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Adoption and impact of production technology of paddy in Marathwada region of Maharashtra

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ABSTRACT

The study revealed the adoption and impact of production technology of paddy cultivation in Marathwadaregion of Maharashtra for the year 2013-14. The study is based on costs and returns structure, production function analysis, resource use efficiencies, yield gap analysis, adoption index and impact of improved paddy technology have been estimated in the study. It has been found that per hectare cost 'C' was Rs. 35,801.52 and BCR is 1.14, whereas, per quintal cost of production was Rs. 1,145.57 at the overall level for improved paddy cultivation methods. Further, there was a 19.97 per cent yield gap between actual yield and demonstration plot yield. The composite index of technology adoption was worked out to 38.62 per cent indicated that the sample farmers adopted less than 61 per cent recommended paddy production technology and obtained 28.10 q/ha yield. The contribution of different components on impact of paddy production technology in Marathwada region, net returns was maximum (49.91 per cent). The added yield was 6.98 q/ha over the local and improved method of adoption. Thus, for producing extra yield per hectare costs were also increased Rs. 7,154 and added returns were also increased Rs.9,756.80. The ICBR ratio indicates that the high adoption of improved production technology adopter farmers were in profit with 1.36 ICBR ratio. It indicates that, the farmers should adopt the improved production technology for paddy to the fuller extent for maximizing returns and minimizing per unit cost.
Keywords: *Decomposition model, Technology Adoption, Impact, ICBR ratio*

INTRODUCTION

India is one of the leading rice producing countries of the world with cultivated area of 43.97 M ha and production of 100 Mt in 2011-12. The leading states in rice cultivation are: West Bengal, Uttar Pradesh, Orissa, Andhra Pradesh and Panjab. Maharashtra is one of the major rice growing states in India. Paddy is grown on 15.40 million ha with an annual production of 35.00 million tonnes and productivity at 1821 kg/ha during the year 2011-12. Maharashtra ranks 12th in production and 13th in productivity among major rice growing states of the country (India Stat.Com, 2011).The present study is an attempt to analyze the impact of improved technologies on paddy production in Marathwada regions of Maharashtra. The study undertaken so far had mostly focused on the favorable effects of technological change. The reasons for the rate of adoption lagging behind expectation have been virtually unexamined. Therefore, a study which focuses on both aspects of technical changes i.e. its impact on yield, returns etc. as well as the reasons for non-adoption of improved technology assumes great importance. Considering the above facts it was necessary to the "Adoption and impact assessment of production technology of paddy in Marathwada region of Maharashtra". Therefore, the present study was undertaken to study the resource use efficiency and cost and returns of paddy and technology adoption and its impact on production of paddy

METHODOLOGY

The study was conducted in the Marathwada region of Maharashtra. Two districts from the region *viz.,* Nanded and Parbhani and from each district two tahsils were selected on the basis of maximum area under study. Two villages from each tahsil were selected. Among each village, 6 samples were selected as per the size group of small, medium and large. The study was based on primary data for the year 2013-14. From each district, 36 farmers were selected who were practicing improved production technology of paddy of cultivation. Thus, there were a total number of sample size of 72 farms. The farmers were interviewed using specially prepared schedules. The farmers were also asked to prioritize the most important constraints they were facing in adopting improved method of paddy cultivation.

Production function analysis

The data were therefore, subjected to functional analysis by using the following Cobb-Douglas type of production function,

$$Y = aX_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} .... X_n^{b_n} e^u$$

Where,

Y= Output of main produce in quintals per hectare
a= Intercept
X_1= Per hectare use of human labour in man days
X_2= Per hectare use of Bullock in pair days
X_3= Seed (kg) per hectare
X_4= Per hectare use of Manure in quintals
X_5= Nitrogen (kg) per hectare

X_6= Phosphorus (kg) per hectare
X_7= Potash (kg) per hectare
e^u = error term

Estimation of marginal value product

The MVP of individual resources was estimated by using the following formula,

Marginal value product= $X_i = b_i \frac{\overline{Y}}{\overline{X}} P_y$

where,

bi= Elasticity of production of i^{th} input
Y = Geometric mean of output
Xi= Geometric mean of of i^{th} input
Py= Per unit price of output

Technological Gap Analysis

Yield gap was worked out as the difference between demonstration plot yield and actual farmer's yield. The following Cobb-Douglas type of production function was used for this purpose (*Gaddi et al, 2002)* [2]

$$Y = a_0 H^{a_1} B^{a_2} M^{a_3} N^{a_4} P^{a_5} e^u$$

where,

Y = Output of main produce in quintals per hectare
a_0 = Intercept
H = Per hectare use of human labour in man days
B = Per hectare use of Bullock in pair days
M = Per hectare use of Manure in quintals
N = Nitrogen (kg) per hectare
P = Phosphorus (kg) per hectare
e^u = error term
a_1 to a_5 elasticities of production.

The combination of different resources to yield gap was estimated with the help of Decomposition Model. The following functional form was used to work out the yield gap. *(Bisliah, 1977)*[3]. The Chow test was conducted for checking the production elasticity of the two functions.

$$\text{Log } (Y_2/Y_1) = [\text{Log } (b_o/a_0)] + [(b_1-a_1) \text{ Log } H_1 + (b_2-a_2) \text{ Log } B_1 + (b_3-a_3) \text{ Log } M_1 + (b_4-a_4) \text{ Log } N_1 + (b_5-a_5) \text{ Log } P_1] + [b_1 \text{ Log } (H_2/H_1) + b_2 \text{ Log } (B_2/B_1) + b_3 \text{ Log } (M_2/M_1) + b_4 \text{ Log } (N_2/N_1) + b_5 \text{ Log } (P_2/P_1)] + [U_2-U_1]$$

Technological Adoption Index

Technology Adoption Index (TAI) was worked out as per Kiresur *et al*. (1996) [4] with the help of following formula.

$$TAI = \frac{A_i}{M_i} x100$$

Where,

Ai=Average adoption score registered by the farmer for Particular component
Mi=Maximum adoption score registered by the farmer for particular component.

RESULTS AND DISCUSSION

Per hectare cost of cultivation of paddy in Marathwada

The Table 1 revealed that at the overall level, per hectare cost of cultivation of paddy i.e. Cost 'C' was Rs. 35,801.52. Amongst the different items of cost, hired human labour charges was the major item of cost followed by rental value of land, bullock labour, family human labour, interest on fixed capital, seed, depreciation on farm implements, Nitrogenous, phosphorus fertilizers, machine power, interest on working capital and manures. The total cost of cultivation of paddy the Cost 'A' was Rs. 23,024.90 (64.31 per cent) and Cost 'B' was Rs. 32,103.35 (86.67 per cent).

Over the size group of holding, per hectare total cost of cultivation of paddy was Rs. 46,210.40, Rs. 34,663.65 and Rs. 32,699.13 for small, medium and large size group of holdings, respectively. At the overall level, per quintal cost of paddy was Rs. 1,145.57. Per hectare cost of cultivation decreased with an increasing of size group of holdings. Per quintal cost of paddy was Rs. 1,547.39, Rs. 1,147.35 and Rs. 1,011.32 for small, medium and large group of holding, respectively. It indicates that the per quintal cost of paddy decreased with increase in size of holdings.

Resource use gap of paddy in Marathwada

The gap between the yield on sample cultivator's farm and demonstration plot was 19.71 per cent. Per hectare use of inputs like human labour, manures and potash fertilizers was utilized less on sample cultivators. The per cent gap utilized of bullock labour, seed, nitrogen and phosphorus was excess use between the sample cultivators and demonstration plot (Table 2).

Results of Cobb-Douglas production function of paddy in Marathwada

The overall level the value of R^2 were 0.72, which indicated that the seven resource variables included in the production function have jointly explained as high as 72 per cent of the total variation in the production of paddy, respectively (Table 3).At the overall level, regression coefficients of human labour (X_1), bullock labour (X_2), manures (X_4) and potash (X_7) were found positive and significant. The variables like seed (X_3), nitrogen (X_5) and phosphorus (X_6) were positive and non-significant which indicates no scope to increase their use in production of paddy on sample farms. It indicates that there is scope to increasing the quantity of manures and potash to increase the output. If we increase manures and potash by 1 per cent the output will be increased by 0.02 and 0.18 per cent, respectively.

Resource use efficiencies of paddy in Marathwada

The marginal value product to factor cost ratio (MVP/MC) was greater than unity in case of resources like human labour (X_1), bullock labour (X_2), manures (X_3) and potash fertilizers (X_6) at the overall level implying the achievement of higher resource use efficiency in case of above mentioned variables, whereas the MVP/MC ratio of seed (X_3), nitrogen (X_5) and phosphorus fertilizer (X_6) were found to be less than unity depicting the inefficient use of these resources (Table 4).

Table 1: Item-wise cost of cultivation paddy in Marathwada (Value in Rs./ha)

Cost items	Small			Medium			Large			Overall		
	Qty	Value	Per cent	Qty	Value	Per cent	Qty	Value	Per cent	Qty	Value	Per cent
Hired Human labour (Man days)												
a. Male	7.20	1079.98	2.34	7.43	1113.85	3.21	9.27	1390.21	4.26	8.36	1254.35	3.50
b. Female	42.53	4252.87	9.20	54.92	5491.87	15.84	68.16	6815.79	20.86	59.60	5959.94	16.65
Bullock power (Pair days)	23.18	6954.02	15.05	15.09	4528.01	13.06	9.83	2949.42	9.03	13.84	4150.52	11.59
Machine power	4.85	2426.56	5.25	2.01	1002.77	2.89	2.57	1308.55	4.00	2.85	1436.45	4.01
Seed (Kg)	88.70	2217.43	4.80	83.75	1674.97	4.83	84.28	2191.18	6.71	84.97	2052.74	5.73
Manures (Q)	21.07	2107.28	4.56	7.61	760.72	2.19	4.28	427.63	1.31	8.40	839.98	2.35
Fertilizers (Kg)												
N	96.30	1559.04	3.37	97.30	1575.33	4.54	96.29	1558.89	4.77	96.57	1563.49	4.38
P	71.48	1300.96	2.82	77.46	1409.68	4.07	90.55	1648.00	5.04	83.28	1515.70	4.23
K	16.67	163.37	0.35	25.58	250.73	0.73	20.85	204.29	0.63	21.37	209.40	0.58
Irrigation Charges		15.33	0.03		26.28	0.08		15.13	0.05		18.27	0.05
Plant protection charges		289.27	0.63		238.87	0.69		369.08	1.13		317.70	0.89
Incidental charges		215.97	0.47		224.46	0.65		237.30	0.73		229.67	0.64
Repairs		262.04	0.57		293.22	0.85		291.28	0.89		286.25	0.80
Working capital		22844.13	49.44		18590.76	53.63		19406.75	59.40		19834.46	55.40
Int.on Working Capital		1370.65	2.97		1115.45	3.22		1164.41	3.56		1190.07	3.32
Depre.on farm implements		5640.54	12.21		2369.52	6.84		412.41	1.26		1951.64	5.45
Land revenue and taxes		30.00	0.06		40.00	0.12		60.00	0.18		48.73	0.14
Cost ‘A’		29885.31	64.67		22115.73	63.80		21043.57	64.41		23024.90	64.31
Rental value of land		7727.77	16.72		6845.15	19.75		6420.13	19.65		6787.20	18.96
Int .on fixed capital		2400.00	5.19		2200.00	6.35		2300.00	7.04		2291.25	6.40
Cost ‘B’		40013.08	86.59		31160.88	89.89		29763.70	91.11		32103.35	89.67
Family labour												
a.Male	31.74	4760.54	10.30	16.75	2512.97	7.25		2000.82	6.12		2668.57	7.45
b. Female	14.37	1436.78	3.11	9.90	989.80	2.86		904.61	2.77		1029.60	2.88
Cost ‘C’		46210.40	100		34663.65	100		32699.13	100		35801.52	100
Output (Q)												
a. Main produce	26.95	42038.31		27.18	37832.37		28.82	35328.16		28.01	37301.59	
b. Bye-produce	45.08	4508.30		34.79	3478.56		35.53	3552.63		37.14	3714.00	
Total gross produce		46546.61			41310.93			38.880.79			41015.59	
Cost ‘C’ net of bye produce		41702.10			31185.09			29146.50			32087.52	
Per quintal cost		**1547.39**			**1147.35**			**1011.32**			1145.57	
B:C ratio at cost		1.01			1.19			1.19			1.14	

(Figures in parentheses indicate percentage to the respective cost C)

Table 2: Resource use gap of paddy in Marathwada (Per hectare)

Particulars	Demonstrationplot	Samplecultivators	AbsoluteGap	% Gap
Total Human labour (Days)	150	96.05	53.95	35.97
Bullock power (Pair days)	9	13.84	-4.84	-53.77
Seed (Kg)	35	84.97	-49.97	-142.77
Manures (Q)	75	8.40	66.60	88.80
Fertilizers (Kg)				
N	80	96.57	-16.57	-20.71
P	50	83.28	-33.28	-66.56
K	50	21.37	28.63	57.26
Yield (Q)	35	28.01	6.90	19.71

-Gap indicates excess use than recommendation; +Gap indicates low use than recommendation

Table 3: Results of Cobb-Douglas production function of paddy in Marathwada

Particulars	Small	Medium	Large	Overall
Intercept	1.6801	0.4939	1.5333	1.7001
Human labour in days (X_1)	0.2985**(0.1126)	0.6635***(0.2285)	0.8117**(0.2761)	0.6451***(0.2119)
Bullock labour in days (X_2)	0.2235*(0.1142)	0.0435(0.2463)	0.1228(0.4613)	0.1634*(0.0880)
Seed (X_3)	0.0560(0.0936)	0.8764(0.9109)	0.6458(0.8245)	0.8766(0.7118)
Manures in q (X_4)	0.0278**(0.0126)	0.3239**(0.1290)	0.3614***(0.1249)	0.0276**(0.0128)
Nitrogen (X_5)	0.0332**(0.0132)	0.2831**(0.1164)	0.0120(0.2714)	0.0052(0.0102)
Phosphorus (X_6)	0.0021(0.1449)	0.0014(0.1897)	0.0967**(0.0345)	0.0036(0.0139)
Potash (X_7)	0.1431***(0.0464)	0.3658***(0.1074)	0.6178***(0.1590)	0.1843**(0.0822)
R^2	0.68	0.65	0.73	0.72
Observation	24	24	24	72
D.F.	16	16	16	64
F-value	23.53***	24.18***	19.33***	21.50***

Figures in parentheses are standard errors of respective regression coefficients
*, ** and *** indicates significance level at 10, 5 and 1per cent level, respectively

Table 4: Resource use efficiencies of paddy in Marathwada

Particulars	bi Value	MP	MVP	MC	MVP/ MC
Human labour (X_1)	0.6451	0.1149	151.54	125.00	1.2124
Bullock labour(X_2)	0.1634	0.8823	1164.04	450.00	2.5868
Seed(X_3)	0.8766	0.2886	38.89	40.00	0.9723
Manures (X_4)	0.0276	0.1248	164.61	100.00	1.6461
N (X_5)	0.0052	0.0104	13.71	16.19	0.8466
P (X_6)	0.0036	0.0084	11.14	18.20	0.6121
K (X_7)	0.1843	0.4686	618.30	9.80	63.0916

Results of decomposition analysis in Marathwada

In Marathwada region, there was 19.71 per cent yield difference because of adoption of practicing new technology in paddy cultivation. In 19.71 yield gap measurably (13.64 per cent) was contributed by differences in cultural practice,whereas, the remaining 6.07 per cent of yield was due to difference in use of input. The maximum difference of input use level measures (10.18 per cent) from bullock labour followed by manures (9.13 per cent), nitrogen (4.35 per cent) and phosphorous (0.39 per cent). Whereas, the potash (-6.34 per cent), seed (-5.98 per cent) and human labour (-5.92 per cent) contributing negatively towards the yield gap. Thus the total difference output was measurably caused by difference in cultural practices, rather than differences in input level (Table 5).

Table 5: Results of decomposition analysis in Marathwada

Source of productivity difference	Percentage contribution
Total difference observed in output	19.71
Source of contribution	
Difference in cultural practices (Non-neutral technological changes)	13.64
Due to difference in input use level (Neutral technological changes)	
a. Human labour	-5.92
b. Bullock labour	10.18
c. Seed	-5.98
d. Manure	9.13
e. Nitrogen	4.35
f. Phosphorous	0.39
g. Potash	-6.34
Due to all inputs	6.07
Total estimated gap from all sources	19.71

Technology Adoption Index of Paddy on Sample Farms in Marathwada

It is seen from the Table 6, at the overall level, the adoption of method of sowing technology component

was observed maximum (72.22 per cent) followed by seed rate (50.00 per cent), nitrogen (48.61 per cent), date of sowing (47.69 per cent), phosphorus (44.91 per cent) and variety (36.11 per cent). At the overall level, the lowest of technology adoption index were found in case of application of manures component (16.67 per cent) and plant protection measures (8.33 per cent) of technology. At the overall level, the composite index of technology adoption was worked out to 38.62 per cent indicated that the sample farmers adopted less than 61.00 per cent recommended paddy production technology obtaining 28.01 q/ha yield.

Table 6: Technology adoption index of paddy on sample farms in Marathwada (Per cent)

Component	Size group			Overall
	Small	Medium	Large	
Date of sowing	44.44	47.22	51.39	47.69
Seed rate	47.22	48.61	54.17	50.00
Variety	29.17	35.42	43.75	36.11
Method of sowing	70.83	72.22	73.61	72.22
Manures	8.33	19.44	22.22	16.67
Nitrogen	45.83	47.22	52.78	48.61
Phosphorous	37.50	50.00	47.22	44.91
Potash	15.28	23.61	25.00	21.30
Plant protection	6.25	8.33	10.42	8.33
Composite index	33.81	40.22	41.83	38.62
Yield (q)	26.95	27.17	28.82	28.01

Among the different size group of holdings, the composite indices were adopted maximum on large group of farmers (41.83 per cent) followed by medium (40.22 per cent) and small group of farmers (33.81 per cent). Thus, the technology adoption index has increased with an increase in size group of holdings. In this region, farmers adopt technology not more than 72 per cent except method of sowing. Hence, that there is great scope to increase the adoption improved paddy production technology through extension workers on farmer's field.

Impact of improved paddy production technology in Marathwada

It is noted from the Table 7 that, the impact of technology on per hectare yield of main produce and by-produce was found to be 24.92 and 21.43 per cent, respectively. Among the per hectare economic impact of paddy production technology on gross return, cost of cultivation and net returns was 23.79, 19.98 and 49.91 per cent, respectively. The impact of paddy production technology on net returns was maximum (49.91 per cent) followed by gross returns and by-produce. The yield per hectare was increased from 21.03 to 28.01quintal per hectare over the difference level of adoption.

Table 7: Impact of improved paddy production technology in Marathwada

Particulars	Local method	Improved method	Per cent impact
Yield (Q/ha)			
Main produce	21.03	28.01	24.92
By-produce	29.16	37.14	21.49
Economics (/ha)			
Gross returns	31259.19	41015.59	23.79
Cost of cultivation	28647.39	35801.52	19.98
Net returns	4303.78	5214.07	49.91
B:C ratio	1.09	1.14	
Cost effectiveness of improved paddy production technology			
Added returns	-	9756.80	-
Added cost	-	7154.13	-
Added yield (Q)	-	6.98	-
% increase in yield	-	33.18	-
Cost (‘/Q)	1362.15	1278.70	-
Unit cost reduction (/Q)	-	83.98	-
% reduction	-	6.17	-
ICBR ratio	-	1.36	-

The added yield was 6.98q/ha over the local and improved methodof adoption. Thus, for producing extra yield per hectare costs were also increased 7,154.13 and added returns were also increased 9,756.80. The ICBR ratio indicates that the high adoption improved production technology adopter farmers were in profit with 1.36 ICBR ratio. It indicates that, the farmers should adopt the improved production technology for paddy to the fuller extent for maximizing returns and minimizing per unit cost.

CONCLUSION

The Technology Adoption Index (TAI) were found positive and significant indicating that it was the important variable for increasing the output. The high level adoption of paddy production technologies helped to increase the output maximization and cost reduction.The impact of paddy production technology on per hectare net return had maximum (49.91 per cent) impact followed by bullock labour and machine power. The per hectare yield has increased from 21.03 to 28.01quintal per hectare over the difference level of adoption. The added yield was 6.98 q/ha over the local and improved method of adoption. Thus, for producing extra yield per hectare costs were also increased 7,154.13 and added returns were also increased 9,756.80 with 1.36 ICBR ratio. This indicated that the adoption of improved crop production technology helped to reduce the cost and increases the returns.

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Agricultural research investment, agricultural growth and livelihood security in Jammu & Kashmir

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ABSTRACT

While agriculture has changed from a resource-based to a science-based venture, the importance of investment in agricultural research is crucial. Agricultural research has been the primary source of total factor productivity growth; therefore, the choice of issues addressed in this study was to make a comprehensive look at the growth of research investment in agriculture in relationship with agricultural growth in the state. This study perused the secondary information obtained from published and unpublished records of Planning & Development Department and Directorate of Economic & Statistics, Government of Jammu & Kashmir. Simultaneous equation model (tested for estimation errors) was fitted and estimated by employing 2SLS procedure to quantify the impact of agricultural research on agricultural productivity in the state. Perusal of the data revealed that the investment in agricultural research in the state has increased significantly upto 2005-06, however, it has shown a drastic decline towards recent years. Currently as high as Rs 304 lakh were invested in agricultural research and constitute only 6 per cent of total agricultural investment. Investment in terms crop land revealed that this investment has gone done from Rs 109/ha to just Rs 27/ha in recent years. The estimates of compound growth rates also indicated that the investment in agricultural research has decelerated over the year. The intensities revealed that agricultural research investment constituted only 0.11 per cent of agricultural net domestic product of the state which is much lower compared to total investment in agriculture or non-agricultural sector. Although capital use efficiency in the state has improved over the years but it is still lower than that of non-agricultural activities. The model estimates revealed significant role of agricultural investment on agricultural growth and livelihood security in the state. Futher the elasticities of investment in agricultural research explained that any further enhancement in the investment would have better pay off. The study emphasized that the declining trend of agricultural research investment should be reversed to have desired impact of this investment and extended policy options for ensuring livelihood security by way of research investment and productivity growth.

Keywords: *Agricultural research investment, agricultural growth, livelihood security, J&K*

INTRODUCTION

In India, agriculture is an integral part of general development system still supporting the heavy burden of working population (65 per cent) despite its declining share (19 per cent) in the Gross Domestic Product (GDP). Slow growth in agricultural sector has become a major concern as it has profound implications for other sectors of the economy. To overcome this inertia in agriculture, need is felt that public and private sectors should learn to line together and assist in the overall economic development. Policy makers claimed agricultural development in two ways, as a source of raw materials and food for industries and people, respectively (Government of India, 1959, Anderson and Lorch, 1994) and as a means to achieve goals of employment led economic growth, poverty alleviation and self-reliance (Johnston, 1997; Desai and Namboodri, 1998). Sustained agricultural growth, therefore, has been a central theme of our developmental planning since Independence, for simultaneously enhancing both availability of and access to food. In this context, Government of India (1998) observed that while private investment has been the principal source of agricultural growth, particularly in the recent past, and will continue to be so in future, public investment is essential to correct existing infirmities and to impart added dynamism to this sector. Undoubtedly, poverty alleviation depends ostensibly on increasing agricultural productivity particularly among small farmers, and investment in agriculture has a major role to play (Roy and Pal, 2002). Realizing the importance of investment, a number of studies have looked into *inter alia,* the trend, impact and complementarity between public and private investment. A substantial investment in agricultural sector during early 1960s' that ushered in green revolution have paid off handsomely (Mishra, 1997). But, studies observed that there has been a decline of public investment in agriculture during 1980s' (Gulati and Bhidi, 1993; Bagwati and Srinivasan, 1993; Mallick, 1993; Chand, 2001). Few of the studies observed that public investment in agriculture has continuously declined even during 1990s', while private investment has increased persistently (Gandhi, 1996; Dhawan and Yadav, 1997; Namboodiri, 1998; Singh, 1997; Chadha and Sharma, 2005) though it has not fully compensated for the loss from falling public investment

AGDP	f(S&T_{-t})	PUB_{-t}	LIT	CRD_t	CI
	ELE	GIR	TRAC	HYV	LND
	$PRINV_{-t}$	FERT	LSI)		**——eq (I)**
S&T	f($AGDP_{-t}$	$CRDT_{-t}$	LIT	POVRT	TOT
	PUB	GIR	LSI	GDP_{-t}	$NAGDP_{-t}$
	AGWRK	$CRDIN_{-t}$)			**——eq (II)**
PUB	f($AGDP_t$	$CRDT_{-t}$	$GRNT_{-t}$	S&T_{-t}	LIT
	TOT	$CRDTIN_{-t}$	GIR	GDP_{-r})	**——eq (III)**
LSI	S&T_{-t}	$AGDP_{-t}$	$PRIV_{-t}$	TOT	NATINDX
	HUINDX	SOINDX*	ECINDX	PHINDX	NAEMP
	PCI)				**——eq (IV)**

(Braun *et al*, 2005). In juxtaposition to this pattern, few studies confirmed complimentarity between public and private investment in agriculture (Wagle, 1994; Dhawan and Yadav, 1995; Jairath and Purohit, 1996; Dhawan, 1996; Karmarkar, 1998; Gulati and Bathla, 2002). A number of studies on investment in Indian agriculture have been researched at the country level, however, investment estimates of these studies are subjected to debate for their limited scope and narrow coverage of public sector agricultural investment as well as for ignoring the two way causation between investment, productivity and other macro-variables (Gulati and Bathla, 2001; Chand, 2001). The important role of investment in capital formation, agricultural growth and poverty alleviation in mountain states was ascertained in other studies (Baba et al., 2010a; Baba et al., 2010b, Baba *et al*., 2010c). While agriculture has changed from a resource-based to a science-based venture, the importance of investment in agricultural research is crucial. Agricultural research has been the primary source of total factor productivity growth; therefore, the choice of issues addressed in this study was to make a comprehensive look at the growth of research investment in agriculture in relationship with agricultural growth in the state. In this backdrop this study is a humble attempt to investigate the behaviour of investment in agricultural research and its impact on agricultural growth and livelihood security in Jammu & Kashmir.

METHODOLOGY

An attempt was made in this study to construct broad series of public investment in agricultural research for a period from 1980-81 to 2013-14 divided into the three sub-periods viz. Period-I (1980-81 to 1996-97 and 1997-98 to 2013-14). The secondary data with respect to various development indicators were collected from various published and unpublished sources like Annual Draft Plans, Digest of Statistics, Economic Review of Jammu & Kashmir, etc.

The model: Structural form and specification

It is difficult to capture the complex phenomenon of rural development within a single equation approach (Van De Walle, 1985, Bell and Rich, 1994). To overcome the limitations of simultaneous bias of the single equation approach and to capture and quantify the direct as well as indirect effect of fiscal measures in agricultural growth and poverty reduction, a simultaneous equation model was developed in this study. Two Stage Least Square (2SLS) procedure was employed to estimate the model. The model consists of four endogeneous variables, namely, per hectare public agricultural S&T investment (S&T), per hectare agricultural net domestic product (AGDP), per hectare public investment in agriculture (PUB), and livelihood security index (LSI). Structural form of the complete system is given in equation (I) to (IV).

Long lead time is required in transforming investment into productive capital asset (Fan *et al*, 2000). Therefore, lags of investment were used (instead of current figure) to capture their lag lead time. Adjusted R^2 criterion was employed to find out appropriate lags of investment. Lags, which gave improved adjusted R^2 were used for estimation of the model.

Where,

PCI = Per capita income (Rs/annum)
GRNT = Grant from central government (Rs/ha)
GDP = State net domestic product (Rs/ha)
TOT = Terms of trade= ratio of agricultural and non-agricultural GDP deflators (%)
LIT = Literacy rate (%)
CRDT = Institutional direct credit to agriculture (Rs/ha)
CRDTIN = Institutional indirect credit to agriculture (Rs ha)
POP = Growth in population (%)
POVRT = Population living below poverty line (%)
CI = Cropping intensity (%)
HYVs = Area under HYVs (ha)
GIR = Irrigated area (% cropped area)
ROAD = Road density (Km/000sqkm)
NATINDX = Natural capital security index
HUINDX = Human capital security index
SOINDX = Social capital security index
ECINDX = Economic capital security index
PHINDX = Physical capital security index
NAGDP = Non-agricultural net domestic product (Rs in crore)

ELE = Villages electrified (%)
TRAC = Mechanization (No. of tractors/power tiller/ 000 ha of TSA)
PRINV = Private investment in agriculture (Rs/ha)
FERT = Fertilizer consumption (kg/ha)
LND = Average size of holding (ha)

RESULTS AND DISCUSSION

Structural Changes in Agricultural S&T Investment in Jammu & Kashmir

Estimates of public investment deflated at 1980-81 prices have been presented in Table 1. J&K underwent many structural changes after Independence and the policies of the government were directed mainly for the development of agricultural sector and building of basic infrastructure. In view of this government investment in agriculture steadily increased from about Rs. 3475 lakh (1980-81) to Rs. 10582 lakh (2005-06). After this, it suffered a minor set back and the growing tempo of public investment witnessed some reversal and declined to just Rs 5062 lakh (2013-14). This was attributed to the shift of emphasis to other economic sectors like administrative services, health and social welfare, information and publicity, etc. This decline in public agricultural investment was also observed in different studies at country level. Researchers have attributed this decline to the shift of emphasis in recent Plan from agriculture to industrial research and development and communication and also to sharp protest environmentalists against construction of irrigation projects, etc at national level. (Mishra and Chand, 1995; Gulati and Sharma, 1997). On the other hand investment in agricultural S&T has increased consistently from Rs 149 lakh (1980-81) to Rs 1196 (2005-06) and later declined to just Rs 304 lakh (2013-14). In terms of percentage of agricultural investment it has declined from 11.3 per cent to just 6.0 per cent in recent years. Between 1980-81 to 2013-14 the investment in agricultural S&T has show eratic behavior and final it declined (Figure 1).

Table 1: State level investment in agricultural S&T at 1980-81 prices

(*Rs. in lakh*)

Year	S&T	% of ag	Agriculture
1980-81	149	4.3	3475
1985-86	201	4.3	4667
1990-91	221	4.1	5445
1995-96	243	4.8	5015
2000-01	531	5.7	9331
2005-06	1196	11.3	10582
2010-11	514	5.1	10039
2013-14	304	6.0	5062

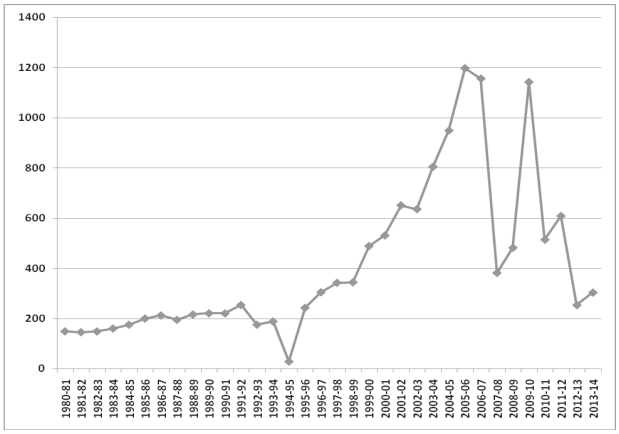

Fig 1: S&T investment in agriculture

Growth and intensity of Agricultural S&T Investment

Using the time series data pertaining to state agricultural S&T investment, analysis was carried out at 1980-81 prices. Ratios were estimated to find out the growth and performance of agricultural investment over time. Public agricultural S&T investment estimates presented in Table 2 revealed that real public agricultural S&T investment increased from Rs 15.3/ha in 1980-81 to Rs 108.7/ha in 2005-06 but later this investment declined steadily to just Rs 26.5/ha. This agricultural S&T investment has followed the behavior of total agricultural investment in the state. The resources might have been deviated towards development and rehabilitation of basic infrastructure like rural electrification, roads and bridges.

Table 2: Pattern of agricultural S&T investment in J&K (Rs./ha)

Year	S&T	Agriculture
1980-81	15.3	356.8
1985-86	19.5	453.3
1990-91	20.7	510.6
1995-96	22.7	467.5
2000-01	47.6	836.8
2005-06	108.7	961.2
2010-11	45.1	880.8
2013-14	26.5	440.9

Estimates of investment intensities revealed that public investment as a whole was about 16 per cent of agricultural net domestic product (ANDP), which in later years rose to over 9 per cent. However, it declined consistently towards recent years. The intensities of S&T investment has remained under 0.50 per cent since 1980-81 but it has reached to 0.69 per cent of ANDP during 2005-06. However it has declined to just 0.11 in 2013-14 which is drastically low compared to non-agricultural sector. The intensity of investment on agricultural research and education has remained much lower than

in developed countries (Pardey and Beintema, 2001) and even now it is declining.

Table 3: Intensity in agricultural S&T investment (% of net domestic product)

Year	R&E	Agriculture	Non-Agr	Total
1980-81	0.30	7.04	24.19	16.12
1985-86	0.35	8.10	18.49	14.22
1990-91	0.37	9.22	31.90	22.10
1995-96	0.27	5.54	22.13	15.85
2000-01	0.40	7.07	14.81	12.27
2005-06	0.69	6.11	17.30	14.07
2010-11	0.24	4.76	15.06	12.72
2013-14	0.11	1.87	9.36	7.59

Estimates of compound growth rates

The compound growth rates of public agricultural S&T investment do not indicate any consistent pattern (Table 4). It is evident from the Table that real public S&T investment in agriculture showed declining trend and during period-II it has decreased at an annual growth rate of about -0.45 per cent. On the other hand total agricultural investment has also shown same decelerating trend which is really a cause of concern for planners. This decline in growth rate of S&T investment might be as result of decline in public investment in view of their complementary relationship between two.

Table 4: Compound growth rates of public investment in agricultural S&T at 1980-81 prices (per cent)

Period	S&T	Agriculture	Non-Agr	Total
All (1980-14)	5.16*	2.88*	6.78*	6.25*
	1.01	0.39	0.21	0.19
Period I (1980-97)	0.30*	2.40*	6.97*	6.18*
	0.07	0.56	0.41	0.38
Period II (1997-2014)	-0.45	-0.29	7.45*	6.56*
	2.47	1.18	0.72	0.69

Figures in the italic indicate standard errors.
*denote significance at 0.05 or better level of probability

Estimates of 2SLS Simultaneous model

The results of the four equation simultaneous model estimated by employing Two Stage Least Square (2SLS) procedures are presented in Table 5. The adjusted R^2 values for all the equations implied that the model to be a best fit and was successful in explaining systematic variations in agricultural S&T investment, agricultural productivity, and livelihood security over the years. The estimates revealed that agricultural S&T investment has not only directly helped in livelihood security but also indirectly by improving agricultural productivity. Moreover S&T is itself determined by agricultural productivity, private investment and other factors. All the coefficient have to be taken care of judiciously in order to have desired impact of agricultural investment more specifically S&T investment.

Table 5: Estimates of simultaneous equation model

Endo.	Constant	Regression coefficients					Adjusted R^2	F
AGDP	3.694	+0.0067 $S\&T_{-3}$*	+0.0376 PUB_{-5}	+0.297 LIT*	+0.022 CRD_{-2}*	-2.382 CI	0.8991	45.50
		(0.002)	*(0.008)	(0.02)	(0.010)	(1.919)		
		+0.422ELE*	+1.946 GIR*	+0.011 TRAC*	+0.139 HYV	-1.295 LND		
		(0.024)	(0.081)	(0.005)	(0.181)	(0.966)		
		+0.052$PRINV_{-3}$*	-0.047 FERT	+0.294 LSI*				
		(0.010)	(0.037)	(0.005)				
S&T	10.927	+5.459 $AGDP_{-2}$*	-0.916 CRD*	+3.605 LIT*	-1.385 POVRT*	-3.384 TOT	0.8442	43.45
		(2.260)	(0.574)	(1.357)	(0.40)	(4.065)		
		+0.051 PUB	+18.801 GIR*	+4.910 LSI*	-6.541 GDP_{-3}	+11.188 $NAGDP_{-2}$		
		(0.5518)	(7.180)	(0.622)	(8.455)	(9.350)		
		+7.885 AGWRK*	+0.186 $CRDIN_{-3}$					
		(2.631)	(0.19)					
PUB	5.659	+1.574 AGDP*	-0.473 $CRDT_{-3}$*	+0.023 $GRNT_{-5}$*	+0.081 S&T*	+0.389 LIT*	0.7411	104.30
		(0.062)	(0.211)	(0.001)	(0.021)	(0.292)		
		+0.75 TOT*	+0.017 $CRDTIN_{-2}$	+0.669 GIR*	+1.923 GDP_{-2}*			
		(0.31)	(0.039)	(0.200)	(0.217)			
LSI	-4131	+0.076 $S\&T_{-3}$*	+0.282 $AGDP_{-1}$*	+0.009 $PRIV_{-2}$*	+0.016 TOT	+0.274NATINDX*	0.8983	34.54
		(0.002)	(0.046)	(0..001)	(0.029)	(0.002)		
		+0.260 HUINDX*	+0.153 SOINDX*	+0.139 ECINDX*	-0.116 PHINDX	-0.212NAEMP*		
		(0.012)	(0.006)	(0.013)	(0.096)	(0.073)		
		+0.111 PCI*						
		(0.02)						

* denote significance at 0.05 or better level of probability the parentheses indicate standard

Figures in the parentheses indicate standard errors.

CONCLUSION

Considering the direct as well as indirect role of S&T investment in agricultural on agricultural productivity and livelihood security, the declining trend in public agricultural S&Tinvestment needs to be reversed. There is a need to develop a consensus on investment themes and priorities. Investment in agriculture particularly S&T investment amounts to a "win-win" strategy for livelihood security directly as well indirectly. There is an immense need to double intensity of S&T investment in agriculture to have manifold growth in agriculture. The Public-Private-Partnership to enhance S&T investment in agriculture would be a remunerative proposition. Whatever subsidies are to be provided should be targeted to the poor and to backward regions, where productivity is less and farmers are unable to invest more in agriculture.

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Credit disbursement for agribusinesses by DCCBs- A case study of Sangli DCCB

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ABSTRACT

The present study was undertaken to assess the pattern of credit disbursement to agribusiness units by Central Co-operative Bank in Sangli district. Total credit requirement for poultry (per lot) was Rs.2,00,773/- and for raisin making unit, total credit requirement was Rs. 2,00,322/-. The credit made available by the SDCCB was Rs.1,33,500/- and Rs. 1,20,000/- for poultry, and raisin making unit, respectively. The credit gap observed was 33.50 per cent in case of poultry and 40.09 per cent in case of raisin making unit. When one per cent credit gap is reduced, the increase in the net returns will be Rs. 1215.76 for poultry unit and Rs. 3986.60 for raisin making unit. Total net incomes obtained per unit were Rs. 2,37,811/-, and Rs.1,59,823/- from poultry and raisin making unit, respectively. Total incomes of selected agribusiness unit owners was observed to Rs.10,98,630/- in case of poultry owners and the same for raisin making was Rs. 9,70,956/-. Of this total income, the share of agribusiness unit- poultry was 66.42 per cent and the share of raisin making unit was 71.58 per cent. In consideration with the fixed capital requirement and working capital requirement of different agribusiness units under study (viz; poultry and raisin making units), the credit gap is ranging from 10.42 to 42.43 per cent. In view, the DCCBs may consider the total credit requirement of such agribusiness units and the credit policy be formulated/ implemented in such a way that there should be a minimum possible gap between credit being made available for such agribusiness units and credit requirement.

