

that in Gujarat, the livestock population has increased by 15.3 per cent. This growing livestock density as well as livestock burden per veterinary institution pushing the demand for more veterinary institution, hospitals, and polyclinics.

Coming back to the discussion on service delivery, there are a number of progressive areas with relatively good access to markets that can profitably support the private veterinary sector. Nevertheless, what is needed is a level playing field for private practitioners. Subsidized delivery of these services by the government provides unfair advantage to the government veterinarians, which, in turn, drives out the private entrepreneurs from the market. First step towards creating a advantageous environment will, gradual withdrawal of government from high potential areas such as central and north Gujarat and putting in place regulatory framework for private veterinary practice. In the relatively remote and marginal areas, government will have a more direct role.

It will be desirable to work with non-government organizations and other stakeholders for sensitizing the poor communities towards creating the demand for these services, training community based health workers for minor treatments, providing drugs and supplies on cost in areas where private distribution network is weak, providing extension advice related to animal husbandry including feeding practices and shelter innovations, etc. Given the current concentration of government veterinary centers in relatively better-off areas, reducing government presence in curative service delivery in these areas can release significant resources for focusing on the marginal areas.

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IMPACT OF SOLAR ENERGY IMPROVE EFFICIENCY UTILIZATION IN AGRICULTURE DEVELOPMENT IN RURAL AREA

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ABSTRACT

Scarcity of non renewable natural energy resources is a big issue in many developing countries, especially electricity in rural areas. Shortage of electricity is a big issue for developing countries especially India. We know that everything is moving towards development but still today we have 4 to 6 hours electricity in rural areas. On the basis of development we can say that demands of electricity is increases day by day but supply still constant. In a survey we found that about 40 percent of residential areas have no electricity. Coal shortage is another issue because we can generate electricity through coal burning so we have only one option to overcome this shortage is solar system. By the help of solar system we can glorify each and every rural area.Such system based upon the solar energy which is produced by the Sun.We can use this system at any location which is covered by the solar light. There are some another alternatives which we can use like wind energy or bio-mass energy. Wind energy is specially used in western countries because at these places we found a huge amount of wind and bio-mass is mostly used in India in this system we have animal dug and a container to store dug.

India is the best place which has solar energy resource. We have about 300 sunny daysin a year in India, depending upon the area. According to the theory India has about 5000 Pet watt-hours per year solar power consumption. The average intensity 200 MW/km^2 of solar radiation is received on India. Within an area of 3.287 million km square, this amounts to 667.4 million MW. However, we know that 87.5% of the land is used for agriculture, forests, fallow lands, etc., 6.8% for housing, industry, etc., and 5.7% is either snow bound, barren, or generally inhabitable. Thus, only 12.6% of the land area (0.414 million km square), in theory, can be used for solar energy plantation. Even if we will use 10% of this area thenthe available solar energy may be 8 million MW, which is equivalent to 5910million tons of oil equivalents per year.

India has a huge potential for renewable energy resources, especially in the area of solar power, ocean energy, biomass and wind power. The current situation shows the capacity of renewable energy is around 92205 MW, which is about 7.3 percent of India's total generation capacity. India has fourth position in the world in case of wind energy and we are investing activity in this area. But in case of solar energy we are still so far. We have not sufficient technology or installation methods. We know that solar energy is a very cost effective technology for electricity generation and production so we should work on that technology with more attention.

Keywords: *Agricultural land, renewable natural energy resources, solar energy technologies electricity in rural areas.*

INTRODUCTION

As we know that India has a huge population and to survive in the world we need more resources of energy. If we will be depend only on limited resources of energy (like non renewable resources) then after sometime due to excessively use of these. These resources will not be present for further use so we need to think about it and we should try to find out new energy resources. We should focus onrenewable resources because these resources will be available for many of years (thousands of years). The best example of renewable resource of energy production is the SUN. Sun is the best energy resource for our day to day life and we know that the solar energy will not reduce with time so we can say that solar energy is reliable resource of energy. In India our government is working on the project of solar energy and we can observe it. In India, Rajasthan will be the best location for solar plantation because in Rajasthan most of the land is desert which is not useful for any type of fertilization or any other activities so in India, Rajasthan will be the best producer of solar energy.

RENEWABLE ENERGY RESOURCE (SUN)

Sun is the best resource for energy production because its energy will not be decayed with time due to its chemical reaction. Sun has 99% Helium on its surface and these helium molecules interact with neutrons and produces more helium and neutrons due to nucleus distortion (diffusion).

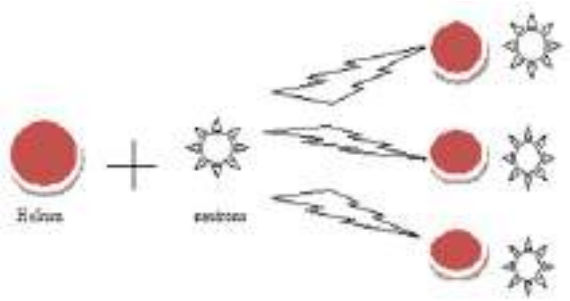


Figure (1) Reaction on Sun surface

Solar energy is very beneficial for various departments like agriculture, electrical, mechanical, social etc. with the use of solar energy we can save and utilize many kilo watts of energy for further use. The basic concept behind solar energy consumption is the conservation of energy for future aspect. We can consume Sun's radiations to produce energy.

Energy Conservation : energy cannot destroy, we can transform it into other form so will use solar energy and transform it into electrical or any other form of energy.

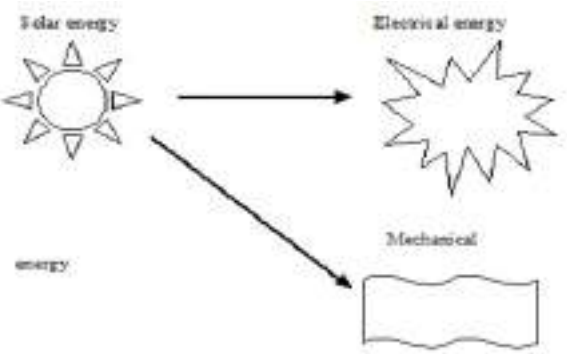


Figure (2) Energy conversion one form to another

CHALLENGES IN SOLAR ENERGY

There are so many challenges in solar energy production like selection of fields and the most effective challenge is that solar energy can be generate when sun will rise so during spring session we cannot generate solar energy. For different appliances based on solar energy application have different problems related to its functionality like if we will talk about solar cooker then we should follow a color coding system which one is defined for it and in case of pointing solar system (which is basically used for frying the bread) we should move (rounded) it according to the direction of the Sun unless it will be useless. So we can say that different solar system has different challenges to perform its task.

SOLAR PANEL ENERGY PRODUCTION

Solar panel will generate energy in watts and these watts will be equal to the multiple of

voltage and current for example a 12volt, 60watt, solar panel with area "20*44" measures voltage 17.5 volt and current 3.1A , V(volts)* A(amps)=W (watts), 17.5V*3.1A=60W

If will capture average 6hrs sun light per day then the solar panel will produce 360 watt-hour power per day; 60W*6hrs = 360Whrs. Since the intensity of sunlight varies through the whole day so will work for an average of all the intensities like sunlight intensity will be less during morning and evening as compare to mid day and the intensity will be less on cloudy days.So if we will plan for solar power system then geographical area will be rated in average sun hours per day based on yearly data of sunlight.

We will wire to solar panel in serial or parallel to increase voltage and current respectively. We can wire in both serial and parallel to increase both voltage and current. If we will wire to solar panel in serial manner then we will attach positive terminal of one panel to the negative terminal of other so finally resultant terminal will produce voltage as the sum of two panels, but current will be same. So if we will connect two 10volt/3amp panel in serial order then it will produce 20V at 3 amp and if we will add four panel then it will produce 40V at 3 amp. In case of parallel wiring we will connect positive terminal of one panel to the positive terminal of other and negative to negative. So the resultant terminal will have constant voltage but current will be the sum of all the panels. If we will take two 10V/3amp panel in parallel manner then the voltage of the resultant terminals will be 10V at 6 amp, if we will take four panel then 10V at 12 amp.

Figure (3) Panels in parallel and serial

1.1 ENERGY CONSUMPTION

Energy required to consumer for its daily purposes like consumer will use many appliances in his day to day life and to use these appliances we need power consumption. We will store power generated by the solar panel into batteries and after that we will use power through battery. The most important factor we should care about it, how much input power is required including all losses. Example we have a microwave oven 400W which has 5% loss so we require 420W power as input. Table 1 shows the basic watts requires in our kitchen, home or shop for different-different appliances in a day or within a week. It gives us a complete picture for solar power scheme. It is basically based upon power consumption worksheet for residential areas. The idea is to find out the energy consumption requirement for a typical home. Finally the prices of energy consumption are calculated for any solar energy based system. Here we have taken a general situation in which we will use solar power for our different-different appliances to make our life easy.

Table : 1 Appliances Power Consumption

APPLIANCE	WATTS	HOUR/WEEK	WATT-HOUR/WEEK
Blender	300	0.5	150
CD player	35	5	175
Clock Radio	1	168	168
Coffee Maker	1000	10	10,000
Computer	125	14	1750
Dryer	350	2	700
Furnace blower	700	21	14,700
Garage door opener	350	1	350
Hair dryer	1200	1	1200
Iron	1000	0.5	500
Microwave	1500	1	1500
Printer	400	1	400
Refrigerator (20cf)	150	70	10,500
18' satellite dish	30	10	300
Toaster	1200	1	1200
TV (25") color	150	14	2100
Vacuum cleaner	1000	0.5	500
VCR	40	4	160
Washing machine	500	1	500
Lights:			
42 W halogen	42	7	294
25 W comp. Flour. (1 bulb 2hrs/day, 1 bulb 4hrs/day, 1 bulb 1 hr/day)	25	49	1371
48519/7=6931			

1.2 SYSTEM ANALYSIS

Approximately 30 panels of 75 watt capacity and 24 units of L-16 batteries is required to bear a daily load of 6931 watt-hours.And it is the requirement of a large system. At this time, we should try to reduce power consumption of home appliances. If we will take a hard look at the previous example then we will find that three items makes most of the power consumption. These items are furnace blower; coffee maker and refrigerator consume power 14,700 watt-hrs/week, 10,000watt-hrs/week and 10,500watt-hrs/week respectively. Instead of coffee maker we can use alternative method to make coffee. We can use wood stove rather than of furnace blower. In case of refrigerator (it is fairly energy efficient model) we can use small size one propane refrigerator but if price of the proposed refrigerator exceed then it will not be possible to make it household appliance.

So we can exclude furnace blower and coffee maker from household appliances. After excluding these two items, we find that the energy load is reduced up to 3403 watt-hrs/week which requires about 12 units of L-16 type batteries.

1.3 REQUIRED COST

Cost of the solar panel is depends on the size of solar power system. In this case, we have many options to choose a solar panel system. We can choose a panel for 6931 watt-hrs/week consumption (including furnace blower and coffee maker) or we can reduce the size of a panel by excluding furnace blower and coffee maker. In case of refrigerator we should consider the best which one has less power consumption and more suitable for our requirements. According to a collected data we found that for 30 module system cost requires 20,000$*. If we reduce to the system by 16 modules then we will save up to 13,000$*. The cost difference between these two systems will affect to the finding of heating source.

*Note: These costs are only approximate values and they do not have installation value. Installation will be based on man power and will be calculated in PM.

SELECTION OF BATTERIES

After finalizing the project location the next step is to select its components to design the required solar energy project. Selection of the best component depends upon the planning. Accuracy of these components should be correct as much as possible. So battery selection is more important. In this part we will discuss about selection of solar energy components.

A. BATTERY (AMP-HRS) SELECTION

Each solar energy system has battery to store power for further use. Appliances use energy from battery with the help of inverter. Inverter converts the DC (battery voltage) into AC voltage. There are various factors to determine battery choice and size. But our discussion is based on a battery which consumes 20% for daily routine and rest for future aspect. Means we have focus on a battery whose 20% is sufficient for our day routine. E.g. if we have a nominal 100Amp-hr battery then its 20% on a daily/nightly bases. That means 20Amp-hr capacity is required for day/night.Which transform to 240 watt-hrs energy for 12V battery (Amp-hrs * battery voltage =Watt-hrs). Due to any reason (like weather problem or high loading etc.) there will be some situation of deeper discharge, but this will be occasionally. After this, it is very important to full charge the battery as soon as possible.

In solar application, battery life is depends upon the discharge cycle. And we know that different type of batteries have different cycle capabilities.

One of the major problems in design solar energy system is misguiding the relationship between amp and amp-hr requirements of a240V AC items and the effects on DC low voltage

batteries. There are some other factors available for determining the full extent of a battery such as start up factors, temperature, etc. these all the work and factors are based upon the consideration.