Keywords: *Credit, agribusiness, DCCB*

INTRODUCTION

Agribusiness tends to be a large scale business operation and may dabble in farming, processing and manufacturing and/or the packaging and distribution of products. Agribusiness includes production, processing and supply of agricultural goods. It includes large scale sugar industries to small scale individual farming i.e. raisin making (small scale), nursery, polyhouses, poultry etc. In grape production Maharashtra occupies the first position with a production of 7.7 lakh tones from an area 0.86 lakh ha, followed by Karnataka, Tamil Nadu, Andhra Pradesh. About 63 per cent production comes from Maharashtra (NHB, 2011). Among the various agricultural commodities grape has been introduced in the cropping pattern on large extent in Western Maharashtra region of the state. Earlier in India, the grapes were mainly used for table purpose. However, due to the low prices of grapes at the time of harvesting, risk of cheating by middleman in grape marketing, being most perishable in nature and the competitive market, the grape producers started processing so as to avoid losses. It is estimated that about 40 per cent of the grapes production in Sangli district is sold only after processing in the form of raisins. The results obtained from the study would be helpful to provide guidelines regarding proper management of agribusiness units. It would provide clear picture of credit requirement, credit gap that exists because of difference between credit requirement and credit availability, income and employment generated in agribusiness units, as observed by Aggarwal *et al.*, 2012, Ayesha and Nawazish, 2013; Bala and Reena, 2015.

METHODOLOGY

Sangli District Central Co-operative Bank Ltd., Sangli was selected purposively for the study. The sample agribusiness units which have taken the loan from Sangli district Central Co-operative Bank was selected purposively. The agribusiness units viz; poultry and raisin making units were selected. Total 60 samples of agribusiness units were selected which comprised of 30 poultry units (each of 1000 birds) and 30 raisin making units. The primary data of the selected sample agribusiness units were collected during the year 2013-14 with the help of specially prepared schedules. The time series data of Sangli District Central Co-operative Bank on the aspects viz., loan disbursed to agribusiness units, composition proportions of various co-operative performance indicators were collected from the SDCCB's records for the period of 15 years i.e. from the year 1995-96 to the year 2010-11.

RESULTS AND DISCUSSION

Credit disbursement by SDCCB to Agribusiness Units

DCCBs provide short-term loans for cultivation of crops, while medium-term loans were advanced for subsidiary occupations such as dairying, poultry farming, polyhouses, etc. The credits disbursed for agribusiness during entire study period are presented in Table 1. The loan provided for poultry during the year 1997-98 was maximum which amounted to Rs.154.08 lakh and during the year 2002-03, it was very less which amounted to Rs.1.55 lakh. During entire study period,

i.e. from the year 1995-96 to the year 2009-10, it was just Rs.7.35 lakh.In the case of raisin making units, during the year 2001-02, the loan disbursed was maximum which amounted to be Rs. 185.59 lakh whereas, it was just Rs.1.03 lakh for the year 2004-05.

Table 1: Credit disbursed to agribusinesses by SDCCB (Rs. in lakhs)

Year	Poultry Units	Raisin making Unit
1995-96	—	—
1996-97	22.1	14.01
1997-98	154.08	—
1998-99	21.54	58.6
1999-00	2.0	57.79
2000-01	9.87	58.75
2001-02	—	185.59
2002-03	1.55	166.16
2003-04	8.91	5.04
2004-05	—	1.03
2005-06	—	2.53
2006-07	—	2.36
2007-08	—	15.54
2008-09	11.87	36.48
2009-10	7.35	89.27

Cost ofbroiler production

The variable costs of maintenance of broiler units includes items such as the value of broilers (chicks), expenses on feed, litter, medicines, labour, electricity and water charges, the depreciation on building and equipments, interest on working capital, land rent, interest on fixed capital investment and miscellaneous expenses. The details regarding these costs have been presented in Table 2 on per unit, per lot and per broiler basis.

The total cost for broiler production was worked out to Rs. 491939.21 per unit for year 2013-14, Rs. 76406.65 per lot and Rs. 87.88 per broiler. It was observed that the share of fixed cost and variable cost in total cost per unit was 3.93 per cent and 96.06 per cent, respectively. Expenses on feed shared 64.25 per cent which was major item in poultry activity followed by expenses on one day old chick which was 18.56 per cent. Labour cost shared 5.43 per cent. Whereas, electricity and water charges, litter material, medical expenses were 0.88, 0.76, and 2.20 per cent, respectively. Among items of fixed cost, the share of depreciation and land rent was 1.06 and 0.27 per cent, respectively while that of interest on fixed capital was 2.58 per cent.

Gross Income from Broiler production

In broiler enterprise, the value of live weight of broiler is the major influencing factor in realizing the good returns which is supplemented by the income from sale of manure and empty gunny bags, etc. The gross incomes from per unit, per lot and per broiler were Rs. 729750.35, Rs. 117134.88 and Rs. 137.94, respectively. Amongst the gross incomes, the per lot income from sale of broilers, manure and gunny bags were Rs. 115414.84, Rs. 1322.71 and Rs. 397.33, respectively.

Table 3: Income and Net Income from different sources of sample poultry units

Source of Income	Per Unit (Rs.)	Per Lot (Rs.)	Per Broiler (Rs.)
Sale of Broilers	719034.46	115414.84	135.93
	(98.53)	(98.53)	(98.54)
Manure	8240.51	1322.71	1.55
	(1.12)	(1.12)	(1.12)
Gunny bags	2475.38	397.33	0.46
	(0.33)	(0.33)	(0.33)
Gross Income	729750.35	117134.88	137.94
	(100.00)	(100.00)	(100.00)
Total Cost	491939.21	76406.65	87.88
Net Income	237811.14	40728.23	50.06

Figures in parentheses indicates percentage to the total

Table 2: Cost of broiler rearing

Particulars		Per Unit(Rs.)	Per Lot(Rs.)	Per Broiler(Rs.)
Variable cost	Price of one day old Chick	91314.11(18.56)	14657.16(19.18)	16.86(19.18)
	Feeds	316095.32(64.25)	50737.61(66.40)	58.39(66.44
	Wages of Labour	26748.33(5.43)	4293.47(5.61)	4.94(5.62)
	Electricity and Water charges	4331(0.88)	695.18(0.90)	0.80(0.91)
	Litter material	3777.17(0.76)	606.28(0.79)	0.69(0.78)
	Medicinal expenses	10826.99(2.20)	1737.87(2.27)	1.99(2.26)
	Other charges	528.83(0.10)	84.88(0.11)	0.09(0.10)
	Total Working Capital (WC)	453621.75(92.21)	72812.45(95.29)	83.76(95.31)
	Interest on Working Capital(@6 %)	18970.08(3.85)	488.70(0.63)	0.56(0.63)
	Total Variable Cost (TVC)	472591.83(96.06)	73301.15(95.93)	84.32(95.94)
Fixed Cost	Depreciation	5241.26(1.06)	841.29(1.10)	0.96(1.09)
	Land rent (@10 %)	1371.90(0.27)	220.20(0.28)	0.25(0.28)
	Interest on Fixed Capital (@10 %)	12734.22(2.58)	2044.01(2.67)	2.35(2.67)
	Total Fixed Cost (TFC)	19347.38(3.93)	3105.50(4.06)	3.56(4.05)
	Total Cost (TFC +TVC)	491939.21(100.00)	76406.65(100.00)	87.88(100.00)
	Gross returns	729750.35	117134.88	137.95

Figures in parentheses indicates percentages to the total

Cost of raisin making

The average per unit cost of raisin production was Rs. 504315.87. Per quintal and per kg cost of raisin production worked out as Rs. 3168.96 and Rs.31.67, respectively. Among various components of fixed costs, depreciation on shed and equipments was Rs. 6022.92 per unit and interest on fixed capital was Rs. 7386.09. Among various components of variable costs, labour cost was Rs. 14050.45, cost of chemicals was Rs. 9093.82, electricity and water changes were Rs.1413.96, packing materials was Rs. 6183.15 and raw material cost was Rs. 459550.66. It was observed that fixed cost shared 2.65 per cent in total cost whereas, variable cost shared 97.35 per cent and it was high because of raw material cost of grapes used (Table 4).

Credit requirement and credit gap for selected Agribusiness Units

To start polyhouse cultivation, the minimum fixed cost has to be incurred, however, this cost can be apportioned on number of lots that has to be taken during the year. But with such apportioned cost if taken into account the polyhouse cannot be started that is why fixed cost has not been divided for different lots. During the study, the fixed capital requirement in the case of poultry was estimated to Rs. 182704.06 and which was Rs.221582.98 for the raisin making unit. The working capital required for the agribusiness units under study in which for the poultry unit it was Rs. 72812.45 and for raisin making units Rs. 30741.38. According to 80 per cent of fixed capital and 75 per cent of working capital approach, total credit requirement in the case of poultry unit was worked out to Rs. 200772.57, and for raisin making Rs. 200322.41.

In consideration with the credit policy of the SDCCB, the credit made available and as per the approaches that have been taken into account for the present study, the credit gap observed in the case of poultry unit was to the tune of Rs. 67272.57. In percentage terms the credit gap observed was 33.50 per cent. In case of raisin making unit, the credit gap observed to be Rs. 80322.41 which was 40.09 per cent of the credit requirement and is the maximum amount the credit gaps observed for the agribusiness units under study.

Table 5: Credit requirement and credit gap (Rs.)

Particulars	Poultry unit	Raisin Making unit
Total Fixed Capital	182704.06	221582.98
Total Working Capital	72812.45 (per lot)	30741.38
80% Fixed Capital	146163.24	177266.38
75% Working Capital	54609.33	23056.03
Total Credit Requirement (3+4)	2,00,772.57	2,00,322.41
Credit gap	67,272.57	80,322.41
Credit availability	133500	120000
Per cent credit gap	33.50	40.09
Impact of Credit on Net Returns	1215.76	3986.60

The impact of credit on net returns was worked out by dividing the net returns by the per cent credit gaps observed. It was seen that, when one per cent credit gap is reduced, the increase in the net returns will be Rs.1215.76 for poultry unit, and Rs. 3986.60 for raisin making unit.

Income generated by the sample agribusiness unit Owners

The incomes from various activities i.e. crop production, agribusiness unit, under study and other activities being carried out by the sample agribusiness unit owners have been assessed and the information is presented in Table 6. The total income of the sample poultry agribusiness units observed to be Rs.10,98,630.35. Of this income the share of income from agribusiness unit under study i.e. poultry was 66.42 per cent (Rs.7,29,750.35) followed by the income from crop production having the share of 30.89 per cent (Rs.3,39,400.00). The total income of the raisin making agribusiness unit owners was estimated to Rs. 9,70,956/- of which the share of agribusiness unit was 71.58 per cent (i.e. Rs. 6,95,016/-) followed by the income from crop production 26.35 per cent (i.e. Rs. 2,55,940/-).

Table 4: Cost of raisin making

Particulars	Per Unit (Rs.)	Per Qtl. (Rs.)	Per Kg. (Rs.)
Fixed cost			
Depreciation on shade and equipments	6022.92(1.19)	120.14(3.79)	1.20(3.78)
Interest on fixed capital @ 10 % per annum	7386.09(1.46)	147.33(4.64)	1.47(4.64)
Total Fixed cost (TFC) (i + ii)	13409.01(2.65)	267.47(8.44)	2.67(8.43)
Variable Cost (VC)			
Labour cost	14050.45(2.78)	280.28(8.84)	2.80(8.84)
Chemicals	9093.82(1.80)	181.40(5.72)	1.81(5.71)
Electricity charges and other charges	1413.96(0.28)	28.20(0.88)	0.28(0.88)
Packing materials	6183.15(1.22)	123.34(3.89)	1.23(3.88)
Total Working Capital (TWC)	30741.38(6.09)	613.22(19.35)	6.12(19.32)
Interest on working capital @ 6 % per annum for four months	614.82(0.12)	12.26(0.38)	0.12(0.37)
Raw material cost of grapes used	459550.66(91.12)	2276.01(71.82)	22.76(71.86)
Total Variable Cost (i to vi)	490906.86(97.34)	2901.49(91.55)	29.00(91.56)
Total Cost (TFC + TVC)	504315.87(100.00)	3168.96(100.00)	31.67(100.00)

Thus, it was observed that more than 60 per cent of the total income was from poultry and raisin making agribusiness unit.

Table 6: Average Income of the Agribusiness Unit owners

Particulars	Poultry unit	Raisin Making unit
Crop production	339400.00(30.89)	255940(26.35)
Agribusiness unit	729750.35(66.42)	695016.16(71.58)
Other (Livestock, Part-time jobs, etc.)	29480.00(2.68)	20000(2.05)
Total	10,98,630.35 (100.00)	9,70,956.16 (100.00)

Figures in parentheses indicate percentage to the total income

CONCLUSION

The loan provided by the SDCCB for poultry units during the year 1997-98 was maximum which amounted to Rs.154.08 lakh and during the year 2002-03, it just amounted to Rs.1.55 lakh. During entire study period, i.e. from the year 1995-96 to the year 2009-10, it was just Rs.7.35 lakh. In the case of raisin making units, during the year 2001-02, the loans disbursed were of Rs. 185.59 lakh whereas, it was just Rs.1.03 lakh for the year 2004-05. Total credit requirement for poultry (per lot) was Rs.2,00,773/- and for raisin making unit, total credit requirement was Rs.2,00,322/-.In consideration with the fixed capital requirement and working capital requirement of different agribusiness units under study (viz; poultry and raisin making units), the credit gap is ranging from 10.42 to 42.43 per cent. In view, the DCCBs may consider the total credit requirement of such agribusiness units and the credit policy be formulated/ implemented in such a way that there should be a minimum possible gap between credit being made available for such agribusiness units and credit requirement.

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Dynamics of non-institutional agricultural credit in Maharashtra

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ABSTRCT

Credit continues to be one of the limiting factors for small and marginal farmers and agricultural labours. The availability of agricultural credit to the small and marginal farmers from the institutional sources is still difficult. Of the various sources of credit for agriculture, non-institutional credit still has dominance in total share of credit being made available to agriculture. And moreover, availability of the credit in requisite quantities and at required time is the need of the hour in agriculture. In most parts the small and marginal farmers are not in the sphere of institutional credit .It's become therefore, imperative to know the sources of non- institutional agencies and the over dues status such famers in the state of Maharashtra. In case of non-institutional loan, maximum loan was acquired from the money lenders and the per cent gap was highest for medium farmers (23.47 per cent). Money lenders were more liberal to sanction the non-institutional loan requirement of farmers,the cost on items like stamp duty, processing fee and other sundry expenses incurred were higher in overall farmers and theoverdues of non-institutional loans were higher in case of medium size group of farmers (74.89 per cent). The majority of the farmers have taken loan from money lenders. Therefore, it is necessary that the farmers should make some investment on other subsidiary occupations like dairy, poultry, sericulture, mushroom production and the likes which will be helpful for generation of income and employment and thereby increasing the farmers own equity/ funds for the developmental activities. The extension agencies have to play an important role in convincing the farmers in this regard and while framing the credit policy, the financial institutions must give more emphasis on small and marginal farmers and their credit needs.

Keywords: *Loan, credit, finance, non-institutional, Theil's entropy*

INTRODUCTION

In agriculture, inputs are borrowed from outside the farm and the period of production is long, therefore, the role of agricultural finance is of paramount importance. Credit continues to be one of the limiting factorsfor small and marginal farmers and agricultural labours. It is a problem when it cannot be obtained and it is also a problem when it is not properly utilized. The availability of agricultural credit to the small and marginal farmers from the institutional sources is still difficult. Of the various sources of credit for agriculture, non-institutional credit still has dominance in total share of credit being made available to agriculture (NABARD,2011).And moreover, availability of the credit in requisite quantities and at required time is the need of the hourin agriculture. In most parts the small and marginal farmers are not in the sphere of institutional credit. The institutional financing agencies are comparatively having less contribution in the credit supply to these people. One more issue is of repayment of the loans. Due to number of reasons, there is problem of overdues in agricultural loans. It becomes therefore, imperative to know the sources of non- institutional agencies and theirrole in extending the credit to such famers in Maharashtra. An attempt has been made to analyze thepattern of loan acquisition from institutional and non-institutional agencies and their magnitudeand estimationof the cost of loan acquisition and overdue status of the loan.

METHODOLOGY

It was proposed to undertake the present investigation regionwise and state as whole. One district was selected from each region. Two tahsils from each district were selected. In all, four districts, eight tahsils and sixteen villages were selected for the study. Ten sample borrowers were selected randomly from each village. Thus, total 160 sample cultivators were selected. The sample farmers were chosen at random from the record of institutional and non-institutional agencies among the borrowers who borrowed during the year 2008-09 to 2010-11. The data were analyzed and presented mostly by way of tabular method.The study was based on secondary data for the period of 26 years, i.e. from the year 1985-86 to 2010-11 and primary data for the year 2010-11. The data related to the institutional agencies of Maharashtra was collected from Annual Reports of NABARD, RBI Bulletins/Reports, Economic Survey of Maharashtra and India and other public surveys. In order to examine whether or not the DCCBs disbursed the loan uniformly across the regions and state the Coefficients of Variations were computed for each year (from 1985 to 2010). Similarly, the Theil's entropy was employed.

RESULTS AND DISCUSSION

Source wise Agricultural credit analysis

The non-institutional agencies are moneylenders, relatives and traders and the institutional agencies are

Scheduled Commercial Banks, Regional Rural Banks and Co-operative Banks who meet the credit requirements of the farmers. Before independence, farmers were not able to obtain sufficient institutional credit were dependent on non-institutional credit agencies, which have exploited them by charging exorbitant rates of interest. Soon after the independence, the Central Government realized the need for institutionalizing rural credit structure. Meanwhile, the All India Rural Credit Survey Committee (1951-54) reviewed credit situation in the country and recommended a new initiation and financial support for the co-operatives from the Government of India. The definite policy of integrated co-operative credit emerged by the end of First Five Year Plan. A shift of credit policy towards multi-agency approach to agriculture finance is seen during 1970's, with the nationalization of 16 major commercial banks, creation of Lead Bank Scheme and afterwards Regional Rural Banks in the year 1975. Inspite of entry of several other institutions, co-operatives are the most important agencies, which supply the largest amount of institutional finance to agriculture. In order to solve the problems relating to agriculture credit, NABARD was setup in the year 1982.The percentage share of institutional and non-institutional agencies in agricultural credit for certain points of time are given in Table 1.

The percent share of institutional agencies increased manifold from 7.30 to 68.80 per cent from the year 1950-51 to 2010-11 in which the per cent share of co-operative bank, commercial bank and regional rural bank increased from 3.30 to 24.90 per cent, 0.90 to 25.10 per cent and 3.10 to 18.80 per cent, respectively and the share of non-institutional agencies decreased from 92.70 per cent to 31.20 per cent from the year 1950-51 to 2010-11 in which the share of money lenders and others(traders, relatives, friends etc.) was declined from 69.70 to 21.90 per cent and 23.00 to 9.30 per cent from the year 1950-51 to 2010-11.

Crop loan acquisition from Non-institutionalagencies

In India, many states have enacted laws to regulate moneylenders through licensing and supervision of their activities including the fixing of rate of interest chargeable by them. The second strategy, known as institutionalizing rural credit, aimed at eventually marginalizing the moneylender through widening and deepening the services of formal rural credit institutions.

Crop loan acquisition from non-institutional agencies generally availed for meeting the expenses for cultivation of land as well as to meet some genuine consumption requirement. In normal course, farmers try hard to meet his expenses with the available sources of income. Institutional agencies were not able to satisfy consumption and social needs of farmers. Based on the foregoing discussion, it can be said that farmer requires non-institutional loan for consumption and social needs from the money lenders, traders, friends, relatives, etc. which plays important role with high interest.

The details regarding the regionwisecrop loan acquisition from non-institutional agenciesin Maharashtra are presented in Table 2. The amount of loan acquisition was not depending upon crops; it depends on need of farmer. It can be seen from the table that in Western Maharashtra, per hectare crop loan acquisition for the kharif crops viz; pearl millet, sorghum, cotton, groundnut, maize, green gram, paddy, soybean, *niger,* pigeon pea and black gram were Rs.15000, Rs.16000,Rs.30000, Rs.25000, Rs. 20000, Rs.14000, Rs.35000, Rs.25000, Rs.10000, Rs.20000 and Rs.12000, respectively and for rabi crops sorghum, wheat, chickpea and safflower were Rs.16000, Rs. 25000, Rs. 20000 and Rs.10000, respectively.In Konkan region, per hectare crop loan acquisition for the kharif crops groundnut, maize, green gram, paddy, soybean, *niger*, pigeon pea and black gram were Rs.30000, Rs.15000, Rs.12000, Rs.35000, Rs.25000, Rs.15000, Rs.20000 and Rs.12000, respectively and for rabi crop, Wheat and Chickpea was Rs.25000 and Rs. 20000.

Loan acquisition from Non-institutional agencies

The co-operatives were playing the major role before the nationalization of commercial banks. After nationalization of the banks, they have assumed a significant role in the field of agricultural finance. The net work of co-operatives has spread all over the country.However, these institutional agencies financing agriculture sector in the state and facing several problems or have some limitations in financing the

Table 1: Share of Institutional and Non-institutional finance to agriculture in India (1950-51 to 2010-11) (Figures in per cent)

Source	1950-51	1960-61	1970-71	1980-81	1990-91	2000-01	2010-11
Institutional	7.30	18.70	31.70	63.20	66.30	61.30	68.80
Co-operative banks	3.30	2.60	22.00	29.80	23.60	30.20	24.90
Commercial banks	0.90	0.60	2.40	28.80	35.20	26.30	25.10
Regional Rural Banks	3.10	15.50	7.30	4.60	7.50	4.80	18.8
Non-institutional	92.70	81.30	68.30	36.80	33.70	38.70	31.20
Money lenders	69.70	49.20	36.10	16.10	17.50	26.80	21.90
Others	23.00	32.10	32.20	20.70	16.20	11.90	9.30
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: Annual Report of NABARD, 2011

Table 2: Per hectare loan acquisition from Non-institutional agencies by borrowers (Figures in Rs.)

Sr. No.	Size group of holding	Non-institutional agencies			Total	Out of total loan	
		Money lenders	Traders	Others	Total Credit	Short-termLoan	Term-loan (Medium+ Long term)
1.	Small	28000.00(68.81)	7250.00(17.82)	5438.89(13.37)	40688.89(100.00)	30158.61(74.12)	10530.28(25.88)
2.	Medium	31066.67(50.17)	10000.00(16.15)	20857.14(33.68)	61923.81(100.00)	45018.61(72.70)	16905.20(27.30)
3.	Large	—	—	—	—	—	—
	Overall	**29533.33(57.56)**	**8625.00(16.81)**	**13148.02(25.63)**	**51306.35(100.00)**	**37588.61(73.41)**	**13717.74(26.59)**

(Figures in the parentheses indicates percentage to the total)

Table 3: Regionwise per hectare crop loan acquisitions from Non-institutional agencies

Sr. No.	Name of Crop	Loan acquisitions from non-institutional agencies (Rs/ha.)				Period of loan approval	Date of repayment	Rate of Interest
		Western Maharashtra	Konkan	Marathwada	Vidarbha			
I	**Kharif**							
1	Pearl millet	15000	—	14000	10000	Any Period	No any date of repayment	36 per cent upto one year and 60 per cent above one year.
2	Sorghum	16000	—	20000	15000			
3	Cotton	30000	—	32000	32000			
4	Groundnut	25000	30000	30000	20000			
5	Maize	20000	15000	25000	15000			
6	Green gram	14000	12000	13000	13000			
7	Paddy	35000	35000	35000	25000			
8	Soybean	25000	25000	30000	22000			
9	Nagali/Niger	10000	15000	10000	10000			
10	Pigeon pea	20000	20000	22000	18000			
11	Black gram	12000	12000	14000	13000			
II	**Rabi**							
12	Sorghum	16000	—	18000	14000	Any Period	No any date of repayment	36.00 per cent uptoone year and 60 per cent above one year.
13	Wheat	25000	25000	25000	25000			
14	Chickpea	20000	20000	20000	20000			
15	Safflower	10000	—	10000	10000			
III	**Annual**							
16	Sugarcane (Suru)80000		—	80000	—	AnyPeriod	No any date of repayment	36 per cent upto one year and 60.00 per cent above one year.
17	Sugarcane (Adsali)100000		—	100000	—			
18	Sugarcane (Ratoon)75000		—	75000	—			

agriculture and especially to small and medium farmers, therefore, easy access of the non-institutional loan without many requirements of documents and time lapse, etc. Thus, still the importance of existence of the non-institutional agencies has to be recognized. The average per hectare loan acquisition from non-institutional agencies is presented in Table 3.

At the overall level, the per hectare total non-institutional loan acquisition worked out to Rs.51306.35. Out of the total loan acquisition, 73.41 per cent (Rs.37588.61) was the short term loan and 26.59 per cent (Rs.13717.74) was the term loans. Money lenders, traders and other non-institutional agencies provided the per hectare loan Rs.29533.33 (57.56 per cent), Rs.8625.00 (16.81 per cent) and Rs.13148.02 (25.63 per cent), respectively.

In case of small size group farmers, the per hectare total non-institutional loan acquisition worked out to Rs.40688.89. Out of the total loan acquisition, 74.12 per cent (Rs.30158.61) was the short term loan and 25.88 per cent (Rs.10530.28) was the term loans. Money lenders, traders and other non-institutional agencies provided the per hectare loan Rs.28000 (68.81 per cent), Rs.7250.00 (17.82per cent) and Rs.5438.89 (13.37 per cent), respectively. In case of medium size group farmers, the per hectare total non-institutional loan

acquisition worked out to Rs.61923.81. Out of the total loan acquisition, 72.70 per cent (Rs.45018.61) was the short term loan and 27.30 per cent (Rs.16905.20) was the term loans. Money lenders, traders and other non-institutional agencies provided the per hectare loan Rs.31066.67 (50.17 per cent), Rs.10000.00 (16.15 per cent) and Rs.20857.14 (33.68 per cent), respectively.

The money lenders played important role in loan disbursement to small and medium farmers. The large farmers did not take non-institutional loan because large farmers of them are money lenders themselves. They are providing non-institutional loan to small and medium farmers. This also noticed that the major share of short term loans in small and medium sized farmers was borrowed for crop productionfrom non-institutional agencies.

Requirement of loans and sanctions byNon-institutional agencies

The loan requirements and the actual amount sanctioned to sample farms by the non-institutional agencies are presented in Table 4. At the overall level, the loan requirement was Rs.41635.34 and loan sanctioned was Rs.51306.35.The gap between loan requirements and amount sanctioned was Rs.9671 (23.22 per cent). The non-institutional agencies like Money lenders provided 23.22 per cent excess loan to farmers than their loan requirement. It can be seen from the table that only small and medium farmers availed the non-institutional loan. Large farmers did not take the non-institutional loan from the non-institutional agencies like Money lenders, traders etc, . In case of small and medium farmers, loan requirement was Rs.33120.69 and Rs.50150. However, the loan sanctioned was Rs.40688.89 and Rs.61923.81.Thus,the excess amount of loan sanctioned by money lenders was 22.85 per cent and 23.47 per cent in case of small and medium size group farmers, respectively. The per cent gap i.e. excess amount of loan sanctioned was highest in case of medium farmers. It observed that money lenders were more liberal to sanction the non-institutional loan requirement of farmers. The foregone discussion showed that by and large non-institutional agencies were more liberal to the small and medium farmers than institutional agencies except, large size group because loan sanctioned was higher than loan requirement as there was their benefit in earning the extra benefits by way of very high rate of interest rates.

Table 4: Requirement ofloans and sanctioned amount to farmers by Non- institutional agencies (Rs./ha)

Size Group	Loan requirement	Amount sanctioned	Gap	Percent gap
Small	33120.69	40688.89	-7568.20	-22.85
Medium	50150.00	61923.81	-11773.81	-23.47
Large	0.00	0.00	0.00	0.00
Overall	41635.34	51306.35	-9671.01	-23.22

-sign indicates the excess amount of loan sanctioned than the loan requirement)

Loan acquisition cost from Non-institutional agencies

The estimated cost of items for which loan was taken were not considered for disbursement of loan by non-institutional agencies. There was no need felt to verification of records for the non-institutional loan. The cost of loan acquisition by small and marginal farmers for the non-institutional agencies was estimated. The results are presented in Table 5. The cost of loan by non-institutional agencies included all items like institutional agencies except processing fee. At the overall level, the average cost of loan acquisition of one lakh was estimated Rs.2311.05. The average costs of obtaining loan Rs.1.00 lakh for small and medium sized group farmers were estimated to Rs.2832.21 and Rs.1789.88. At the overall size group, the cost on obtaining land records, stamp duties, processing fee, travelling- lodging expenses and middleman expenses wereRs.376.81(16.30 per cent), Rs.550.51 (23.82 per cent), Rs.215.92 (9.34) and Rs.1167.81 (50.53 per cent), respectively. In case of small size group, the cost on obtaining land records, stamp duties, processing fee, travelling- lodging expenses and middleman expenses were Rs.466.82 (16.48 per cent), Rs. 656.23 (23.17 per cent), Rs.240.12 (8.48) and Rs.1469.05 (51.87 per cent), respectively. In case of medium size group, the cost on obtaining land records, stamp duties, processing fee, travelling- lodging expenses and middleman expenses were Rs.286.81 (16.02 per cent), Rs.444.79 (24.85 per cent) Rs.191.72 (10.71) and Rs. 866.56 (48.41 per cent), respectively.

Table 5: Loan acquisition cost from Non-institutional agencies (Rs./lakh)

Item	Size Group			Overall
	Small	Medium	Large	
Obtaining land records, No dues etc.	466.82	286.81	0*	376.81
Percentage (to total)	16.48	16.02	0.00	16.30
Stamp duty	656.23	444.79	0*	550.51
Percentage (to total)	23.17	24.85	0.00	23.82
Travelling, etc.	240.12	191.72	0*	215.92
Percentage (to total)	8.48	10.71	0.00	9.34
Middleman	1469.05	866.56	0*	1167.81
Percentage (to total)	51.87	48.41	0.00	50.53
Total Cost	2832.21	1789.88	0*	2311.05
	(100.00)	(100.00)		(100.00)

*Indicates No loan taken from Non-institutional agencies by large farmers

The total cost of non-institutional loan acquisition was lower than the institutional loan acquisition. Further, it was also noticed that many farmers had obtained loan from non-institutional agencies like money lenders, traders and others for consumption or production purposes. Many poor peasants, mostly belonging to small size group spent major part of their loan to meet the necessities. They were in distress on account of high rate of interests from non-institutional agencies. In case of institutional loan, obtaining no dues and no objection

certificates from other financing institutions operating in the area was necessary but in case of non-institutional agencies, no dues and no objection certificates from any financing institutions was not necessary.

Overdues status analysis of Non-institutional loans

The overdueson per hectare basis of non-institutional loan are depicted in Table 6.

Table 6: Per hectare overdues of Non-institutional loans *(in Rs.)*

Size group	Loantaken	Loanrepaid	Overdues	Per cent
Small	40688.89	14179.31	26509.58	65.15
Medium	61923.81	15550	46373.81	74.89
Large	—	—	—	—
Overall	51306.35	14864.66	36441.70	71.03

The non-institutional loanper hectare taken at the overall level and loan repaid by the farmers were Rs.51306.35 and Rs.14864.66. The non-institutional loan overdues were Rs.36441.69 (71.03 per cent). In case of small size group, the loan taken per hectare and loan repaid by farmers were Rs.40688.89 and Rs.14179.31. The non-institutional loan overdues were Rs.26509.58 (65.15 per cent). In case of medium size group, the loan taken and loan repaid by farmers were Rs.61923.81 and Rs.15550.00. The non-institutional loan overdues were Rs.46373.81 (74.89 per cent). It is important to note that the farmers from medium size group were having the highest percentage of overdues.

CONCLUSION

In case of non-institutional loan, maximum loan was acquired from the money lenders and in case of non-institutional agencies, the per cent gap was highest for medium farmers (-23.47 per cent). Money lenders were more liberal to sanction the non-institutional loan requirement of farmers. The overdues of non-institutional loans were higher in case of medium size group of farmers (74.89 per cent).Most of the sample farmers have taken loansfrom the money lenders. It is therefore, necessary that the farmers must make little investment on other subsidiary occupations like dairy, poultry, sericulture, mushroom production, etc. which will be helpful for generation of income and employment and thereby increasing the farmers own equity/funds for the developmental activities. The extension agencies have to play an important role in convincing the farmers in this regard and while framing the credit policy, the financial institutions must give more emphasis on small and marginal farmers and their credit needs.

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Economic analysis of production of carnation (cut flower) under protected condition in Amravati district

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ABSTRACT

The present study is an attempt to evaluate the "Economic analysis of production of Carnation (cut flower) under protected condition in Amravati district". Data used were pertaining to the period Jan. 2016 to Dec. 2016 From Amravati district, twenty four poly house of 560 m^2 and 1008 m^2 sizes were selected.It was observed that the total cost estimated for the year was to be Rs. 850926.8 for Carnation. Net return from cut flower production was accounted to be Rs. 371587.8 for Carnation. The total farm business income worked out to be Rs. 698368.3 for Carnation. The total family labour income was accounted to be Rs. 389554.5 for Carnation. The total farm investment income as estimated to be Rs. 680401.6 for Carnation. The total input- output ratio of first and second year profit at cost 'C' was 3.08 for Carnation respectively.
Keywords: *Growers, Gross return, Net return, Benefit cost ratio.*

INTRODUCTION

Growing of flowers is in rogue in India since long time for flowers play an important role in recreation and keeping in mind the good spirit. Flower is a symbol of love, beauty, purity and passion. Flowers are rich in recreational as well as aesthetic values. Flowers serve as an important source of scent, marriage decorations and raw material in industries in which essentials oils are extracted. Flowers are inseparable from the social fabric of human life.In the past, flowers were not of much importance as they are, because some years ago, flowers were being grown to meet particularly aesthetic desire and to some extent selective social needs of individuals. However, at the out sector of changed life style, more particularly of the civilized society affection, in it for varied flowers, treating them as means of beauty to upkeep harmony in pleasure growing of flowers has been initially adopted by it as the hobby, which then subsequently took a farm of commercial undertaking. As such today flowers and many flowering plants have not remained subjected to mere growing in window gardens, but they have occupied prominent places in living houses and office establishment to enhance their place utility by way of changing their form. *(www.apeda.com)*.

Scope of Greenhouse & Poly house Cultivation

After the advent of green revolution, more emphasis is laid on the quality of the agricultural product along with the quantity of production to meet the ever-growing food and nutritional requirements. Both these demands can be met when the environment for the plant growth is suitably controlled. The need to protect the crops against unfavourable environmental conditions led to the development of protected agriculture. Greenhouse is the most practical method of achieving the objectives of protected agriculture, where natural environment is modified by using sound engineering principles to achieve optimum plant growth and yield.

Our country is self-dependent on food grain production but to fulfil the nutritional security, the gap between increasing demand of horticultural produce has to be filled. This gap cannot be filled by traditional horticulture which required large area under horticulture to increase the production for the ever growing population. The present study has been undertaken to study the economics of cut flower production.

METHODOLOGY

The object of any scientific investigation is to draw the useful conclusion in the light of objectives of study. It is essential to the investigator to adopt appropriate method and procedure, keeping this in view, this chapter has denoted to explain the methodology adopted to fulfil the objective of study. The present investigation is undertaken to study the "Economic Analysis of Production of Carnation (Cut flower) under Protected Condition in Amravati district".

Cost of cultivation of cut flowers worked out by using following consideration.

Cost 'A'

It is the actual paid out cost by the cultivators in the form of cash.

Cost 'B'

It was calculated by adding the interest on fixed capital @ 10 per cent per annum and rental value of owned land @ 1/6th of gross produce - Land revenue.

Cost 'C'

It is the total cost of production which included all the cost items, actual as well as imputed. The imputed value of own labour is to be imputed and added to cost 'B' to work out cost 'C'.

Cost 'C'= Cost 'B' + imputed value of family labours.

Net profit: Net profit is calculated by subtracting annual total cost of cut flower production from annual total return derived from the respective cut flower enterprise.

Farm business income: This is return to farm operator for his management, family labour contribution and investment on land and fixed capital.

Farm business income= Gross income – Cost C

Family labour income: These indicate the surplus of gross income over cost B. This is a measured of return cut- flower cultivation to family labour.

Family labour income = Gross income - Cost B

Farm investment income: This measure of income indicates the returns to the capital in the farm and is computed from the following equation.

Farm investment income= Farm business income – Imputed value of family labour.

Input output ratio: Input output ratio will be worked out by dividing annual total return returned received from the cut flowers by its annual total cost of production.

RESULTS AND DISCUSSION

Cost structure of Carnation production in poly house per unit area (560 m^2)

The profitability of any enterprise depends upon income generating capacity and cost structure. For every analytical consideration, total costs are discussed under three categories cost 'A', cost 'B' and cost 'C'. Carnation is economically profitable crop of two years. The data presented in Table 1 clearly state that the total cost per unit area under protective condition was estimated Rs. 884405.2 for two years taken together on an average the total cost of cultivation is higher in first amounting Rs. 553338 as compared to second year Rs. 291067.2 because in the second year the planting material and farm yard manure is not included in the cost of cultivation.

The cost of cultivation of first year includes different items of which the major cost item such as hired human labour was Rs. 41080 (7.42 per cent), planting material was Rs. 187376 (33.86 per cent), FYM was Rs. 20400 (3.69 per cent), rice husk was Rs. 1860 (0.34 per cent), fertilizer was Rs. 31174.83 (5.63 per cent), plant protection was Rs. 6521.66 (1.18 per cent), power charges was Rs. 6153.5 (1.11 per cent), land revenue was Rs. 2.17 (0.0003 per cent), depreciation was Rs. 29521 (5.33 per cent), transportation charges was Rs. 17274.5 (3.12 per cent) and other charges was Rs. 636 (0.11 per cent), hence the working capital was Rs. 341999.7 (61.80 per cent) and interest on working capital was Rs. 41039.96 (7.42 per cent).The cost 'B' for first year includes the cost 'A' was Rs. 383039.6 (69.22 per cent), rental value of land was Rs. 109620.5 (19.81 per cent) and interest on fixed capital was Rs. 52532.83 (9.50 per cent). The cost 'C' for first year includes the cost 'B' was Rs. 545193 (98.53 per cent) and family labour was Rs. 8145 (1.47 per cent). Hence the cost 'C' was Rs. 553338. The cost of cultivation of second year includes different items of which the major cost item such as hired human labour was Rs. 36545 (12.28 per cent), rice husk was Rs. 1860 (0.63 per cent), fertilizer was Rs. 27474.33 (9.23 per cent), plant protection was Rs. 6521.66 (2.19 per cent), power charges was Rs. 6153.5 (2.07 per cent), land revenue was Rs. 2.17 (0.0007 per cent), depreciation was Rs. 29521 (9.92 per cent), transportation charges was Rs. 17274.5 (5.81 per cent) and other charges was Rs. 636 (0.21 per cent), hence the working capital was Rs.

Table 1: Cost of cultivation of Carnation under poly house (Rs./560 m^2).