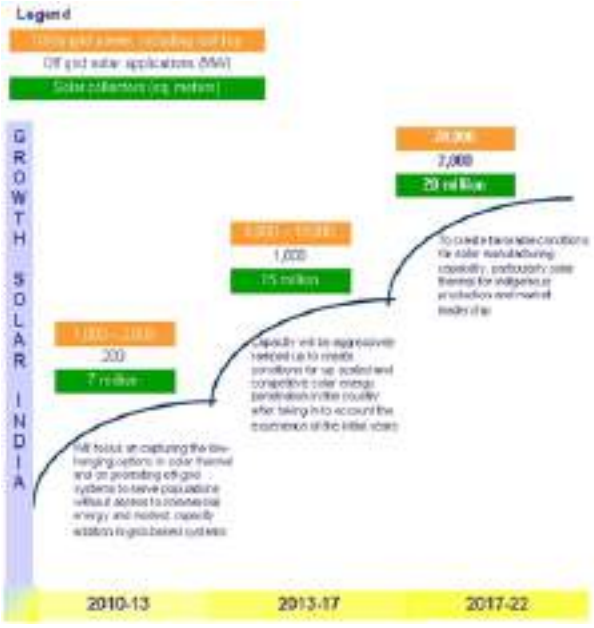
CONCLUSION

Solar system plantation is a best way to produce energy for very long time. The best locations in India for solar plantation are west and North West areas because these areas are mostly unfertilized and there is a huge amount of land. At these areas we can get peak solar energy data for storage and consumption. Many states are contributing incentives and tax savings to promote solar based application. Gujarat and Rajasthan have formulated progressive regulatory framework for the continuous growth of the solar industry. States like Uttar Pradesh, Maharashtra, West Bengal, Chandigarh and Delhi are also promoting solar energy for the development of rural areas.

Low electricity production is one of the main obstacles in the development of rural India. Grid system in India is mostly under-designed, with main sections of its populace still working off-grid. According to a survey which was held in 2004, there are about 80,000 villages in the country which has no electricity. Some ofthese villages, about 18,000 have not extension of the conventional grid. A target of electrifying 5,000 such villages was set in Tenth National Five Year Plan (2002–2007). And we found in2004; more than 2,700 villages had been electrified, mostly using solar photovoltaic systems. Solar system architecture provides more electricity with less amount of money investment.

It is the best alternative to generate cheap electricity for a mass.

Currently planned projects include 3000 villages of Orissa, which will get electricity by solar power from 2014.



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AN ECONOMICS ANALYSIS MARKETING OF WHEAT CROP IN BLOCK AMNOUR DISTRICT SARAN (CHHAPRA), BIHAR

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ABSTRACT

The marketable surplus is the surplus over total produce after making a deduction towards quantity retained for seed purposes, utilized for family consumption, quantity paid as wages and other uses and marketed surplus I that quantity of the produce which the producer farmer actually sells in the market, irrespective of his requirements for family consumption, farm needs and other payments. The marketed surplus may be more, less or equal to the marketable surplus. As such marketable or marketable surplus for different categories of different farms.

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Keywords : *Wheat crop, economics, anaylysis*

INTRODUCTION

It was the wheat, which played an important role during green revolution (1966-1967). The Indian Council of Agricultural Research (ICAR-1929) has been in the fore front in guiding and co-ordination wheat developments with the adoption of H.Y.V. (High Yielding Variety). Programme, the food grain production in India increased from more 50.8 million tonne during 1950-51 to 288 million tonne in 2021-22.

The nutrient composition of wheat (per 100 gm)

S.No.	Nutrient	in gm
1.	Protein	12 g,
2	Carbohydrates	70.8 gm
3.	Fat	1.5 gm
4.	Crude fiber	1.1 gm
5.	Mineral water	1.75 gm
6.	Calcium	1.5 gm
7.	Phosphorus	4.30 mg
8.	Energy	346 k.cal

Wheat flour is the first addition though the value added is low. Wheat flour serve as the raw material for processed foods such as biscuit, cakes and several other products.

Marketing is a part of productive process and marketing costs form a part of overall costs of the production. The producer, the middleman and the consumer looks upon the marketing process from his own individual point of view. The producer is primarily concerned with selling his products at such remunerative prices a would enable him to continue to produce or stay in his business. The ideal marketing system is one that ensures the long run welfare of society.

In india the history of regulation of markets dates to 1897 when beraract was passed for cotton and grain markets. The Indian cotton committee appointed by the government of india recommended

regulation of cotton on the line of berar markets. In presence to this recommendation, the government of bombay was the first to in act. Bombay cotton market act, 1927. The Royal Commission on Agriculture, in its report submitted in 1926, besides on overall survey of Indian agriculture recommended the establishment of regulated markets on the pattern as modified by the bombay cotton market Act 1927. In 1935 the government of india established the office of the agriculture Marketing Adviser (Directorate of Marketing and Inspection) under the ministry of food and agriculture to look into the problems of the marketing of agricultural produce.

An efficient and reliable marketing system by itself can stimulate increase in agricultural production while lack of it can lesion, subdue and shrink the impact of any number of production programmes, administration effort and volume of investment. It is such an important role of agricultural marketing that seem to have promoted the Government of India to place particular emphasis of agriculture marketing in the post independence period in general and after the third five year plan in particular.

During the first and second five year plans, agricultural marketing did not receive much important but during third five year plan, a number of marketing development programmes were initiated as co-operative marketing, market news service and warehousing. The fourth five year plan laid greater emphasis on development if infrastructural facilities in wholesale markets. The fifth and sixth five year plan further accelerated, the market development programmes as well as grading and standardization programme. During the seventh and eight five year plan the progress of agricultural marketing programme continued with some Para. The implementation of these programmes had a significant bearing on agricultural marketing practices and perspective in the country. The importance of marketing has also been emphasized during 11th five year plan, since food security was the main concerned.

The farmer is the back-bone of Indian economy. Historically he did not get a fair deal when he visited the markets to sell his produce. The exploitation of the toiling farmer and the growing rural indebtedness in india had attracted the attention of the government and various commissions and committees had urged the improvement of the marketing system particularly the need for public warehousing to regulate agricultural marketing and reduce burden of rural indebtedness.

Food grain marketing is very important in India. It provides cash and barter income for Indian farmers a lively hood for thousands of grain traders and processors and their employees and food for India's consumers. It in estimates that India's rural consumer spend more than urban consumers house hold budget on food grains.

Food grain marketing is of such importance in india that at various levels of government have become heavily involved in the operation and regulation. The indiangovernment and its agencies own and considerable food grain storage and processing facilities. They regulate trucking and market transactions and provide market yards, market information and grading services. In addition, various level of government in india influence prices by price fixing, rationing, food zones and direct procurements and distribution.

There are at least two necessary conditions for a food grain marketing system to exist. One is a demand for food grains by some element in the population and the other is a supply of food grains from food grains producer or through imports.

because over all supply and demand conditions for food grains so basic to an appreciation of the scope, importance and problems of food grain marketing in india.

MATERIALS AND METHODS

Only those markets, where the farmers of selected villages used to sale their produce, were considered for the present enquiry. The producers were found to sale their produce regulated market Saran (Chhapra) was selected purposively.

Selection of the producers

For working out marketable surplus and marketed surplus marketing and marketing margins in the selected market. 10 producers for each market was selected randomly irrespective of their size groups, from 50 selected farmers, thus, in all 10 producers were selected randomly.

Selection of market functionaries

All the important market functionaries of the two selected markets were interviewed in respect to the marketing of the crops. The marketing functionaries which were interviewed are given as below-

1. Commission agents (Arhatiya)
2. Brokers (Dalals)
3. Weight-men (Toulas)
4. Palledars

Marketable Surplus

It is the residual product available with the farmer after meeting his family and farm needs.

$$MS = \frac{\text{Total production quantity retained by farmer}}{\text{Total production}} \times 100$$

Area and production of wheat per hectare

The area and per hectare yield of wheat under different size of holdings was worked out an the results are presented in Table 1.

It reveals that the percentage of area under wheat to cultivated area was the highest on big size of holding being 41.63 percent followed by small and marginal farms being 39.62 percent and 37.80 percent with an average of 40.10 percent on the sample farms. Total production of wheat in case of big farms 55.49 percent was high in respect to small farm 25.86 percent and marginal farms 12.24 percent with an average yield of 31.19 percent.

Table : 1 - Total quantity of wheat, quantity retained for seed, quantity consumed by the family, quantity given as wages and other use.

S.No.	Particulars	Size groups of farm (m ha)			Overall Average
		Marginal (0-1)	Small (1-2)	Medium (2 & above)	
1.	Total quantity of wheat (qt)	12.24	25.86	55.49	31.19
2.	Quantity retained for seed (qt)	0.60	1.05	2.32	1.32
3.	Quantity consume by family (qt)	5.80	11.15	17.85	11.63
4.	Quantity given as wages (qt)	0.95	2.20	4.36	2.50
5.	Other	0.60	1.35	2.90	1.61
6.	Marketable surplus (qt)	4.29	10.21	28.06	14.18
7.	Marketed surplus (qt)	4.00	8.21	20.50	10.90

RESULTS AND DISCUSSION

Marketing surplus and marketed surplus of wheat

The marketable surplus is the surplus over total produce after making a deduction towards quantity retained for seed purposes, utilized for family consumption, quantity paid as wages and other uses and marketed surplus that quantity of the produce which the producer farmer actually sells in the market, irrespective of his requirements for family consumption, farm needs and other payments. The marketed surplus may be more, less or equal to the marketable surplus. As such marketable or marketable surplus for different categories of different farms have been worked out .

The indicates that, quantum of marketable surplus of wheat showed an increasing trend with the increase in the size of farms being 4.29, 10.29 and 28.06 quintals on marginal, small and medium farms, respectively.

The average marketable surplus came to 14.18 quintals and quantum of marketed surplus of wheat also slowed an increasing trend with the increase in the size of terms being 4.00, 8.71 and 20.50 quintals on marginal, small and medium farms, respectively the average market surplus to 11.07 quintals.

Marketable and marketed surplus as percentage to production

Marketable surplus and marketed surplus as percentage to production for different categories of different farm have been worked out .

Table - 2 : Total production, marketable surplus, marketed surplus and as percentage to production

S.No.	Particulars	Size groups of farm (m ha)			Overall Average
		Marginal (0-1)	Small (1-2)	Medium (2 & above)	
1.	Total production of wheat (qt)	12.24	25.86	55.49	31.19
2.	Marketable surplus	4.29	10.21	28.06	14.18
3.	Marketed surplus (qt)	4.00	8.71	20.50	11.07
4.	Marketable surplus as percentage to production	35.04	39.48	50.56	41.69
5.	Marketed surplus as percentage to production	32.67	33.68	36.94	34.43

indicates that, the marketable and marketed surplus with highest medium sized holdings being 50.56 percent and 36.91 percent respectively followed by small sized 39.48 percent and 33.68 percent respectively followed by marginal sized 15.44 percent and 32.67 percent marketable and marketed surplus of wheat. The average marketable and marked surplus of wheat worked out 14.18 quintals 11.07 quintals and its stage to total production of wheat was calculated as 41.69 percent and 34.43 percent per farm, respectively.

Marketing Cost and Marketing Margin

The producer's share in consumer's price largely depends upon the method of sale and the channels through which the produce reaches the

ultimate consumer's. Other things remaining the same, the larger the chain of intermediaries between producers and seller, the lesser was the share of the producer, because a major part of the profit was shared by the intermediaries. Due to forced sale and having poor storage facilities, the producers generally as a small share as profit for their produce.

In this chapter an attempt has been made to study the different channels through which producers share in consumers price, marketing cost of wheat ad the marketing margins of middlemen like wholesalers and retailers have been worked out. In the study area, the following marketing channels of what were found under operation.

Channel I : Producer-Consumer

Cannel II: Producer-Village Trader-Wholesaler retailer-Consumer

Channel III: Producer-Wholesaler-Retailer-Consumer

Channel IV: Producer-Govt. agency-Fair price shop-Consumer

Channel I: Producer-Consumer

This channel is better than all the marketing channels because in this channel cultivar directly sells his produce to the consumers at district level by transporting and get the maximum share of his produce. But this may be done on a very limited scale due to absence of transport facilities. In a village market almost all are farmers/producer and only a few are labours who needs to purchase wheat for family consumption.

Channel II: Producers-Villages Trader-Wholesaler-Retailer-consumer

In this channel village trader goes from village to village collecting the produce from the farmer at comparatively low price or price which is close to the primary market. These merchants then bring the produce in a wholesale market and sell to the wholesaler after taking their profit margin, which in term reached to consumer through retailers.

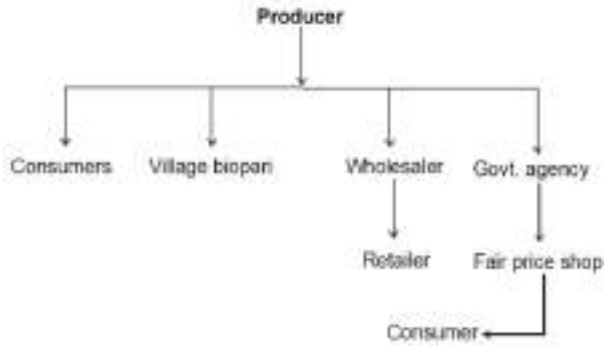
Channel III: Producer-Wholesaler-Retailers-Consumer

In this channel some big farmers directly sell their produce to wholesaler, who sells to retailers in town and cities and in last to consumes.

Channel IV: Producer-Govt. agency-fair price shop-Consumer

The channel IV, where wheat was purchased by overnment through its own agency i.e. FCI and co-operatives. All the marketing expenses incurred in process of marketing were made by government. This wheat was made available to consumers at the same price which is paid by the Government to the producers and some time it was supplied even at lower rate for the welfare of men. Hence in this channel we do not make attempt to work out the share of producer's in consumer's price.

Marketing channels of wheat



Marketing cost

shows that marketing cost paid by producer intermediaries different channel and margins of intermediaries in per quintal.

The shows that total marketing cost was the highest in channel II (Rs. 98.70) because of its length and it was followed by channel III (Rs. 97.60) and channel I (Rs. 0.00) respectively. There was no margin in channel I because producer sell the produce directly to consumer. For margins, retailers margin was the highest.