Particular	Carnation		
	I year	II year	Total
Hired human labour	41080(7.42)	36545(12.28)	77625(9.12)
Planting material	187376(33.86)	–	187376(22.02)
Farm yard manure	20400(3.69)	–	20400(2.40)
Rice husk	1860(0.34)	1860(0.63)	3720(0.44)
Fertilizer	31174.83(5.63)	27474.33(9.23)	58649.17(6.67)
Plant protection charges	6521.66(1.18)	6521.66(2.19)	13043.33(1.53)
Power charges	6153.5(1.11)	6153.5(2.07)	12307(1.45)
Land revenue	2.17(0.0003)	2.17(0.0007)	4.35(0.0005)
Depreciation	29521(5.33)	29521(9.92)	59042(6.94)
Transportation charges	17274.5(3.12)	17274.5(5.81)	34549(4.06)
Other charges	636(0.11)	636(0.21)	1272(0.37)
Working Capital(W.C.)	341999.7(61.80)	125988.2(42.34)	467987.9(55.00)
Interest on W.C. @ 12 % / annum for the crop duration	41039.96(7.42)	15118.58(5.08)	56158.54(6.60)
Cost 'A'	383039.6(69.22)	141106.8(47.42)	524146.4(61.60)
Rental value of land($1/6^{th}$) of gross produce land revenue	109620.5(19.81)	94127.6(31.63)	203748.1(23.94)
Interest on fixed capital @ 10% of the fixed capital	52532.83(9.50)	52532.83(17.65)	105065.7(12.35)
Cost 'B'	545193(98.53)	287767.2(96.70)	832960.2(97.89)
Family labour income	8145(1.47)	9821.66(3.30)	17966.67(2.11)
Cost 'C'	553338(100.00)	297588.9(100.00)	850926.8(100.00)

Note: Figures in parentheses indicate percentage to the total cost

125988.2 (42.34 per cent) and interest on working capital was Rs. 15118.58 (5.08 per cent).

The cost 'B' for second year includes the cost 'A' was Rs. 141106.8 (47.42 per cent), rental value of land was Rs. 94127.6 (31.63 per cent) and interest on fixed capital was Rs. 52532.83 (17.65 per cent). The cost 'C' for second year includes the total cost 'B' was Rs. 287767.2 (96.70 per cent) and family labour was Rs. 9821.66 (3.30 per cent). Hence the cost 'C' was Rs. 297588.9. The cost of cultivation of first and second year includes different items of which the major cost item such as hired human labour was Rs. 77625 (9.12 per cent), planting material was Rs. 187376 (22.02 per cent), FYM was Rs. 20400 (2.40 per cent), rice husk was Rs. 3720 (0.44 per cent), fertilizer was Rs. 58649.17 (6.67 per cent), plant protection was Rs. 13043.33 (1.53 per cent), power charges was Rs. 12307 (1.45 per cent), land revenue was Rs. 4.35 (0.0005 per cent), depreciation was Rs. 59042 (6.94 per cent), transportation charges was Rs. 34549 (4.06 per cent) and other charges was Rs. 1272 (0.37 per cent), hence the working capital was Rs. 467987.9 (55.00 per cent) and interest on working capital was Rs. 56158.54 (6.60 per cent).The cost 'B' for first and second year includes the cost 'A' was Rs. 524146.4 (61.60 per cent), rental value of land was Rs. 203748.1 (23.94 per cent) and interest on fixed capital was Rs. 105065.7 (12.35 per cent). The cost 'C' for first and second year includes the cost 'B' was Rs. 832960.2 (97.89 per cent) and family labour was Rs. 17966.67 (2.11 per cent). Hence the cost 'C' was Rs. 850926.8.

Table 2: Cost of cultivation of poly house enterprises according to cost concepts.

Particulars	Unit	Carnation		
		I Year	II Year	Total
Cost 'A'	No.	383039.6	141106.8	524146.4
Cost 'B'	No.	545193	287767.2	832960.2
Cost 'C'	No.	553338	297588.9	850926.8

The cost concepts consideration for Carnation read as follows. The total Cost 'A' of Carnation amounted to Rs. 524146.4, for its life period inclusive of Rs. 383039.6 and Rs. 141106.8, respectively during first and second year. The total Cost 'B' Rs. 832960.2, which included Rs. 545193 and Rs. 287767.2 in successive two years. The total Cost 'C' estimated amounted to Rs. 850926.8, which was the total of Rs. 553338 and Rs. 297588.9 during first and second year respectively.

An important element in the farm business organization relates to the farmer in which resources are allowed because a measuring sick is necessary to provide guide lines and standard for appraising the use of various resources. To achieve this objective, various income measures viz. gross income, farm investment income, family labour income, farm investment income and input output ratio profit at Cost 'C' respectively.

Table 3: Measures of farm income

Particulars	Carnation		
	I Year	II Year	Total
Gross returns	657736	564778.7	1222515
Net returns	104398	267189.8	371587.8
Farm business income	276696.4	423671.9	698368.3
Family labour income	112543	277011.5	389554.5
Farm investment income	266551.4	413850.2	680401.6
Output input ratio	1.18	1.90	3.08

The total gross return from Carnation worked out amounts Rs. 1222515 which includes Rs. 657736 and Rs. 564778.7 during in two successive years. The total net return estimated from the sale flowers amounted to Rs. 371587.8 which is the total of Rs. 104398 and Rs. 267189.8 during the first year and second year, respectively. The total farm business income from Carnation is worked out Rs. 698368.3 which includes Rs. 276696.4 and Rs. 423671.9 during the first and second year respectively. The total family labour income is accounted to Rs. 389554.5 from comprising Rs. 112543 and Rs. 277011.5 during initial and second year respectively. The total farm investment income as estimated to Rs. 680401.6, out of which Rs. 266551.4 and Rs. 413850.2 corresponds to beginning and second year. The total input – output ratio profit at Cost 'C' is 3.08 out of which 1.18 and 1.90 during the first and second year respectively.

CONCLUSION

It can be concluded from the present study that the major limitation was high cost of poly house, soluble fertilizer and Carnation plants.The cut flower cultivation is labour intensive enterprise.Most of the sample grower purchased the planting materials from Pune market.Nearly all sample growers used tube well for irrigation. The cultivation of Dutch rose under poly house owners is a profitable venture.

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Economic analysis of production of Dutch rose (cut flower) under protected condition in Amravati district

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ABSTRACT

The present study is an attempt to evaluate the "Economic analysis of production of Dutch rose (cut flower) under protected condition in Amravati district". Data used were pertaining to the period Jan. 2016 to Dec. 2016 From Amravati district, twenty four poly house of 560 m² and 1008 m² sizes were selected.It was observed that the total cost estimated for the year was to be Rs. 833982.8 for Dutch rose. Net return from cut flower production was accounted to be Rs. 297577.2 for Dutch rose. The total farm business income worked out to be Rs. 641738.5 for Dutch rose. The total family labour income was accounted to be Rs. 306675.5 for Dutch rose. The total farm investment income as estimated to be Rs. 632640.1 for Dutch rose. The total input- output ratio of first and second year profit at cost 'C' was 2.77 for Dutch rose respectively.
Keywords: *Cost, Production, Poly house, Benefit cost ratio.*

INTRODUCTION

The floriculture sector is a full time involvement and requires continuous attention for various activities like pruning, harvesting, spraying, packing, weeding and regular maintenance. The new technologies in agri-business have enforced the farmers to undergo for protected cultivation of cut flowers. Initially, there was a good deal of response for the cut flower business and numbers of polyhouses were erected in this area.

Importance of Poly House Technology

Today the world scenario has been changing from plentiful to limited resources owing to exponential growth of population. This exerts a continuous pressure on land and agriculture demands a radical change in agriculture practices in year to come. Sustainable environment principles will be the guiding line in determining the desirability of certain agricultural practices over the other.Poly house cultivation as well as other modes of controlled environmental cultivation have been evolved to create favourable microclimates in which flowers or crops production could made possible all throughout the year required. Poly house flowers or crop production offers means for moving forward greater degree of environmental control. (www.indianfloriculture.com)

Indian scenario and trade

According to the horticulture production year book 2001 of national horticultural board, an area of 88,600 ha during 1999-2000 was under floriculture in India with production of 5.09 lakh MT of loose flowers and 680.6 million numbers of cut flowers. Flowers are grown under open cultivation and also under protected cultivation. In the poly houses, mainly roses are grown for export. Other exotic flowers like carnations, gerbera, orchids, lilium and other bulbous flowers are now increasingly produced commercially both for export and domestic market.The total area under floriculture crops in India was estimated to be 191 thousand ha. with production of 17.14 lakh tonnes of loose flowers and 746.77 crores number of cut flowers. The total export of flowers and floriculture products in India during 2013-2014 was 3,09, 26,023 MT and revenue Rs.365.32 crores (APEDA-2014). The present study was undertaken to assess the economics of cut flower production in Amravati district.

METHODOLOGY

The object of any scientific investigation is to draw the useful conclusion in the light of objectives of study. It is essential to the investigator to adopt appropriate method and procedure, keeping this in view, this chapter has denoted to explain the methodology adopted to fulfil the objective of study. The present investigation is undertaken to study the "Economic Analysis of Production of Dutch rose (Cut flower) under Protected Condition in Amravati district".

Cost of cultivation of cut flowers worked out by using following consideration:

Cost 'A': It is the actual paid out cost by the cultivators in the form of cash.

Cost 'B': It was calculated by adding the interest on fixed capital @ 10 per cent per annum and rental value of owned land @ 1/6thof gross produce - Land revenue.

Cost 'C': It is the total cost of production which included all the cost items, actual as well as imputed. The imputed value of own labour is to be imputed and added to cost 'B' to work out cost 'C'.

Cost 'C'= Cost 'B' + imputed value of family labours.

Net profit: Net profit is calculated by subtracting annual total cost of cut flower production from annual total return derived from the respective cut flower enterprise.

Farm business income

This is return to farm operator for his management,

family labour contribution and investment on land and fixed capital.

Farm business income= Gross income – Cost C

Family labour income

These indicate the surplus of gross income over cost B. This is a measured of return cut- flower cultivation to family labour.

Family labour income = Gross income - Cost B

Farm investment income

This measure of income indicates the returns to the capital in the farm and is computed from the following equation.

Farm investment income = Farm business income – Imputed value of family labour

Input output ratio

Input output ratio will be worked out by dividing annual total return returned received from the cut flowers by its annual total cost of production.

RESULTS AND DISCUSSION

Cost structure of Dutch rose of cut flower production in poly house

The profitability of any enterprise depends upon income generating capacity and cost structure. For every analytical consideration, total costs are discussed under three categories cost 'A', cost 'B' and cost 'C'. Cost 'A' includes expenses on labour to perform different cultural practices and expenses incurred on material inputs viz. fertilizers, plant protection chemicals, power charges, interest on working capital etc. Cost 'B' includes interest on fixed capital and rental value of land. Cost 'C' includes the family labour.

Dutch rose is economically beneficially crop of three years. The data presented in Table 1 clearly state that the total cost per unit area under protective condition is estimated Rs. 833982.8 for two years taken together on an average the total cost of cultivation is higher in first amounting Rs. 485086.7 as compared to second year Rs. 348896.1 because in the second year the planting material and farm yard manure was not included in the cost of cultivation.

The Cost of cultivation of first year includes different items of which the major cost item such as hired human labour was Rs. 45262.5 (9.33 per cent), planting material was Rs. 75500 (15.56 per cent), FYM was Rs. 40800 (8.41 per cent), rice husk was Rs. 3720 (0.77 per cent), fertilizer was Rs. 40541.16 (8.36 per cent), plant protection was Rs. 6521.66 (1.34 per cent), power charges was Rs. 4077.16 (0.84 per cent), land revenue was Rs. 2.17 (0.0004 per cent), depreciation was Rs. 43031.07 (8.87 per cent), transportation charges was Rs. 17274.5 (3.56 per cent) and other charges was Rs. 636 (0.14 per cent), hence the working capital was Rs. 277366.5 (57.18 per cent) and interest on working capital was Rs. 33283.99 (6.86 per cent). In the cost 'B' for first year includes the cost 'A' was Rs. 310650.6 (64.04 per cent), rental value of land was Rs. 97349.16 (20.07 per cent) and interest on fixed capital was Rs. 73237 (15.10 per cent).The cost 'C' for first year the share of cost 'B' was Rs. 481236.7 (99.21 per cent) and family labour was Rs. 3850 (0.79 per cent). Thus the cost 'C' was Rs. 485087. The cost of cultivation of second year includes different items of which the major cost item such as hired human labour was Rs. 43887.5 (12.58 per cent), rice husk was Rs. 3720 (1.07 per cent), fertilizer was Rs. 40541.5 (11.62 per cent), plant protection was Rs. 6804.16 (1.95 per cent), power charges was Rs. 4077.16 (1.17 per cent), land revenue was Rs. 2.17 (0.0006 per cent), depreciation was Rs. 43031.07 (12.33 per cent), transportation charges was Rs. 17274.5 (4.95 per cent) and other charges was Rs.

Table 1: Cost of cultivation of Dutch rose under poly house (Rs./1008 m^2).

Particular	Dutch rose		
	I year	II year	Total
Hired human labour	45262.5 (9.33)	43887.5 (12.58)	89510 (10.69)
Planting material	75500(15.56)	–	75500(9.05)
Farm yard manure	40800(8.41)	–	40800(4.89)
Rice husk	3720(0.77)	3720(1.07)	7440(0.89)
Fertilizer	40541.5 (8.36)	40541.5 (11.62)	81083 (9.72)
Plant protection charges	6521.66 (1.34)	6804.16 (1.95)	13325.83 (1.60)
Power charges	4077.16 (0.84)	4077.16 (1.17)	8154.33 (0.98)
Land revenue	2.17 (0.0004)	2.17 (0.0006)	4.35 (0.0005)
Depreciation	43031.07 (8.87)	43031.07 (12.33)	86062.13 (10.33)
Transportation charges	17274.5 (3.56)	17274.5 (4.95)	34549 (4.14)
Other charges	636(0.14)	636(0.18)	1272(0.15)
Working Capital(W.C.)	277366.5 (57.18)	159974.1 (45.85)	437340.1 (52.44)
Interest on W.C. @ 12 %/annum for the crop duration	33283.99 (6.86)	19196.89 (5.50)	52480.88 (6.29)
Cost 'A'	310650.6 (64.04)	179171 (51.35)	489821.5 (58.73)
Rental value of land ($1/6^{th}$) of gross produce land revenue	97349.16 (20.07)	91239.83 (26.15)	188589 (22.61)
Interest on fixed capital @ 10% of the fixed capital	7323773237 (15.10)	73237 (20.99)	146474 (17.56)
Cost 'B'	481236.7 (99.21)	343647.8 (98.49)	824884.5 (98.90)
Family labour income	3850 (0.79)	5248.33 (1.51)	9098.33 (1.10)
Cost 'C'	485086.7 (100.00)	348896.1 (100.00)	833982.8 (100.00)

Note: Figures in parentheses indicate percentage to the total cost.

636 (0.18 per cent), hence the working capital was Rs. 159974.1 (45.85 per cent) and interest on working capital was Rs. 19196.89 (5.50 per cent).The cost 'B' for second year includes the cost 'A' was Rs. 179171 (51.35 per cent), rental value of land was Rs. 91239.83 (26.15 per cent) and interest on fixed capital was Rs. 73237 (20.99 per cent).The cost 'C' for second year includes the cost 'B' was Rs. 343647.8 (98.49 per cent) and family labour was Rs. 5248.33 (1.51 per cent). Hence the cost 'C' was Rs. 348897.The cost of cultivation of first and second year includes different items of which the major cost item such as hired human labour was Rs. 89510 (10.69 per cent), planting material was Rs. 75500 (9.05 per cent), FYM was Rs. 40800 (4.89 per cent), rice husk was Rs. 7440 (0.89 per cent), fertilizer was Rs. 81083 (9.72 per cent), plant protection was Rs. 13,325.83 (1.60 per cent), power charges was Rs. 8,154.33 (0.98 per cent), land revenue was Rs. 4.35 (0.0005 per cent), depreciation was Rs. 86,062.13 (10.33 per cent), transportation charges was Rs. 34,549 (4.14 per cent) and other charges was Rs. 1,272 (0.15 per cent), hence the working capital was Rs. 4,37,340.1 (52.44 per cent) and interest on working capital was Rs. 52,480.88 (6.29 per cent).The cost 'B' for first and second year includes the cost 'A' was Rs. 4,89,821.5 (58.73 per cent), rental value of land was Rs. 1,88,589 (22.61 per cent) and interest on fixed capital was Rs. 1,46,474 (17.58 per cent).The cost 'C' for first and second year includes the cost 'B' was Rs. 8,24,884.5 (98.90 per cent) and family labour was Rs. 9,098.33 (1.10 per cent). Hence the cost 'C' was Rs. 8,33,982.8.

Table 2: Cost of cultivation of poly house enterprises according to cost concepts

Particulars	Unit	Dutch rose		
		I Year	II Year	Total
Cost 'A'	No.	310650.6	179171	489821.5
Cost 'B'	No.	481236.7	343647.8	824884.5
Cost 'C'	No.	485086.7	348896.1	833982.8

The cost concepts consideration for Dutch roses read as follows. The total Cost 'A' of Dutch roses amounted to Rs. 4,89,821.5, for its life period inclusive of Rs. 3,10,650.6 and Rs. 1,79,171, respectively during first and second year. The Cost 'B' Rs. 8,24,884.5, which included Rs. 4,81,236.7 and Rs. 3,43,647.8 in successive two years. The total Cost 'C' estimated amounted to Rs. 8,33,982.8, which was the total of Rs. 4,85,086.7 and Rs. 3,48,896.1 during first and second year respectively.

An important element in the farm business organization relates to the farmer in which resources are allowed because a measuring sick is necessary to provide guide lines and standard for appraising the use of various resources. To achieve this objective, various

Table 3: Measures of farm income

Particulars	Unit	Dutch rose		
		I Year	II Year	Total
Gross returns		584108	547452	1131560
Net returns		99021.28	198555.9	297577.2
Farm business income		273457.4	368281	641738.5
Family labour income		102871.3	203804.2	306675.5
Farm investment income		269607.4	363032.7	632640.1
Output input ratio		1.20	1.57	2.77

income measures viz. gross income, farm investment income, family labour income, farm investment income and input output ratio profit at Cost 'C' respectively.The total gross return from Dutch roses was Rs. 11,31,560, which includes Rs. 5,84,108 and Rs. 5,47,452 during in two successive years. The total net return estimated from the sale flowers amounted to Rs. 2,97,577.2, which is the total of Rs. 99,021.28 and Rs. 1,98,555.9 during the first year and second year, respectively. The total farm business income from Dutch rose is worked to Rs. 6,41,738.5, which includes Rs. 2,73,457.4 and Rs. 36,8281 during the first and second year respectively. The total family labour income is accounted to Rs. 3,06,675.5 from comprising Rs. 1,02,871.3 and Rs. 203,804.20 during initial and second year respectively. The total farm investment income as estimated to Rs. 6,32,640.1 out of which Rs. 2,69,607.4 and Rs. 3,63,032.7 correspond to beginning and second year. The total input – output ratio profit at Cost is 2.77 out of which 1.20 and 1.57 during the first and second year respectively.

CONCLUSION

It can be concluded from the present study that the major limitation was high cost of poly house, soluble fertilizer and Dutch rose plants.The cut flower cultivation is labour intensive enterprise.Most of the sample grower purchased the planting materials from Pune market.All the sample growers used raised bed system for planting and drip irrigation as a method of irrigation.However, the cultivation of Dutch rose under poly house owners is a profitable venture.

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Economic performance in production of banana for local varieties and improved varieties in Sindhudurg District

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ABSTRACT

The area under banana cultivation in Sindhudurg district of Konkan region is increasing since last decade. The importance of this crop in the economy of the region is in near future therefore it is need of time to conduct systematic research in respect of production and other related aspects of this highly remunerative crop. A cross sectional sample of 60 improved variety and 60 local variety banana growers was drawn from Sawantwadi and Dodamargtahsils. The data related to the agricultural year 2015-2016 were collected by personal interviews with the banana growers and analyzed with suitable statistical tools. Banana growers preferred Goa mandol, Keralmandol, Sonyal, Saldati, Rasbal and Manyal varieties for plantation as there is assured market for disposal. The banana cultivation is a labour intensive venture providing higher employment opportunities to the family members. The per hectare yield realized from improved variety of banana was 56750 kg and its rate received was Rs.10.47/kg. Hence, returns received from banana were Rs. 594172.50. the per hectare yield received from Goamandol was 35646 kg. The rate realized was Rs. 37.42/kg and hence returns received from banana were Rs.13.34 lakhs.

Keywords: *Banana, economic, BC ratio*

INTRODUCTION

Banana (*Musa paradisiacal* L.) is a popular and an important commercial fruit crop in India. India is a country having varying agro-climatic conditions and diverse soil types, providing ample scope for horticulture. Even today dietary pattern in India is changing and hence consumption of fruits and their products is increasing day by day across various regions of the country. Hence, horticulture has occupied a prominent place in Indian agriculture and in recent years area under horticultural plantation is increasing. There is a vast scope for horticultural plantation, which is useful for improving productivity and returns added with nutritional security, increased employment opportunities and environment friendliness.

The area under banana cultivation in Sindhudurg district of Konkan region is increasing since last decade. Goa is the nearest market to Sindhudurg. Considering the importance of this crop in the economy of the region in near future, it is need of time to conduct systematic research in respect of production and other related aspects of this highly remunerative crop. In view of the above mentioned aspects the present study was undertaken in Sindhudurg districts of Maharashtra state.

METHODOLOGY

Sindhudurg district of Maharashtra state was selected purposively because since last few years area under this crop is increasing rapidly. There are eight tahsils in Sindhudurg district out of which two tahsils *viz.,* Dodamarg and Sawantwadi were randomly selected for present study. The list of all villages growing banana crop from both Dodamarg and Sawantwaditahsils were obtained from the revenue records of concerned tahsils. From each tahsil, six villages were selected randomly and from each village five farmers growing banana were selected randomly. The data were collected by survey method with the help of specially designed pretested schedule for the banana grower. The data pertained to the agricultural year 2015-16 were collected by personal interviews with the banana growers and the required information from the cultivators was obtained. The standard cost concepts were used to estimate cost of production of banana.

RESULTS AND DISCUSSION

Preferences for varieties grown by sample growers

Preferences for varieties grown by sample growers are given in Table 1. It is seen from the Table 1 that, all the 30 sample improved variety banana growers exclusively preferred only one variety i.e. Grand nine. The average area per farm under this variety was 0.68 ha. Whereas local variety banana growers mostly preferred *Goamandol* because of its good keeping quality and also good demand coupled with better price in market. Twenty eight growers (48.27)had preferred this variety with average per farm area of 0.54 ha, followed by *Sonyal* variety which has got sour test and number of fruits per bunch are comparatively more because of small fruit size. Fourteen growers (24.14)had shown preference for this variety with 0.32 ha per farm area. *Keralmandol* variety was preferred by nine growers (15.52), with per farm area of 0.47 ha.

This variety was mostly demanded in Goa market because of its large fruit size. *Rasbal, Velchi, Saldati* and *Manyal* varieties were preferred by 3.45 per cent, 1.72 per cent, 5.17 per cent and 1.72 per cent banana

growers respectively with per farm area of 0.49 ha, 1.91 ha, 0.15 ha and 2.08 ha, respectively.

Table 1: Varieties grown by sample growers

Varieties	Area	No.	Per farm area
Improved varieties			
G-9	20.40	30	0.68
Local varieties			
Goamandol	15.3	28	0.54
Keralmandol	4.3	9	0.47
Saldati	0.45	3	0.15
Rasbal	0.98	2	0.49
Sonyal	4.56	14	0.32
Manyal	2.08	1	2.08
Velchi	1.91	1	1.91
Total	29.58	58	0.51

Per hectare cost, returns and profitability of improved variety

The yield received, gross returns, cost incurred and profitability of improved variety of banana is worked out at different level of cost and presented in Table 2.

Table 2: Per hectare cost, returns and profitability of improved variety

Item	Improved varieties(N=30)
Yield (kg)	56750
Rate (Rs./kg)	10.47
Returns 594172.50	
Sale of sucker	16540
Gross return (Rs.)	610712.50
Cost A (Rs.)	98637.89
Cost B (Rs.)	198891.89
Cost C (Rs.)	234396.89
Returns at	
Cost A (Rs.)	512074.61
Cost B (Rs.)	411820.61
Cost C (Rs.)	376315.61
Benefit cost ratio	2.61

The yield realized from improved variety of banana was 56750 kg and its rate received was Rs.10.47/kg. Hence, returns received from banana were Rs. 594172.50. The additional returns from sale of the banana suckers were of Rs. 16540. The profitability was Rs. 512074.61 at cost 'A', Rs. 411820.61 at cost 'B' and Rs. 376315.61 at cost 'C' with the benefit cost ratio of 2.61. This showed that improved variety banana cultivation is a profitable venture like the other fruit crops in the Konkan region.

Cost, returns and profitability of local variety

The yield received, gross returns, cost incurred and profitability of local variety of banana is worked out and presented Table 3. The yield received from *Goamandol* was 35646 kg. The rate realized was Rs. 37.42/kg and hence returns received from banana were Rs.13.34 lakhs. The additional returns from sale of the banana suckers were of Rs. 13250, hence the gross returns were Rs. 13.47 lakhs. The benefit cost ratio was 3.96. The cultivation of *Goamandol* was profitable than other local verities. The per hectare yield of *Keralmandol* was 31245 kg and its rate was Rs. 35.67/ kg. Hence, returns received from banana fruits were Rs. 11.15 lakhs. The additional returns from sale of banana suckers were of Rs.12800. Thus the gross returns were Rs. 11.27 lakhs. The benefit cost ratio was 3.81 indicated the profitability this variety of banana production. The yield realized from local variety of banana *Saldati* was 27500 kg. The rate received was Rs.13.18/kg and hence returns received from banana fruits were Rs.3.62 lakhs. The additional returns from sale of the banana suckers were of Rs. 8240. The benefit cost ratio was 2.14 which indicated that this variety of banana cultivation is also profitable. The yield of *Rasbal* variety was 26300 kg. The rate realized was Rs. 61.30/kg and hence returns received from banana fruits were Rs.16.12 lakh. The additional returns from sale of the banana suckers were of Rs. 8545. The benefit cost ratio was 4.28 indicated cultivation of *Rasbal* banana is a profitable ventures like the other fruits crop in the Konkan region. The yield realized from *Sonyal* variety was 27800 kg and rate received was Rs. 48.20/kg. Hence returns received from banana fruits were Rs. 13.40 lakhs. The additional returns from sale of the banana suckers were of Rs. 11245. The benefit cost ratio was 4.03 indicated profitability of this variety. This variety mostly used for home consumption purpose. The yield received from variety *Manyal* was 23425 kg and rate realized was Rs. 23.22/kg. Hence returns received from banana fruits were Rs. 5.44 lakhs. The additional returns from sale of the banana suckers were of Rs. 6700 and its benefit cost ratio was 2.79. This variety is also used for home consumption.

The yield realized from local variety, of banana *Velchi* was 18967 kg. The rate realized was Rs.27.22/ kg and hence returns received from banana fruits were Rs.5.16 lakhs. The additional returns from sale of the banana suckers were of Rs. 5890. The gross returns were Rs.5.22 lakhs. The benefit cost ratio was 2.76. This showed that *Velchi* variety banana cultivation is also profitable. Similar studies were also conducted by Kunhiraman *et al.* (1974), Latha and Radhakrishnan. (1988), Samban. (1991), Kshirsagarand Chavan (1994), Mishra *et al.* (2000), Rane and Bagade (2006) and Kalathiya *et al.* (2007).

Variety wise and agency wise per farm production and disposal of banana

Disposal of banana included total quantity sold, and the variety wise disposal of banana is presented in Table 4. The total production of improved variety was 38590 kg, out of which quantity sold was 98.67 per cent. It is also observed that out of the total per farm production of local varieties of banana 18689 kg

Table 3: Per hectare cost, returns and profitability for local varieties

Item	*Goa Mandol*	*Keral Mandol*	*Saldati*	*Rasbal*	*Sonyal*	*Manyal*	*Velchi*
Yield (kg)	35646	31245	27500	26300	27800	23425	18967
Rate (Rs/kg)	37.42	35.67	13.18	61.30	48.20	23.22	27.22
Return (Rs.) in lakhs	13.34	11.15	3.62	16.12	13.40	5.44	5.16
Sale of sucker (Rs.)	13250	12800	8240	8545	11245	6700	5890
Gross return (Rs.) in lakhs	13.47	11.27	3.71	16.21	13.51	5.51	5.22
Cost–A	75638.06	69283.91	73884.69	70331.06	74376.37	71973.05	70527.51
Cost–B	302074.06	259103.91	137655.69	342454.06	301408.37	165664.05	159279.51
Cost–C	339451.21	295749.27	173287.72	378528.27	334747.53	197662.67	189191.77
Returns at							
Cost–A	1271361.94	1057626.09	297115.31	1550668.94	1276623.63	479026.95	451472.49
Cost–B	1044925.94	867896.09	233344.31	1278545.94	1049591.63	385335.95	362720.49
Cost–C	1007548.79	831250.73	197712.28	1242471.73	1016252.47	353337.33	332808.23
Benefit cost ratio	3.96	3.81	2.14	4.28	4.03	2.79	2.76

Table 4: Per farm agency wise disposal of banana (in kg)

Variety grown	Production	Sold	Sale on own farms to contractors		Sale to commission agent		Total No. of farmer
			No. of farmer	Qty. (%) sold	No. of farmer	Qty. sold (%)	
G–9	38590	38076	8(26.67)	9961(26.16)	22(73.33)	28115(73.84)	30(100.00)
Goa mandol	19249	18689	08(28.57)	4366(23.36)	22(78.57)	14323(76.64)	28(100.00)
Keralmandol	14685	14516	03(33.33)	5518(38.01)	07(77.78)	8998(61.99)	09(100.00)
Saldati	4125	3977	01(33.33)	1095(27.53)	02(77.78)	28.82(72.47)	03(100.00)
Rasbal	12887	12459	-	2711(21.76)	02(100.00)	9748(78.24)	02(100.00)
Sonyal	8896	8527	07(50.00)	2707(31.73)	11(78.57)	5821(68.27)	14(100.00)
Manyal	48724	47043	-	10086(21.44)	01(100.00)	36957(78.56)	01(100.00)
Velchi	36227	35521	-	11839(33.33)	01(100.00)	23682(66.67)	01(100.00)

Figures in the parentheses are percentages to quantity sold and total no. of farmers

Table 5: Constraints faced by banana growers

Types of problem	Improved varieties (N=30)	Local varieties (N=30)
Inadequate technical knowledge about modern cultivation practices	20(66.67)	23(76.67)
Shortage of water during the month of April and May (Incomplete work of Tilari canal)	19(63.33)	22(73.33)
Shortage of labour and also costly during the peak period	16(53.33)	19(63.33)
Marketing of banana is in the hands of outsiders from Kerala and other state which is the situation of monopsony and therefore returns are not reasonable.	14(46.67)	12(40.00)
Irregular supply of electricity	13(43.33)	11(36.67)
Menace of wild animals mainly the monkeys and elephant and shingada	11(36.67)	9(30.00)
Untimely availability of planting material	6(20.00)	7(23.33)
Attack of stem beetle reduces the yield specifically for the local varieties	3(10.00)	10(33.33)

(Figures in the parentheses are percentages to total)

Goamandol, 8527 kg *Sonyal*, 14516 kg *Keralmandol*, 47043 kg *manyal*, 12459 kg *Rasbal*, 35521 kg *Velchi* and 3977 kg of *Saldati* were sold. Total quantity sold was maximum in *Goamandol* (97.09%) followed by *Keralmandol* (98.85%), *Saldati* (96.40%), *Velchi* (98.05%), *Sonyal* (95.85%), *Rasbal* (96.68%) and *Manyal* (96.55%).

Thus, among all local varieties almost 96.00 per cent quantity was sold. Information of agency wise disposal of banana revealed that only 2 channels were used by the farmers for selling there marketable surplus

Channels adopted by banana growers

There are mainy two channels identified as adopted by the banana growers as below:

Channel–I Producer to contractor i.e. Direct sale on own farm to contractors.

Channel–II Producer to Commission Agents i.e. distant market place.

The proportion of sale in channel I ranged from 21.44 to 38.01 per cent and in channel II from 61.99 per cent to 78.56 per cent in all varieties.

Constraints faced by banana growers

The information regarding the constraint faced by the banana growers in cultivation of banana is presented in Table 5. It is revealed from the Table 5 that, the major constraints faced by the banana growers were Inadequate technical knowledge about modern cultivation practices, Shortage of water during the month of April and May (Incomplete work of tilari canal), Shortage of labour and also costly during the peak period, Marketing of banana is in the hands of outsiders from Kerala and other state which is the situation of monopsony and therefore returns are not reasonable, irregular supply of electricity, menace of wild animals mainly the monkeys and elephant and *shingada,* untimely availability of planting material and attack of stem beetle reduces the yield specifically for the local varieties.

CONCLUSION

Banana growers preferred *Goa mandol, Keralmandol, Sonyal, Saldati, Rasbal* and *Manyal* varieties for plantation as there is assured market for disposal. Banana cultivation is a labour intensive venture providing higher employment opportunities to the family members. The disposal pattern indicated that there are two agencies in sale of banana either at farm gate or at market. This needed to be further investigated or organized to ensure better prices to banana producers through network of marketing institutions. The majority of growers had constraints regarding inadequate technical knowledge about modern cultivation practices, shortage of water during the month of April and May (Incomplete work of tilari canal), shortage of labour and also costly during the peak period, marketing of banana is in the hands of outsiders from Kerala and other state which is the situation of monopsony and therefore returns are not reasonable, irregular supply of electricity, menace of wild animals mainly the monkeys and elephant and *shingada,* untimely availability of planting material and attack of stem beetle reduces the yield specifically for the local varieties.

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Economics of farming systems in Pune district of Maharashtra

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ABSTRACT

Afield experiment was conducted on farmer's field at plain zone area of Pune district during the year of 2014-15. The study was carried out with before and after approach for study the economics of diversification of existing farming systems. Before diversification, the results of crop component, animal component, product diversification and capacity building were Rs. 2,05,209, Rs. 33,502, Rs. 7,607 and Rs. 2,63,674. After diversification these were increased Rs. 2,32,594 (13.34%), Rs. 63,599 (89.84 %), Rs. 1,311 (72.38%) and Rs. 33,185 (25.85%). These results were because of providing improvedvarieties and inputs, arranging visit and training to farmers on field crop production, providing technical knowledge of improved package of practices, supply for semen and artificial insemination and mineral mixture and goat kids of improved breed, providing technical knowledge regarding animal health and providing equipments like grading sieve /ghee making equipments, etc. The study results revealed that the interventions at each aspect of crop, animal and product diversification were increases in employment, income and improved the standard of living of selected farmers. The sustainable diversified farming systems are seen highly profitable and the appropriate diversification of components increases the production per unit area, and reduced the costs of production.

Keywords: *Diversification, farming system, sustainability, cropping pattern*

INTRODUCTION

Diversification is the outcome of the interactive effect of resource related factors *namely;* irrigation, rainfall, soil fertility, technology related factors (seed, fertilizers, marketing, storage, processing) and household related factors (food and their price, etc.). With the advent of modern technology, there is continuous surge for diversified agriculture in terms of crops, animals and product diversification with economic consideration. Crop diversification is needed to give a wider choice in the production of a variety of crops in a given area so as to expand production related activities on various crops and also to lesson risks. Crop diversification is generally viewed as a shift from traditional grown less remunerative crops to more remunerative crops. The crop diversification also takes place due to governmental policies and thrust on some crops over a period time. Market infrastructure development and certain other price related supports also induce diversification. High profitability and stability in production also induce diversification. The experiments have been conducted on farmer's field in six centers in Pune district. Pune district was selected purposively for the present study and study has been conducted during the year 2014-15 with the specific objectives as to estimate the profitability in crop, animal and product diversification of selected house holds, to improve the livelihood and nutritional security through diversification, to estimate the impact of capacity building through diversification and to study the constraints in diversification.

METHODLOLOGY

The data of 24 field experimental trials under On Farm Research Centre at Haveli and Maval tahsils of Pune district were collected by the cost accounting method with the help of designed schedule provided by the Directorate, ICAR-Indian Institute Farming System Research, Modipuram, Meerut, Uttar Pradesh.

In each tehsil, three villages and from each village, four farmers were selected. Thus, total 24 farmers were selected for the study. The bench mark survey were carried out for the year of 2012-13, and the diversification experimental field trials were conducted in *Kharif* and *Rabi* season during the year 2014-2015.

Table 1: Treatments (Modules) conducted for diversification in *Kharif* and *Rabi*season (2014-15)

Treatments	Interventions on Farmer's field
M_{0}- Bench marks	Comprehensive survey along with GPS location.
M_{1}- Crop diversification	Change the cropping pattern and provided improved varieties with chemical fertilizers.
M_{2}- Livestock diversification	Supplies of Phule Triveni semen for A.I, mineralmixture, goat kids and poultry chicksof improved breed.
M_{3}- Product diversification	Provided grading sieves /ghee making equipments.
M_{4}- Capacity building	Arranged training and provided Sugi magazine /Krishi dairyto selected farmers.

RESULTS AND DISCUSSIONS

Existing and diversified cropping patterns

The cropping pattern is dependent on several factors such as soil type, climate, resource availability with the farmers, decision making ability of the farmers under situation of changing prices and relative price of output of different crops. Low yield and long duration of existing varieties were replaced by improved varieties (Table 2).

Effect of diversification on the productivity and returns of different crops

The per hectare production and net returns of all selected crops for the year of 2012-13 benchmark survey are given in Table 3, and also for the year 2014-15. After diversification, per hectare production and net returns of all crops were seen increased due to replacement of local and low yielding varieties with hybrid and improved varieties. The per hectare net returns from the crop component before the diversification were Rs. 2,05,209 and after the provision of technical knowledge about package of practices, it was increased by 13.34 per cent (i.e. Rs. 2,32,594).

Profitability from benchmark and diversified animal component

Before diversification, the milk production of cow and buffaloe were 1761 litre and 819 litre for the year 2012-13. After diversification, the milk production of cows, buffaloes and goats increased by 2,075 litres and 1,052 litres for the year 2014-15(Table 4). The net returns from the animal component before diversification was Rs. 33,502 and after diversification, it increased by Rs. 63,599 (i.e. 89.84%). It is definitely attributed to making available the improved breed semen for artificial insemination of Phule Triveni, the improved goat kid of Sangamneri/Osmanabadi breed, mineral mixtures and provided technical knowledge of animal health, etc.