Table - 3 : Details of marketing charges of wheat under different marketing channels

S.No.	Particulars	Marketing cost under different channel		
		Channel-I	Channel-II	Channel-III
A.	**Charges paid by producer**			
1	Transportation			13.50
2	Weighing			2.00
3	Loading and unloading			4.00
4	Other			1.00
	Sub total	**0.00**	**0.00**	**20.50**
B.	**Charge paid by village trades**			
1	Transportation		13.00	
2	Weighing		2.00	
3	Loading and unloading		4.00	
4	Other		3.00	
	Sub total		**22.00**	
C.	**Charge paid by wholesaler**			
1	Transportation		10	10.50
2	Mandi fees		1% of value (12.70)	1% of value (13.10)
3	Weighing		2.00	2.00
4	Loading and unloading		4.00	4.00
5	Warehouse charge		4.50	4.50
6	Bardana		30	30
	Sub total	**0.00**	**63.70**	**64.10**
D.	**Charges paid by retailer**			
1	Transportation		8.00	8.00
2	Loading and unloading		4.00	4.00
3	Other		1.00	1.00
	Sub total		**13**	**13**
	Gross total marketing charges (A+B+C+D)		98.70	97.60

Producers share in consumer's price

Producer's share in consumers price and percentage distribution of different costs and margins in wheat marketing .

The shows that producers share in consumers price was highest in channel-I followed

Table - 4 : Price spread in wheat under different channels (Rs. per quintal and percentage)

S.No.	Particular	Channel-I		Channel-II		Channel-III	
		Value Rs.	%	Value Rs.	%	Value Rs.	%
A.	Producer					2010	
1.	Sale price	1995		1970		1310	
2.	Marketing cost						
3.	Net price received by producer	1995	100	1970	89.21	2010	91.35
B.	Village trader						
1.	Purchase price of village trader			1970			
2.	Marketing charges			22.00	1.02	20.50	1.00
3.	Margin			47.00	2.19		
4.	Sale price			2039		2030.50	
C.	Wholesaler						
1.	Purchase price of wholesaler			2039		2030.50	
2.	Marketing charges			63.70	2.97	64.10	3.00
3.	Margin			41.00	1.91	41.00	1.91
4.	Sale price			2143.70		2135.60	
D.	Retailer						
1.	Retailer price of retailer			2143.70		2135.60	
2.	Marketing charges			13.00	0.59	13.00	0.59
3.	Margin			51.50	2.33	51.50	2.34
4.	Sale price of retailer or purchase of consumer	1995	100	2208.20	100	2200.10	100
	Total margin			139.50		92.50	
	Producer share in consumer price (in per cent)	100		89.21		91.35	

by channel-III (91.35) and channel-II (89.21), respectively.

It was, because of existence of more middlemen in channel-II leading to more marketing cost being Rs. 98.70 in channel-II and Rs. 97.60 in channel-III.

From the above finding it may be concluded that produces share in consumers price goes on decreasing with the increase in number of middlemen a marketing channel. It was mainly due to lower sale price received by the farmer and higher margins of profit charged by market middlemen.

Marketing

Some important constraints in the marketing of wheat are listed below:

I. **Low marketable surplus**– Most of the small farmers have a very low marketable surplus.

II. **Payment by Cheque** – The Govt. agency do not make payment in cash instead they pay it in the farm of cheque. Cheque takes as long length of time to encash.

III. Location: The main problem with majority of the farmers was the location of mandi yards at a long distance from their village. The construction of mandi yards in confined to tehsil or district head quarters which was not accessible to majority of the farmers living in for flung Village of the districts. So the farmers did not prefer to come at the mandiyards for selling their produce from a long distance.

IV. Publicity: Through the farmers were of the regulated markets but they were ignorant about

the benefits and functions of Regulated Mandies and its committees. The farmers were also not aware of the information's regarding prices and arrivals in mandies.

V. **Supervisions and vigilance:** The farmers who went to market yard felt that the officials in the market yard were not keen on the transactions in the yard; as a result their faith in regulated mandies was not so firm.

VI. **Transaction:** the business is confirmed only to a few fixed hours on working days. So the farmers coming from for of places find difficulty in reaching the market yard in time. As most of the farmers are ignorant and illiterate, it was difficult for them to find out the exact and days and hours of transactions. This created problems and discouraged the farmers to hours of transaction. This created problems and discouraged the farmers to bring the produce in the mandies.

VII **Lack of grading the standardization:** Regulated markets also lack grading and standardization facilities. It the absence of proper grades and standards, farmers were faced by the middleman to sell their produce at lower price. The middleman also used to take sample from the farmers bags without certain limit, which was not considered just in views of producers, resulting in the reduction of producer's share.

VIII. **Lack of storage facilities:**The regulated mandies under study lacked storage facilities. The farmers who failed to sell their produce during the day of their arrival felt insecure of their produce in market yard. They also did not have confidence in keeping the produce in were- houses of the mandies, which was seldom available for all the farmers. These facts kept the farmers away from the regulated mandies and farmers did not prefer to sell their produce through regulated mandies.

IX. **Higher marketing cost:** Small and marginal farmers were of the opinion that marketing of the produce through regulated mandies was uneconomical to them because of high transportation cost. On one hand and very low marketable surplus with them on the other. So they preferred to sell their produce in the village markets rather than bringing it to the regulated mandies.

X. **Lack of input centres:** Provision of input centres for farmers benefit was considered as one of the main task in the mandi area under mandi Act. But it was noted that none of the regulated markets could provide these facilities at mandi yards.

XI. **Forced sale:** The village money landers, village merchants and traders use to make advances to the producers/farmers for meeting out their financial needs in respect marriages, purchase of inputs and other necessities, under some definite terms. Under these conditions the producers were bond to sell their produce just after harvest to these agencies from whom they have taken money in advance. The farmers also sell their produce just after harvest in local markets to meet out their day to day requirements. The forced sale regulated in low prices and low arrivals in regulated mandies.

XII. **Lack of infrastructural facilities:** Regulated mandies under study also lacked infrastructural facilities like-mandi yard, road link with hinter land village, poor transport facilities and communication. It was also observed that the farmers did not enjoy processing facilities like Rice hullers,

Oil machines etc. In rural areas. So they were bound to sell their produce as such.

XIII. The pricing policy play a major role on the extent of area put to wheat sand their production. Non fixation support price in time compels the farmers to switch over to a more remunerative crop.