Profitability from product diversification

It is depicted from Table 5, that before, the profitability from product diversification of the total value was Rs. 7,607, and after the diversification it was increased by Rs. 13,113 (72.38%), due to adoption improved technologies and impact of product diversification. The farmers were provided knowledge for use of grading food grain sieve and were supplied

Table 2: Benchmark status and diversified cropping pattern of sample farmers

Benchmark status of cropping pattern (2012-13)				Diversified cropping pattern (2014-15)			
Kharif		Rabi		Kharif		Rabi	
Crop	**Variety**	**Crop**	**Variety**	**Crop**	**Variety**	**Crop**	**Variety**
Groundnut	SB-11/Jalgaon	Onion	PunaFursungi	Soybean	JS-335	Onion	N-2-4-1
Paddy	Darna	Chickpea	Vijay/local	Soybean	JS-335	Chickpea	Digvijay
Paddy	Darna	Wheat	HD-2189	Paddy	PhuleSamrudhi		Wheat
	NIAW-301						
Soybean	Local/ MACS-123	–	–	Soybean	JS-335	–	–
Grass	Local	–	–	Hybrid Napier	Phule Jayawant	–	–
Maize (fodder)	PanchGanga	–	–	Maize	Africantall (fodder)	–	–

Table 3: Effect of diversification on productivity and returns (2012-13 &2014-15)

Crop	Benchmark status (2012-13)		Diversification (2014-15)		Percentage increase	
	Average Productivity (q/ha)	Net Returns (Rs./ ha)	Average Productivity (q/ha)	Net Returns (Rs./ ha)	Average Productivity	Net Returns
Paddy	16.00	19200	18.00	28800	12.50	50.00
Soybean	14.00	19600	15.00	25500	7.14	30.10
Groundnut	12.00	14400	0.00	0.00	0.00	0.00
Maize(fodder)	185.00	22200	201.00	25125	8.65	13.18
Wheat	13.00	19500	14.00	22400	7.69	14.87
Onion	175.00	89250	181.00	101269	3.43	13.47
Chickpea	14.00	20300	15.00	22500	7.14	10.84
Grass	16.00	759	0.00	0.00	0.00	0.00
Hybrid napier	0.00	0.00	14.00	7000	0.00	0.00
Total	–	205209	–	232594	–	13.34

Table 4: Profitability from existing and diversified animal component (Rs./animal/year)

Animal	Milk (litre/ year/animal)	Gross Returns	Cost of Rearing	Net Returns	B:Cratio
Benchmark status (2012-13)					
Cows	1761	24654	10184	14470	2.42
Buffaloes	819	26204	7172	19032	3.65
Goats	-	0	0	0	0.00
Total	2120	50858	17356	33502	2.93
Diversified (2014-15)					
Cows	2075	39425	11363	28062	3.47
Buffaloes	1052	42080	8478	33602	4.96
Goats	309	4635	2700	1935	1.72
Total	2623	86140	22541	63599	3.82
Per cent increase over benchmark					
Cows	17.83	59.91	11.58	93.93	–
Buffaloes	28.45	60.59	18.21	76.56	–
Goats	0.00	0.00	0.00	0.00	–
Total	**23.73**	**69.37**	**29.87**	**89.84**	

Table 5: Per farm profitability from product diversification (per year)

Product	Benchmark status			After Diversification			Value increased due to after diversification (Per cent)
	Total product obtained after processing (kg)	Price of the processed product (Rs./kg/l)	Total Value (Rs.)	Total product obtained after processing (kg)	Price of the processed product (Rs./kg/l)	Total Value (Rs.)	
Soybean	223	34	7607	326	38	12388	
Milk	–	–	–	2.42	300	725	
Total			7607			13113	72.38

Table 6: Livelihood and nutritional security through diversification approach (Rs./animal/year)

Name of Items	Quantity used/year (kg)	Price (Rs./kg)	Total Expenditure (Rs.)	Per cent
Edible oil	76	95	7220	18.07
Wheat	236	24	5664	14.18
Jowar	140	34	4760	11.91
Paddy	253	44	11132	27.86
Green gram	53	95	5035	12.60
Pigeon pea	25	73	1825	4.57
Potato	52	30	1560	3.90
Chicken/ Meat	10	140	1400	3.50
Egg	60	5	300	0.75
Ghee	3	353	1059	2.65

the grading sieves and also provided the equipment for ghee making.

Livelihood and nutritional security through diversification approach

It is revealed from the Table 6, the expenditure on consumption of paddy was more (27.86 %) followed by edible oil, wheat, green gram, jowar, chicken/meat, pigeon pea, potato, ghee and egg were daily consumed by sample households.

Capacity building on different component

Before diversification, the gross income from different components was Rs. 2,63,674, and after diversification it increased by Rs. 3,31,852. It can be attributed to technical knowledge and improved package of practices, arranging visit and training to farmers, supply of semen artificial insemination and mineral mixture and goat kids of improved breed, providing technical knowledge of animal health and providing grading sieve/ghee making equipment etc.

Constraints in Crop, animal and Product diversification

The major problems and constraints in crop diversification identified include unavailability of improved variety seeds, imbalanced fertilizer use by the farmers, unavailability of mineral mixtures,

Table 7: Capacity building for different components

Capacity building on different component	Name of training	Pre-evaluation score (out of 100) before training	Post evaluation score (out of 100) after training	Gross income (Rs.) before training after training	Gross income (Rs.) (after 6 months) (Per cent)	Gross income increased due to training
Capacity building for crop component	Field crop production, Visits to various agriculture exhibitionsb Visits to agriculture college farm, Visits to mushroom production plant, Visits to biofertilizer production plant, conducting field days	45	75	205209	232594	13.34
Capacity building for animal component	Technical knowledge of animal housing /nutrition/ breed/ health	40	70	50858	86145	69.38
Capacity building for product diversification	Grading sieve /ghee making	45	80	7607	13113	72.38
			Total	263674	331852	25.85

unavailability of improved breed and lack of technical knowledge about feeding/ animal nutritional and housing, etc.

CONCLUSION

After diversification, the net returns from crop component, animal component and product processing were increased by 13.34, 69.38 and 72.38 per cent, respectively, and total gross income after capacity building on different component sincreased by 25.85 per cent. Thus, diversification of existing farming systems was profitable and increase the output and also there cost was reduction. The diversification farming systems provides sustainable productivity and profitability through resource recycling and replacing in all the micro farming and it would provide maximum net returns per unit land area. The diversification component provides employment for the farm family throughout the year. It can be recommended that diversification farming systems is suitable for plain zone area of Pune district.

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Economics of goat rearing business in Osmanabad District of Maharashtra

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ABSTRACT

Goat being one of the earliest domesticated animals is known for its relatively longer association with human beings and known as "poor man's cow" in India. The world current population of goat is around 810 million and that of India alone possesses 124.36 million. India possesses 15 per cent of goat population as compared to the world goat population and stands second to China. India's contribution to world's goat milk, meat, skin and wool productions accounted for 6 per cent, 19 per cent, 18 per cent and 13.2 per cent, respectively. Similarly, goat meat constitutes 25.40 per cent of the total meat production in India. The contribution of goat milk is just 3 per cent of total milk production of the country. India possesses 22 well recognized breed besides a majority of non-descript of interbreed goat out of the globally indentified 102 breeds. The goat population of Maharashtra is 10.68 million. The present study was undertaken in Osmanabad district. To study economics and marketing of goat by using primary data collected by survey method. Multistage sampling design was adopted in selection of district, tehsils, villages and goat rearers. A sample of 60 goat rearers was drawn from selected villages randomly. From each village 6 goat rearers were selected. Four groups of goat units viz. small, medium, and large were considering for study. The information was however, collected for group of 60 goat rearers. Tabular analysis, linear regression analysis and frequency and percentage were used to accomplish the objectives of the study. The results revealed that per goat net profit from goat rearing business was Rs 1377.88, Rs 2038.91, Rs 1994.89 and Rs 1803.89 in small, medium, large and overall size of goat units, respectively. The Output-Input ratio for small, medium, large and overall size of goat unit was 1.19, 1.36, 1.40 and 1.32, respectively.
Keywords: *Economics, goat, output-input ratio*

INTRODUCTION

Goat is a multipurpose animal which provides milk, meat, hair and skin. In crop production, it helps by the way of enhancing soil by its manure which is twice rich as compared to cattle manure. Goat can survive under adverse climatic conditions, such as extreme hot and cold and area of desert and mountains. Due to small size of body and domicile nature, housing requirements and management problems with goats is less. Goats are prolific breeders and achieve sexual maturity at the age of 10-12 months; gestation period in goat is short (150 days) and at the age of 16-17 months it starts giving milk. Twinning is very common and triplet and quadruplets are rare. The animal can thrive well on wide variety of thorny bushes, weeds, crop residues, agricultural by-products unsuitable for human consumption.The world current population of goat is around 810 million and that of India alone possesses 124.36 million. India possesses 15 per cent of goat population as compared to the world goat population and stands second to China. India's contribution to world's goat milk, meat, skin and wool productions accounted for 6 per cent, 19 per cent, 18 per cent and 13.2 per cent, respectively. Similarly, goat meat constitutes 25.40 per cent of the total meat production in India. The contribution of goat milk is just 3 per cent of total milk production of the country.

Goat is an important part of rural economy, particularly in the arid, semi-arid and mountainous regions of India. With more than 124.36 million goats account for more than 25 per cent of the total livestock in the country and contributes Rs 106335 million annually to the national economy. In the country goat is reared for milk in addition to meat. The country ranks second in goat meat production with 16.19 per cent (430 tonnes).

The goat population of Maharashtra is about 10.68 million. In Maharashtra two major breeds of goat are Osmanabadi and Sangamneri found in Osamanabad, Latur and Beed districts of Marathwada region. Goat is having very closely association with lives and aspiration of poorest of the poor and landless agriculture laborers, peasants and those in the economically backward scheduled caste and small farmers. Goat creates employment to the rural poor besides effectively utilizing unpaid family labour. There is ample scope for establishing cottage industries based on goat meat and value addition to skin and fiber.

Another important aspect of goat rearing is that the goat under proper condition of upkeep kids three times in two years and twinning is very common. Goat has religious and ritualistic importance in many societies. However Osmanabadi goat is very important breed in Marathwada region. It is essential to study the economics of Osmanabadi goat rearing. The present study is analytic oriented. Hence, structural inter-

relationship among various variables of the system can be known. By considering the above aspects the present study has been undertaken to estimate costs and returns of goat rearing business

MATERIALS AND METHODS

Multistage sampling design was adopted for the selection of district, tehsils, villages and goat rearers. In first stage, Osmanabad district was purposely selected because of more goat population. In second stage, Tuljapur and Osmanabad tehsils of Osmanabad district were selected on the basis of highest goat population. In third stage, from each selected tehsils five villages were selected on the basis of highest number of goat rearers in villages. The villages namely Ganjewadi, Jalkotwadi, Kati, Kemwadi and Savargaon from Tuljapur tehsil. The villages namely Bembali, Dhuta, Kangara, Palaswadi and Sarola (san.) from Osmanabad tehsil. In fourth stage, separate list of goat rearers was taken from each village with goat flock size. Then, this list was prestratified into three groups like small (1 to 5 goats), medium (6 to 10 goats) and large (11 to 15 goats). From each group two goat rearers were randomly selected. Thus from each village, six goat rearers were selected. In this way, from 10 villages of two tehsils, 60 goat rearers were selected. Then cross sectional data were collected with the help of well-structured pretested schedule by personal interview method. The data were collected during the year 2015-16 for the period from 1th July, 2015 to 30th June, 2016. The data were related to socio-economic characteristics, costs and returns, net worth statement and income statement, market margin and price spread, constraints and suggestions of goat rearers.

RESULTS AND DISCUSSION

Costs and returns in goat rearing business

The physical inputs can be transformed in production of goats. The inputs can be converted into monetary term to determine the cost of rearing per goat. Similarly, young goats, milk and manure can be converted into monetary term to know gross return. With the help of costs and returns, profitability of goat rearing was determined as follows.

Annual physical inputs and outputs in goat rearing

The annual physical input and output in goat rearing business unit per farm as a whole were calculated and are presented in Table 1. The results showed that use of dry fodder was 67.25 kg in small size of goat unit followed by 120.65 kg and 184.39 kg in medium and large size of goat units, respectively. Use of dry fodder was increasing as increase with size of goat unit. At overall level use of dry fodder was 124.10 kg. Then, use of green fodder was 193.93 kg in small size of goat unit while it was 337.10 kg in medium size of goat unit and 517.41 kg in large size of goat unit. It was clear that the use of green fodder was also increases as with an increase in size of goat unit. In general,, use of green fodder was 349.47 kg. Similarly, use of concentrate was increasing from 98.06 kg to 249.37 kg as size of goat unit increases. Thus, on an average use of concentrate was 176.22 kg. Use of human labour was 179.30 man days in small size of goat unit while that was 253.44 man days in medium size of goat unit and 352.55 man days in large size of goat unit. It was concluded that the small goat rearer was taking more care of goats as compared to other goat rearers. At overall level use of human labour was 261.76 man days as employment in goat rearing business.

Regarding annual output from goat rearing business, production of young goats was 29.15 numbers in large size of goat unit followed by 18.60 and 10.55 numbers in medium and small size of goat units, respectively. At overall level production of young goats was 19.43 in numbers. Production of milk was 199.52 liters in small size of goat unit while that was 310.20 and 283.50 liters in medium and large size of goat units, respectively. At overall level milk production was 264.41 liters. Production of manure was increasing with an increase in size of goat unit. At overall level production of manure was 7.19 quintals.

Annual expenditure in goat rearing

The annual expenditure in goat rearing per farm was estimated and is presented in Table 2. The results revealed that, the variable cost was higher as Rs 48031.71 in large size of goat unit followed by Rs 34515.01 and Rs 23461.91 in medium and small size

Table 1: Per farm annual physical inputs and outputs in goat rearing (Physical unit/business unit)

Particular	Physical unit	Size of goat unit as whole			Overall
		Small	Medium	Large	
Input					
Dry fodder	kg	67.25	120.65	184.39	124.10
Green fodder	kg	193.93	337.10	517.41	349.48
Concentrate	kg	98.06	181.23	249.37	176.22
Human labour	man day	179.30	253.44	352.55	261.76
Output					
Young goats(Produced goats)	No.	10.55	18.60	29.15	19.43
Milk	L	199.52	310.20	283.50	264.41
Manure	q	3.74	6.72	11.13	7.19

Table 2: Per farm annual expenditure in goat rearing business unit as a whole (Rs/business unit)

	Particular	Size of goat unit as whole			Overall
		Small	Medium	Large	
1.	Dry fodder	201.75(0.66)	361.95(0.78)	553.17(0.81)	372.29(0.78)
2.	Green fodder	193.93(0.64)	337.10(0.73)	517.41(0.76)	349.48(0.72)
3.	Concentrate	1961.23(6.46)	3624.73(7.79)	4987.40(7.32)	3524.45(7.29)
4.	Human labour	17930.27(59.08)	25343.82(54.49)	35255.00(51.73)	26176.36(54.15)
5.	Medicine	226.52(0.74)	425.66(0.92)	683.24(1.00)	445.14(0.92)
6.	Electricity charge	60.93(0.20)	99.71(0.21)	139.84(0.21)	100.16(0.21)
7.	Miscellaneous expenditure	189.00(0.63)	351.29(0.76)	369.88(0.54)	303.39(0.62)
8.	Interest on working capital @ 13%	2699.27(8.89)	3970.75(8.54)	5525.77(8.11)	4065.26(8.42)
9.	Variable Cost Σ (1 to 8)	23462.91(77.31)	34515.01(74.21)	48031.71(70.49)	35336.54(73.11)
10.	Depreciation on goat @ 12.5%	3256.25(10.73)	5737.50(12.34)	9812.50(14.40)	6268.75(12.96)
11.	Depreciation on shed @ 10%	251.68(0.83)	383.43(0.82)	555.00(0.81)	396.71(0.82)
12.	Depreciation on equipments @ 10%	112.45(0.37)	192.40(0.41)	235.70(0.35)	180.18(0.37)
13.	Interest on fixed capital @ 11%	3266.04(10.76)	5682.41(12.22)	9504.77(13.95)	6151.07(12.73)
14.	Fixed Cost (Σ 10 to 13)	6886.42(22.69)	11995.74(25.79)	20107.97(29.51)	12996.71(26.89)
15.	Total Cost (Σ 9 and 14)	30349.33(100)	46510.75(100)	68139.68(100)	48333.24(100)

Figures in parentheses indicate percentage to total

of goat units, respectively. At overall level variable cost was Rs 35336.54. Among the various items of expenditure, the proportionate share of human labour was predominant as 59.08 per cent, 54.49 per cent, 51.73 per cent and 54.15 per cent in small, medium, large and overall size of goat units, respectively. It is inferred that share of human labour was decreasing as increase in size of goat unit. The proportionate share of interest on working capital was 8.89 per cent in small size of goat unit followed by 8.54 per cent and 8.11 per cent in medium and large size of goat unit. In general, interest on working capital was 8.42 per cent. In regards to concentrate the amount was decreased as increase in size of goat unit. At overall level share of expenditure on concentrate was 7.29 per cent. In case of small, medium, large and overall size of goat unit fodder (dry plus green) accounted 1.30 per cent, 1.51, 1.57 and 1.50 per cent, respectively. The proportionate share of expenditure on medicine, electricity and miscellaneous expenditure was as 0.74, 0.20 and 0.63 per cent in small size of goat unit. In medium size of goat unit it was 0.92, 0.21 and 0.76 per cent and in large size of goat unit it was 1.00, 0.21 and 0.54 per cent, respectively. At overall level share of expenditure was 0.92, 0.21 and 0.62 per cent on medicine, electricity and miscellaneous expenditure, respectively.

The fixed cost was highest as Rs 20107.97 in large size of goat unit followed by Rs 11995.74 and Rs 6886.42 in small and medium size of goat units, respectively. At overall level fixed cost was Rs 12996.71. Thus, total cost was Rs 68139.68, Rs 46510.75 and Rs 30349.33 in large, medium and small size of goat units, respectively. In general, total cost was Rs 48333.24 in which share of variable cost was 73.11 per cent followed by that of fixed cost (27.89 per cent). The similar results were found by Das (1992) in regards to percentage of variable cost and fixed cost in goat rearing business.

Annual profitability in goat rearing

The annual profitability in goat rearing was estimated and is presented in Table 3. It was observed that, gross return was Rs 95566.05 per goat in large size of goat unit followed by Rs 63229.80 and Rs 36274.21 in medium and small size of goat unit. At overall level gross return was Rs 65023.35. On the contrary, total cost was Rs 30349.33, Rs 46510.75, Rs 68139.68 and Rs 48333.24 in small, medium, large and overall size of goat units, respectively. The net profit in business was Rs 5924.88 in small size of goat unit, Rs 16719.05 and Rs 27429.74 in medium and large size of goat unit. At overall level net profit was Rs 16690.22 per goat unit. It was clear that output-input ratio was higher as 1.40 in large size of goat unit than that of medium (1.36) and small (1.19) size of goat unit. At overall level output-input ratio was 1.32. It inferred that the large and medium size of goat units were profitable than that of small size of goat unit because of variable cost is high in small size of goat unit. It revealed that, capital investment in large and medium size of goat unit rearing was more efficient than that of small size of goat unit. The results are conformity with results obtained by Deoghare and Bhattacharyya (1994) with respect to net income.

Physical inputs and outputs in goat rearing

The annual physical inputs and output in goat rearing business were calculated and are presented in Table 4. The results showed that use of dry fodder was 15.64 kg in small size of goat unit followed by 14.71 kg and 13.41 kg in medium and large size of goat units, respectively. Use of dry fodder was decreasing as increase with size of goat unit. At overall level use of

Table 3: Per farm annual profitability in goat rearing business unit as whole (Rs./business unit)

Particular	Size of goat unit as whole			Overall
	Small	Medium	Large	
Return from young goats (Produced goats)	31934.85(88.29)	56302.20(90.07)	88237.05(92.33)	58824.70(89.28)
Return from milk	3591.36(9.51)	5583.60(7.74)	5103.00(5.34)	4759.32(7.82)
Return from manure	748.00(2.20)	1344.00(2.19)	2226.00(2.33)	1439.33(2.25)
Gross return (Σ 1to 3)	36274.21(100)	63229.80(100)	95566.05(100)	65023.35(100)
Variable cost	23462.91 (77.19)	34515.01 (74.33)	48031.71 (70.49)	35336.54(73.11)
Fixed cost	6886.42(22.81)	11995.74(25.67)	20107.97(29.51)	12996.71(26.89)
Total cost (Ó 5 and 6)	30349.33(100)	46510.75(100)	68139.68(100)	48333.24(100)
Operating income (Gross return minus variable cost)	12811.30	28714.79	47534.71	29686.93
Net profit (Gross return minus total cost)	5924.88	16719.05	27429.74	16690.22
Output-Input ratio (Gross return divided by total cost)	1.19	1.36	1.40	1.32

Figures in parentheses indicate percentage to total

dry fodder was 14.59 kg. Then, use of green fodder was 45.10 kg in small size of goat unit while it was 41.11 kg in medium size of goat unit and 37.63 kg in large size of goat unit. It was clear that the use of green fodder was decreased as with an increase in size of goat unit. In general, use of green fodder was 41.28 kg. Use of concentrate was decreasing from 22.80 kg to 18.13 kg as size of goat unit increased. Thus, on an average use of concentrate was 21.01 kg. Use of human labour was 41.70 man days in small size of goat unit while that was 30.91 man days in medium size of goat unit and 25.64 man days in large size of goat unit. It was concluded that the small goat rearer was taking more care of goats as compared to other goat rearers. At overall level use of human labour was 32.75 man days as employment in goat rearing business.

Regarding annual output per goat from goat rearing business, production of young goats was 2.45 in numbers in small size of goat unit followed by 2.26 and 2.12 in numbers in medium and large size of goat units, respectively. At overall level production of young goats was 2.27 in numbers. Production of milk was 46.40 liters in small size of goat unit while that was 37.83 and 20.61 liters in medium and large size of goat units, respectively. Higher production of milk was observed in small size of goat unit due to more care. At overall level milk production was 28.45 liters. Production of manure was decreasing with an increase in size of goat unit. At overall level production of manure was 0.82 quintals.

Costs involved in goat rearing

The annual variable cost, fixed cost and total cost in goat rearing business was estimated and is presented in Table 5. The results revealed that, the variable cost was higher as Rs. 5456.49 in small size of goat unit followed by Rs. 4209.15 and Rs. 3493.21 in medium and large size of goat units, respectively. At overall level variable cost was Rs. 4386.28. Among the various items of expenditure, the proportionate share of human labour was predominant as 59.08 per cent, 54.49 per cent, 51.73 per cent and 54.15 per cent in small, medium, large and overall size of goat units, respectively. It is inferred that share of human labour was decreasing as increase in size of goat unit. The proportionate share of interest on working capital was 8.89 per cent in small size of goat unit followed by 8.54 per cent and 8.11 per cent in medium and large size of goat units, respectively. In general, interest on working capital was 8.42 per cent. In regards to concentrate the amount was decreased from

Table 4: Per goat annual physical inputs and outputs in goat rearing business (Physical unit/invested goat)

Particular	Physical unit	Size of goat unit			Overall
		Small	Medium	Large	
Input					
Dry fodder	kg	15.64	14.71	13.41	14.59
Green fodder	kg	45.10	41.11	37.63	41.28
Concentrate	kg	22.80	22.10	18.13	21.01
Human labour	man day	41.70	30.91	25.64	32.75
Output					
Young goats(Produced goats)	No	2.45	2.26	2.12	2.27
Milk	L	46.40	37.83	20.61	28.45
Manure	q	0.87	0.82	0.81	0.82

Table 5: Per goat annual variable cost, fixed cost and total cost in goat rearing business (Rs./invested goat)

Particular	Size of goat unit			Overall
	Small	Medium	Large	
Dry fodder	46.92(0.66)	44.14(0.78)	40.23(0.81)	43.77(0.77)
Green fodder	45.10(0.64)	41.11(0.73)	37.63(0.76)	41.28(0.72)
Concentrate	456.10(6.47)	442.04(7.79)	362.72(7.32)	420.28(7.29)
Human labour	4169.83(59.08)	3090.71(54.49)	2564.00(51.73)	3274.84(54.15)
Medicine	52.68(0.74)	51.91(0.91)	49.69(1.00)	51.42(0.92)
Electricity charge	14.17(0.20)	12.16(0.21)	10.17(0.21)	12.16(0.21)
Miscellaneous expenditure	43.95(0.63)	42.84(0.76)	26.90(0.54)	37.89(0.62)
Interest on working capital @ 13%	627.71(8.89)	484.24(8.54)	401.85(8.11)	504.57(8.42)
Variable Cost (Σ1 to 8)	5456.49(77.31)	4209.15(74.21)	3493.22(70.49)	4386.28(73.11)
Depreciation on goat @ 12.5%	757.27(10.73)	699.70(12.34)	713.65(14.40)	723.54(12.96)
Depreciation on shed @ 10%	58.53(0.83)	46.76(0.82)	40.36(0.81)	48.55(0.82)
Depreciation on equipments @ 10%	26.15(0.37)	23.46(0.41)	17.14(0.35)	22.25(0.37)
Interest on fixed capital @ 11%	759.54(10.76)	692.98(12.22)	691.26(13.95)	714.60(12.73)
Fixed Cost (Σ10 to 13)	1601.49(22.69)	1462.91(25.79)	1462.40(29.51)	1508.93(26.89)
Total Cost (Σ9 and 14)	7057.98(100)	5672.04(100)	4955.61(100)	5895.21(100)

Figures in parentheses indicate percentage to total

Rs. 456.10 to Rs. 362.72 as increase in size of goat unit. At overall level share of expenditure on concentrate was 7.29 per cent. In case of small, medium, large and overall size of goat unit fodder (dry plus green) accounted 1.30 per cent, 1.51, 1.57 and 1.50 per cent, respectively. The proportionate share of expenditure on medicine, electricity and miscellaneous expenditure was as 0.74, 0.20 and 0.63 per cent in small size of goat unit. In medium and large size of goat unit it was 0.92, 0.21 and 0.76 per cent and 1.00, 0.21 and 0.54 per cent, respectively. At overall level share of expenditure was 0.92, 0.21 and 0.62 per cent on medicine, electricity and miscellaneous expenditure, respectively.

The fixed cost was highest as Rs. 1601.49 in small size of goat unit followed by Rs. 1462.40 and Rs. 1462.40 in medium and large size of goat units, respectively. At overall level fixed cost was Rs. 1508.93. Thus, total cost was Rs. 7057.98, Rs. 5672.04 and Rs. 4955.59 in small, medium and large size of goat units, respectively. In general, total cost was Rs. 5523.79 in which share of variable cost was 73.11 per cent followed by that of fixed cost (27.89 per cent).

Per goat annual profitability in goat rearing

Profitability in goat rearing business was estimated and is presented in Table 6. It was observed that, gross return was Rs. 8435.86 per goat in small size of goat unit followed by Rs 7710.95 and Rs. 6950.26 in medium and large size of goat unit. At overall level gross return was Rs 7699.02. On the contrary, total cost was Rs. 7057.98, Rs. 5672.04, Rs. 4955.61 and Rs. 5895.21 in small, medium, large and overall size of goat unit,

Table 6: Per goat annual profitability in goat rearing business (Rs./invested goat)

	Particular	Size of goat unit			Overall
		Small	Medium	Large	
1.	Return from young goats (Produced goats)	7426.70(88.29)	6866.12(90.07)	6417.24(91.72)	6903.35(89.28)
2.	Return from milk	835.20(9.51)	680.93(7.74)	371.13(5.79)	629.09(7.82)
3.	Return from manure	173.95(2.20)	163.90(2.19)	161.89(2.39)	166.58(2.25)
4.	Gross return (Σ 1to 3)	8435.86(100)	7710.95(100)	6950.26(100)	7699.02(100)
5	Variable cost	5456.49(77.19)	4209.15(74.33)	3493.22 (70.49)	4386.28 (73.11)
6.	Fixed cost	1601.49(22.81)	1462.91(25.67)	1462.40(29.51)	1508.93(26.89)
7.	Total cost (Σ 5 and 6)	7057.98(100)	5672.04(100)	4955.61 (100)	5895.21 (100)
8.	Operating income (Gross return minus variable cost)	2979.37	3501.80	3457.07	3312.74
9.	Net profit (Gross return minus total cost)	1377.88	2038.91	1994.89	1803.89
10.	Output-Input ratio (Gross return divided by total cost)	1.19	1.35	1.40	1.32

Figures in parentheses indicate percentage to total

respectively. The net profit in business was Rs 1377.88 in small size of goat unit, Rs 2038.91 and Rs. 1994.89 in medium and large size of goat units, respectively. At overall level net profit was Rs. 1803.89 per goat. It was clear that output-input ratio was higher as 1.40 in large size of goat unit than that of medium (1.36) and small (1.19) size of goat unit. At overall level output-input ratio was 1.32. It inferred that the large and medium size of goat units were profitable than that of small size of goat unit because of variable cost per goat was high in small size of goat unit. It revealed that, capital investment in large and medium size of goat unit rearing was more efficient than that of small size of goat unit. The similar results were found by Bhutekar (1997) in regards to per goat gross return in goat rearing business.

CONCLUSION

The annual net profit in business was Rs. 5924.88, Rs. 16719.05, Rs. 27429.74 and Rs. 16690.22 in small, medium, large and overall size of goat units, respectively. Output-input ratio was (1.40) large, (1.36) medium and (1.19) small size of goat units, respectively. At overall level output-input ratio was 1.32. Hence, it was concluded that large and medium size of goat units was more profitable than small size of goat unit.

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Economics of resource use of greengram production in Maharashtra

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ABSTRACT

The data were related to green gram output and inputs collected from office record of State Cost of Cultivation Scheme, Govt. of Maharashtra, during the year 2013-14. The total sample size was 138. The simple statistical tools and the Cobb Douglas production function was fitted to the data. Result indicated that at state level, the per hectare use of human, bullock, machine power and seed utilization indicated that irrespective of region, use of these resources was more or less same at region and state level. The per hectare manure utilization is less than the recommended dose 50 q/ha due to the non-availability and increasing cost of manures. Whereas use of chemical fertilizers nitrogen, phosphorus and potassium was 18.46, 23.38 and 5.20 kg/ha, respectively. The results in respect of productivity all seven have jointly explained 74 per cent of the total variation in the output of green gram, in that regression coefficient of human labour, bullock labour, manure and potash fertilizer at state level were positive and significant which indicated that these variables have major contribution on output. The resource use efficiency in green gram production in Maharashtra state was observed that, the ratios of MVP to MC was positive and more than unity for human labour, manures, nitrogen and potash indicating less use, which could help to increase production up to maximum level by their optimum utilization.

Keywords: *Green gram, Cobb-Douglas production function, resource use productivity, resource use efficiency*

INTRODUCTION

India is the largest producer and consumer of pulses in the world. Major pulses grown in India are Chickpea, Pigeon pea, Green gram, Black gram and Lentil. Among various pulse crops, For the triennium ending 2012-13, the total area under pulses was 23.90 million hectare. India's population would reach 1.68 billion by 2030 from the present level of 1.21 billion. Accordingly, the projected pulse requirement for the year 2030 is 32 million tons with an anticipated required growth rate of 4.2% (IIPR Vision 2030). India has to produce not only enough pulses but also remain competitive to protect the indigenous pulse production. In view of this, India has to develop and adopt more efficient crop production technologies along with favourable policies to encourage farmers to bring more area under pulses. In which the green gram are the major ones.In Maharashtra state, green gram is cultivated in 6.71 lakh hectare with production 3.71 lakh tonnes. Its productivity is 552.91 kg/ha. The reasons for low productivity are low inputs usage. In green gram production process, some of the resources either are underutilization or overutilization. There is need to know optimum resource use for maximum profit in the production of green gram. Keeping in view the above aspects, the present study has been undertaken with specific objective to study the resource use structure, productivity and efficiency of green gram in Maharashtra.

METHODOLOGY

The study is based on the secondary data collected from the 138 farm families under the Scheme for Creating Permanent Machinery Studying the Cost of Cultivation of Principal Crops in Maharashtra. The data pertained to the agricultural year 2013-2014. The sample recorded from Western Maharashtra (73), Marathwada (35) and Vidarbha (30) for further analysis. The samples are not available for green gram in Konkan regions of Maharashtra, In the present investigation, the data was compiled and analyzed, with simple statistical tools such as arithmetic mean average, percentage and ratios were used. Costs are calculated as per the standard format of cost of cultivation i.e. Cost-A, Cost-B and Cost-C.

Functional analysis

Cobb Douglas production function was used for estimating factors influencing the productivity of pulses.

$$Y = aX_1^{b_1}X_2^{b_2}X_3^{b_3}X_4^{b_4}X_5^{b_5}X_6^{b_6}X_7^{b_7}e^u$$

where,
Y= Output of main produce (q ha-1)
a= Intercept.
X1= Human labour (man days ha-1)
X2= Bullock power (pairs days ha-1)
X3= Machine power (hr ha-1)
X4= Manure (q ha-1)
X5= Nitrogen (kg ha-1)
X6= Phosphorus (kg ha-1)
X7= Potassium (kg ha-1)
u= Error term
bi´s= Regression coefficients of respective variables

Estimation of marginal value product

The marginal value products (MVPs) of the individual resources were estimated and compared with

the marginal cost (MC). The MVP of resources were estimated by using the following formula,

$$\text{Marginal value product(MVP) of } X_i = b_i \frac{\bar{Y}}{\bar{X}} P_y$$

where,

b_i= Elasticity of production of i^{th} input

$\bar{Y}$ = Geometric mean of output

$\bar{X}_i$=Geometric mean of i^{th} input

P_y = Per unit price of output in Rupees

RESULTS AND DISCUSSION

Resource use structure in green gram

The information on utilization of different resource for green gram is presented in Table 1 on per hectare basis. At state level, the per hectare use of human labourbullock labour, and machine power utilization level was 52.45 man days, comprising 17.81 male and 34.54 female labour days, 4.88 pair days and 3.64 hr. It is concluded from above fact that irrespective of region, use of labour was more or less same on region and state level of green gram grower. The utilization of machine power per hectare was observed more (i.e. 4.15 hr) in case of Vidarbha region as compare to other region i.e. Marathwada (3.62 hr.) and Western Maharashtra (3.23). On an average at state level, the utilization of seed per hectare was 14.33 kg. The utilization of seed per hectare was observed more or less same irrespective of region. The use of manures at state level, was 3.82 q/ha. The per hectare manure utilization by Western Maharashtra, Marathwada and Vidarbha region of green gram grower were 3.16, 8.27 and 2.61 quintals respectively, It is less than the recommended dose 50 q/ha due to the non-availability and increasing cost of manures. At the state level, per hectare use of chemical fertilizers nitrogen, phosphorus and potassium was 18.46, 23.38 and 5.20 kg/ha, respectively. The plant protection charges incurred were ¹ 179.63 per ha for green gram. The per hectare plant protection charges was observed very less in case of all region and state because of farmer purpose in that crop was subsistence crop and crop rotations.

Resource use productivities in green gram

The Cobb-Douglas production function were used for estimating resource use productivities in green gram production on the basis of goodness of fit (R^2) which indicates the proportion of total variation of the dependent variable jointly explained by the independent variables. The results of resource use productivities for green gram production in different region of Maharashtra are presented in the Table 1. The results revealed that, the seven resource variables viz; human labour (X_1), bullock labour (X_2), machine power (X_3), manure (X_4), nitrogen (X_5), phosphorus (X_6) and potash (X_7) were included in the production function analysis of green gram. The analysis showed that, these variables have jointly explained about 78 per cent variation in the yield of green gram in Western Maharashtra. The regression coefficients of human labour (X_1), manures (X_4), phosphorus (X_6) and potash (X_7) were turned out to be positive and significant indicating thereby that, one unit increase in the use of these variables would increase the yield by 0.4857, 0.2411, 0.0983 and 0.0583 per cent, respectively. However, bullock labour, machine power and nitrogen were not significant but positive, it indicate that they have positive impact on output.

In Marathwada the value of coefficient of multiple determination (R^2) was 0.73 which indicated that, 73 per cent variation in green gram production was explained due to variation in all independent variables. Therefore, it can be concludes that, each explanatory variable on its own was very important but together they explained significantly part of variation in green gram production. Further, regression coefficients with respect to human labour (X_1), manure (X_4), nitrogen (X_5) and potash (X_7) were 0.3882, 0.2349, 0.3496 and 0.2996 which were positive and significant at 5 per cent level and indicated that, when we increase the use of these variables by 5 per cent over their geometric mean, would

Table 1: Resource use structure for green gram in Maharashtra (*Per hectare*)

Resources	Unit	Region			Maharashtra
		Western Maharashtra	Marathwada	Vidarbha	
Total Human labour	Mandays	52.48	52.99	53.04	52.35
a. Male		17.54	18.25	18.17	17.81
b. Female		34.94	34.74	34.87	34.54
Bullock Power	Pairdays	5.70	5.31	3.65	4.88
Machine Power	hr	3.23	3.62	4.15	3.64
Seed	kg	14.97	14.34	13.52	14.33
Manures	q	3.16	8.27	2.61	3.82
Total Fertilizers	kg	35.65	73.70	49.08	47.04
Nitrogen		16.07	20.93	20.31	18.46
Phosphorus		13.67	45.16	25.57	23.38
Potassium		5.91	7.61	3.20	5.20
Plant protection charges	(¹)	36.12	00.00	440.83	179.63

Table 2: Result of Cobb-Douglas production function for green gram in Maharashtra

Particular	Region			Maharashtra
	Western Maharashtra	Marathwada	Vidarbha	
Intercept (a)	0.4149	0.2777	0.1839	0.3991
Human labour(days/ha)(X_1)	0.4857***(0.1139)	0.3882**(0.1429)	0.4269*(0.2172)	0.3818***(0.1439)
Bullock power(Pair days/ha)(X_2)	0.0721(0.0579)	0.0363(0.1236)	0.0262(0.1260)	0.0072*(0.0043)
Machine power(hr/ha)(X_3)	0.0126(0.0308)	0.1661(0.3217)	0.0091(0.0119)	0.0012(0.0028)
Manures (q/ha)(X_4)	0.2411**(0.1028)	0.2349**(0.1123)	0.2461**(0.1123)	0.2132**(0.1024)
Nitrogen (kg/ha)(X_5)	0.0129(0.0614)	0.3496**(0.1347)	0.2802**(0.1132)	0.3216***(0.1238)
Phosphorus (kg/ha) (X_6)	0.0983***(0.0260)	0.0257(0.0267)	0.0147(0.2109)	0.0168(0.3588)
Potash (kg/ha)($X_{7)}$	0.0583**(0.0250)	0.2996**(0.1232)	0.0394***(0.0122)	0.0716***(0.0246)
R^2	0.78	0.73	0.71	0.74
Number of observation	73	35	30	138
Degree of freedom	65	27	22	130

(Figures in parentheses are standard errors of respective regression coefficient)
*, **, and ***indicates significance at 10, 5 and 1 per cent level respectively

lead to increase green gram production by 0.3882, 0.2349, 0.3496 and 0.2996 per cent respectively, while regression coefficients with respect to bullock power (X_2) and phosphorus (X_6) were 0.0363 and 0.0257 which were positive but not significant indicated that, it indicate that they have positive impact on output. The estimated parameters of human labour (X_1), manure (X_4), nitrogen (X_5) and potash (X_7) were significant in Vidarbha, it indicating that for every one per cent increase in the expenditure on these resources would result in increased gross return by 0.4269, 0.2461, 0.2802 and 0.0394 per cent respectively. The value of coefficient of multiple determination (R^2) was found to be 0.71 which indicate that 71 per cent variation in output was jointly explained by seven independent resource variables under consideration. At the state level, coefficient of multiple determination(R^2) turned out to be to be 0.74 indicating that 74 per cent variation in

Table 3: Resource use efficiency in production of green gram in different region of Mharashtra

Particular	Units	GM X	GM Y	Py	bi's	MPP	MVP	MC	MVP/MC
Western Maharashtra									
Total human labour	Man Days	52.48	5.07	4918.85	0.4857	0.0469	230.81	183.42	1.2584
Total bullock labour	Pair Days	5.60	5.07	4918.85	0.0721	0.0653	321.19	650.00	0.4941
Manures	q	3.16	5.07	4918.85	0.2411	0.3868	1902.80	150.00	12.6853
N	kg	16.07	5.07	4918.85	0.0129	0.0041	20.06	29.44	0.6813
P	kg	13.67	5.07	4918.85	0.0983	0.0365	179.33	45.98	3.9002
K	kg	5.91	5.07	4918.85	0.0583	0.0499	245.69	20.29	12.1089
Marathwada									
Total human labour	Man Days	50.40	7.10	3802.40	0.3882	0.0547	207.94	184.45	1.1274
Total bullock labour	Pair Days	4.15	7.10	3802.40	0.0363	0.0620	235.87	450.00	0.5241
Manures	q	7.12	7.10	3802.40	0.2349	0.2342	890.50	150.00	5.9366
N	kg	18.13	7.10	3802.40	0.3496	0.1369	520.58	36.17	14.3927
P	kg	40.16	7.10	3802.40	0.0257	0.0045	17.28	37.63	0.4591
K	kg	6.20	7.10	3802.40	0.2996	0.3431	1304.51	19.60	66.5565
Vidarbha									
Total human labour	Man Days	51.14	6.50	4042.00	0.4269	0.0543	219.31	184.39	1.1868
Total bullock labour	Pair Days	2.80	6.50	4042.00	0.0262	0.0609	246.07	550.00	0.4474
Manures	q	2.60	6.50	4042.00	0.2461	0.6154	2487.31	150.00	16.5821
N	kg	19.31	6.50	4042.00	0.2802	0.0943	381.30	26.04	14.6430
P	kg	23.52	6.50	4042.00	0.0147	0.0041	16.44	41.53	0.3959
K	kg	3.20	6.50	4042.00	0.0394	0.0801	323.79	18.65	17.3615
Maharashtra									
Total human labour	Man Days	49.30	6.41	4038.75	0.3818	0.0496	200.47	185.60	1.0801
Total bullock labour	Pair Days	4.12	6.41	4038.75	0.0072	0.0112	45.13	585.13	0.0771
Manures	q	3.70	6.41	4038.75	0.2132	0.3693	1491.42	149.91	9.9488
N	kg	18.46	6.41	4038.75	0.3216	0.1117	451.13	29.34	15.3760
P	kg	23.38	6.41	4038.75	0.0168	0.0046	18.58	41.47	0.4481
K	kg	5.20	6.41	4038.75	0.0716	0.0883	356.64	19.72	180.052

output is jointly explained by the above considered independent factors. The regression coefficient of variables human labour (X_1), bullock labour (X_2), manure (X_4), nitrogen (X_5) and potash (X_7) were statistically significant. This indicated that, one unit increase in the human labour (X_1), bullock labour (X_2), manure (X_4), nitrogen (X_5) and potash (X_7) would result into 0.3818, 0.0072, 0.2132, 0.3216 and 0.0716 per cent increase in the output respectively (Table 2).

Resource use efficiency in green gram production

The resource use efficiency in green gram production on the sample farms in different regionsof the state was judged with the help of MVP/MC ratio and the results of resource use efficiency are presented in Table 3. The resource use efficiency in green gram production in Western Maharashtra region was observed that, the ratios of MVP to MC was positive and more than unity for human labour, manures, phosphorus and potash, indicating that, these resources were used advantageously and there was greater chance to increase the use of these resource. When MVP to price ratio tends to unity at that point, there would be efficient utilization of resource. Whereas, it was less than one in case of bullock labour and nitrogen, indicating over utilization of these inputs in green gram cultivation. In Marathwada region resource use efficiency in production of green gram is noticed that, marginal value product to factor cost ratio (MVP/MC) was greater than unity in case of human labour, manures, nitrogen and potash. This implied that, higher resource use efficiency was achieved in case of these variables. The MVP/MC ratio for bullock labour and phosphorus were found to be less than unity suggesting the inefficient use of these resources. Vidarbha revealed that (MVP/MC) was greater than unity in case of human labour, manure, nitrogen and potash. This means these variable were underutilized and there is scope for increasing inputs utilization whereas others are excessively used. In case of state level farmer category the MVP/MC ratio is showing above 1 for human labour, manure, nitrogen and potash indicating less use, which could help to increase production up to maximum level by their optimum utilization. Hence needs to train the farmers regarding use of different inputs in a manner to optimize yield.

CONCLUSION

At the state level, the per hectare use of human, bullock, machine power and seed utilization indicated that irrespective of region, use of these resources was more or less same on region and state level of green gram grower. In case of resource use productivities in green gram cultivation for state level, it was observed that all seven variable viz., human labour, bullock power, machine power, manures, nitrogen, phosphorus and potash included in the production function analysis have jointly explained 74 per cent of the total variation in the output of green gram. At state level resource use efficiency in production of green gram is noticed that, marginal value product to factor cost ratio was greater than unity in case of human labour, manures, nitrogen and potash. This implied that, higher resource use efficiency was achieved in case of these variables. Hence need to train the farmer regarding use of different inputs in a manner to optimize yield.

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Economics of sericulture in Osmanabad district of Maharashtra

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ABSTRACT

Sericulture is an art of rearing silkworm for the production of cocoons which is the raw material for the production of silk. It is an important agro based rural industry that helps our economy and generates higher income and employment. It is practiced in a wide range of agro-climatic regions. In fact, the recent technological advancements have made it possible to practice it on an intensive scale, mainly due to increased profits obtained from it as compared to most of the crops and enterprises. Multistage sampling design was adopted in selection of district, tehsil, villages and sericulture producers. In first stage, Osmanabad district was selected in Osmanabad district, Osmanabad and Kalam tehsils were selected. Five villages from each tehsils were selected. Sixty sericulture producers were selected. The data were collected during the year 2015-2016 from 1st July, 2015 to 30th June 2016. The gross return was found to be Rs 43135 from per field and Rs 74370.62 from per hectare of mulberry garden, Cost-C was Rs 36901.45 and Rs 63623.19 from per field and per hectare, respectively. In regards to the cocoon production gross return from the 3.48 batches was Rs 78895.19 and from one batch was Rs 22670.00 Total cost was Rs 49707.11 and Rs 14283.34 from 3.48 and one batch, respectively. Net profit from 3.48 batches was Rs 29187.98 and from one batch was Rs 8387.18. The output-input ratio was 1.58. Per kg cost of production was found to be Rs 200.75.

Keywords: *Sericulture, cocoon, economics, silkworm*

INTRODUCTION

Sericulture is an art of rearing silkworm for the production of cocoons which is the raw material for the production of silk. Silk is the queen of fabrics, starting from the Vedas to this day. India is the second largest producer of raw silk in the world next to China. India's raw silk production was 1450 tonnes in 2014-15. Mulberry raw silk contributes about 85 per cent the total silk production in India. The total area of mulberry in the country is around 282244 hectares. The area under mulberry plantation and raw silk production of Maharashtra is 4504 hectares and Marathwada is 200 tonnes and 444 hectares 10.53 tonnes respectively. India also the largest importer of raw silk and largest consumer of the silk in the world. Sericulture has a remarkable advantage of simultaneously addressing several governments of India's development properties related to economic growth and social development.

Silk is the queen of fabrics, starting from the Vedas to this day. There are four types of silk mulberry (*Bombyx mori)* tassar (*Antheraea paphia*), eri (*Philosomia ricini*) and muga (*Antherea assama)*. India is the second largest producer of raw silk in the world next to China. India's raw silk production was 1450 tonnes in 2009-10. Mulberry raw silk contributes about 85 per cent the total silk production in India. The total area of mulberry in the country is around 282244 hectares. The area under mulberry plantation and raw silk production of Maharashtra is 4504 hectares and Marathwada is 200 tonnes and 444 hectares 10.53 tonnes respectively. India also the largest importer of raw silk and largest consumer of the silk in the world. Sericulture has a remarkable advantage of simultaneously addressing several governments of India's development properties related to economic growth and social development. Sericulture is an important agro based rural industry that helps our economy and generates higher income and employment. It is practiced in a wide range of agro-climatic regions. In fact, the recent technological advancements have made it possible to practice it on an intensive scale, mainly due to increased profits obtained from it as compared to most of the crops and enterprises.

The success of sericulture business is completely depends on the factors like silkworm variety quality of mulberry leaves and management. Because these factors decides the quality and quantity of good cocoon production. To increase the cocoon production and to reduce the labour cost it is advisable to choose silkworm strain and mulberry variety which is suitable for particular set of condition, soil and climate. There is a scope for development of sericulture industry in Maharashtra. From the point of view of farmers (rearers) innovators, extension workers. There is a need for finding out the relative production for obtaining higher net returns from sericulture enterprise. By considering the above aspects the present study has been undertaken in Osmanabad district to estimate cost of cultivation of mulberry crop and to estimate costs and returns of cocoon production.

METHODOLOGY

Multistage sampling design was adopted in selection of district, tehsil, villages and sericulture

producers. In first stage, Osmanabad district was selected in Osmanabad district, Osmanabad and Kalam tehsils were selected. Five villages from each tehsils were selected. Sixty sericulture producers were selected. Then cross sectional data were collected with the help of well-structured pretested schedule by personal interview method. The data were collected during the year 2015-16 from 1st July, 2015 to 30th June 2016. The analytical techniques like tabular analysis, functional analysis, and frequency and percentage method were used to analyze the data in the present study.

RESULTS AND DISCUSSION

Cost of cultivation of mulberry

The different aspects of cost incurred in the cultivation of mulberry has been discussed below:

Establishment of mulberry garden

Establishment cost of mulberry garden was estimated and is presented in Table 1. Total cost was Rs 82214.39 in which rental value was predominant itemof expenditure followed by human labour, irrigation and interest on working capital.In other words, proportionate expenditure on rental value of land was found to be 34.36 per cent followed by that of human labour (23.61 per cent) and irrigation (14.94 per cent). The results were conformity with the results obtained by Radhika Rani (2003) in regard to expenditure on various items in establishment cost of mulberry garden.

Table 1: Per hectare establishment cost of mulberry garden

Particular		Amount (Rs/ha)	Per cent
1.	Human labour	19411.67	23.61
2.	Cuttings	4466.67	5.43
3.	Manure	6166.66	7.50
4.	Fertilizers	2318.16	2.82
5.	Irrigation	12286.67	14.94
6.	Land revenue	30.00	0.04
7.	Interest on working capital @13%	5808.37	7.06
8.	Depreciation @ 10%	1655.32	2.02
9.	Rental value of land	28250.00	34.36
10.	Interest on fixed capital@ 11%	1820.87	2.22
11.	Total cost	82214.39	100.00

Physical inputs and outputs in mulberry cultivation

The physical inputs and outputson field and hectarebasis in mulberry cultivation were estimated and are presented in Table 2. Regarding per field mulberry garden, use of hired human labour was 23.94 man days for 0.58 hectare. The use of bullock labour was 6.78 pair days. On the contrary, use of machine labour was 3.60 hours. In regard to manure, it was 6.41 quintals. Use of nitrogen, phosphorus and potash was 170.04 kg, 50.84 kg and 17.65 kg, respectively. Use of irrigation water was 3430 cubic meter.

The use of plant protection was 2.26 liters. Use of family labour was 17.36 man days in mulberry cultivation. It was also observed from table that yield of main produce i.e. mulberry leaves was 66.25 quintals and the by produce (sticks) was 14.29 quintals. Regarding per hectare physical inputs and output use of hired human labour for per hectare mulberry farm was 41.27 man days. Use of bullock pair was 11.68 pair days. While use machine labour was 6.20 hours. In regard to manure, use of manure was 11.05 quintals. Use of nitrogen, phosphorus and potash was 293.17 kg, 87.65 kg and 30.43 kg respectively. Use of irrigation water was 5913.79 cubic meter. The use of family labour was 29.93 man days. It was also observed from the table that the yield of the main produce (mulberry leaves) was 114.22 quintals and by produce from (sticks) was 24.64 quintals per hectare.

Costs and returns in mulberry cultivation

The annual expenditure of mulberry cultivation with respect to per field (0.58 ha) and per hectare was estimated and is presented in Table 3. Per field cost of cultivation was Rs 36901.45 while per hectare cost of cultivation was Rs 63623.19.Among individual items amortization cost was predominant item of expenditure.

Table 2: Annual physical inputs and outputs of mulberry cultivation

Particular	Physical Unit	Mulberry garden (unit /0.58 ha)	Mulberry garden (unit/ha)
Input			
Hired human labour	man day	23.94	41.27
Bullock labour	pair day	6.78	11.68
Machine labourFertilizers	hours	3.60	6.20
Nitrogen	kg	170.04	293.17
Phosphorus	kg	50.84	87.65
Potash	kg	17.65	30.43
Manure	q	6.41	11.05
Plant protection	lit	2.26	
Irrigation	m3	3430	5913.79
8.Family labour	man day	17.36	29.93
Output			
Main produce (leaves)	q	66.25	114.22
By produce (sticks)	q	14.29	24.64

Table 3: Annual expenditure in mulberry cultivation

Particular	Amount(Rs/ 0.58 ha)	Amount(Rs /ha)	Per cent
Costs			
Hired human labour	2872.80	4953.10	7.78
Bullock labour	1695.00	2922.00	4.59
Machine labour	1620.00	2793.10	4.39
Fertilizers	3538.69	6101.18	9.59
Manures	3205.00	5525.86	8.68
Plant protection	850.00	1465.52	2.30
Irrigation	3430.00	5913.79	9.29
Land revenue	34.48	59.44	0.09
Incidental expenditure	360.50	621.55	0.98
Interest on working capital@ 13%	2288.84	3946.27	6.21
Depreciation on capital assets @ 10%	513.21	884.84	1.39
Cost-A (Σ items 1 to 11)	20408.52	35187.10	55.29
Rental value of land	5486.35	9459.22	14.87
Interest on fixed capital @ 11%	564.53	973.32	1.53
Amortised cost	8358.85	14411.81	22.65
Cost-B (Σ item 13 to 15)	34818.25	60031.40	39.05
Family human labour	2083.2	3591.60	5.66
Cost-C (Σ item 16 to 17)	36901.45	63623.19	100.00
Returns			
Main produce	33125.00	57112.00	76.79
By produce	10010.00	17258.62	23.21
Gross return	43135.00	74370.62	100.00
Net return	6233.55	10747.43	—
Output input ratio	1.17	1.17	—
Per quintal cost of leaves production	202.95	202.95	—

The amortization cost per field was Rs. 8358.85 while that of per hectare was Rs. 14411.81.In other words, proportionate expenditure on amortization cost was 22.65 per cent. Rental value of land was the next important item of expenditure. It was Rs 5486.35 for 0.58 hectare while that was Rs. 9459.22 for one hectare. In short, the share of rental value of land was found to be 14.87 per cent. In the next order use of fertilizer was Rs. 3538.69 for 0.58 hectare of mulberry garden while that of Rs 6101.18 for one hectare of mulberry garden. Share of fertilizer expenditure in mulberry cultivation was 9.59 per cent. Irrigation was the next important item of expenditure whereas per field expenditure was Rs. 3430.00 and per hectare expenditure was Rs. 5913.79. Thus proportionate expenditure on irrigation was 9.29 per cent. It was clear that share of manure in expenditure was 8.68 per cent followed by hired human labour (7.78 per cent), interest on working capital (6.21 per cent) and family human labour (5.66 per cent). Other items of expenditure showed negligible percentage in mulberry cultivation.In regard to return it was also observed from table 3 that main produce of mulberry in the form of green leaves was Rs. 33125.00 per field while that of Rs. 57112.00 per hectare. Share of main produce in gross return was 76.79 per cent. By produce of mulberry plants in the form of sticks was Rs. 10010.00 per field and that of Rs 17258.62 per hectare. The share of by produce in gross return was 23.21 per cent. Thus gross return per field was Rs 43135.00 while that was Rs 74370.62 per hectare. In general output-input ratio was 1.17. Per quintal cost production of green leaves was Rs. 202.95. The results were conformity with the results obtained by Radhika Rani *et.al. (*2003) in regard to expenditure on various items in costs and returns of mulberry cultivation.

Costs and returns of cocoon production

The costs and returns involved in cocoon production is discussed below:

Physical inputs and outputs in cocoon production

The physical inputs and outputs in cocoon production per batch annually for 3.48 batches were estimated and are presented in Table 4. Regarding 3.48 batches,use of hired human labour was 23.81 man days. Use of family human labour was102.94 man days. The use of disease free layings was 657.50 in numbers.

The use of mulberry leaves was 56.35 quintals. Use of the disinfecting material was 184.60 kg and the use of electricity for rearing was 428.98 el units. It was observed that the main produce (cocoon) from 3.48 batches in a year was 386.00 kg and the by produce

(manure) was 35.27 kg. While use of hired human labour for per batch was 6.84 man days. Use of family human labour was 29.58 man days. Then the use of disease free layings was 188.94 in number. Use of mulberry leaves was 16.19 quintals. Use of disinfecting material was 53.04 kg. The use of electricity was 123.27 units. It was observed that the main produce (cocoon) from per batch was 110.92 kg and by produce (silkworm excreta) was 10.13 kg.

Costs and returns of cocoon production

The costs and returns in cocoon production business were estimated and are presented in Table 5. The total cost for 3.48 batches during the year was Rs 49707.11 while that of for one batch was Rs 14283.34. It was clear that predominant item of expenditure was family labour. Expenditure on family labour for 3.48 batches was Rs 12352.80 while that of forone batch was Rs 3549.60. The proportionate expenditure on family labour was 24.85 per cent. Expenditure on mulberry leaves the second most important item of expenditure. Thus expenditure on mulberry leaves was Rs 11436.23 for 3.48 batches and Rs 3286.27 for one batch, respectively.

The share of expenditure on mulberry leaves was 23.01 per cent. In next order, expenditure on disinfecting material was Rs 11076.00 for 3.48 batches. Expenditure on disinfecting material was Rs 3182.76 per batch. Proportionate expenditure on disinfecting material was 22.21. It implied that more than 70 per cent expenditure was done on use of family labour, mulberry leaves and disinfecting material together in cocoon production. In short share of variable cost was 93.62 per cent. Proportionate expenditure fixed cost was 6.38 per cent. It inferred that long term investment was very small as compare to current investment. In regard to return from cocoon production, main produce (cocoons) that was Rs 78189.59 from 3.48 batches while that was Rs 22468.27 from one batch. Return from by produce was

Table 4: Annual physical inputs and outputs in cocoon production

Particular	Physicalunit	Unit /3.48 batches	Unit/ batch
Input			
Hired human labour	man day	23.81	6.84
Family labour	man day	102.94	29.58
Disease free layings	no	657.50	188.94
Mulberry leaves	q	56.35	16.19
Disinfecting material	kg	184.60	53.04
Electricity	el. unit	428.98	123.27
Output			
Main produce(cocoons)	kg	386.00	110.92
Byproduce (silkworm excreta)	kg	35.27	10.13

Table 5: Costs and returns in cocoon production

Particular	Amount Rs/3.48 batch	Amount Rs/batch	Per cent
Costs			
Hired human labour	2857.20	820.80	5.75
Family labour	12352.80	3549.60	24.85
Disease free layings	1643.75	472.34	3.31
Mulberry leaves	11436.23	3286.27	23.01
Disinfecting material	11076	3182.76	22.28
Electricity	1102.48	316.80	2.22
Miscellaneous	715.83	205.69	1.44
Interest on working capital@13%	5353.96	1538.49	10.77
Variable cost (Σ item 1 to 10)	46538.25	13372.75	93.62
Depreciation on asset @10%	1508.98	433.61	3.04
Interest on fixed capital@11%	1659.88	476.98	3.34
Fixed cost (Σ item 9 to 10)	3168.86	910.59	6.38
Total cost (Σ item 9 and 12)	49707.11	14283.34	100.00
Returns			
Main produce (cocoon)	78189.59	22468.27	99.11
By produce (Silkworm manure)	705.50	202.72	0.89
Gross return	78895.09	22671.00	100.00
Net profit (GR-TC)	29187.98	8387.18	—
Output input ratio (GR/TC)	1.58	1.58	—
Per kg cost of cocoons	200.75	200.75	—

Rs 705.50 from 3.48 batches and Rs 202.73 from one batch, respectively. Thus gross return from cocoon production was found to be Rs 78895.09 from 3.48 batches and Rs 22671.00 from one batch. Proportionate share of cocoon was 99.11 per cent while by produce share was negligible (0.89 per cent). Thus net profit was Rs 29187.98 from 3.48 batches during the year. Net profit per batch was Rs 8387.18. In general output-input ratio was 1.58 in cocoon production business. It was obvious that per kg cost of cocoon production was found to be Rs 200.75. The result were confirming with the results obtained by Lakshmanan *et al.* (1997) in regard to human labour and disease free layings in cocoon production.

CONCLUSION

The net profit obtained from cocoon production from 3.48 batches was Rs 29187.98 and from per batch was Rs 8387.18. In regard to regression coefficient with respect to disease free layings and disinfecting materials were positive and significant. Hence there was scope to increase these variables in cocoon production.

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Effect of migration of *Apis mellifera* colonies from Kashmir valley to Jammu on the honey production and colony development

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ABSTRACT

A study was undertaken to assess the effect of migration of Apis mellifera *on the honey production and colony development. During winter season, 850 colonies of* Apis mellifera *were migrated from SKUAST-Kashmir, Shalimar to sub-tropical region of Jammu at different locations in Miran Sahib, Maralia and Purmandal during the year 2012-2013 and 2013-14 by the Research and Training Centre for Pollinators, Pollinizers and Pollination Management of SKUAST-K, Shalimar campus, Srinagar. It can be concluded that migration of* A. mellifera *from Kashmir valley to Jammu region proved successful and economically viable to the bee-keepers.*

Keywords: *Apis mellifera, migration, colony development, honey production*

INTRODUCTION

Bee keeping is an old industry in the state of Jammu and Kashmir and counts back to 1470 A.D. The State of Jammu and Kashmir is one of the most important bee-keeping zones in India. It offers great potentialities of bee-keeping due to its rich bee flora found in abundance in different agro-climatic regions. Kashmir in particular is known fort its floral gaieties where numerous varieties of cultivated crops and wild plants bloom from early spring till late fall. This provides sufficient raw material (nectar and pollen) to the honey bees for the production of honey and wax for industrial purposes. But due to severe winter in Kashmir, most of the bee-keepers from different districts of Kashmir valley migrates their colonies to sub-tropical region of Jammu and other parts of northern India. The adoption of migratory bee-keeping by some bee-keepers from these districts of Kashmir valley during the winter season with *Apis mellifera* has been proved very successful and has greatly induced interest among the bee-keeping community to adopt this winter migration which has increased the scope of bee-keeping in the state of Jammu and Kashmir. Therefore, keeping in view the popularity of migratory bee-keeping among the bee-keeping community, the present study was conducted to analyse the effect of migration of honey bee colonies on honey production and colony development.

METHODOLOGY

The study was conducted to analyse the effect of migration of honey bee colonies on honey production and colony development. During winter season, 850 colonies of *Apis mellifera* were migrated from SKUAST-Kashmir, Shalimar to sub-tropical region of Jammu at different locations in Miran Sahib, Maralia and Purmandal during the year 2012-2013 and 2013-14 by the Research and Training Centre for Pollinators, Pollinizers and Pollination Management of SKUAST-K, Shalimar campus, Srinagar. Among 850 colonies, 650 colonies were migrated to Miran Sahib, Maralia and 200 colonies were migrated to Purmandal. These colonies were multiplied and the effect of migration on production of honey, bees wax and colony development was studied at the end of winter season. The bees availed of the brown sarson bloom (Toria) and *Brassica* bloom and later surplus honey was gathered from *Eucalyptus* spp. in February-March and from Sheesham. The honey was harvested at the place of migration and then shifted their colonies back to Kashmir valley.

RESULTS AND DISCUSSION

During the year 2012-2013 and 2013-14, 850 Colonies of *Apis mellifera* were migrated from SKUAST-Kashmir, Shalimar to sub-tropical region of Jammu at Miran Sahib, Maralia and Parmandal by the Research and Training Centre for Pollinators, Pollinizers and Pollination Management. The results revealed that an average of 16.50 kg honey/colony, 15.65 kg honey/colony and 15.45 kg honey/colony was harvested at the place of migration in Miran Sahib, Maralia and Parmandal, Jammu. The results also revealed that an average of 32.57 Kg, 31.97 kg and 33.75 kg of bee-wax from the colonies was harvested at the place of migration in Miran Sahib, Maralia and Parmandal, Jammu (Table 1).

850 colonies were transported and maintained at Miran Sahib, Maralia and Purmandal. From 850 mother colonies, the colonies number increased to 1350 in one migratory cycle. There was an average increase of 1.55 times. The total honey production from the sample lot

Table 1: Effect of migration of *Apis mellifera* colonies from Kashmir valley to Jammu on the honey production and colony development

Location	Number of colonies			Production (kg)		
	Initial	After winter season	Average increase in number/times	Honey		Wax
				Total	Average colony	
Meerian sahib	350	619	1.76	5775	16.50	32.57
Maralia	300	457	1.52	4695	15.65	31.97
Parmandal	200	274	1.37	3090	15.45	33.75
Total	**850**	**1350**	**1.55**	**13560**	**15.87**	**32.76**

Figures mentioned above represent amount of honey collected from Eucalyptus spp., Brown sarson (Toria) and Sheesham flow at the place of migration in Jammu.

of 850 colonies was 13,515 kg. The average honey production per colony was 15.87 kg/colony. The results revealed that 75 per cent bee-colonies produced 15-20 kg honey per colony and the remained 25 per cent produced more than 10 kg honey per colony. Besides an average of 32.76 kg of bee-wax was produced from the colonies placed at three different locations. The results further revealed that we harvested still low production of honey and attributed this low production of honey to *Varroa destructor* mite.

CONCLUSION

The results concluded that migration of *A. mellifera* from Kashmir valley to Jammu region proved successful and economically viable to the bee-keepers.

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Effect of mulching and sustainable irrigation practices on fruit cracking and quality of litchi (*Litchi chinensis* Sonn) cv. Dehradun

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ABSTRACT

The sustainable use of water in agriculture is the need of the hour. In this context, the management of irrigation in Litchi trees which need regular watering is very essential. Keeping in view the importance of water management in Litchi crop, an experiment has been conducted to assess the effect of mulching and irrigation intervals on fruit cracking and quality of litchi (Litchi chinensis Sonn.) cv. Dehradun. It was found that irrigation at 6 days intervals resulted in less fruit drop, maximum fruit yield and minimum peel weight. Black polythene and irrigation at 6 days intervals had a synergistic effect in reducing fruit drop and increasing fruit quality. Increase in cost of cultivation by black polythene mulch is compensated by reduced irrigation.
Keywords: *Litchi, mulching, irrigation*

INTRODUCTION

The litchi (*Litchi chinensis* Sonn.) is an important sub-tropical evergreen fruit tree belonging to the family Sapindaceae. India is the second largest producer of litchi in the world after china. In India litchi is growing under an area of 91 thousand hectares with a total production of 578 thousand metric tonnes (NHB 2016-17). It is grown in the states of Bihar, Tripura, West Bengal, Uttar Pradesh, Punjab and Haryana. In Jammu division, litchi is grown under an area of 930.51 hectares with a total production of 2264.40 metric tonnes (Anonymous, 2016).

Litchi flowers in March and the fruit matures during the month of June, a season characterized by high temperatures and relatively low rainfall. Thus, water deficit is a major limiting factor in litchi fruit production (Kour *et al*., 2017) Water management is an important aspect of litchi cultivation. Litchi requires optimum soil moisture for its optimum growth, development and fruit production. An average litchi plant requires 600-800 mm water but the water requirement may vary with plant age or size (Spohrer *et al*., 2006) as well as season (Menzel *et al*., 1986).

Mulching is a beneficial practice to obtain higher income from orchards (Prakash *et al.,* 2007) and results in higher yield. The practice of mulching in fruit trees imparts manifold beneficial effect, like stabilization of soil temperature, reduced water loss through evaporation, resulting more stored soil moisture (Shirgure *et al.,* 2003), maintenance of soil fertility, suppression of weed growth (Bhutani and Bhatia, 1994), improvement in growth and yield (Pande *et al*., 2005), reduces erosion by wind or water, checks surface run-off and suppress the weed growth.

Keeping in view the immense importance of water management for successful litchi cultivation, the present investigation was therefore, carried out to assess with the objective to study the "Effect of mulching and irrigation intervals on fruit cracking and quality of litchi (*Litchi chinensis* Sonn.) cv. Dehradun.

METHODOLOGY

The present investigation entitled "Effect of Mulching and irrigation intervals on fruit cracking and quality of litchi (*Litchi chinensis* Sonn.) cv. Dehradun was carried out in the year 2015, at the Research Farm, Division of Fruit Science, FoA Udheywalla, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu. Twenty year old plants of Litchi cultivar Dehradun were selected with different types of mulching materials *viz*., black polythene, paddy straw and controlled irrigations @ 200 liters/ tree at 3, 6, 9 intervals. Regulated irrigations were applied from the fruit set till harvesting. Mulching of plants and Irrigation was started in month of April. Number of fruits present on the randomly selected branches of the trees at the time of fruit drop were recorded and number of fruits retained on these branches till maturity/harvest were recorded. The data that recorded was expressed as per cent fruit drop. The crop load removed from the tree during harvesting season of 2014 was recorded as yield per tree and expressed in q/acre. Peel weight was obtained by subtracting the seed weight + pulp weight from the total fruit weight and was expressed in grams.

RESULTS AND DISCUSSION

Effect of mulching and irrigation practices

The least amount of fruit drop (67.57%) was observed in T_8 (Black Polythene + irrigation at 6 days interval) which was significantly lower than control (74.56%). Maximum fruit drop was recorded in T_9 (Black Polythene + irrigation at 9 days interval) i.e. 84.3

Table 1: Effect of mulching and sustainable irrigation practices

Treatments	Fruit drop (%)	Fruit yield (q/acre)	Peel weight(g)
T_1 (Irrigation at 3 days interval [control])	74.56	13.08	3.37
T_2 (Irrigation at 6 days interval)	75.99	12.72	3.45
T_3 (Irrigation at 9 days interval)	82.26	11.16	3.58
T_4 (Paddy Straw + irrigation at 3 days interval)	73.08	13.45	3.36
T_5 (Paddy Straw + irrigation at 6 days interval)	72.56	13.58	3.14
T_6 (Paddy Straw + irrigation at 9 days interval	77.23	12.41	3.67
T_7 (Black Polythene + irrigation at 3 days interval))	68.39	14.62	3.11
T_8 (Black Polythene + irrigation at 6 days interval)	67.57	14.83	3.02
T_9 (Black Polythene + irrigation at 9 days interval)	84.3	10.65	3.83
C.D at 5%	0.79	1.56	0.67

%. These results are in accordance with Batten *et al*. (1994) who reported that water deficits experienced by the unirrigated trees significantly reduced fruit drop in Litchi. This may have been due to suppression of vegetative growth due to reduced irrigation but fruit drop increased with increase in irrigation intervals to 9 and 12 days (78.49% and 77.65%) due to excessive water deficit (Table 1).

The maximum fruit yield (14.83 q/acre) was recorded in T_8 (Black polythene + irrigation at 6 days interval) followed by (14.62 q/acre) recorded under T_7 (Black polythene + irrigation at 3 days interval). The minimum yield (10.65 q/acre) was recorded in T_9 (Black polythene + irrigation at 9 days interval) which was significantly lower than control .The results are in conformity with Joshi *et al.* (2012) who reported higher yield under the mulch treatment, because of higher values of yield attributing characters, higher nutrient status and less fruit cracking.

The minimum peel weight (3.02 g) was recorded in T_8 (Black polythene + irrigation at 6 days interval) followed by (3.11 g) recorded under T_6 (Black polythene + irrigation at 3 days interval).The maximum peel weight (3.83g) was recorded in T_9 (Black polythene + irrigation at 9 days interval). Cracking occurs during the final stage of fruit growth when the aril develops and exerts pressure on the inactively growing pericarp. Thus, a balance between turgor pressure from the expanding aril and the mechanical structure and elasticity of skin is indispensable to prevent fruit cracking. Huang *et* al. (1999) showed that cracking coincided with thinning of the skin during aril expansion; however, the peak of cracking did not occur at harvest when the skin was thinnest. Resistant Huaizhi had an even thinner pericarp than Nuomici at the critical period when the fruit started to turn red (Wang 1998). It was hypothesized that a balance between turgor pressure, structure and elasticity of skin could prevent fruit cracking in litchi and that fruit cracking occurs only when aril produces more turgor pressure against the skin or reduces the structure and elasticity of the skin (Li *et al*., 2014).

CONCLUSION

It can be concluded that mulching with black polythene enhances the productivity and fruit quality in litchi in terms of reducing fruit drop. Thus resulting into the minimum fruit drop, maximum yield and minimum peel weight of fruit. In case of irrigation intervals, irrigation at 6 days intervals resulted in less fruit drop, maximum fruit yield and minimum peel weight. Black polythene and irrigation at 6 days intervals had a synergistic effect in reducing fruit drop and increasing fruit quality. Increase in cost of cultivation by black polythene mulch is compensated by reduced irrigation. Thus by applying black polythene mulch quality litchi fruits can be obtained with less irrigation. These results will help in sustainable use of water in litchi cultivation. Drought or deficit irrigation promotes fruit cracking in litchi while high water supply was also reported to play an equally contributing role. Light but frequent irrigation that maintain a congenial microclimate within and around the plant has been found to minimize this problem.

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Effect of PBR's and nutrient applications on nutrient status and fruit cracking of Eureka lemon

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ABSTRACT

The studies were conducted to evaluate the impact of different foliar application of PBR's and nutrient on leaf/ fruit nutrient status and fruit cracking of Eureka lemon with the objectives to find out the effect of foliar application of PBR's and nutrients on fruit cracking and nutrient status of Lemon cv. Eureka. It was found that application of 10% Potassium Sulphate was found superior in improving the leaf and fruit nutrient status while reducing the fruit cracking and among the growth regulators 40ppm NAA recorded least fruit cracking incidence in Eureka lemon.

Keyword: *Nutrient application, fruit cracking, Eureka lemon*

INTRODUCTION

Citrus is an important genus of the family Rutaceae, which occupies unique position among popular fruit crops and extensively grown in tropical and sub-tropical regions. Among the acidic citrus fruits, lemon is a leading premier citrus and is quite popularly grown in the northern plains of India. Lemon has potential to bear in many flushes making it long duration crop having round the year availability of the fruits and longer shelf life. Lemon juice is widely used in the preparation of soft drinks and possesses special dietic values associated with its high vitamin C content. On the other hand, lemon is confronted with a very serious problem of fruit cracking. Garcia-Luis *et al.* (2001) studied the response of application of growth regulators to fruit cracking and found them relevant to splitting as this application markedly affected the rind structure, affecting both cell size and the thickness of the flavedo. Hoffmann (2007) explained citrus fruit splitting as one of the most exasperating problems experienced by the citrus fruit growers. Deficiencies of calcium, boron and potassium in plant have been reported to cause nutritional imbalance leading to fruit cracking. Foliar feeding of PBR's and nutrients is a new and innovative approach to check fruit the fruit cracking. Proper spraying schedule of PBR's and nutrients before fruit splitting helps to control cracking and enhance the nutrient status of the plant. The application of the synthetic auxins results in thin and/or smooth rinds, leading to an increase in thickness and rind coarseness which has subsequently been shown to reduce fruit splitting. Potassium is involved in numerous biochemical and physiological processes which are vital to plant growth, yield, quality and stress. Adequate potassium nutrition has also been associated with increased yields, fruit size, increased soluble solids, ascorbic acid concentrations, improved fruit color, increased shelf life and shipping quality of many horticultural crops (Lester *et al*., 2007; Kanai *et al.,* 2007). Therefore the studies were carried out to evaluate the impact of different foliar application of PBR's and nutrient on leaf/fruit nutrient status and fruit cracking of Eureka lemon with the objectives to find out the effect of foliar application of PBR's and nutrients on fruit cracking and nutrient status of Lemon cv. Eureka.

MATERIALS AND METHODS

The studies were carried out at Rainfed Research Sub Station for Subtropical Fruit Crops, Raya, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu during 2014-2015. The experiment was laid out during the month of May in randomized block design with thirteen treatments replicated thrice consisting of foliar sprays of 6.0% Potassium Sulphate, 8.0% Potassium Sulphate, 10% Potassium Sulphate, 0.5% Calcium Chloride, 0.75% Calcium Chloride, 1% Calcium Chloride, 20ppm 2,4-D, 30ppm 2,4-D, 40 ppm 2,4-D, 20ppm Naphthalene Acetic Acid, 30ppm Naphthalene Acetic Acid, 40ppm Naphthalene Acetic Acid and control (10ppm Gibberellic Acid). Gibberellic Acid was used as control because it is the recommended practice for managing fruit cracking. All the trees were maintained under uniform cultural schedule before and during the course of investigation. Two sprays of nutrients and growth regulators were given in the month of May at an interval of 20 days. First spray was given on 9th May and second on 29th May on 7-8 year old Eureka lemon trees. Required quantities of chemicals NAA, 2,4-D and GA_3 were weighed and dissolved in 10ml of 95% methyl alcohol whereas Calcium Chloride was directly dissolved in distilled water. All the solutions were diluted to a required volume and entire tree was sprayed thoroughly. Leaf nutrient status was analyzed by taking thirty fully expanded leaves collected from each treatment from different directions of plant. Washing, cleaning, drying, grinding and storing of samples were

carried out as per the method outlined by Chapman (1964). One gram of leaf sample was taken for digestion in a diacid (HNO_3 and $HClO_4$ in ratio of 9:4) for Potassium and Ca Calcium estimation. Potassium status of leaf was estimated in the digested sample by flame photometer and calcium in leaves was estimated in the digested sample by EDTA methods as described by (Piper 1966). Potassium and Calcium status of fruit was estimated by digesting 10 grams of fresh lemon pulp as described by (Piper 1966). The incidence of fruit cracking was calculated on the basis of total number of fruits initially present on the tree and expressed as percent.

RESULTS AND DISCUSSION

It was evident from the data presented in Table 1 that all the treatment of PBR's and nutrients improve nutrient status and reduces the fruit cracking of Eureka lemon. The maximum Potassium content in leaf (1.68%) and fruit (0.78%) was recorded under treatment T_3 (10% Potassium Sulphate) and highest Calcium content in leaf (2.03%) and fruit (1.18%) was recorded with foliar spray of 1.0% calcium chloride which was significantly higher as compared to rest of the treatments. Similarly, Ahmed *et al.* (2014) reported that calcium chloride at 2% alone or in combination with other nutrients increase the calcium contents in leaves of pomegranate. Grzegorz *et al*. (2015) also observed that calcium spraying prove effective way to deliver calcium to the plants, as it increases its content in both the leaves and the fruits of sweet cherry. Reduction in the level of calcium was observed under Potassium Sulphate treatments, while calcium chloride spray increased the calcium content in the peel.

The maximum percent fruit cracking (36.21%) was recorded under application of 20ppm 2,4-D and the minimum fruit cracking was recorded with 40ppm NAA. The treatment involving spray of 40ppm NAA proved to be most effective for minimizing the fruit cracking in lemon, where it was recorded to be 13.06% which is followed by fruit cracking percentage under 30ppm NAA, 10ppm GA_3 and 10% K_2So_4 treatments. Therefore the PBR's and nutrient sprays significantly reduced the fruit cracking. Amiri *et al.* (2012) reported that sprays of synthetic auxins decreases fruit splitting and increases rind thickness. Similar results have been reported by Sandhu and Bal (2013) in lemon cv. Baramasi that NAA substantially reduced the cracking losses by 94.5% and resulted in impressive improvement on fruit quality. Application of auxins causes enlargement of cells by increasing the elasticity or permeability of cell wall (Cline and Trought, 2007). Thus, peripheral tissues of fruit would keep pace in growth with that of cortex resulting in the control of fruit cracking, since one of the reasons for cracking of fruits is thought to be the differential growth rates of the peripheral and cortex tissues. Among the nutrient applications, minimum fruit cracking was observed in treatment involving 10% Potassium Sulphate. Low level of potassium is also been found to be responsible for splitting of Washington Navel orange (Rahman *et al.,* 2012). Morgan *et al.* (2005) reported that imbalances in potassium can contribute to thin or weak rind and can therefore, indirectly increase the likelihood of splitting. The results are in close conformity with the findings of Sandhu and Bal (2013) who reported that Potassium Sulphate reduces the fruit cracking in lemon. Reduction in fruit cracking with the spray of Calcium Chloride application may be due to strengthening of rind. Results from the present investigation also revealed that the control treatment i.e. 10 ppm GA_3 (University recommendation) also effective in minimizing fruit cracking in lemon cv. Eureka. Moreover, growth regulators play a significant role in peel resistance and plasticity that determine intensity of cracking.