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STUDIES ON HYPHOMYCETOUS FUNGI FROM RHIZOSPHERE AND RHIZOPLANE OF ROOT-KNOT NEMATODE, MELOIDOGYNE SPP. AFFECTED CAPSICUM (CAPSICUM ANNUUM L.) CROP FROM POLYHOUSES OF LUCKNOW (UTTAR PRADESH)

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ABSTRACT

Plant parasitic nematodes are known to cause severe damage and losses in Tomato, Cucumber and Capsicum crop under Polyhouse conditions. This is an emerging technology for raising vegetables and ornamental crops under controlled protected environmental conditions. This has resulted in better quality produce, high productivity and growth round the year and has gained popularity among the farmers for getting more yield and better produce. This is feasible in India under tropical and subtropical climatic conditions for raising high value crops. Hence, a survey was undertaken in the Farmer's Polyhouse of Lucknow, Uttar Pradesh area. He was raising Capsicum (*Capsicum annuum L.*) commonly known as Shimla mirch in Polyhouses. This crop is often attacked by root-knot nematode, *Meloidogyne spp.* which is one of the major limiting factors and crop suffers heavy yield losses. In addition to direct damage, these nematodes pre-dispose the plants to soil borne bacteria and fungi and plays an important role in disease complexes. Hence an investigation was undertaken on the Hyphomycetous fungi from rhizosphere and rhizoplane of root-knot nematode affected Capsicum crop and further larvicidal and ovicidal test was done.

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Keywords : *Polyhouse, plant-parasitic nematodes, fungi, crop, losses, diseases.*

INTRODUCTION

Protected cultivation of horticultural crops like Tomato, Cucumber and Capsicum is an emerging technology for raising vegetables and ornamental crops under controlled environmental conditions. This is feasible in India under tropical and subtropical climatic conditions for raising high value crops. This has resulted in better quality produce, high productivity and growth round the year. This has gained popularity among the farmers as getting more yield and better produce. (Khan and Esfahani, 1990) In India Protected Cultivation is practised in many states of India i.e., Bangalore, Andhra Pradesh, Rajasthan, West Bengal, Gujarat, Tamil Nadu, Palampur and Uttar Pradesh. High day temp and relative humidity within the Polyhouses provide ideal conditions for the introduction and rapid multiplication of pathogens like Fungal, viral, bacterial and diseases caused by plant-parasitic nematodes.(Askary *et al.,* 2015; Jatala, 1986 and Goswami & Mittal, 2012) Hence, a survey was undertaken in the Farmer's Polyhouse of Lucknow, Uttar Pradesh area. He was raising Capsicum (*Capsicum annuum L.*) commonly known as Shimla

mirch in Polyhouses. (Fig.1) This is a highly remunerative vegetable Solanaceous crop grown in open as well as protected cultivation in most parts of the Country. These are good sources of Vitamin C and in fact they have twice the amount of Vitamin C by weight than citrus fruits. The Vitamin C acts as an antioxidant that may be effecting in preventing certain cancers.

Plant parasitic nematodes are known to cause severe damage and crop losses in Capsicum spp. (*Shotorbani et al*., 2013) Root-knot nematodes of the genus *Meloidogyne spp.* is a Polyphagous nematode causing great damage to majority of the crop and comprising over hundred species. Among the most damaging are *Meloidogyne incognita*, *M. javanica*, *M. arenaria* and *M. hapla* (Hussey and Barker, 1973). They have large host range, wide geographic distribution and high destructive potential. (Taylor and Sasser, 1970) Capsicum crop is often attacked by root-knot nematode, *Meloidogyne spp.* and crop suffer heavy yield losses. (Nagnathan, 1984). However, *Meloidogyne incognita* (Kofoid and White) Chitwood is one of the major limiting factors affecting the production of Capsicum in India. An estimated yield loss of 20 percent in Capsicum has been reported due to *M. incognita* in India (Singh and Kumar, 2015). In addition to direct damage, these nematodes pre-dispose the plants to soil borne bacteria and fungi and plays an important role in disease complexes. (Agrios, 2005; Alam *et al.,* 1973). In the present investigation, study was undertaken on the Hyphomycetous fungi from rhizosphere and rhizoplane of root-knot nematode affected Capsicum crop (*Capsicum annuum L.*).

MATERIALS AND METHODS

Survey was undertaken in the Farmer's Polyhouses of Lucknow area. (Fig.1) On uprooting the plants some roots were having galled roots infected by *M. incognita* and rhizosphere soil was also collected. The roots were washed thoroughly in running tap water. The eggmasses were surface sterilized with 0.01 percent mercuric chloride and then transferred to Potato Dextrose agar slants following incubation at 25 ± 2^0C for 10-15 days. The rhizosphere soil adhering to galled roots were isolated through soil dilution plate method. Each of the mycoflora thus appeared were isolated, purified and identified. All these above fungal species were subjected to in vitro tests. (Larvicidal and ovicidal).

Fig. 1. View of Polyhouse having Capsicum crop

For the in vitro tests each of the fungal species was isolated on PD broth and then allowed to incubate at $25+2^0$ C for 15 days. The culture filtrate from each was taken as standard extract. Then hundred freshly hatched juveniles of *M. incognita* were exposed to each of the standard extract of fungus. Observations taken after 24, 48 and 72 hrs keeping adequate check in water. Further, for the ovicidal test, three eggmasses were surface sterilised with 0.1% Hgcl2 for 30 seconds. The surface sterilized eggmasses were allowed to soak for 48 hr in each of the above dilutions following which they were transferred to sterilized water. The observations were recorded after 2, 4, 6 and 8 days of hatching. Both the tests were repeated three times.

As regards the egg parasitization capacity of *M. incognita* by the fungi isolated a test was conducted by growing fungi on PDA of each species. The eggmasses were surface sterilized with

0.1% Hgcl2 for 30 seconds and then transferred to each of the fungal species and kept in BOD for one week at 25 $\pm$ 2^0 C. The eggmasses were stained with cotton blue lactophenol, crushed and observation under stereobinocular for egg parasitisation and the % of eggs parasitized was then recorded.

RESULTS AND DISCUSSION

In the present investigation it is clear from Table 1 that fungus growing on wilted roots after subculturing and purification was identified as *Fusarium moniliforme* along with *Penicillium* spp. while number of fungi encountered from the rhizosphere soil. On the other hand, the soil collected from the rhizosphere of less wilted plants showed *Aspergillus nidulans, Aspergillus niger, Cladosporium cladosporioides, Gliocladium virens* and *Trichoderma harzianum* and *Paecilomyces lilacinus* from the eggmasses of root knot infected Capsicum plants was found. Some more unknown fungus still observed in the process of identification.

Data presented in Table 2 reveals that *A. niger* and *A. nidulans* caused 100% mortality of *M. incognita* larvae in standard extract (SE) after 72 hrs of exposure. This is followed by *Penicillium* spp., *Gliocladium virens* and *Cladosporium cladosporioides*. But the pathogenic fungus *F. moniliforme* does not show larvicidal activity and expressed least kill. However, the egg-parasitic one, *Paecilomyces lilacinus* showed mild toxicity exhibiting 50% respectively after 72hrs of exposure period. The mortality was confirmed by revival test.