Table 1: Effect of PBR's and nutrient applications on nutrient status and fruit cracking of Eureka lemon.

Treatments	Potassium content (%)		Calcium content (%)		Fruit cracking (%)
	Leaf	Fruit	Leaf	Fruit	
6% K_2SO_4	0.73	1.64	1.63	1.05	26.05
8% K_2SO_4	0.75	1.66	1.60	1.06	21.99
10% K_2SO_4	0.78	1.68	1.58	1.08	17.96
0.5% $CaCl_2$	0.69	1.50	1.91	1.14	30.11
0.75% $CaCl_2$	0.69	1.51	1.99	1.15	28.08
1.0% $CaCl_2$	0.70	1.54	2.03	1.18	24.02
20 ppm 2,4-D	0.62	1.49	1.50	1.04	36.21
30ppm 2,4-D	0.63	1.50	1.52	1.06	34.17
40 ppm 2,4-D	0.65	1.51	1.53	1.07	32.15
20 ppm NAA	0.70	1.55	1.55	1.09	19.98
30 ppm NAA	0.71	1.62	1.64	1.11	14.10
40 ppm NAA	0.72	1.67	1.70	1.06	13.06
10 ppm GA_3 (Control)	0.71	1.63	1.62	1.05	15.93
$CD_{0.05}$	0.05	0.12	0.05	0.03	2.00

CONCLUSION

It was concluded from the present study that application of 10% Potassium Sulphate was found superior in improving the leaf and fruit nutrient status while reducing the fruit cracking and among the growth regulators 40 ppm NAA recorded least fruit cracking incidence in Eureka lemon.

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Effectiveness of Kissanvani Programme of AIR Kathua in transfer of agricultural technologies

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ABSTRACT

Communication channels play pivotal role in disseminating information. But when the bulk of population is illiterate and inaccessible to modern means of communication, the challenge is all the more difficult. In this situation mass media like radio can play a significant role in disseminating information. Radio is a very popular and powerful communication medium and has proved very effective in helping to disseminate agricultural information. One of the special features of All India Radio is its 'farm and home units', which are engaged in disseminating scientific information about farming to needy people living mostly in poorly accessible villages. There are number of sources of agricultural information which a farmer can use. In order to find out how the farmers rate radio broadcast in respect of the credibility of the information as compared to other sources. The present study was conducted in Kathua district of J&K state. The total sample consisted of 120 respondents form ten villages of two blocks. Data were collected with the help of structured interview schedule. Over whelming majority (85.9 %) reported that the programme Kissan Vani was very useful. Majority of respondents (57.6 %) were perceived to be in medium effectiveness of Kissan Vaniprogramme in transfer of agricultural technology. Majority (77.5 %, 74.1 % and 65.0%) of the respondents suggested that the Technical terms/scientific words should be simplified in to Dogri language, Interview with the progressive farmers and organization of Kissan Goshti in case of modes of presentation respectively. A very high majority (72.3%) of the respondents suggested that there should be a Broadcast of live programme with Successful entrepreneur where as 65.6 per cent suggested that there should be an increase in the duration of the programme, 65.0 per cent are in favour of discussion of farmers with KVK Scientists followed by 62.5 per cent which are in favour of use of local language respectively.

Keywords: *Effectiveness, broadcast, agriculture, technology*

INTRODUCTION

India is the second largest producer of agricultural products and it also has second largest arable land. India occupies top global position in the production of milk and pulses and the second position in the production of rice, wheat, cereal grains, sugarcane, fruits and vegetables, tea, egg and culture fishery. The agriculture sector is the backbone of Indian economy. The success of agricultural development programmes in developing countries largely depends on the nature and extent of use of mass media in mobilization of people for development. The planners in developing countries realize that the development of agriculture could be hastened with the effective use of mass media. Radio is considered as an effective tool to disseminate agricultural information among the farmers and it is the most powerful mass media for broadcasting Information quickly. It is a powerful communication medium, particularly in India where, in the absence of regular and stable electric supply in rural areas. People have to depend on radio to meet their needs of information. Radio can reach large audience at the same time. In terms of cost, it is an extremely economical medium as compared to other extension media and methods involving individual and group contacts. Radio is considered as a credible source of information and is taken as authentic, trustworthy and prestigious medium of communication. Credibility refers to the trustworthiness of information perceived by farmers as important and gave weight age in adoption of information. This influenced the adoption of agricultural technology as farmers think them as praiseworthy. A credible source of information stimulates farmers to adopt the recommended package which is suitable to local farm condition. One of the special features of All India Radio is its 'farm and home units', which are engaged in disseminating scientific information about farming to needy people living mostly in poorly accessible villages. There are number of sources of agricultural information which a farmer can use. In order to find out how the farmers rate radio broadcast in respect of the effectiveness of KissanVani programme as compared to other sources. The Kissan Vani programme aired from AIR, Kathua has been taken to investigate the effectiveness of the programme.

All India Radio (AIR) as a public service broadcaster has been catering the communication needs of diverse sections of Indian society ever since its inception. The responsibility has always full of challenges with regard to playing a purposeful role of promoting desirable changes in the society on the one hand and maintaining its relevance in a dynamic society

on the threshold of taking a quantum leap forward on the other. During this course, All India Radio has undergone tremendous changes in programming and its reach across the length and breadth of the country.

The contribution of All India Radio in the area of farm extension has been notable. It has relentlessly innovated and evolved through time in its search for new and appropriate formats as well as suitable communication contents for meeting the objective. In the several characters evolved across the diverse mosaic of India that transcended time and became forceful proponents of new ideas and practices in a rapidly changing society. The gainful impact of All India Radio has been perceptible and eminently recognized by people and development agencies functioning in different areas of activity.

One of the important objectives of radio is to provide essential knowledge and information to stimulate grater agriculture production. The fast changing agricultural technology demands for more information to be transmitted to our increasing volume of clientele. Agricultural information is disseminated to the farmers through Kissan Vani programme aired from all India Radio Kathua on 102.2 Frequency modulation everyday from 6:15 pm to 7:00 pm.

The value of the programme can only judged through audience perception and response. Perception is the immediate apprehension of an object or all the sense organs by way of sensation. Perception is influenced by environment in which communication takes place. It is not intrinsic quality or attribute of an object, individual or message. It was therefore, felt necessary to study the effectiveness of KissanVani programme in transfer of technology to determine the effectiveness of programme in transfer of technology and to determine the preferences of radio listeners about different aspects of Kissan Vani programme and strategies for making the programme effective.

METHODOLOGY

The study was conducted in Kathua district of Jammu & Kashmir.120 respondents were selected form ten villages of two blocks. After selection of villages, a village wise list of Kissan Vani programme listeners was prepared and from each village ten listeners were selected by using simple random sampling method. Thus the total sample for the study was 120 respondents .The data were collected through a well structured and pre-tested interview schedule.

RESULTS AND DISCUSSION

Detail of AIR Programmes

The detail of programmes and schedule of All India Radio Kathua has been presented in Table 1. The timings and schedule possess an important plac in aspect of transmission of agricultural programmes. The area covered by the AIR is also wide which includes Kathua district in full, parts of Udhampur district. The programmes of the station are listening by the audience clearly up to Pathankot, Batala area of Punjab, parts of Himachal Pradesh and also across the border.

Perceived effectiveness of KissanVaniProgramme in transfer of agricultural technology

The higher percentage (61.7 %) of the respondents are listening Kissan Vani programme irregularly while 23.3 percent listening regularly while only 15.0 percent listen occasionally. As observed majority i.e. 58.9 percent respondents listen Kissan Vani Programme with full attention, while 28.3 percent with partial attention and only 15.8 percent with little attention. In case of audio quality of the programme majority (60.9 %)of the respondents rated the audio quality of the programme was average followed by good (31.6) and poor (7.5 %). The majority (69.2 %) of the respondents felt that messages given in the programme were 'timely' (Table 2). A very vast majority (81.7 %) of the respondents perceived that the messages were 'relevant'. Regarding

Table 1: Details about All India Radio Kathua

Name of The Station	AIR, Kathua
Date of Commissioning	29th April,1990
Date of First Broadcasting	24th April,1991
Date of start of KissanVaniProgramme	April, 1996
Frequency of Transmission	102.2 MHz
Timings of KissanVaniProgramme	18:16- 17:00 Hours
Transmission timings & Duration	Ist 6:00-10:00 Hours weekdays (up to 10:15 hrs on Sunday) Duration-4 Hours and 4 Hours 15 minutesIInd 12:00-17:00 Hours Duration-5 HrsIIIrd 18:00-23:00 Hours Duration-5 Hrs
Programme Origination (per day in Hours)	Ist Transmission-3 HrsIInd Transmission-55 minutesIIIrd Transmission- 2 Hrs 30 minutes
Language in which programmes are broadcast	Dogri and Hindi
Composition of Originated programmes	Music and Spoken words
Population covered	10.0 Lacs
Area covered	Kathua district in full, parts of Udhampur district (programmes of the station are listen clearly up to Pathankot, Batala area of Punjab, parts of Himachal Pradesh and also across the border)

adequacy of information, 55.8 percent of the listeners opined that information was adequate in the broadcast of the Kissan Vani programme. It is apparent that majority (57.5%) of the respondents perceived the message as 'clear' followed by very clear (30.0 %) and confusing (12.5 %). With respect to practicability of messages, it could be observed that more than half (65 %) of the listener spelt out 'practicable' followed by somewhat practicable and only 10.9 percent listener were in the category of 'not practicable'. It is further clear that over whelming majority (85.9 %) reported that the programme Kissan Vani was very useful followed by only 14.1 in useful category.

Table 2: Perceived effectiveness of KissanVani Programme

Factors	Categories	Number	Percentage
Frequency of Listening	Regularly	28	23.3
	Irregularly	74	61.7
	Occasionally	18	15.0
Attention Paid	Full attention	67	58.9
	Partial attention	34	28.3
	Little attention	19	15.8
Audio quality	Good	38	31.6
	Average	73	60.9
	Poor	09	7.5
Timeliness of messages	Timely	83	69.2
	Untimely	37	30.8
Relevancy of messages	Relevant	98	81.7
	Not relevant	22	18.3
Adequacy of information	Very good	45	37.5
	Adequate	67	55.8
	Inadequate	08	6.7
Clarity of messages	Very clear	36	30.0
	Clear	69	57.5
	Confusing	15	12.5
Practicability of messages	Practicable	78	65.0
	Somewhat Practicable	29	24.1
	Not Practicable	13	10.9
Utility of information	Very Useful	17	14.1
	Useful	103	85.9

The majority of respondents (57.6%) were perceived medium effectiveness of farm broadcast category in transfer of agricultural technology, followed by 26.6 percent of respondents who perceived high effectiveness of farm broadcast category and 15.8 percent respondents who perceived low effectiveness of Kissan Vani programme in transfer of agricultural technology (Table 3).

The majority (77.5 %, 74.1% and 65.0%) of the respondents suggested that the Technical terms/scientific words should be simplified in to Dogri language, Interview with the progressive farmers and organization of KissanGoshti in case of modes of presentation

Table 3: Distribution of respondents according to perceived effectiveness of Kissan Vani Programme in transfer of agricultural technology

Categories	Number	Percentage (%)
Low (<10.00)	19	15.8
Medium (10.00-17.00)	69	57.6
High (>17.00)	32	26.6
Total	120	100.00
Mean	14.13	
SD	3.90	

respectively. More than half (59.1% & 55.8%) of the respondents suggested that the Programme should be broadcast 6.30 pm onwards and the duration of the programme should be increased up to one hour (Table 4).

Table 4: Distribution of the respondent according to their preferences about different aspects of KissanVani programme

Preferences	Number	Percentage (%)
Time of broadcast		
Programme should be broadcast 6.30 pm onwards	71	59.1
Duration of programme		
Duration of the programme should be increased up to one hour	67	55.8
Modes of presentation		
Discussion	46	38.3
Dramatized	48	40.0
Question answer	53	44.1
Kissan Goshti	78	65.0
Krishi Sammelan	61	50.8
Interview with progressive farmers	89	74.1
Language of broadcast		
Technical terms/scientific words should be simplified in to Dogri language	93	77.5

A very high majority (72.3%) of the respondents suggested that there should be a Broadcast of live programme with Successful entrepreneur whereas 65.6 per cent there should be an increase in the duration of the programme, 65.0 per cent are in favour ofdiscussion of farmers with KVK Scientists followed by 62.5 per cent which are in favour of use of local language respectively (Table 5). The table reveals that 50.4 percent of respondents were in favour of provide timely information about plant protection measures, 49.0 percent respondents were in favour of intimate theinformation about the programme in advancewhereas 48.8 per cent in favour of increase in coverage area followed by 47.3 per cent respondents were in favour of start in favour of Phone-in programme based on practical field problems.

Table 5: Strategies for making the KissanVaniprogramme more effective.

Suggestions	Percentage (%)	Rank
Increase the duration of the programme	65.6	II
Broadcast of live programme with Successful entrepreneur	72.3	I
Discussion of farmers with KVK Scientists	65.0	III
Start of Phone-in programme based on practical field problems	47.3	VIII
Provide timely information about plant protection measures	50.4	V
Use of local language	62.5	IV
Commercial breaks can be reduced	34.0	IX
Coverage should be increased	48.8	VII
Information about the programme in advance	49.0	VI

CONCLUSION

The majorityof the respondents listen Kissan Vani Programme with full attention and reported that the programme Kissan Vaniwas very useful majority of respondents (57.6%) were perceived medium effectiveness of farm broadcast category in transfer of agricultural technology.majority (77.5 %, 74.1 % and 65.0%) of the respondents suggested that the Technical terms/scientific words should be simplified in to Dogri language, Interview with the progressive farmers and organization of Kissan Goshti in case of modes of presentation respectively.revealed that a very high majority (72.3%) of the respondents suggested that there should be a Broadcast of live programme with Successful entrepreneur where as 65.6 per cent there should be an increase in the duration of the programme, 65.0 per cent are in favour ofdiscussion of farmers with KVK Scientists followed by 62.5 per cent which are in favour of use of local language respectively.

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Efficiency of ginger marketing in Amravati division

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ABSTRACT

The present study of economics of marketing of Ginger in Amravati division was carried out during the year 2013-2014. The study was based on primary data. The primary data of 90 farmers were collected from tehsils of Amravati division and functionaries involved in Ginger procurement producer, wholesalers, and retailer were selected for collecting information. In case of Ginger, Producers share in consumer's rupees was highest in Channel I (Producer-Village trader-Consumer) i.e. 95.31 per cent followed by channel II (Producer-Village trader- wholesaler-Consumer) i.e. 88.84 per cent and in channel III (Producer-wholesaler-Retailer-Consumer) 87.84 per cent. From this, it was concluded that channel-I was most profitable than channel lI and III.
Keywords: *Ginger, marketing channel, producer share*.

INTRODUCTION

India is popularly known as the "Spice Bowl of the World" as a wide variety of spices with premium quality is grown in the country since ancient times. Ginger is a very important spice in India. Its botanical name is *Zingiberofficinale*. and belongs to family of the Zingiberaceae. It isalsoknown as 'Indian Saffron' which is originated from South-east Asia. Its active ingredient is zingiferine. Ginger requires a warm and humid climate. It thrives best on deep, well drained, loamy or alluvial, loose, friable and fertile soils. Ginger is propagated through rhizomes.

In the world scenario, the major ginger producing countries are India, China, Nigeria, Indonesia, Bangladesh, Thailand, Philippines and Jamaica etc. It is also grown in Australia, Fiji, Brazil, Sierra Leone and Japan. United Kingdom, United States, Japan and Saudi Arabia import large quantities of ginger. Nigeria ranks first with respect to area under ginger covering about 56.23% of the total global area followed by India (23.6%). Asian countries lead in the supply of ginger in the world market. Japan and USA are the major importers. China has the major export share. India exports mainly in the form of whole and dry ginger. Production is efficient not only on the basis of how best one produces but also on the basis of how well one markets the resultant products. Therefore, marketing forms an integral part of successful production process. The importance of research studies on agricultural marketing, particularly in the context of developing countries like India, therefore, needs to be highly emphasized. The quantity of ginger available for consumption and the price paid by consumer depends on how efficient the marketing system for ginger functions. Marketing of ginger is the main source the product can get to the reach of consumers in the study area. This study therefore becomes relevant and timely. However, no systematic efforts have been made so far to study the marketing of ginger in Amravati division. Therefore, an attempt is made to study economics of marketing of ginger in Amravati division.

METHODOLOGY

Sampling procedure

The multistage sampling technique (*i.e.*four stage random sampling technique)was used in this study for the selection of ginger cultivators. District as a primary unit, Tahsil as a secondary unit, village as a tertiary unit and ginger cultivator as a final unit were taken for the study.

Selection of districts

There are five districts in Amravati division out of which four districts *viz.,*Amravati, Akola, Washim, Yavatmal were randomly selected for present study.

Selection of tahsils

There are 43 tahsils in selected districts out of which ten tahsils namelyAchalpur, Anjangoan Surji, Tiosa, Warud and Morshifrom Amravati district, Telhara and Barshitakali from Akola district, Karanja from Washim district and lastly Pusad and Darwha from Yavatmal district were randomly selected for present study. Soil and agro climatic conditions prevailing in these tahsils are favourable for growing ginger.

Selection of villages

For the selection of villages, the list of all villages growing ginger crop from Achalpur, Haram, Rajna, Anjangaon, Deogaon, Chincholi, Warud, Jarud, Benoda, Morshi, Asona, Rajurwadi, Tiosa, Shivangaon, Bharwadi, Telhara, Dahigaon, Belkhed, Barshitakali, Hatola, Nimbhora, Karanja, Waghola, Alalpur, Darwha, Chopadi, Taroda, Pusad, Bori, Sheluwere obtained from the Taluka agricultural officers. From each Tahsil villages were selected randomly.

Selection of ginger cultivators

For the selection of ginger cultivators, a list of ginger cultivators was obtained for each village from the office of Taluka agriculture officer. The technique

of simple random sampling was applied for selecting the ginger cultivators, and from that tenginger cultivators were selected randomly from each village. Thus, the final sample consisted of 10 villages and 90 ginger cultivators.

Collection of data

The data were collected by survey method with the help of specially designed pretested schedule for the ginger cultivators. The data pertained to the agricultural year 2013-2014 were collected by personal interviews with the ginger cultivators and the required information from the farmers were obtained.

Analysis of data

To study the effect of farm size on productivity and profitability of ginger, the selected sample cultivators were classified according to their size of plot under ginger. The stratification was carried out with the help of mean and standard deviation as follows *i.e.,* Arithmetic mean (A.M.) minus one-fourth standard deviation (S.D.) for I category, A.M plus one-fourth S.D. for II category and A.M. and above for III category. The cultivators were classified into three categories *viz.,* i) Small farmer upto 2.00 ha. ii) Medium farmer from 2.01ha. to 4.00 ha. and iii) Large farmer 4.01ha. and above.

RESULTS AND DISCUSSION

Marketing channel and price spread for Ginger

Process of production is not completed till the product reaches into the hands of final consumer. However, various aspects pertaining to marketing of Ginger viz., channels of distribution, price spread, producer's share in consumer's rupee, etc. have been studied and discussed. Cost of marketing of Ginger includes marketing cost incurred by producer, wholesaler and retailer and includes various charges as loading, transportation, grading, commission, miscellaneous expenditure, market cess etc.

Channels of Distribution

Following are the channels of distribution have been observed while marketing of Ginger.

Channel I: Producer→Village Trader→Consumer.

Channel-II:Producer→Village trader→Whoesaler→ Consumer

Channel III: Producer→Village trader→Whoesaler →Retailer→consumer

Channel I indicates that farmer sold his produce in local market or in village. Channel II and Channel III indicate that farmers sold their produce in Agriculture produce market committee. It is observed that largest quantity of Ginger was sold through wholesaler as first sale point. The proportion of quantity sold through wholesaler i.e. channel I to total quantitysold workout to 47.78 per cent followed by Channel II and channel III is 28.89 per cent and 23.33 per cent respectively (Table 1).

Table 1: Distribution of farmer according to channels

Channels	No. of Ginger grower
Channel I (sale through village trader)	43(47.78)
Channel II (sale through wholesaler)	26(28.89)
Channel III (sale through retailer)	21(23.33)
Total	**90(100)**

Figures in parenthesis indicate the percentage to total

During the course of investigation it was observed that channel I i.e. Produce→Village Trader→Consumer, is the major channel of distribution and overall 43 (47.78 per cent) farmers sold their produce by this channel, Followed by channel II and channel III28.89 per cent and 23.33 per cent farmers respectively.

Marketing cost and market margin of Ginger

In marketing channel I, the marketing cost incurred by producer was Rs. 27.84. Among the different items of expenditure the highest charges was paid for cost of gunny bags i.e. Rs. 18.92. The village trader incurred marketing cost of Rs. 81.32 while, the margin of village trade was Rs. 79.18 (Table 2).

Table 2: Marketing cost and market margin of Ginger (Rs./ q)

Particulars	Channel I	Channel II	Channel III
Marketing cost incurred by Producer			
Cost of Gunny Bags	18.9	19.47	20.05
Cost of packing	3.42	3.52	3.69
Cost of loading	0.00	0.00	0.00
Transportation	0.00	0.00	0.00
Weighing Charges	2.41	2.64	3.26
Hamali	3.11	2.91	3.84
Commission	0.00	0.00	0.00
Marketing cost	27.84	28.54	30.84
Selling price of producer	3855.48	3770.82	3796.65
Net price received by producer	3827.64	3742.28	3765.81
Marketing cost incurred by Village Trader			
Storage	8.45	7.65	7.65
Transportation	54.59	56.89	57.32
Labour charges	5.21	5.57	5.35
Cost of Gunny Bags	6.37	5.57	3.75
Weighing Charges	2.85	2.75	0.98
Hamali	3.85	2.76	2.80
Marketing cost	81.32	81.19	77.85
Selling price of Village Trader	4015.98	4020.12	4030.76
Margin of Village Trader	79.18	168.11	156.26
Marketing cost incurred by Wholesaler			
Storage	0.00	6.25	7.83
Transportation	0.00	75.96	82.56

Labour charges	0.00	4.36	3.98
Gunny bags	0.00	11.65	19.05
Weighing Charges	0.00	2.8	2.98
Hamali	0.00	3.75	3.95
Market cess fund	0.00	8.86	9.12
Marketing cost	0.00	113.63	129.47
Selling price of Wholesaler	0.00	4212.53	4255.69
Margin of Wholesaler	0.00	78.78	95.46
Marketing cost incurred by Retailer			
Transportation	0.00	0.00	18.89
Labour charges	0.00	0.00	3.91
Shop rent	0.00	0.00	3.82
Hamali	0.00	0.00	3.11
Weighing Charges	0.00	0.00	3.68
Marketing cost	0.00	0.00	33.41
Selling price of Retailer/Purchase price of consumer	4036.68	4212.53	4315.26
Margin of Retailer	0.00	0.00	26.16
Total Marketing cost	109.16	223.36	271.57
Total Margin	**79.18**	**246.89**	**277.88**

In channel II the marketing cost incurred by producer was Rs 28.54, and village traders was Rs. 81.19.The margin of village traders was Rs 168.11. Wholesaler incurred marketing cost Rs. 113.63 and received the margin of Rs. 78.78(Table.2).In channel III, the marketing cost incurred by producer was Rs. 30.84. The village trader incurred marketing cost of Rs. 77.85and received the margin of Rs. 156.26. The wholesaler incurred marketing cost Rs. 129.47and received the margin of Rs, 95.46 and incurred retailer incurred marketing cost Rs. 33.41and received the margin of Rs. 26.16.From above discussion it is concluded that, highest marketing cost was observed in channel III i.e. Rs. 271.57and highest total margin was observed in channel III Rs. 277.88.

Producer share in consumer's rupee

The net price received by producer in channel-I, channel-II and channel-III were Rs. 3827.64, Rs. 3742.28 and Rs. 3765.81 per qt respectively. The producer's share in consumer's rupee was highest in channel-I i.e. Rs. 95.31 followed by channel-II and channel-IIIbecause in channel III there are large number of intermediaries (Table3).

The total market cost was highest in channel-III as compared to other channels. The total market margin was higher in channel-III. Though the producer's share in consumer's rupee was highest in channel-I as compared to other channels i.e. Rs. 3827.61 Rs/qt hence selling of Ginger through channel-I by Ginger grower was found more remunerative than other channels in study area.

CONCLUSION

Channel I was most profitable than channel II and III. Ginger Producers share in consumer's rupees was highest in Channel I (Producer - Village trader - Consumer) i.e. 95.31 percent followed by channel II (Producer - Village trader - wholesaler - Consumer) i.e. 88.84 percent and in channel III (Producer - wholesaler - Retailer - Consumer) 87.84 percent.

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Table 3: Price spread in marketing of Ginger through various channels

Particulars	**Total price**		
	Channel I	**Channel II**	**Channel III**
Net Price received byProducer(Rs/qtl)	3827.64(95.31)	3742.28(88.84)	3765.81(87.27)
Total Marketing costincurred by producer,village trader, wholesalerand retailer	109.16(2.72)	223.36(5.30)	271.57(6.29)
Total market margin ofwholesaler and retailer	79.18(1.97)	246.89(5.86)	277.88(6.44)
Selling price of retailer/Purchase price of consumer	4015.98(100.00)	4212.53(100.00)	4315.26(100.00)

Figures in parenthesis indicate the percentage to Purchase price of consumer

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Gaps in adoption of production technologies in gobhi sarson (*Brassica napus l.*)

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ABSTRACT

Oilseed crops have been the backbone of agricultural economy of India from time immemorial. Oilseeds are the main source of raw materials for vegetable oils. They are essential components of human diet and are rich source of energy and earners of fat soluble vitamins A, D, E and K. The productivity of oilseed crop in the district is low (8 quintals/ha) as farmers are growing these crops in marginal area and due to non-adoption of improved package of practices, therefore efforts have been made through FLDs to introduce new high yielding varieties of these crops to demonstrate improved production technologies to increase productivity of oilseed crops in the district. The present study was undertaken in Kathua District of Jammu & Kashmir to analyze the status of Gobhi Sarson production technology, constraints in its cultivation and the possibilities to increase production. A fundamental problem to overcome insignificantly increasing oilseed production is to change the prevailing perceptions of their status as a subsistence crop and to consider as a commercial crop. This will require aggressive on-farm demonstrations of the viable technical options to alleviate the gaps in technology of production of oilseed crops.It emphasizes dissemination of improved varieties and low cost, environmental friendly crop husbandry techniques. Keeping this in view front line demonstrations (FLDs) on Gobhi Sarson were conducted during rabi 2013-14 and 2014-15 and proved immensely useful in increasing the production and productivity of oilseed crops in the district along with evaluation of adoption gaps. The improved practice produced 49.7 and 51.8 per cent more seed yield and 61.5 and 71.3 per cent higher returns of Gobhi Sarson than the crop raised by the farmers themselves in 2013-14 and 2014-15 respectively.

Keywords: *Front line demonstration, Gobhi Sarson, Production technology, seed yield*

INTRODUCTION

Agriculture sector plays an important role in India's social security and overall economic welfare. Oilseeds crops are the second most important determinant of agricultural economy, next only to cereals. Today, the demand for vegetable oils is out pacing the supply with more than half of its annual requirements being met mainly through imports. India has the 5th largest vegetable oil economy in the world next to USA, China, Brazil and Argentina accounting for 7.4% world oilseed output; 6.1% of oil meal production; 3.9% world oil meal export; 5.8% vegetable oil production; 11.2% of world oil import and 9.3% of the world edible oil consumption. In India, oilseeds contribute 3% and 10% to gross national products and value of all agricultural products, respectively, with 14 and 1 million people involved in oilseed cultivation and processing, respectively. India is one of the biggest importers of vegetable oils. There is a spurt in the vegetable oil consumption in recent years, both for edible purposes as well as for industrial uses. This is further likely to go up in coming years with the change in consumption patterns as well as in rising living standards.

Rice-Wheat is the most important cropping system of the Kathua district. The issue of crop diversification is, now a day's getting very popular as the adverse impacts of Rice-wheat system are being realized not only by the scientists but also by the farmers. Gobhi Sarson is well adapted to our agro-ecological conditions and its cultivation can play a crucial role in crop diversification. In addition Gobhi Sarson helps to control *phalaris minior* due to its early sowing.

In the J&K state, the area, production and productivity of oilseed crops is 59199 ha, 40.4 million tonnes and 846 kg/ha respectively (Directorate of Economics and Statistics, 2014-15). These crops were grown under irrigated and un-irrigated conditions with low productivity. Many high yielding varieties have been released for cultivation, but their adoption by farmers is minimal. Majority of the area is under cereals; however, efforts are being made by the KVK to motivate the farmers to grow these crops by organizing awareness camp cum training programmes and field days. In, Kathua district area under oilseed crop is 11285 ha with production of 78995 quintals and productivity of about 7 quintals/ha. Since the productivity of oilseed crop in the district is low as farmers are growing these crops in marginal area and due to non-adoption of improved package of practices, therefore efforts have been made through FLDs to introduce new high yielding varieties of these crops to demonstrate improved production technologies to increase productivity of oilseed crops in the district.

Front line Demonstration (FLDs) is the concept of field demonstration evolved by the Indian Council of Agricultural Research (ICAR) with the inception of technology mission on oilseed crops during mid eighties. The field demonstration conducted under the close supervision of scientists of National Agricultural Research System are called Front Line Demonstration because the technologies are demonstrated for the first time by the scientists themselves before being fed into the main extension system of the State Department of Agriculture. There is a rapid growth under area and production of oilseed crops in Jammu Province particularly in Kathua district, but still ample scope for further improvement of production and productivity of oilseed crops for raising the income level of the farming community of the district. Poor yield under real farming conditions can be attributed towards use of traditional/ old varieties of oilseed crops. With an objective to combat the causes of poor yield and lower economic returns, dissemination of recommended technology through front line demonstration was successfully attempted. Inview of this an attempt has been made to review the progress pertaining to the productivity potentials and profitability of the technologies that are recommended for oilseed production and existing extension gaps in adoption of these improved production technology under field conditions.

METHODOLOGY

The district is predominantly rural (95%) in its demography with a spread of over 2502 sq. Kms. It lies between 17 degree and 55 degree North latitude and 70 degree and 16 degree East longitude. The district is surrounded by Punjab in the south-east, Himachal Pradesh in north-east, district Doda and Udhampur in North and north-west, Samba in the West and Pakistan in the south-west. The district falls under Humid to Temperate zone of agro climatic zones of J&K.

The different blocks having assured irrigation of district Kathua of J&K state selected for the study. Krishi Vigyan Kendra, Kathua conducted Front Line Demonstration on Gobhi Sarson cv. DGS-1 (recommended variety by SKUAST-Jammu) during 2013-14 and 2014-15. 42 and 50 demonstrations were conducted on farmer's field in the year 2013-14 and 2014-15 in different blocks of Kathua district. All the required agri-inputs were supplied to all the farmers. The farmers were selected randomly from different blocks of the district for study. Regular visits by the KVK scientists to demonstration fields were ensured and made to guide the farmers. The critical inputs were duly supplied to the farmers by the KVK. Field days and group meetings were also organized at the demonstration sites to provide the opportunities for other farmers to witness the benefits of demonstrated technologies. Yield data was collected from control (Famer's practice) and demonstration plots and cost of cultivation, net income and cost benefit ratio were computed and analyzed.

RESULTS AND DISCUSSION

Performance of frontline demonstrations

The results of frontline demonstrations (FLDs) conducted on Gobhi Sarson, clearly revealed its good scope in crop diversification. The seed of variety DGS-1 was identified as the most critical input. The demonstrations with recommended technology produced on an average 10.6 and 11.5 q/ha seed yield of Gobhi Sarson during 2013-14 and 2014-15(Table 1).

The improved practice produced 49.7 and 51.8 percent more seed yield than the crop raised with existing technology. This was mainly attributed to more seed yield in improved practice as a result of application of Gypsum, proper inter and intra-plant spacing (45×10 cm) through thinning at 21-25 days after sowing. The Table 2 clearly depicts that the gross return obtained with recommended technology were Rs. 30300 and Rs. 40512 which were 47.9 and 51.8 percent higher than that of existing technology in the year 2013-14 and 2014-15 respectively.

The Table 3 presents the economics of FLDs on gobhi sarson. The net returns obtained with the recommended technology were to the tune of Rs. 19800 and Rs. 29812 during both the years respectively.

Table 1: Average yield and Cost Particulars of demonstrations and local check in year 2013-14 and 2014-15.

Year/Block	No. of Farmers	Average Yield (q/ha)		
		Existing Technology	Recommended Technology	% increase
2013-14				
Kathua	19	7.4	10.7	44.0
Hiranagar	12	7.0	9.8	40.0
Barnoti	11	6.9	11.4	65.2
Mean	42	7.1	10.6	49.7
2014-15				
Kathua	9	7.9	13.0	64.0
Hiranagar	10	7.6	12.4	63.1
Barnoti	15	8.0	11.3	41.2
Marheen	16	6.9	9.6	39.1
Mean	50	7.6	11.5	51.8

Table 2: Seed yield and net returns of Gobhi Sarson at different locations in the year 2013-14 and 2014-15.

Name of Block	No. of farmers	Gross return (Rs./ha)		Average cost of Cultivation (Rs./ha)		Net Returns (Rs./ha)	
		Existing Technology	Recommended Technology	Existing Technology	Recommended Technology	Existing Technology	Recommended Technology
2013-14							
Kathua	19	22220	29400	9050	10500	13150	18900
Hiranagar	12	21000	32100	9050	10500	11950	21600
Barnoti	11	20700	29400	9050	10500	11650	18900
2014-15							
Kathua	9	27650	45500	9200	10700	18450	34800
Hiranagar	10	26600	43400	9200	10700	17400	32700
Barnoti	15	28000	39550	9200	10700	18800	28800
Marheen	16	24150	33600	9200	10700	14950	22900

Price: Rs. 3000/q (2013-14) and Rs. 3500/q (2014-15)

Table 3: Economics of FLDs on Gobhi Sarson

Particulars	2013-14		2014-15	
	Existing Technology	Recommended Technology	Existing Technology	Recommended Technology
Average Yield (q/ha)	7.1	10.6	7.6	11.5
Increase in Yield over existing technology (q/ha)	_	3.3	_	3.9
Average sale Price (Rs. /ha)	3000	3000	3500	3500
Total Incremental income over existing Technology (Rs. /ha)	_	9900	_	13650
Gross Return (Rs. /ha)	21306	30300	26600	40512
Cost of Cultivation (Rs. /ha)	9050	10500	9200	10700
Additional Cost of Cultivation from existing technology (Rs./ha)	_	1450	_	1500
Net Returns (Rs. /ha)	12256	19800	17400	29812

Table 4: Level of gaps in adoption of recommended technology in *Gobhi Sarson*

Item	Existing technology	Recommended Technology	Adoption Gaps
Variety	GSC-6	DGS-1	-
Sowing implements	Broadcast	Line sowing	Considerable
Seed rate (Kg/ha)	6.0	5.0	Considerable
NPK level & application time	60-30-15-100 (Through Urea, DAP, MOP and Gypsum) Half N and whole quantity of others at sowing and remaining N with first irrigation	60-30-15 (Through Urea, DAP and MOP) Half N and whole quantity of others at sowing and remaining N with first irrigation	Considerable
Spacing	Broadcasting and no thinning to main plant to plant distance	30×10 cm maintained by thinning	Considerable
Irrigations	4	4	
Weed control	Hoeing	Hoeing	
Plant Protection	More no of sprays	On ET level of insects	Considerable
Average Yield (q/ha)	7.3	11.0	Considerable

The existing recommended technologies of Gobhi Sarson and gap between them are presented in Table 4. Farmers in general procured seed from unauthorized local seed shops. They do not have the habit to take seed from authorized seed like certified seed from Government approved agencies. They rely on local dealers for every agri- input like seeds, fertilizers, insecticides, pesticides and other chemicals. Besides all, farmers usually go for broadcast sowing of this crop rather than line sowing due to which only intercultural

operations get difficult but also optimum plant population cannot achieved which leads undue competition between the plants. For application of phosphatic fertilizers, preference should be given to Single Super Phosphate (SSP) than that of Di-ammonium Phosphate because SSP contains sulphur, which is desirable nutrient for oilseed crops. As far as the plant protection measures are concerned farmers use plant protection measures without taking care of the economic threshold levels (ETLs) which increases the cost of cultivation per unit area. Economic threshold level is the level below which the insect population will not cause any harm to the crop. So, considerable gaps were observed in almost whole crop production system and plant protection measures. Besides this farmers in general purchased pesticides available with local companies without taking care of any brand name and status of manufacturing company. They just rely only on local shopkeepers for all inputs. Considerable gap was observed in method of sowing, fertilizer application and plant protection measures which definitely were the reasons for not achieving the potential yield of crop. Similarly Roy *et. al.* (2010) elicited that farmers usually followed broadcast method of sowing against the recommended line sowing and because of this. They applied higher seed rate than the recommended. They further observed full gap in case of irrigation and plant protection measures.

CONCLUSION

It can be concluded that extension gaps in adoption of improved oilseed production technologies had been identified. In most of the cases, farmers did not follow the recommended practices for sowing and plant protection measures. Frontline demonstrations were really helpful in crating awareness among the farmers and clearly exhibited recommended existing production technology. Transfer of technology should be strengthened in farmer participatory mode with involvement of multidisciplinary team of researchers.

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Growth of pigeon pea crop in Maharashtra-TFP Analysis

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ABSTRACT

Measurement of productivity growth is very essential to take appropriate policy decisions for the development of the agriculture sector. Present study measures total factor Productivity growth of pigeon pea crop in sub-sector of Maharashtra State. The Tornquist-Theil chained Divisia index approach was applied for the measurement of total factor productivity using output and input data of Pigeon pea crop. Farm-level data on yield, level of inputs use and their prices for the period 1989-90 to 2008-09 were taken from the state funded cost of cultivation scheme. The multi-variable model was estimated to know the determinants of total factor productivity growth taking total factor productivity as dependent variable. Beside double sown area, other explanatory variables includes total amount of loan, net cropped area, area under irrigation, area under high yielding variety, annual rainfall, villages electrified, number of tractors, number of pump sets, road density. The results indicated that total factor productivity growth was positive in Pigeon pea crop in sub sector of Maharashtra State. Area under irrigation, area under high yielding varieties, rainfall, and road density has positive and significant impact on total factor productivity of pigeon pea crop in sub- sector.

Keywords: *Pigeon pea, Productivity, Total Factor Productivity, Tornquist-Theil Index,*

INTRODUCTION

Pulses are basic ingredient in the diet of a vast majority of Indian population as they provide a perfect mix of high biological value when supplemented with cereals. Importance of pulses is relatively more in our country as its contribution in nutrient supply is far more that in Asia and world as a whole. Each plant of pulse crop is virtually a nature's mini nitrogen fertilizer factory, which enables it to meet its own nitrogen requirement and also benefits the succeeding cereal crop. Pulses are also excellent feed and fodder for livestock. Besides, having dietary value and nitrogen fixing ability, pulses also play an important role in sustaining intensive agriculture by improving physical, chemical and biological properties of soil and considered excellent crops for diversification of cereal-based cropping systems. After independence, India has made much progress in agriculture. Indian agriculture, which grew at the rate of about 1 per cent per annum during the fifties, has grown at the rate of 2.6 per cent per annum in the post-independence era. Expansion of area was the main source of growth in the period of fifties and sixties. After that, the contribution of increased area under agricultural production has declined over time and increase in productivity became the main source of growth in agricultural production.