Hatching inhibition test was carried out with standard extract of each of the fungal filtrates separately and thus confirmed observation of the larvicidal test. (Table 3) Highest inhibition was recorded in *Aspergillus niger* followed by *A. nidulans* and *Trichoderma harzianum* while the fungal bioagents showing egg-parasitic nature *P. lilacinus* in general allowed larvae to hatch more freely. However, the pathogenic wilt fungus *F. monilifome* did not respond good hatching inhibition.

Table. - 1 : Fungi associated with rhizosphere ®, Pathogenic (P) and eggmasses(EG) of *M. incognita* infecting Capsicum crop

S. No.	Fungus	Association
1.	*Aspergillus niger*	Rhizosphere
2.	*Aspergillus nidulans*	Rhizosphere
3.	*Trichoderma harzianum*	Rhizosphere
4.	*Cladosporium cladosporioides*	Rhizosphere
5.	*Gliocladium virens*	Rhizosphere
6.	*Fusarium moniliforme*	Pathogenic
7.	*Penicillium spp.,*	Rhizosphere
8.	*Paecilomyces lilacinus*	Eggmasses

Table - 2 : Larvicidal test of different fungal filtrates against *M. incognita*

Fungus (Standard extract)	Larval Kill (%) after (hr)		
	24	48	72
A. *niger*	60	75	100
A. *nidulans*	70	100	100
T. harzainum	54	70	90
P. *lilacinus*	38	44	50
Penicillium spp.	15	24	32
Cladosporium cladosporioides	20	30	34
Gliocladium virens	12	22	32
F. moniliforme	10	20	30
Control	2	3	6

As regards egg-parasitization capacity by the fungal species and it showed variability. *P. lilacinus* showed 65% egg parasitisation respectively while *Penicillium spp*. trapped only 20%. However, *Aspergillus niger* and *A. nidulans* failed to parasitise the eggs of *M. incognita*. Similar trend was observed with *T. harzainum* and other fungi were able to invade the egg-masses in the range of 5-10% respectively. Thus further studies are needed under Polyhouse conditions for effective management of disease complexes caused by plant-parasitic nematodes and fungi.

Table - 3 : Effect of culture filtrates of different isolated fungi on hatching of *M. incognita* juveniles

(Average of 3 replicates)

Fungi (Standard Extract)	At transfer	Number of juveniles hatched (after days) 2	4	6	8
A. niger	30	48	56	80	84
A. nidulans	40	50	70	76	90
T. harzianum	22	40	56	70	96
P.lilacinus	24	30	62	98	110
Penicillium spp.	34	58	84	90	140
C.cladosporioides	20	42	50	96	136
Gliocladium virens	32	50	78	102	146
Fusarium moniliforme	46	80	122	160	198
PD Broth	90	102	166	210	250
Control	100	120	220	290	320

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EFFECT OF CALCIUM NUTRITION ON YIELD AND QUALITY OF CABBAGE (BRASSICA OLERACEA)

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ABSTRACT

An experiment was carried out during winter (rabi) seasons of 2015-16and 2016-17 to study the response of calcium fertilization on cabbage (Brassica oleracea, var. Capitata) . The treatments comprised five levels of calcium (0, 3,5,7 and 9 kg ha^{-1}) were evaluated in randomized block design with four replications. The results revealed that the application of calcium up to 7kg Ca ha^{-1} significantly increased the edible head yield and dry matter production of cabbage over control. The magnitude of mean response to 7 kg calcium ha^{-1} application was recorded as 48.4% over control. Successive calcium levels had a significant beneficial effect on its uptake by the vegetable crop up to 9 kg Ca ha^{-1}. A phenomenal increase in N, K and S uptake was recorded in the crop due to increasing levels of Ca up to 7 kg ha^{-1}. Ca application significantly improved the content and yield of protein in the crop over control and maximum values were recorded at 7kg Ca ha^{-1}. The apparent recovery of Ca was influenced by its levels with maximum at 5 kg Ca ha^{-1} in cabbage. Better Ca use efficiency in cabbage (1917.5 kg produce/Ca applied) was obtained with 5 kg Ca ha^{-1}. The Ca use efficiency decreased with its increasing levels and minimum use efficiency was recorded with 9 kg Ca ha^{-1} application.

Keywords : *Calcium, cabbage, yield, response.*

INTRODUCTION

Cabbage is a voracious feeder crop. Calcium element is entirely responsible for head size and compactness. Vegetables play a very important role in the human diet. They are valuable roughages, which promote digestion and help to prevent constipation. They supply carbohydrate, fats, protein, vitamins and mineral elements. Cabbage is a leafy green plant grown as vegetable crop for its dense leaved heads. The vegetables have given a push to Indian economy and boosted up her trade. Average productivity of vegetable crops is however, very low and not sufficient to meet the need of local consumption. Among the several constraints, improper nutritional management is an important impediment for increasing the productivity of cabbage. Vegetable crops have a high Calcium requirement due to its many functions in plant growth. Calcium application is less expensive but can give higher profits than other nutrients (Solanki *et al.*, 2010). Calcium, as a plant nutrient, has very significant impact on yield and

quality of vegetable crops. Calcium also plays a role in the activation of enzymes. In recent years, an increased frequency of calcium deficiency has been observed in crops and Ca may become a factor limiting yield and quality of crops. Ca deficiency is observed mainly due to high crop yield, therefore, higher rate of Ca removed by crops and lesser use of Ca containing fertilizers. The farmers of the area, by and large, use N, P and K fertilizers in vegetable crops and as a consequence, deficiency of Ca is increasing. About 80 % soils of India are low in available Ca and these soils are under intensive cultivation with no or little application of Ca fertilizers (Shukla, 2011). The information regarding the response of cabbage to Ca application under identical soil and weather conditions was considered to be of interest. It was felt imperative to find out the response of cabbage to Calcium application for higher production and quality. However, the information pertaining to response of cabbage crop to Ca application is limited. Therefore, the present study was planned to assess the response of cabbage crop to Ca application in Allahabad conditions.