TFP is influenced by changes in technology, institutional reform, infrastructure development, human resource development, investment in research and development, level of technology adoption and other factors. (Kumar *et al.*, 2008). Recent experience shows a slowdown in productivity growth of various crops or even some setbacks indicating that all is not well. This has given rise to some pertinent questions namely what is the direction of productivity? Are inputs efficiently utilized? What is the growth in inputs and outputs? This needs elaboration from the TFP studies. Empirical studies of the TFP on developing countries in agriculture are becoming increasingly important in providing a complex picture of technological change. The TFP for Indian crop sector was measured by Rosegrant and Evenson (1992), but the results of the sectoral approach cannot be used precisely for policy decisions with respect to individual crops because technological change varies across crops. Thus TFP growth has to be examined for individual crops (Kumar and Rosegrant, 1994). Hence, the main focus of study was to measure the growth in total factor productivity of Pigeon pea crop in Maharashtra and its determinants.

METHODOLOGY

Farm-level data on yield, level of input use and their prices for the period 1989-90 to 2008-09 were collected from the "Scheme for the study of cost of cultivation of principal crops" Government of Maharashtra, for the Pigeon pea crop grown in the state. This data set provided a rich source for measuring and analyzing the agricultural productivity. The time series data on infrastructural variables (road density, number of village electrified, number of pump sets, number of tractors), cropping intensity, total loan amount disbursed, annual rainfall, area under irrigation, area under high yielding variety, land-use pattern etc were collected from various publications of government of Maharashtra.

Analysis of total factor productivity (TFP)

Total Factor Productivity (TFP) sometimes referred as multifactor productivity, is a true measure of economic efficiency. TFP measures the extent of increase in output, which is not accounted by increase in total inputs. There are three main approaches for

estimating the TFP, namely the production function approach (PFA), growth accounting approach (GAA) and non parametric approach. The Production Function Approach (PFA) is associated with various problems like multicollinerity, autocorrelation and degree of freedom, whereas non parametric approach like Data Envelope analysis is very sophisticated and uses linear programming methodology. InGrowth Accounting Approach (GAA),TFP is measured as a residual factor, which attributes to that part of growth in the output that is not accounted for by the growth in the basic factor inputs.Amongst three approaches, growth accounting approach is popular mainly because it is easy to implement, requiring no econometric estimation.

The use of TFP indices gained prominence since Diewert (1976) proved that the Theil-Tornqvist discrete approximation to the Divisia index is consistent in aggregation and superlative for a linear homogeneous Tran logarithmic production function. In the present study, Divisia-Tornqvist index has been used for computing the total output, total input and TFP for specified year "t" by for selected crops.

Total output index (TOI)

$$TOI_t / TOI_{t-1} = \delta_j (Q_{jt}/Q_{jt-1})^{(R_{jt} + R_{jt-1})1/2} \quad \text{.....[1]}$$

Total input index (TII)

$$TII_t / TII_{t-1} = \delta_j (X_{it}/X_{it-1})^{(S_{it} + S_{it-1})1/2} \quad \text{..... [2]}$$

Where,

R_{jt} is share of the j^{th} output in total revenue

Q_{jt} is Output of the j^{th} commodity

S_{it} is share of the i^{th} input in total input cost

X_{it} is quantity of the i^{th} input

t is the time period

For productivity measurement over a long period of time, chaining indexes for successive time period is preferable. With chain liking, an index was calculated for two successive periods t and t-1 over the whole period 0 to T (samples form time t = 0 to t = T) and the separate index was then multiplied together.

TOI (t) = TOI (1). TOI (2) ..... TOI (t-1) .....[3]

TII (t) = TII (1).TII (2) ..... TII (t-1) ..... [4]

Total factor productivity index (TFP) is given by equation ..... [5]

$$TFP_t = (TOI_t / TII_t) \quad \text{.....[6]}$$

Chain-linking index takes in to account the changes in relative values/costs throughout the period of study. This procedure has the advantage that no single period plays a dominant role in determining the share weights and biases are likely to be reduced. For constructing the total input index, ten important inputs viz. human labour, bullock labour, machine labour, farm yard manure (FYM), nitrogen, phosphate and potash fertilizers, irrigation, plant protection and land were included.

Factors influencing TFP

To know the influence of infrastructural, socio-economic and technological variable on the productivity of major crops a multi-variable model in the form of log linear was estimated as fallows. The time series data from the year 1989-1990 to 2008-2009 were considered for the present study.

$$LnY = Ln\ a + b_1 \ln X_1 + b_2 \ln X_2 + \ldots\ldots + b_n \ln X_n$$

Where,

Y= TFP

b_i= Elasticities

X_1=Total amount of loan (short term + medium term + long term loans) sanctioned by commercial banks, regional rural banks, cooperative banks, primary agricultural cooperative societies and land development banks per thousand hector of net cultivated area (in Rs. lakhs).

X_2= Proportion of double sown area.

X_3= Proportion of net cropped area under irrigation.

X_4= Proportion of net cropped area under high yielding varieties.

X_5= Annual rainfall (mm)

X_6= Number of villages electrified per 000' ha of net cultivated area

X_7= Number of tractors per 000' ha of net cultivated area.

X_8= Number of pump sets per 000' ha area of net cultivated area

X_9= Road density kilometer per 000'ha of net cultivated area.

In all there were nine factors studied, the step wise regression analysis which gave only more significant variables in the model was run.

RESULTS AND DISCUSSION

Performance of Pigeon pea in Marathwada region

The area production and productivity of Pigeon pea in Marathwada as well as Maharashtra region shows positive growth over the study period. In Marathwada region the production of Pigeon pea shows 11.46% growth rate over the study period as in case of Maharashtra it was found 3.27%. Use of improved seeds and technologies during study period results in productivity increase in Pigeon pea. Hence increase in production of Pigeon pea is because of increase in area and productivity of Pigeon pea in both Marathwada and Maharashtra region (Table 1).

Input share

The share of input in cost of cultivation showed the importance of that input in total cost structure. Table 2 depicts input share in cost structure of Pigeon pea in Marathwada region. Rental value of land was having major share in cost of cultivation Pigeon pea in all the time span of research. Energy component was second important input in cost structure of Pigeon pea. Farmers were adopted conservative agricultural production technologies to cultivate Pigeon pea crop which were not suitable for using modern inputs and mechanization; hence farmers utilized more energy in the form of male labour, female labour, and bullock labour.

Table 1: Growth and instability in Pigeon pea (1989-90 to 2008-09)

Parameter	Marathwada			Maharashtra		
	Area	Production	Productivity	Area	Production	Productivity
a	3853.51	923.657	354.224	9857.16	5037.37	519.369
b	28.703	105.87	20.78	56.32	165.13	11.97
r	0.674**	0.780**	0.712**	0.692**	0.55^{NS}	0.459*
CGR	0.69	11.462	8.174	0.571	3.278	2.304
Mean	4145.9	2035.3	472.429	10448.6	6771.2	644.5
CV (%)	6.059	39.425	36.589	4.607	26.2	23.89
Instability	4.6	25.31	26.44	3.42	22.48	21.8

*** Indicate significance at 1% level, ** Indicate significance at 5% level

Area(00 ha), Production (00 tones) and productivity (Kg/Ha)

Table 2: Input share in total input cost of Pigeon pea in Marathwada region

Particular	Pigeon Pea	
	Cost	Share
Total Input cost	11263.92	100.00
Male	1882.52	16.71
Female	1653.05	14.68
Bullock labour	1775.98	15.77
Machine labour	324.53	2.88
Seed / Set	338.58	3.01
Manure	863.09	7.66
Nitrogen	286.57	2.54
Phosphorous	343.88	3.05
Potash	87.53	0.78
Insecticide	396.93	3.52
Rental value of land	2427.00	21.55
Other	782.5	6.95
Total	11263.92	100.00

The low seed cost in Pigeon pea cultivation was due to varieties [BDN-1, BDN-2, BSMR-736, BDN-708 etc.] are dominant in farmers field. Not a single Pigeon pea hybrid was successful on farmers' field during last two decade. Maximum Cotton area was under hybrids [in past decade] and that to Bt hybrid in recent years, which were costlier than variety. Nutrients especially nitrogen, phosphorous and potash are required in different quantum hence differences have been observed in nutrient cost.

Input and output growth

Growth rate figures highlighted the trend in input use and output achievement over the time. Results of input and output growth rate of Pigeon pea in sub sector Marathwada region of Maharashtra State was presented in table 3. The Pigeon pea yield was increased by 2.90 per cent annually in the Marathwada region. To attend this growth in Pigeon pea production, farmers of this region had increased the utilization of some of the important inputs *viz* male labour [3.95%], female labour [2.92%], bullock labour [3.62%], phosphorous [4.77%], potash [3.38%] and insecticide [5.85%]. Use of seed and nitrogen remained stagnated over the period of time. The output value of Pigeon pea crop was increased over the years, this result in positive growth in rental value of land [6.75%]

Table 3: Input-Output growth rate of Pigeon pea in Marathwada region

Particulars	Unit	Pigeon pea		
		Period I	Period II	Overall
Output Input	Qt ha^{-1}	1.37^{NS}	2.51^{NS}	2.9*
Male	days ha^{-1}	2.92^{NS}	2.72^{NS}	3.95*
Female	days ha^{-1}	6.65**	4.3**	2.92*
Bullock labour	days ha^{-1}	1.4^{NS}	3.96*	3.62*
Machine labour	Hrs ha^{-1}	3.38^{NS}	1.64^{NS}	2.7^{NS}
Seed	Kg ha^{-1}	-2.37**	0.6^{NS}	-0.11^{NS}
Manure	Qt ha^{-1}	-8.46**	-0.83^{NS}	1.46^{NS}
Nitrogen	Kg ha^{-1}	-5.03**	1.32^{NS}	1.68^{NS}
Phosphorous	Kg ha^{-1}	0.15^{NS}	5.65*	4.77*
Potash	Kg ha^{-1}	-1.03^{NS}	3.1^{NS}	3.38*
Insecticide	Lit ha^{-1}	2.67^{NS}	3.67^{NS}	5.88*
Irrigation	No.	—	—	—
Rental value of land	Rs ha^{-1}	5.08**	5.56**	6.75*

*** Indicate significance at 1% level

** Indicate significance at 5% level

Total factor productivity

Sustainable growth in agriculture led to development, which in turn was critically dependent upon the productivity growth, technological change, economics of scale and efficiency of factor used. The productivity behaviors were examined for two separate decades and overall, the obtained results were presented in table 4 and 5. Within twenty years, total factor productivity was recorded highest in the year 2002-03 which was 178.04. Lowest total factor productivity was observed in the year 1991-92 which was 96.38. The Input index (2.29%) & output index (4.82%) growth in Pigeon pea were positive, which leads to positive total factor productivity for overall period (2.54%). In both the decade, output growth was more than input growth resulted positive TFP growth in Pigeon pea [Chand *et al*., 2012].

Near about eighteen season, were categorized as good season for Pigeon pea cultivation where as two seasons were falls under bad category. Wilt and sterility were the major problem in Pigeon pea. These two problems were counteracted through better breeding programme and new agronomic practices which were adopted by agriculture research station, Badnapur Dist. Jalana and have developed varieties like BDN-1, BDN-2, BSMR-736, BDN-708 etc which are resistant against wilt and sterility. These new genotype is a key for getting positive TFG growth; because they are resistant against wilt and sterility as well as they give good response for better agriculture practices specially for nutrient management.

Table 4: Tornquist-Theil Divisia Index of Output, Input and TFP of Pigeon pea in Marathwada region.

Year	Pigeon pea		
	Output Index	Input Index	TFP Index
1990-91	100.00	100.00	100.00
1991-92	97.00	100.64	96.38
1992-93	109.21	96.70	112.94
1993-94	123.01	126.70	97.08
1994-95	122.12	111.67	109.36
1995-96	128.64	111.59	115.27
1996-97	135.32	110.34	122.64
1997-98	99.25	87.76	113.09
1998-99	117.59	104.57	112.45
1999-00	150.22	119.54	125.66
2000-01	174.05	127.76	136.23
2001-02	203.98	129.19	157.89
2002-03	234.38	131.64	178.04
2003-04	219.11	129.63	169.03
2004-05	187.43	129.47	144.77
2005-06	155.84	141.00	110.52
2006-07	192.70	144.16	133.67
2007-08	273.66	155.04	176.50
2008-09	199.30	138.37	144.03

Table 5: Output, Input and TFP indices growth rates of Pigeon pea and in Marathwada region

Period	Pigeon pea			
	Output Index	Index Index	TFP	TFP Share in output (%)
Period I	1.87	-0.12	1.99	106.58
Period II	2.45	2.10	0.35	14.39
Overall	4.82	2.29	2.54	52.59

Factors influencing total factor productivity growth

The step down multiple regression method was used to identify significant parameters by avoiding problem of Multicollinearity. The results obtained are presented in table 05. Proportion area under high yielding varieties, proportion area under irrigation, number of villages electrified, number of tractor available for cultivation and road density were the important factors which have influence on total factor productivity in Pigeon pea.

Table 6: Factors influencingtotal factor productivity growth of Pigeon pea in Marathwada region

Variables	Pigeon Pea Parameter estimate (b_i)
Intercept (a)	6.04*(2.55)
Proportion of double sown area	-0.93^{NS}(0.46)
Proportion of area under irrigation	0.92^{**}(0.23)
Proportion of area under high yielding variety	1.27^{**}(0.28)
Number of villages electrified	2.94^{*}(0.87)
Number of tractors	1.94^{NS}(1.59)
Road density (km/hr)	0.98^{**}(0.32)
R^2	0.75

CONCLUSION

The TFP growth rate was positive in crop sub-sector i.e. Cotton, Sugarcane and Pigeon pea in Maharashtra State. The positive TFP growth is because of technological and infrastructural breakthrough in Cotton, Sugarcane and Pigeon pea production system. It was also realized that, an appropriate policy environment, infrastructure, institutions and favorable weather conditions were pre conditions for a steady TFP growth in crop sub sector.

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Technological gaps in maize cultivation: Is it an outcome of extension deficit in tribal areas of Kashmir

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ABSTRACT

Tribal people are most vulnerable sections of the society and they rely on subsistence agricultural practices for their living. The agricultural practices are practiced under rain fed conditions over terraces drawn out on undulated topography. This background motivated us to analyze the maize cultivation in relationship with technological gaps so as to arrive at the extension gaps and policies to bridge them. This study mainly perused the primary data obtained from sample respondents selected in tribal areas of Kashmir valley though; some secondary information was employed to substantiate the findings. Appropriate tools were employed to analyze the data. The results revealed that tribal people were allocating major proportion of their cropped area for maize cultivation followed by cherry and legumes. It was observed that there were huge technological gaps in the use input technologies. Moreover their intercultural operations were far from the scientific recommendations which led to lower returns and uneconomical farming practices. Further lower productivity and fairly low quality of the produce resulted in lower returns to their little surpluses. Study revealed poor role of extension agencies in these area which could be the major cause of their unscientific maize cultivation. Only few respondents were found to have seen any extension personnel around their farms and major of them even did not know about such agencies. A significant difference was observed in yield levels of respondents having received information from friends or extension worker and those having no information. The study also examined the various dimension of their contacts and information sources and could ascertain an important role of extension agencies if their farming has to be made remunerative. Based upon findings, this study emphasized upon strengthening/streamlining extension system in these areas among other policy options.
Keywords: *Frontline demonstrations, technological gaps, maize.*

INTRODUCTION

Maize is the second important crop among tribes of Kashmir next to rice. Maize is a major staple food followed by other legumes of majority of population in tribal farmers and is important for its diversified utilization in animal feeds and other uses. More than 46 per cent of the total food grain area of the tribal population of Kashmir is under maize cultivation. The livelihood of tribal people mainly depends on agriculture for their subsistence use. Though the technological breakthrough in agriculture has resulted in increased productivity, yet the crop yields realized on the farmers' fields are considerably low as compared to those obtained on demonstration plots and farmers of Research Stations. There exists considerable un-trapped yield potential in various crops which may be attributed to the gap in adoption of recommended practices and differences in input use levels between at the farmer's field and demonstration plots. As a step towards narrowing down the yield gap at farmer's fields, there is need to analyze the yield levels and the causative factors.

Yield gaps exist mainly because known technologies that can be applied at a local experiment station are not applied in farmers' fields having the same natural resource and ecological characteristics. One main reason why yield gaps exist is that farmers do not have sufficient economic incentives to adopt yield enhancing seeds or cropping techniques. This may be explained by numerous factors, including lack of access to information, extension services and technical skills. Poor infrastructure, weak institutions and unfavourable farm policies can also create huge obstacles to the adoption of improved technologies at farm-level. Other factors can be that available technologies have not been adapted to local conditions. Solutions lie with public sector investments in institutions and infrastructure, better research-extension-farmer linkages and sound policies to stimulate adoption of technologies that improve productivity and reduce costs, thus increasing agricultural incomes. Changes in crop management techniques can also help closing yield gaps. Plant breeding plays an important role in closing yield gaps by adapting varieties to local conditions and by making them more resilient to biotic (e.g. insects, diseases, viruses) and a-biotic stresses (e.g. droughts, floods). Studies estimate that the global yield loss due to biotic stresses averages over 23 percent of the estimated attainable yield across major cereals. The present study was undertaken to find out the knowledge and adoption gap of maize grower tribal farmers and to find out the constraints responsible for low production of maize, as conducted by Rao & Rao, 1996; Bala *et al.*, 2005, Mignouna *et al.*, 2010; and Singh & Yadav, 2014.

METHODOLOGY

The study was conducted in the tribal area of Srinagar district of Jammu and Kashmir where maize is

cultivated as major crop by tribal people. In order to select a representative sample, a simple random sampling method was adopted by randomly selected the number of individuals in a particular tribal area. A complete list of these individual farmers was prepared and was categorized into marginal, small and large farmers on the basis of their land holdings. Then 100 farmers, were selected from that particular area. The data were collected by using questionnaire designed for that purpose, the knowledge level of farmers about the recommended technology and methods for maize cultivation was obtained through individual ranking method by asking questions to the farmer.

RESULTS AND DISCUSSION

Knowledge level of respondents

The majority of the respondents (56%) had low level of knowledge, followed by 35.00% who had medium level of knowledge and it was further observed that only 9.00% had high level of knowledge. On the basis of the results the low level of knowledge percentages was very high. It may be due to the lack of awareness and lack of proper information regarding the recommended maize production technology (Table 1).

Table 1: Level of knowledge regarding improved maize production technology

Category	Frequency (N=100)	Percentage
Low knowledge level	56	56.00
Medium knowledge level	35	35.00
High knowledge level	9	9.00

Adoption gaps regarding improved maize

The Table 2 revealed that 64% of respondents had high level of adoption gap regarding the recommended maize cultivation technology, followed by 31% of them having medium level of adoption gap and only 5% had low level of adoption gap. The reason behind that more percentage in the high adoption gap level due to unavailability of improved seeds, high cost of insecticides/pesticides and lack of irrigation facilities about the maize cultivation.

Table 2: Adoption gap regarding improved maize

Category	Frequency (N=100)	Percentage
Low adoption gap level	5	5.00
Medium adoption gap level	31	31.00
High adoption gap level	64	64.00

Constraints in maize production

According to the study nine constraints had been responsible for the low yield of maize. Among them, about 68.33% of the farmers reported that main constraints for low yield of maize are the expensive costs related to cultivation followed by non-availability of timely information regarding improved maize production technology with the percentage of 66.67% and so on (Table 3).

Table 3: Responsible constraints for low yield of maize

Constraints	Percentage	Ranks
Unawareness about improved maize cultivation practices	37.17	VIII
More expensive due to high cost of cultivation	68.33	I
Unavailability of improved seed	49.17	IV
High cost of fungicides/pesticides	52.50	III
Lack of modern agricultural equipment	37.50	VII
Lack of irrigation facilities	45.17	V
Lack of yard manure	44.17	VI
Non-availability of timely information related to improved maize production technology	66.67	II

CONCLUSION

On the basis of the results, it is concluded that farmers/tribal farmers had low knowledge and low adoption gap of maize production technology. The main reason for more adoption gap being the illiteracy of farmers, small land holdings, less annual income, insufficient availability of inputs, less irrigation facilities, poor access to amenities, inaccessible areas, poor infrastructure, poor roads and also proper farm equipments were not available. The main reason of all is the unawareness of the tribal farmers to the latest agricultural technologies and lack of extension facilities in the tribal areas. However, the farmers were made aware about the target of yield and adoption gap of maize production technology. It is concluded that to increase the knowledge of the tribal farmers they should be made aware about the technology through different information sources and to minimize the adoption gap and their level of technical knowledge be increased. Particularly literacy, size of land holdings, income, and availability of inputs at lower rates, irrigation, proper farm equipments and fungicides/pesticides factors are taken into consideration to minimize the adoption gap.

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Identification of existing farming systems in North Konkan region of Maharashtra

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ABSTRACT

A study was conducted to identify the existing farming systems in North Konkan region of Maharashtra, including rice based production activities undertaken by the farmers to work out the contribution of each production activity in the identified farming systems. Crop production + dairy + Goatry, crop production + goatry and crop production + dairy farming systems are giving more gainful employment and per capita income. Hence, it is recommended to motivate the farmers to adopt these farming systems.
Keywords: *Farming system, Labour use pattern, Land use pattern, Profitability*

INTRODUCTION

Agriculture is the single largest industry in India, both in respect of number of people dependent on it and its contribution to the national income. Types and systems of farming in India are as old as Indian civilization itself. The farming in India is carried out under diverse conditions of agro-climate, soil types and individual farm resources. Different crop combinations and crop and livestock combinations are used on different farms and in different regions to suit local situations and to fulfill individual household requirements. Experiments and experiences have shown that mixed farming gives more income than pure farming. Besides it provides more employment on the same land. For subsistence living and getting sustainable income, farmers have to combine several other production activities such as dairy, poultry, goat keeping, sheep rearing, etc., with crop farming. So that they can get gainful employment on their own farm and can use their surplus resources more advantageously. Integrated farming research is going on at Regional Agril. Research Station, Karjat to develop synthesised farming system models. Therefore the study of identification of existing farming systems in North Konkan was undertaken to identify the different rice based production activities undertaken by the farmers; to synthesise and integrate available resources into different farming systems and to work out the contribution of each production activity in the identified farming systems.

METHODOLOGY

In the present study, the three stage random sampling method was followed for selecting tahsils, villages and farmers from Raigad District. The selected sample of 120 farmers from 4 tahsils of Raigad district was selected for the study. The data for the year 2013-14 were collected by personally interviewing the selected samples farmers. Simple statistical tools viz., averages, percentages, ratio were used to analyse the data. Standard cost concepts of "Farm Management Studies" were used for estimation of cost and returns from the various farm activities.

RESULTS AND DISCUSSION

Farming Systems prevailing in Raigad district

The identified farming systems in Raigad district are presented in Table 1. In the district, it is revealed that only cropping system was observed on 47.50 per cent of sample farmers. Crop + poultry farming system was followed by 19.17 per cent farmers and crop + dairy were followed by 15.83 per cent of the sample farmers. The other farming systems were crop + dairy + poultry (9.17 %), and crop + Goatry (5.83 %).

Table 1: Identified Farming Systems in Raigad district

Farming System	No. of farmers	Percentage to total
Only Cropping		
Rice-Fallow	20	16.67
Rice-vegetables	31	25.83
Rice-Pulses	03	2.50
Rice-Vegetable-Fruits	03	2.50
Sub-Total	57	47.50
Crop + Dairy	19	15.83
Crop + Poultry	23	19.17
Crop + Goatry	07	5.83
Crop+ Dairy + Poultry	11	9.17
Crop + Dairy + Goatry	03	2.5
Total	120	100

Socio-economic status of the farmers

The socio-economic information of the farmer is given in Table 2 which revealed that the average age of the sample farmer was in the range of 46 to 61 years and education was between 5th standard to 9th standard, the family size was 4 to 7 members of which 2 to 3 members were working on farm. The average annual income was highest Rs. 1,18,286 in crop+goatry farming system. While in remaining farming systems the annual income was in the range of Rs. 55,067 to Rs. 99727.

Land asset and its utilization

The average size of land holding and its utilization is given in Table 3 and it was revealed that the farmers ware having own land in the range of 0.56 ha.-1.05 ha.

Livestock asset

The status of per farm livestock asset is given in Table 4 and it was found that the size of livestock assets among different farming systems was marginal.The farm households are having very limited numbers of livestock maintained in their farms.

Investment on farm assets

The farmers engaged in in crop + dairy + poultry

Table 2: Socio-economic status of the farmer

Particulars	Only Cropping				Crop+ Dairy	Crop+ Poultry	Crop+ Dairy+ Poultry	Crop+ Goatry	Crop+ Dairy+ Goatry
	Rice	Rice-Pulses	Rice-Vegetable	Rice-Fruits					
No. of farmers	20	03	31	03	19	23	11	07	03
Age (years)	52.3	61.33	48.94	46	52.02	55.48	52.27	47.71	61.67
Education score	6.95	8.67	7.61	7.33	7.26	4.78	5.55	7.86	5.33
Family size	6.0	3.34	5.65	4.67	5.36	6.74	7.64	5.57	6.66
Male	3.1	1.34	2.84	2.67	2.68	3.13	3.82	2.57	3.33
Female	2.9	2.00	2.81	2.00	2.68	3.61	3.82	3.00	3.33
Occupation									
Main Farming	20	03	31	03	19	23	11	07	03
Secondary									
i) Wages	15	9	1	–	14	12	05	–	–
ii) Service	05	02	–	–	–	04	02	1	–
iii) Other	01	–	01	–	–	–	–	1	–
Annual Income(Rs.)	65720	55067	69261	57665	87574	73265	99727	118286	83667

Table 3: Land asset and its utilization.

Particulars	Only Cropping				Crop+ Dairy	Crop+ Poultry	Crop+ Dairy+ Poultry	Crop+ Goatry	Crop+ Dairy+ Goatry
	Rice	Rice-Pulses	Rice-Vegetable	Rice-Fruits					
Cultivated land	0.50	1.27	0.58	0.75	0.73	0.75	0.90	0.66	0.70
Rainfed	0.48	1.27	0.25	0.57	0.60	0.61	0.72	0.59	0.38
Irrigated	0.02	–	0.33	0.18	0.13	0.14	0.18	0.27	0.32
Varkas	0.06	–	0.04	0.05	0.11	0.08	0.14	–	–
Total owned land	0.56	1.27	0.62	0.80	0.84	0.83	1.05	0.66	0.70

Table 4: Livestock asset

Particulars	Only Cropping				Crop+ Dairy	Crop+ Poultry	Crop+ Dairy+ Poultry	Crop+ Goatry	Crop+ Dairy+ Goatry
	Rice	Rice-Pulses	Rice-Vegetable	Rice-Fruits					
Bullock	0.70	1.33	1.16	0.67	1.68	1.91	2	1.2	1.29
Cow									
i) Milking	–	–	–	–	0.95	–	0.91	–	0.33
ii) Below 3 years	–	–	–	–	0.26	–	0.64	–	–
Buffaloes									
i) Milking	–	–	–	–	3.84	–	1.00	–	1.67
ii) Below 3 years	–	–	–	–	–	–	0.09	–	–
Goat	–	–	–	–	–	–	–	3.57	0.67
Poultry	–	–	–	–	–	9.52	9.82	–	–

Table 5: Per farm investment on farm assets (excluding land)

Particulars	Only Cropping	Crop+ Dairy	Crop+ Poultry	Crop+ Dairy+Poultry	Crop+ Goatry	Crop+ Dairy+Goatry
Farm Building	278789(88.55)	541632(74.07)	508695(90.06)	534727	246852	238333
Implements	652	2784	1741	7368	1457	533
Machinery & Equipments	4602	14889	9643	111172	158714	400
Hand Tools	3623	5181	3873	11376	2625	2316
Livestock	21312	166759	40878	176654	73616	63000
Total	314851	731238	564830	841297	483264	304582

farming system had more investment (Rs. 8,41,297) on farm assets followed by the farmer in crop + dairy (Rs. 7,31,238), crop + poultry (Rs. 5,64,830), crop + Goatry (Rs. 4,83,264), cropping (Rs. 3,14,851) and crop + dairy + Goatry (Rs. 3,04,582). In cropping and crop + Goatry farming system, farmers were having less than 10 per cent investment.

Cropping Pattern

The Cropping pattern of the farmer in each farming system is presented in Table 6 which revealed that the cropping intensity was more than (156.90 %) in rice + vegetable (Double cropping), followed by crop + dairy + Goatry (145.71%), rice + pulses (139.37 %).

Labour use pattern

The labour use pattern in different farming system is presented in Table 7 which revealed that maximum work (490.86 days) was available in crop + dairy + Goatry farming system followed by crop + Goatry and crop + dairy farming system. Among the cropping system rice + vegetable system generated maximum employment (341.31 day/ha.)

Source wise annual income

The source wise annual income of the sample farmers is presented in Table 8 which revealed that overall farmer derived 78.23 per cent of income from farming activities and 21.77 per cent income from non-farming activities. The maximum income (Rs. 1,18,286)

Table 6: Cropping pattern

Particulars	Only Cropping				Crop+ Dairy	Crop+ Poultry	Crop+ Dairy+ Poultry	Crop+ Goatry	Crop+ Dairy+ Goatry
	Rice	Rice- Pulses	Rice- Vegetable	Rice- Fruits					
Rice	0.52	1.27	0.58	0.75	0.73	0.75	0.90	0.66	0.70
Pulses	–	0.5	–	–	0.13	0.06	0.06	–	–
Vegetables	–	–	0.33	0.18	0.13	0.14	0.18	0.27	0.32
Fruits	–	–	–	–	–	–	0.01	–	–
Gross Cropped Area	0.52	1.77	0.91	0.93	0.99	0.95	1.15	0.93	1.02
Cropping Intensity (%)	104	139.37	156.90	124	135.62	126.67	127.78	104.91	145.71

Table 7: Per farm labour use pattern (days).

Particulars	Only Cropping				Crop+ Dairy	Crop+ Poultry	Crop+ Dairy+ Poultry	Crop+ Goatry	Crop+ Dairy+ Goatry
	Rice	Rice- Pulses	Rice- Vegetable	Rice- Fruits					
Crop Production	84.76	249.51	198	178.7	179.30	177.75	224.10	195.27	235.10
Livestock Production	–	–	–	–	160	–	120	145	155
Total Labour									
Per Farm	84.76	249.51	198	178.7	339.30	177.75	344.10	340.27	390.10
Per ha.	169.52	196.46	341.31	238.22	405.62	237	369	440.86	490.86

Table 8: Source wise annual income

Particulars	Only Cropping				Crop+ Dairy	Crop+ Poultry	Crop+ Dairy+ Poultry	Crop+ Goatry	Crop+ Dairy+ Goatry
	Rice	Rice- Pulses	Rice- Vegetable	Rice- Fruits					
Rice	13305	26666	18035	27000	19105	23683	27273	25571	19333
Pulses	-	8400	-	-	1995	1026	1000	-	-
Vegetables	—	-	33161	16666	14421	16609	21364	48857	19000
Fruits	-	-	-	9000	1352	3434	7000	4246	1667
Other	1000	5000	645	-	2105	3957	2273	-	-
Total	14305	40066	51841	52666	38978	48709	58910	78674	40000
Dairy	-	-	-	-	33632	-	7909	-	20333
Poultry	-	-	-	-	-	5904	3909	-	-
Goatry	-	-	-	-	-	-	-	15286	18333
Total Farming	14305	40066	51841	52666	72914	54613	70727	94000	78667
Service	33640	-	12903	-	3158	9739	21273	17143	5000
Wages	17775	15000	4516	1666	11842	6087	5000	-	-
Other Occupation	-		-	3333	-	2826	2727	7144	-
Total Non-farming	51415	15000	17419	4999	15000	18652	29000	24286	5000
Total	65720	55066	69260	57665	87614	73265	99727	118286	83667

was obtained from crop + Goatry farming system in which system contributed 79.47 per cent income. Minimum income (Rs. 61,928) was obtained from only cropping system (64.14 %). Among the cropping systems rice-vegetable-fruit cropping system contributed 91.33 per cent (Rs. 52,666) followed by rice-vegetables (74.85 %) and rice-pulses (72.76 %).

In identified different farming systems it is clearly seen that the proportion of income from farming activities increased while income from non-farming activities has considerably declined (Table 9). The per cent contribution of crops in farming income was more than livestock (Table 10). In crop + dairy farming system contribution of livestock was 48.59 per cent followed by rice 25.20 per cent and vegetables 19.02 per cent. In crop + dairy + Goatry it was 35.19, 34.08, 30.73 per cent respectively. In other farming systems contribution of livestock was less than 16 per cent.

Economics of farming systems

The maximum net returns were obtained from crop + Goatry farming system (Rs. 94000 per farm) in which farmer was having 0.91 ha cultivated land (rice- 0.66 ha. and vegetable 0.33 ha.) and 3.57 goat followed by crop + dairy + Goatry farming system (Rs. 78,667 per farm) in which farmer possess 0.97 ha. Cultivated land (rice 0.66 ha and vegetables 0.27 ha.) and 0.67 goat and dairy unit of 0.33 cow and 1.67 buffaloes. Crop + dairy farming system gave net returns Rs. 72,574 per farm in which farmer is having 0.73 ha. Cultivated land (rice 0.73 ha, 0.13 ha. pulses and vegetables crop each) and 0.95 cows and 3.84 buffaloes in milch (Table 11). However, per capita income analysis revealed that per capita income was highest (Rs. 41690) in crop + poultry followed by crop + dairy (Rs. 32086).

CONCLUSION

The farmers in Raigad district (47.50 per cent) following only cropping system in which rice – vegetables (Double cropping) was more prevalent system (25.83 %), followed by rice- fallow (16.67 %). In crop+ livestock farming system crop + poultry system (19.17 %) was prevalent system followed by crop + dairy (15.83 %) and crop + Goatry (9.17%). The main occupation of

Table 9: Contribution of farming and non-farming activities in annual income

Farming system	Farming activities	Non-Farming activities	Total income
Only Cropping			
Rice	14305(21.77)	51415(78.23)	65720(100)
Rice-Pulses	40066(72.76)	15000(27.24)	55066(100)
Rice-Vegetable	51841(74.85)	17419(25.15)	69260(100)
Rice-vegetables-fruits	52666(91.33)	4999(8.67)	57665(100)
Sub Total	39720(64.14)	22208(35.86)	61928(100)
Crop+Dairy	72574(82.87)	15000(17.13)	87574(100)
Crop+Poultry	54613(74.54)	18652(25.46)	73265(100)
Crop+Dairy+Poultry	70727(70.92)	29000(29.08)	99727(100)
Crop+Goatry	94000(79.47)	24286(20.53)	118286(100)
Crop+Dairy+Goatry	78667(94.02)	5000(5.98)	83667(100)
Total	68384(78.23)	19024(21.77)	87408(100)

Table 10: Per cent contribution of crops and livestock in the farming income

Farming system	Rice	Pulses	Vegetable	fruits	Dairy	Poultry	Goat	Other	Total
Only Cropping									
Rice	100	–	–	–	–	–	–	–	100
Rice-Pulses	66.56	20.97	–	–	–	–	–	12.47	100
Rice-Vegetable	34.79	–	63.97	–	–	–	–	1.24	100
Rice-vegetables-fruits	51.27	–	31.64	17.09	–	–	–	–	100
Crop+Dairy	25.20	2.63	19.02	1.78	48.59	–	–	2.78	100
Crop+Poultry	43.37	1.88	30.41	6.29	–	10.81	–	7.25	100
Crop+Dairy+Poultry	38.56	1.41	30.21	9.90	11.18	5.53	–	3.21	100
Crop+Goatry	27.20	–	51.98	4.56	–	–	16.26	–	100
Crop+Dairy+Goatry	24.58	–	51.13	–	14.97	–	9.32	–	100

Table 11: Economics of identified farming system (Rs. Per farm)

Particulars	Only Crop	Crop+ Dairy	Crop+ Poultry	Crop+ Dairy+Poultry	Crop+ Goatry	Crop+ Goatry+Dairy
Gross Returns	82073	281131	113524	190589	276239	236399
Total Cost	42353	208557	58910	119862	182239	157732
Net Returns	39720	72514	54614	70727	94000	78667
Per Capita income	22190	32086	41690	28751	28571	23624

the farmers was farming and wages, service, etc were secondary sources of earning income. At overall level 78.23 per cent income of the farmer derived by farming activities. In crop + dairy farming system the contribution of crop and dairy was more or less similar (50 % each). In other farming system the contribution of livestock was less than 15 per cent. The farm investment on assets per farm was more (Rs. 841297) in crop + dairy + poultry farming system. The employment per person per hectare was more (490.86 days) in crop + dairy + Goatry. The maximum net returns (Rs. 94000) were obtained from crop + Goatry farming system in which 83.74 per cent contribution was of cropping and only 16.26 per cent contribution of Goatry. The per capita income was increasing in different farming systems having crop + poultry followed by crop + dairy + poultry, crop + Goatry and crop + Goatry + dairy.

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Impact assessment of adopted cotton production technology and constraints in Vidarbha region

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ABSTRACT

Cotton as a cash crop is grown in more than 80 countries in the world and is mainly produced in three zones of India. Maharashtra ranks 2nd in production and 2nd in productivity amongst the major cotton growing states of the country. The study has assessed the impact of production technology of cotton cultivation in Vidarbha region of Maharashtra for the year 2013-14, based on the data of costs and returns. Two districts from Vidarbha region viz., Yavatmal and Buldhana were selected on the basis of maximum area under cotton. The survey method was used for the collection of primary data Apart from benefit-cost ratio (BCR), yield gap analysis, resource use efficiencies, adoption index, impact of improved cotton technology and the constraints faced by the cotton growing cultivators have been estimated in the study. It has shown that the per hectare cost 'C' was Rs.42161.58 and BCR is 1.03, whereas the per quintal cost of production was Rs. 4012.94 at the overall level for improved cotton cultivation methods. Further, there was a 31.58 per cent yield gap between actual yield and yield of demonstration plot.The composite index of technology adoption was worked out to 50.93 per cent indicated that the sample farmers adopted less than 48 per cent recommended cotton production technology and obtained 10.40 qtls/ha yield. The contribution of different components on impact of cotton production technology in Vidarbha region, net returns was maximum (19.61 per cent). The constraints faced by the cotton growing cultivators were abnormal distribution of rainfall, lack of technical knowledge, high cost of seed and fertilizers, high wage rates, high labour requirement, non-availability of seed and fertilizers, low price to produce were the major constraints in adoption of cotton production technologies.
Keywords: *Cotton, production technology, impact.*

INTRODUCTION

Cotton (Gossipium SPP) is considered as one of the most important cash crops which plays a vital role in the economy of the country by providing substantial employment and making significant contributions to export earnings. Cotton, the king of fibers is often quoted as 'white Gold' because its higher commercial values. Cotton is one of the principal crops of the country, it is third in total acreage planted among all crops in India behind rice and wheat.

Cotton is cultivated in more than 70 countries of the world introducing production of cotton in China (27.10 per cent), India (21.83 per cent), United States (12.67 per cent), Pakistan (8.58 per cent), Brazil (7.52 per cent), Uzbekistan (3.40 per cent) and other (18.90 per cent).China is the largest producer of cotton in the world, whereas, India is second largest followed by Uniated states, Pakistan and Brazil.