MATERIALS AND METHODS

300 The field experiment was conducted during winter seasons of 2015-16 and 2016-17 at Research farm, KulbhaskarAshram Post Graduate College Prayagraj (U.P.). The experimental site is characterized by semi-arid climate with extreme temperature during summer (42º to 44º C) and very low temperature during winter (as low as 4º C). The average rainfall is about 680 mm, most of which is received from June to September. The soil was sandy loam in texture having pH (7.7), EC (0.28dS m^{-1}), organic carbon (3.0 g kg^{-1}), available N (130 kg ha^{-1}), P (9.0 kg ha^{-1}), K (117 kg ha^{-1}), S (7.0 mg kg^{-1}) and DTPA – Zn (0.47 mg kg^{-1}). The treatments consisting 5 levels of Zn (0, 3, 5, 7 and 9 kg ha^{-1}) were tested in randomized block design with four replications. The seedlings of cabbage were planted on 20 November in both the years. A basal dose of 100 kg N, 50 kg P_2O_5 and 50 kg K_2O ha^{-1} was applied through urea, diammonium phosphate and muriate of potash, respectively. Full dose of phosphorus and potassium along with half nitrogen were applied at planting and remaining half dose of nitrogen was applied after 40 days of planting. Calcium was applied through Calcium sulphate at the time of planting. The crop was raised with recommended agronomic practices. The crop was harvested at physiological maturity and cabbage head yields were recorded. The cabbage head was cut in to small pieces, dried, ground and digested with di-acid mixture of HNO_3 and $HCIO_4$ in 9 : 1 ratio. Phosphorus, K, S and Ca were determined by vanadomolybdophosphoric yellow colour method, flame photometer, turbidimetric method (Chesnin and Yien, 1951) and atomic absorption spectrophotometer, respectively. Nitrogen content was determined following micro Kjeldahl method (Jackson 1973). The protein content was computed from the nitrogen content multiplied by a factor 6.25. The uptake of nutrient was calculated by multiplying the concentration values with respective economic yield data. The following formulae were used to calculate calcium use efficiency and apparent calcium recovery:

Calcium use efficiency (kg produce/kg Ca applied): Yield (F) – Yield (C)/Fertilizer Ca applied

Apparent Ca Recovery (%) = [Uptake of Ca in treated plot – Uptake of Ca in control plot/applied Ca dose] x 100

Where F and C are fertilizer treated and control plot, respectively.

Data obtained from consecutive two years were statistically analyzed as per procedure given by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Economic Yield

The results on economic yield distinctly indicated that the test crop responded markedly to Ca application. In general, each additional dose of Ca application up to 7 kg Ca ha^{-1} increased significantly the yields. Thereafter, a decreasing trend was observed at 9 kg Ca ha^{-1} (Table 1). The per cent increase in head yield due to 7kg Ca ha^{-1} over control was 37.4. This increase in yields with Ca levels seems to be associated with the increased Ca availability from applied Ca as the experimental soil was low in available Ca. The response to Ca may be attributed to improved nutritional management as a result of increased Ca supply which might have favourable influence on the growth and yield of cabbage crop. Solanki *et al.* (2010) and Singh *et al.* (2009) also reported significant response of vegetable crops to Ca application. Increasing levels of Ca significantly increased dry matter production in cabbage from 2.37 to 3.31 tonnes ha^{-1} (Table 1).

Table - 1 : Effect of Calcium fertilization on yield and quality of cabbage (mean of 2 years)

Ca (kg ha^{-1})	Head yield (t ha^{-1})	Dry matter yield (t ha^{-1})	Protein content (%)
0	37.50	2.30	4.30
3	40.50	2.60	4.60
5	45.17	3.00	4.80
7	48.44	3.30	5.00
9	46.16	3.10	5.10
SEm±	0.71	0.08	0.09
CD (P=0.05)	1.30	0.17	0.19

Crop exhibited practically no difference at higher levels of Ca. Hence, 7 kg Ca ha^{-1} can be regarded as suitable dose for cabbage crop. Increase in dry matter production due to Ca addition was largely a function of improved growth, translocation of more photosynthates towards sink and consequent accumulation of more dry matter in edible heads. The lowest dry matter production in cabbage was noted in control. Solanki *et al.* (2010) also reported significant response of the vegetable crops to Ca application.

Table - 2 : Uptake of N, P, K, (kg ha^{-1}) and Ca (g ha^{-1}) in cabbage as influenced by Calcium fertilization (mean of two years)

Ca (kg ha)	Nitrogen	Phosphorus	Potassium	Ca
0	15.5	3.8	14.5	68.9
3	18.6	4.8	15.8	77.4
5	22.5	5.1	18.4	89.9
7	26.2	4.9	20.4	100.3
9	25.9	4.6	20.2	105.1
SEm±	1.30	0.09	0.40	1.90
CD (P=0.05)	3.10	0.21	0.87	4.10

Uptake of nutrients

Nitrogen uptake by cabbage increased significantly with increasing levels of Ca and the highest N uptake (26.2 kg ha^{-1}) was observed with 7 kg Ca ha^{-1} and the lowest in the control i.e. 15.5 kg ha^{-1} (Table 2). Thus, the beneficial effect of Ca on N uptake by the crop seems to be associated with promoted nitrogen availability with a concomitant increase in crop yield. The significant increase in P uptake by cabbage crop was noticed with the application of Ca and maximum value was recorded at 5 kg Ca ha^{-1}. Thus, Ca application increased the efficiency of vegetable crops to utilize the phosphorus (Solanki *et al.* 2010). A progressive increase in Ca levels up to 7 kg ha^{-1} gradually increased K uptake by the cabbage crop. Higher uptake of K might be due to higher yield and K content in the edible heads of cabbage crop (Singh *et al.* 2009). Since, the uptake of nutrient is a function of dry matter and nutrient content, the increased dry matter yield of cabbage crop with higher Ca content resulted in greater uptake of this element (Singh *et al.* 2009). The Ca uptake increased from 68.9 to 105.1 g ha^{-1} with 9 kg S ha^{-1}. It seems that application of Ca enriched the available Ca status of soil which was easily utilized by the crop. The results indicate beneficial effect on Ca utilization by cabbage crop

under higher levels of Ca (Singh *et al.* 2009 and Radder*et al.* 2006).

Table - 3 : Effect of Calcium levels on efficiency indices in cabbage (mean of two years)

Ca level (kg/ha	Apparent Ca recovery (%)	CaUE (kg produce/kg Ca supplied)
0	-	-
3	5.25	1600.0
5	6.25	2017.5
7	6.23	1923.3
9	5.52	1182.5

Efficiency indices

The maximum value of apparent recovery of Ca by cabbage was 6.25% at 5 kg Ca ha^{-1} (Table 3). The minimum value of apparent recovery of Ca in the crop was noted at 9 kg Ca ha^{-1} level. The yield improvement over unit quantity of Ca addition was calculated as Ca use efficiency. Critical examination of the data (Table 3) showed that the different levels of Ca tried had influenced the Ca use efficiency. The response varied from 1600.0 to 2017.5 kg edible head/kg Ca in cabbage. Calcium use efficiency (kg produce increase/kg Ca) increased with an increase in the rates of Ca up to the level of 5 kg Ca ha^{-1} in the vegetable crop. Better Ca use efficiency was obtained with 5 kg Ca ha^{-1} and recorded 2017.5 kg produce in cabbage head per kg Ca applied.TheCa UE in the vegetable crop decreased at 9 kg Ca ha^{-1}. This may be due to the fact that input-output relationship follows the law of diminishing return as far as the relationship between Ca and yield is concerned. Similar findings have been reported by Solanki *et al.* (2010).

CONCLUSION

Based on two years of field study, it may be concluded that application of 7kg calcium ha^{-1} to cabbage is sufficient dose for increased productivity and quality of produce under Allahabad conditions.

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