The studies undertaken so far had mostly focused on both aspects of technical changes i.e. its impact on yield, returns etc. as well as the reasons for non adoption of improved technology assumes great importance. Considering the above facts the study on "Impact Assessment of Adopted Cotton Production Technology and Constraints in Vidarbha Region of Maharashtra State." was under taken.

However, in spite of many advantages, farmers have their own difficulties for not adopting improved technology at a rapid pace owing to improved methods of cotton production technology requiring management of resources skillfully which requires high precision in handling of farm resources. With this background, present study was undertaken to study the resource use efficiency and cost and returns of cotton in Vidarbha region.

i. To study technology adoption and its impact on production of cotton in Vidarbha region
ii. To examine the constraints in adoption of cotton production technologies in Vidarbha region

METHODOLOGY

The study was conducted in the Vidarbha region of Maharashtra. Two districts from the region *viz.,* Yavatmal and Buldhana and from each district two tahsils were selected on the basis of maximum area under study. Two village from each tahsil were selected. Among each village, 4 samples were selected as per the size group of small, medium and large. The study was based on primary data for the year 2013-14. From each district, 48 farmers were selected who were practicing improved production technology of cotton cultivation. Thus, there were a total of 96 farmers. The farmers were interviewed using specially prepared schedules. The farmers were also asked to prioritize the most important constraints they were facing in adopting improved method of cotton cultivation.

Analytical Tools

Cobb-Douglas Type of Production Function:

To identify the important factors affecting the cotton production technology for cotton cultivation, following Cobb-Douglas type of production function was employed.

$$Y = aX_1^{b_1}X_2^{b_2}X_3^{b_3}X_4^{b_4}X_5^{b_5}e^u$$

Where,
Y= Output of main produce in quintals per hectare
a= Intercept
X_1= Per hectare use of human labour in man days
X_2= Per hectare use of Bullock in pair days
X_3= Per hectare use of Manure in quintals
X_4= Nitrogen (kg) per hectare
X_5= Phosphorus (kg) per hectare
e^u= error term

Estimation of marginal value product

The marginal value products (MVPs) of the individual resources were estimated and compared with the marginal cost (MC). The MVP of individual resources was estimated by using the following formula,

$$\text{Marginal value product(MVP) of } X_i = b_i \frac{\bar{Y}}{\bar{X}} P_y$$

Where,
bi = Elasticity of production of i^{th} input
Y = Geometric mean of output
Xi = Geometric mean of of i^{th} input
Py = Per unit price of output

Technological gap analysis

Yield gap was worked out as the difference between demonstration plot yield and actual farmer's yield. The following Cobb-Douglas type of production function was used for this purpose. (*Guddi et al., 2002)*

$$Y = a_0 H^{a_1}B^{a_2}M^{a_3}N^{a_4}P^{a_5}e^u$$

Where,
Y= Output of main produce in quintals per hectare
a_0= Intercept
H= Per hectare use of human labour in man days
B= Per hectare use of Bullock in pair days
M= Per hectare use of Manure in quintals
N= Nitrogen (kg) per hectare
P= Phosphorus (kg) per hectare
e^u= error term

a_1 to a_5 elasticities of production.

The combination of different resources to yield gap was estimated with the help of Decomposition model. The following functional form was used to work out the yield gap. (Bisliah, 1977) The Chow test was conducted for checking the production elasticity of the two functions.

Technological adoption pattern on sample farm

In order to measure the technology adoption, index the adoption of cotton production technology viz; date of sowing,method of sowing, seed rate, manures, application of FYM and chemical fertilizers and plant protection measures, etc; were considered. The Technology Adoption Index (TAI) in percentage was estimated by using the following formula.

$$TAI = \frac{A_i}{M_i} \times 100$$

Where,
Ai = Average adoption score registered by the farmer for particular component
Mi = Maximum adoption score registered by the farmer for particular component.

RESULTS AND DISCUSSION

Per hectare cost of cultivation cotton for Vidarbha region

The information about per hectare resource use gap of cotton in Vidarbha region is given in Table 1. It is revived from the table that, all the inputs were used below than recommendation except nitrogen and phosphorus use. The per cent gap observed in utilization of human labour, seed and bullock power between farms of sample cultivators and recommended plot was 13.45, 34.68 and 19.31 per cent, respectively. The per hectare utilization of manures was found 9.56 and 75 q on farms of sample cultivators and recommended plot and the per cent gap in the utilization of manures on farms of sample cultivators was found to be 87.26 per cent.

The per hectare use of chemical fertilizers i.e. nitrogen, phosphorous and potash was 134.58, 62.20, 574.41 kg on farms of sample cultivators and 120, 60, 60 on recommended plot, respectively. The per cent excess use was observed more in nitrogen (12.15 per cent) followed by phosphorous (3.66 per cent) and gap of 4.32 per cent in potash. The gap between the yield on sample cultivators farm and demonstration plot was 31.58 per cent.

Table 1: Per hectare resource use gap of cotton for Vidarbha region

Sr.No.	Particulars	Actual	Recommended	Gap	% Gap
1.	Total Human labour (Days)	121.32	140.15	18.83	13.43
2.	Bullock power(pair days)	7.38	9.15	1.77	19.31
4.	Seed (Kgs)	1.63	2.5	0.87	34.68
5.	Manures (q)	9.56	75	65.44	87.26
6.	Fertilizers: N	134.58	120	-14.58	-12.15
	P	62.20	60	-2.20	-3.66
	K	57.41	60	2.59	4.32
7.	Yield (q)	10.26	15	4.74	31.58

(-ve sign indicates excess use)

Per hectare cost of cultivation cotton for Vidarbha region

The information on cost of cultivation of cotton for different size groups of holdings is presented in Table 2. It can be observed from the table that at the overall level, per hectare cost of cultivation of cotton i.e. Cost 'C' was 42161.58. Amongst the different items of cost, charges of family human labour was the major item of cost which accounted for 9,930.69 (23.56 per cent) followed by rental value of land 1,7083.38 (16.80 per cent), hired human labour 6,403.83 (15.19 per cent), fertilizers (NPK) 4,294.50 (10.18), bullock pair 3,191 (7.57 per cent), seed 3087.31 (7.32 per cent), manures 1,911.62 (4.53 per cent) and interest on working capital 1,311.81 (3.11 per cent).Of the total cost of cultivation of cotton, Cost 'A' was 24,378.84 (57.82 per cent) and Cost 'B' was 32230.90 (76.45 per cent).The per hectare total cost of cultivation of cotton was 42,386.95, 40,665.64 and 43082.49 for small, medium and large size group of holdings, respectively. The per quintal cost

Table 2: Item-wise per hectare cost of cultivation cotton for Vidarbha region (Value in Rs.)

Sr. No.	Cost items	Small			Medium			Large			Overall		
		Qty	Value	Per cent	Qty	Value	Per cent	Qty	Value	Per cent	Qty	Value	Per cent
1.	**Hired Human labour (Mandays)**												
	a.Male	20.72	3107.78	7.33	10.78	1616.80	3.98	28.13	4219.50	9.79	21.09	3162.77	7.50
	b. Female	24.03	2883.60	6.80	23.96	2875.15	7.07	30.14	3616.80	8.40	27.01	3241.06	7.69
2.	Bullock power (Pair days)	8.01	3204.00	7.56	8.88	3907.20	9.61	6.15	2706.00	6.28	7.38	3191.00	7.57
3.	Machine power	3.56	44.50	0.10	4.76	571.08	1.40	5.07	607.82	1.41	4.69	494.76	1.17
4.	Seed (Kgs)	1.60	2880.00	6.79	1.70	3342.20	8.22	1.60	2992.00	6.94	1.63	3087.31	7.32
5.	Manures (Qtls.)	15.36	3072.00	7.25	6.95	1389.23	3.42	9.19	1838.67	4.27	9.56	1911.62	4.53
6 .	Fertilizers (Kgs) N	120.19	1945.88	4.59	110.12	1782.84	4.38	156.23	2529.36	5.87	134.58	2178.85	5.17
	P	55.60	1234.32	2.91	45.80	1016.76	2.50	75.60	1678.32	3.90	62.20	1380.79	3.27
	K	60.12	769.54	1.82	48.90	625.92	1.54	62.13	795.26	1.85	57.41	734.86	1.74
7.	Irrigation Charges (Rs.)		712.34	1.68		1009.26	2.48		996.59	2.31		949.83	2.25
9.	Plant protection charges (Rs.)		1125.12	2.65		1036.35	2.55		694.93	1.61		884.51	2.10
10.	Incidental charges (Rs.)		220.45	0.52		223.84	0.55		221.03	0.51		221.85	0.53
11.	Reapirs (Rs.)		421.60	0.99		428.05	1.05		422.68	0.98		424.26	1.01
	Working capital (Rs.)		**21621.12**	**51.01**		**19824.69**	**48.75**		**23318.98**	**54.13**		21863.47	**51.86**
12.	Int.on Working Capital		1297.27	3.06		1189.48	2.93		1399.14	3.25		1311.81	3.11
13.	Depre.on farm impliments		1200.56	2.83		1021.04	2.51		1008.22	2.34		1046.92	2.48
14.	Land revenue and taxes		155.60	0.37		158.07	0.39		156.08	0.36		156.65	0.37
	Cost 'A'		**24274.55**	**57.27**		**22193.29**	**54.58**		**25882.43**	**60.08**		24378.84	**57.82**
15.	Rental value of land		6958.73	16.42		6998.03	17.21		7186.07	16.68		7083.38	16.80
16.	Int.on fixed capital		1310.07	3.09		1620.52	3.98			0.00		768.68	1.82
	Cost 'B'		**32543.35**	**76.78**		**30811.84**	**75.77**		**33068.49**	**76.76**		32230.90	**76.45**
17.	Family labour											0.00	
	a. Male	32.76	4914.00	11.59	40.98	6147.00	15.12	38.12	5718.00	13.27	38.10	5715.26	13.56
	b. Female	41.08	4929.60	11.63	30.89	3706.80	9.12	35.80	4296.00	9.97	35.13	4215.43	10.00
	Cost 'C'		**42386.95**	**100**		**40665.64**	**100**		**43082.49**	**100**		42161.58	**100**
II.	**Output (q)**											0.00	
	a. Main produce	10.00	41600.00		10.11	42057.60		10.46	43042.90		10.26	42459.70	
	b. Bye-produce	10.86	1086.00		8.79	879.00		10.10	1009.98		9.80	980.45	
III.	Cost 'C' net of bye produce		41300.95			39786.64			42072.51			41181.13	
IV	Per quintal cost		**4130.09**			**3935.37**			**4022.23**			**4012.94**	

Figures in parentheses indicate percentage to the respective cost C

Table 3: Results of Cobb-Douglas production function for Vidarbha region

Particulars	Small	Medium	Large	Overall
Intercept	1.6801	0.4939	1.5333	1.7001
Human labour in days (X_1)	0.2985**(0.1126)	0.6635***(0.2285)	0.8117**(0.2761)	0.3320***(0.1036)
Bullock labour in days (X_2)	0.2235*(0.1142)	0.0435(0.2463)	0.1228(0.4613)	0.0376(0.0388)
Machine labour in hr ($X_{3)}$	0.2023(0.2007)	0.0729(0.0656)	0.0923(0.0858)	0.1249(0.1166)
Seed in kg (X_4)	0.0560(0.0936)	0.8764(0.9109)	0.6458(0.8245)	0.4959(0.3731)
Manures in q (X_5)	0.0278**(0.0126)	0.3239**(0.1290)	0.3614***(0.1249)	0.2765*(0.1331)
Nitrogen in kg (X_6)	0.0332**(0.0132)	0.2831**(0.1164)	0.0120(0.2714)	1.1796***(0.4318)
Phosphorus in kg (X_7)	0.0021(0.1449)	0.0014(0.1897)	0.0967**(0.0345)	0.0120(0.2024)
Potash in kg (X_8)	0.1431***(0.0464)	0.3658***(0.1074)	0.6178***(0.1590)	0.0267(0.0849)
R^2	0.68	0.65	0.73	0.74
Observation	32	32	32	96
D.F.	23	23	23	87
F-value	23.53***	24.18***	19.33***	21.50***

Figures in parentheses are standard errors of respective regression coefficients
*, **, *** are significant at 10, 5, and 1 per cent level

of cotton was 4,130.09, 3,935.37 and 4,022.23 for small, medium and large group of holding, respectively. It indicates that per quintal cost of cotton decreased with an increase in size group of holdings.

Results of Cobb-Douglas production function for Vidarbha region

At the overall level, regression coefficients of bullock labour (X2), manures (X4), nitrogen (X6) and potash (X8) were found positive significant. The variables like human labour (X1), seed (X3) and phosphorus (X7) were positive and non-significant which indicates no scope to increase their use in production of cotton on sample farms. It indicates that there is scope to increase the quantity of bullock labour, manures, nitrogen and potash to increase the output of cotton. If we increase bullock labour, manures and potash by 1 per cent the output will be increased by 0.342,0.241 and 0.539 per cent, respectively.

Decomposition analysis of cotton for Vidarbha region

The Table 4 depicted the results of decomposition analysis in Vidarbha region. There was 31.58 per cent yield difference because of adoption of practicing new technology in cotton cultivation.

Table 4: Results of decomposition analysis for Vidarbha region

Source of productivity difference	Percentage contribution
Total difference observed in output	31.58
Source of contribution	
Difference in cultural practices	10.62
Due to difference in input use level	
Human labour	2.71
Bullock labour	-1.12
Seed	2.34
Manure	6.12
Nitrogen	4.02
Phosphorous	3.80
Potash	3.09
Due to all inputs	20.96
Total estimated gap from all sources	**31.58**

The maximum positive difference of input use level was found from manures (6.12 per cent) followed by nitrogen (4.02 per cent), phosphorus (3.80 per cent), potash (3.09 per cent), human labour (2.71 per cent) and seed (2.34 per cent).

Technology adoption index in Vidarbha region

At the overall level the technology adoption index of method of sowing technology component was observed maximum (84.03 per cent) on sample farms followed by date of sowing (74.65 per cent), variety (64.58 per cent), seed rate (61.81 per cent), nitrogen (46.18 per cent), phosphorus (34.38 per cent). At the overall level, the lowest technology adoption indices were found in use of manures component (28.13 per cent), plant protection measures (31.61 per cent) and application of potash fertilizers (32.99 per cent).

Table 5: Technology adoption index on sample farm for Vidarbha region (Per cent)

Sr. No.	Component	Size group			Overall
		Small	Medium	Large	
1.	Date of sowing	72.92	75.00	76.04	74.65
2.	Seed rate	60.42	61.46	63.54	61.81
3.	Variety	63.54	64.58	65.63	64.58
4.	Method of sowing	82.29	84.38	85.42	84.03
5.	Manures	25.00	28.13	31.25	28.13
6.	Nitrogen	43.75	44.79	50.00	46.18
7.	Phosphorous	33.33	34.38	35.42	34.38
8.	Potash	30.21	33.33	35.42	32.99
9.	Plant protection	25.00	31.25	38.54	31.61
10.	Composite Index	48.50	50.81	53.47	50.93
11.	Yield (q)	12.45	9.19	16.46	10.40

At the overall level, the composite index of technology adoption was worked out to 50.93 per cent indicated that the sample farmers adopted less than 49 per cent recommended cotton production technology obtaining

Table 6: Impact of improved cotton production technology for Vidarbha region

Particulars	Low adopters	Medium adopters	Low to Medium % impact	High adopters	Medium to High % impact
Adoption %	42.92(Below 50)	57.92(50-70)		72.93(Above 70)	
Yield (q/ha)					
Main produce	9.52	10.89	12.58	11.96	8.94
By-produce	5.86	6.74	13.06	7.10	17.46
Economics(Rs/ha)					
Gross returns	40246.00	43057.00	6.53	44542.00	3.98
Cost of cultivation	36946.00	38844.00	4.89	39437.00	2.73
Net returns	3300.00	4213.00	21.67	4105.00	19.61
B:C ratio	1.09	1.11		1.12	
Cost effectiveness of improved cotton production technology					
Added returns		2811.00		1785.00	
Added cost		1898.00		1093.00	
ICBR ratio		1.48		1.63	
Cost (Rs./q)	3880.88	3566.94		3339.21	
Unit cost reduction (Rs./q)		313.94		227.73	
% reduction		8.09		6.28	
Added yield (q)		1.37		1.07	
% increase in Yield		14.40		9.94	

Table 7: Constraints in adoption improved production technology of cotton for Vidarbha

Particulars	Group			Overall
	Small (N=32)	Medium (N=32)	Large (N=32)	(N=96)
Rainfall				
Abnormal distribution of rainfall	53.13	43.75	37.50	44.79
Inadequate	46.88	40.63	37.50	41.67
Seed rate				
High cost	62.50	56.25	56.25	58.33
Lack of awareness	40.63	40.63	37.50	39.58
Time of sowing and variety				
Lack of awareness	43.75	40.63	37.50	40.63
Non-availability of proper variety seed	62.50	59.38	59.38	60.42
Method of Sowing				
Recommendation not known	46.88	37.50	40.63	41.67
Expensive and more labour required	65.63	62.50	59.38	62.50
Seed treatment				
Unawareness	46.88	68.75	65.63	60.42
High cost	59.38	50.00	46.88	52.08
Fertilizer application				
High cost of fertilizer	81.25	78.13	75.00	78.13
Inadequate supply	50.00	43.75	40.63	44.79
Lack of knowledge about fertilizers	46.58	50.00	50.00	48.96
Irrigation				
unavaibility of irrigation sources	68.75	56.25	53.13	59.38
lack of irrigation technology	75.00	62.50	59.38	65.63
Labour				
Inadequate	43.75	37.50	31.25	37.50
High wage rates	84.38	78.13	75.00	79.17
Non-availability at peak period	62.50	68.75	65.63	65.63
Plant protection				
Inadequate supply	34.38	37.50	34.38	35.42
Higher cost	65.63	65.63	62.50	64.58
Improved implements				
High cost	37.50	43.75	40.63	40.63
Poor economic condition	65.63	46.88	43.75	52.08
Small and fragmented land holding	65.63	56.25	53.13	58.33
Lack of technical know-	50.00	53.13	46.88	50.00
Low price to produce	78.13	75.00	71.88	75.00

10.40 q/ha yield (Table 5). The highest composite index of technology adoption was in case of large (53.47 per cent) size group of farmers followed by medium (50.81 per cent) and small group of farmers (48.50 per cent). It is concluded from the table that, all the farmers have adopted the improved cotton production technology more than 50 per cent except application of manures, use of plant protection, phosphorus and potassic fertilizer measures.

Impact of improved cotton production technology for Vidarbha region

The impact of improved cotton production technology in Vidarbha region is presented in Table 6. The impact on per hectare yield of main produce was found to be 12.58 and 8.94 per cent in the medium adopters and high adopters, respectively. Among, in medium adopters, the per hectare economic impact of cotton production technology on gross return, cost of cultivation and net returns was 6.53, 4.89 and 21.67 per cent, as compared to the low adopters, whereas in high adopters over the medium adopters, it was 3.98, 2.73 and 19.61 per cent, respectively. The added yield was 1.37q/ha in the medium adopters over the low adopters and in the high improved method of adoption, it was 1.07q/ha over the medium adopters. Thus, for producing extra yield per hectare costs and added returns were also increased.

The ICBR ratio indicates that the high adoption improved production technology adopter farmers were in profit with 1.63 ICBR ratio. It indicates that, the farmers should adopt the improved production technology for cotton to the fuller extent for maximizing returns and minimizing per unit cost.

Identification of major constraints in adoption improved production technology of cotton for Vidarbha

The information regarding various constraints faced by the cultivators growing cotton is presented in Table 7. The constraints regarding rainfall like abnormal distribution of rainfall and inadequate rainfall were reported by 44.79 and 41.67 per cent farmers, respectively at the overall level. Low price to produce, high price of fertilizer, High wage rates, lack of irrigation technology, expensive and more labour required and high cost of seed was common complaint reported by above 50.00 per cent of the farmers. In case of method of sowing, about 42 per cent farmers expressed difficulties to know the recommendation. The constraints regarding adoption of improved cotton production technology were reported similar trends in small, medium and large size group of holdings, respectively.

CONCLUSION

The resource use gaps were highest in use of FYM and seed rate. Whereas per hectare resource use gap of cotton in Vidarbha region the yield gap was to be found 31.58 per cent. The cost of production of cotton and the Benefit: cost ratio of cotton was greater than unity. Therefore, cotton is profitable enterprise; it was due to the introduction of Bt cotton cultivation. The positive and significant coefficients indicated that, one unit increase in the use of human labour, manures, nitrogen and phosphorus will minimise the gap. The decomposition function revealed that 31.58 per cent yield increase was to adoption of new technologies in cotton. High level adoption impact of cotton production technologies helped to increase the annual income and employment of the sample farm families. The major constraints in asoption of cotton production technology were high cost of inputs, unawareness and low price to produce.

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Impact assessment of production technology of paddy in Nashik district in Maharashtra

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ABSTRACT

Paddy (OryzasativaL.) is one of the important cereal crops of the world and forms the staple food for more than 62 per cent of the world people. The data was collected for the year 2014-15. The study covered 90 Paddy farmers, 15 each from small (Upto 0.20 ha), medium (0.21 to 0.40 ha) and large (Above 0.41 ha) size groups, spread over six village of the Igatpuri and Trimbakeshwar tehsil of Nasik District.The use of total human labour was 109.27 man days per hectare, comprising 60.91 male and 48.36 female labor days. The per hectare bullock power utilization was observed more in case of low adopters group (13.76 Pair days) than the other groups. Factor share analysis interpret that, char-sutrimetho showed highest contribution (i.e.32.84 per cent) on yield, followed by Urea (19.76 percent). Number of manures and patash shows nearly contribution of about 12.02 and 14.84 percent respectively. Intercultural operation, Planting distance, Transplanting time contributes about 8.09 percent, 6.08 percent, 2.43 percent respectively.Yield gap I was found 15 quintals (23.08 percent). The Yield gap II was 12.21 quintal (24.22%) for low, 7.66 quintals (15.32%) for moderate, 5.47 quintals (10.94%) for high adoption level. Highest yield gap was found in low adoption level followed by medium and high adoption level. The Yield Gap III for low adoption level was 27.21 quintals (41.86%) for high adoption level. Highest yield gap III was found in low adoption level followed by medium and high adoption level. The major constraint faced by all adoption levels farmers was costly chemical fertilizers, which expressed by 96.88 percent of low, 91.11 percent of medium and 96.88 percent of high adoption levels farmers. Next constraints conveyed by 89.03 percent of farmers were delay in availability chemical fertilizer on proper time.The majority of the farmers'experienced the problems like high cost of key inputs and their non-availability at proper time. Also high interest rate was the main constraints to barrow loan for paddy production

Keywords: *Paddy, production technology, Impact*

INTRODUCTION

Paddy (*OryzasativaL.*) is one of the important cereal crops of the world and forms the staple food for more than 62 per cent of the world people. Rice has shaped the culture, diets and economics of thousands of millions of people. India is one of the leading rice producing countries of the world. The cultivated area of India is 43.39 M ha and production of 104.32 Mt and productivity 2404 kg/ha in 2015-16. The leading states in rice cultivation are: West Bengal, Uttar Pradesh, Orissa, Andhra Pradesh and Punjab. Maharashtra is one of the major rice growing states in India. Paddy is grown on15.03 Lakh ha with an annual production of 25.93 lakh tonnes and productivity at 1725 kg ha during the year 2015-16.Maharashtra ranks12th in production and 13th in productivity among major rice growing states of the country. Paddy is the second largest important crop next to jowar in Maharashtra. The position of Maharashtra in rice production is comparatively poor. In the state, paddy is grown in districts with varying extent. However, the major rice growing districts are Thane and Raigad in Konkanregion, Kolhapur and Nasik districts in Western Maharashtra region, Nanded and Parbhani districts in Marathwada region, Bhandara and Gondia districts in Vidarbha region.

The present study is an attempt to analyze the impact of improved technologies on paddy production in Nashik district of Maharashtra. The reasons for the rate of adoption lagging behind expectation have been virtually unexamined. Therefore, a study which focuses on both aspects of technical changes *i.e.* its impact on yield, returns etc. as well as the reasons for non-adoption of improved technology assumes great importance. Considering the above facts, the present study was undertaken to assess the economics and extent of adoption of technology in kharif paddy production.

METHODOLOGY

The study was conducted in Nashik District in Maharashtra state. Two tehsils viz, Igatpuri and Trimbakakeshwar were selected on the basis of maximum area under paddy. From each district, 45 farmers was selected who were practicing improved production technology of paddy of cultivation on the basis of small, (upto 0.20) medium (0.21 to 0.40) and large size (above 0.41) ha group holding. The study was based on primary data which was collected of 90 paddy cultivators for the year 2014-15. The farmers were interviewed using specially prepared schedules. The farmers was also asked to prioritize the most important constraints they were facing in adopting improved method of paddy cultivation.

Technological gap analysis

Yield gap was worked out as the difference between demonstration plot yield and actual farmer's yield. The following Cobb-Douglas type of production function was used for this purpose (*Gaddi et al, 2002)* [8]

where,

Y = Output of main produce in quintals per hectare

a_0= Intercept

H = Use of human labour in man days (per hectare)

B = Use of bullock in pair days (per hectare)

M = Use of manure in quintals N = Nitrogen (kg) per hectare

P = Phosphorus (kg) per hectare e^u = error term

The combination of different resources to yield gap was estimated with the help of Decomposition model. The following functional form was used to work out the yield gap. *(Bisliah, 1977)*. The Chow test was conducted for checking the production elasticity of the twofunctions.Log (Y /Y) = [Log (b /a)] + [(b -a) Log H +(b -a)

Technological adoption index

Technology Adoption Index (TAI) was worked out as per Kiresur*et al*. (1996) with the help of following formula.

$$TAI = \frac{A_i}{M_i} X\ 100$$

where,

A_i = Average adoption score registered by the farmer forparticular component

M_i = Maximum adoption score registered by the farmer for particular component.

Constraints in adoption of improved production technology of paddy in Maharashtra. The constraints were estimated with help of percentages.

RESULTS AND DISCUSSION

Cropping Pattern

At the overall level in kharif season paddy and nagali are the major crop which covered 25.66 and 12.87 percent area to gross crop area .Groundnut is major crop observed in all groups of the selected farmers. In rabbi season, wheat occupied 25.35 percent of gross cropped area. In small and medium size group, wheat have dominated share of 28.27 and 25.35 percent respectively, while in large group,the share is only 22.42 percent (Table 1).

Figures in the parenthesis indicate percentage

Extent of adoption of recommended technology and average index**.**

The extent of adoption of recommended technology rate adopted by different size groups of farmers was calculated and presented in Table 2. This technique was used to study the separate analysis for estimation of cost, returns and profitability in each group was carried out to know the impact of technology on productivity and per quintal cost of cultivation of paddy.

Resource Use Structure

The utilization of different inputs by selected adopters was presented in Table 3. At the overall level the use of total human labour was 109.27 man days perhectare, comprising 60.91 male and 48.36 female labour days. The use of bullock labour per hectare was 7.8 pair days. The per hectare bullock power utilization was observed more in case of low adopters group (13.76 Pair days) than the other groups. The utilization of machine power per hectare was observed to 5.94 hrs. The highest use of machine power was observed more 11.48 hrs in case of high adopters group than moderate and low adopters groups. The utilization of seed was 59.62 kg /ha which is higher than the recommended seed rate for paddy (40kg/ha).At the overall level, the use of manure was 20.58 q/ha. The use of manure was found more in moderate size group

Table 1. Cropping pattern of selected farmers (ha)

Particulars	Size Groups			Overall
	Small	Medium	Large	
Kharif				
Paddy	0.35 (24.14)	0.59 (27.19)	0.72 (25.62)	0.55 (25.66)
Nagali	0.17 (11.73)	0.26(11.98)	0.42 (14.95)	0.28 (12.87)
Sub-Total	0.52 (35.87)	0.85(39.17)	1.14 (40.57)	0.83(38.53)
Rabi				
Wheat	0.41 (28.27)	0.55(25.35)	0.63 (22.42)	0.54(25.35)
Gram	0.12 (8.27)	0.13(5.99)	0.22 (7.83)	0.15 (7.36)
Sub-total	0.53 (36.54)	0.68(31.34)	0.85 (30.25)	0.69(32.71)
Summer				
Groundnut	0.33 (22.76)	0.49(22.58)	0.60 (21.35)	0.47(22.23)
Vegetables	0.07 (4.83)	0.15(6.91)	0.22(7.83)	0.15(6.53)
Sub- total	0.40 (27.59)	0.64(29.49)	0.82 (29.18)	0.62(28.76)
G.C.A.	1.45 (100.00)	2.17(100.00)	2.81 (100.00)	2.14(100.00)
Net cropped area	0.94	1.14	1.49	1.19
Cropping Intensity (%)	154.25	190.35	188.59	179.83

than low and high adopters.The per hectare use of chemical fertilizers i.e. NPK, WAS 110.52,63.40 AND 24.27 kg/ha respectively. The low adopter group farmers used more fertilizers than moderate and high adopters group. The per hectare irrigation charges was more in high adopters group Rs. 2579/ha than that of moderate as Rs.2251.44/haand low as Rs. 684.2 /ha adopter groups. The plant protection charges incurred for paddy crop was Rs.502.61.

Table 2. Extent of adoption of recommended technology and average index.

TAI Range%	No of farmers	Adoption level	Average TAI	Yield/ha
Up to 62.45	24	low	59.93	37.79
62.46 to 79.17	45	Moderate	69.91	42.34
Above79.17	21	High	88.44	44.53
Total	90	Overall	71.57	41.63

Costs and return structure

It is observed that paddy crop is profitable crop at the overall level considering the all cost in Economics, as evident from the Table5.

Table 5: Costs and Return Structure of selected farmers (per ha)

Particulars	Adopters			
	Low	Moderate	High	Overall
Total cost				
Cost 'A'	38598.04	43755.43	51555.00	44200.02
Cost 'B'	50608.2	57545.62	70441.88	58693.0
Cost 'C'	62232.2	66709.62	77591.91	68043.17
Profit at				
Cost 'A'	27263.46	32587.47	34335	31505.5
Cost 'B'	15253.3	18797.28	15448.12	17012.41
Cost 'C'	3629.3	9633.28	8298.12	7662.35
Production	37.79	42.34	44.53	41.63
Gross income	65861.5	76342.9	85890.00	75705.52
B:C Ratio at				
Cost 'A'	1.17	1.74	166	1.71
Cost 'B'	1.3	1.33	1.22	1.28
Cost 'C'	1.06	1.14	1.11	1.11

Table 3: Resource use structure of selected sample farmers (Per/ha)

Particulars	Unit	Adopters			
		Low	Moderate	High	Overall
Total Human Labour	days	130.54	107.34	88.69	109.27
Male		75.90	58.60	48.74	60.91
Female		54.64	48.74	39.95	48.36
Bullock power	pair days	13.76	5.41	4.77	7.48
Machine power	hr.	1.1	5.95	11.48	5.94
seed	kg	60.48	60	57.83	59.62
Manures	q	21.16	21.34	18.29	20.58
Fertilizers	kg				
N		113.50	112.08	103.81	110.52
P		66.23	50	88.90	63.40
K		24.41	25	22.58	24.27
Irrigation Charges	Rs.	684.2	2251.44	2579	1909.94
P.P charges	Rs.	525.97	510.20	459.67	502.61

Contribution of different recommended technology on yield. It is observed that charsutri method showed highest contribution (32.84%) on yield followed by urea (19.76 %) the contribution of manures and potash about 12.02 and 14.84% respectively. The contribution of intercultural operation, planting distance and transplanting contributes about 8.09, 8.05 and 4.40% respectively. The contribution of different recommended technology on yield was presented in Table 4.

Table 4. Contribution of different recommended tech.

Technology	Variables	Percent contribution
Transplanting time(days)	X_1	4.40
Planting distance (cm)	X_2	8.05
Manures tones / ha	X_3	12.02
Urea kg/ha	X_4	19.76
Potash kg/ha	X_5	14.84
Intercultural operation	X_6	8.09
Char-sutri method (No.)	X_7	32.84

The total yield per hectare obtained from paddy at the overall level was 41.63 q. The per hectare yield among the group the yield was 37.79, 42.34 and 44.53 q/ha in low,medium and large size groups respectively. The per hectare gross income received was Rs. 65861.5 ,Rs. 76342.9 and Rs. 85890 for low,moderate and high adopters levels, respectively. At the overall level the gross income was Rs 75705.52. The cost C per hectare was Rs. 7662.35 at the overall level and Rs.3629.3, 9633.28 and 8298.12 in low,medium and high group respectively. The benefit cost ratio at cost c was highest in case of moderate adopters group (1.14) followed by high adopters (1.11), low adopter group (1.06) and at the overall level it was 1.11 respectively. The benefit cost ratio in all groups was more than unity, therefore the cultivation of paddy is viable economic proposition in all the adopter range of Rs. 3000 to 9000 per hectare.

Yield gap I analysis

The potential yields was 65 q and farm location trial yield was 50q/ha. Yield obtained was based on

adoption of technology recommended by MPKV, Rahuri. Yield gap I analysis of paddy crop was presented in Table 6.

Table 6. Yield gap I in Paddy Crop

Particulars	Quintals
Potential yield	65.00
FLT yield	50.00
Yield gap	15.00
Yield gap (%)	23.08

Yield gap II and III analysis

The yield obtained by low,moderate and high adoption level was 37.79, 42.34 and 44.53 quintals in farmers and actual yield gap was 12.21q (24.22%) for low, 7.66 (15.32) in medium and 5.47 (10.94) in high groups respectively. At the overall level yield gap was 8.37 q (16.74%). The yield gap III worked out for different adoption level and the result was 27.21q (41.86%), 22.66q (34.86%) and 23.37 (35.95%) in low, medium and high groups respectively.

Table 7. Yield gap II and III in paddy

Particulars	Adoption Levels			Overall
	Low	Moderate	High	
Yield gap II				
Yield obtained	37.79	42.34	44.53	41.63
FLT gap	50.00	50..	50.00	50.00
Yield gap	12.21	7.66	5.47	8.37
Yield gap (percent)	24.22	15.32	10.94	16.74
Yield gap III				
Yield obtained	37.79	42.34	44.53	41.63
Potential yield	65.00	65.00	65.00	65.00
Yield gap	27.21	22.66	20.47	23.37
Yield gap (Percent)	41.86	34.86	31.49	35.95

Constraints in adoption of recommended production technology

The information regarding various constraints faced by the cultivators growing paddy in kharif season is presented in Table 8.The natural constraints Natural constraints like rainfall abnormal distribution of rainfall and inadequate rainfall was reported by 26.55 %, 58.82% and 49.39% farmers respectively at overall level. The constraints regarding HYV seed material was high cost of seed, inadequate supply and non-availability in times which was 100%,27.21% and 39.69 % farmers,respectively. Cent percent adopters of all three categories quoted the constraint of high cost of seed, About chemical fertilizers problem like high cost,inadequate supply, untimely supply and lack of knowledge in application fertilizers was reported by 74.76 percent, 28.35%, 51.77% and 13.15% farmers respectively. Availability of labour was another important constraint. Inadequate supply of labour, high wage rates and non-availability of labour in peak period was reported by 37.16 %, 91.05 % and 38.15% sample farmers, respectively. Regarding credit, inadequate owned capital, complicated loan procedure, untimely supply and inadequate supply was difficulties reported by 38.19%, 34.11%, 28.61% and 37.32% sample farmers, respectively.

In case of seed treatment, constraints like unawareness, more labour requirement and time consuming are the major constraints of line transplanting was reported by 11.11% 89.29% and 62.33% farmers, respectively at an overall level. In low and transplanting in adoption of modern technologies in paddy production was high labour requirement and time consuming method. The constraints regarding adoption of improved implements was high cost, poor economic condition

Table 8. Constraint in adoption of recommended production technology of Paddy

Particular	Low	Moderate	High	Overall
Constraints regarding rainfall				
Excess	20.83	33.82	25.00	26.55
Abnormal distribution of Rainfall	50.00	76.47	50.00	58.82
Inadequate	70.83	30.88	46.43	49.39
Constraints regarding HYV seed				
High cost	100	100	100	100
Inadequate supply	37.5	44.12	00	27.21
Non availability in time	54.17	47.06	17.86	39.69
Fertilizer application				
High cost	83.33	83.82	57.14	74.76
Inadequate supply	29.17	55.88	00	28.35
Untimely supply	66.67	52.94	35.71	51.77
Lack of knowledge at peak period	29.17	10.29	00	13.15
Labour constraints				
Inadequate	41.61	17.65	53.57	37.61
High wage rates	100	100	82.14	94.05
Non availability at peak period	29.17	35.29	50.00	38.15
Credit constraint				
Inadequate owned capital	83.33	19.12	14.29	38.91
Complicated loan procedure	45.83	27.94	28.57	34.11
Untimely supply	37.5	16.18	32.14	28.61
Inadequate supply	50.00	19.11	42.86	37.32

Plant Protection measures				
Inadequate supply	00	00	00	00
Higher cost	100	100	57.14	85.71
Non availability in time	25.00	00	00	8.33
Seed treatment				
Unawareness	62.50	37.76	17.86	39.37
High cost	33.33	13.24	00	15.52
Line transplanting				
Unawareness	33.33	00	00	11.11
Labour requirement is more	100	100	67.86	89.29
It is time consuming method	100	44.12	42.86	62.33
Improved implements				
High cost	29.17	19.12	17.86	22.05
Poor economic condition	58.33	19.12	00	25.82
Small and fragmented land Holding	62.50	11.76	25.00	33.09
Lack of technical Know-how	88.42	29.41	10.71	42.85
Low MSP	100	88.24	85.71	91.32

and small and fragmented land holding reported by 22.05% 25.82% and 33.095 farmers respectively.Lack of technological know-how to attaining higher yields was expressed by 88.42% in low adopters,49.41% moderate adopters and 10.71% high adopters. Other constraints like the low MSP to farm produce was reported by cent percent in low adopters,88.24% in moderate adopters and 85.11% in high adopters.

CONCLUSION

In kharif season, paddy and nagali are the major crop which covered 25.66 and 12.87 percent area to gross crop area.This technique was used to study the separate analysis for estimation of cost, returns and profitability in each group was carried out to know the impact of technology on productivity and per quintal cost of cultivation of paddy.Yield gap I was found 15 quintals (23.08 percent). The yield gap II was found 12.21 quintal (24.22%) for low, 7.66 quintals (15.32%) for moderate, 5.47 quintals (10.94%) for high adoption level. Highest yield gap was found in low adoption level followed by medium and high adoption level. The Yield Gap III for low adoption level was 27.21 quintals (41.86%) for high adoption level. Highest yield gap III was found in low adoption level followed by medium and high adoption level.The major constraint faced by all adoption levels farmers was costly chemical fertilizers, which expressed by 96.88 percent of low, 91.11 percent of medium and 96.88 percent of high adoption levels farmers. Next constraints conveyed by 89.03 percent of farmers were delay in availability chemical fertilizer on proper time. The majority of the farmers experienced the problems like high cost of key inputs and their non-availability at proper time. Also high interest rate was the main constraints to barrow loan for paddy production.

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Impact of climate change on crop production

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ABSTRACT

The proposed study was undertaken with the aim to study impact of climate change on sorghum and paddy crop, for sorghum in Akola and Washim district and for Paddy in Bhandara and Gondia district of Maharashtra state. In Akola district, cotton and other pulses were major crops of the District during 2000-2001 constituting 67.50 per cent of total cropped area but during span of 15 years the area under cotton reduced by 14 per cent and soybean emerged as of major crop occupying 43.50 per cent of gross cropped area of region. In Washim district, cotton and other pulses were major crops of the District during 2000-2001 constituting 66 per cent of total cropped area, but during the span of 15 years the area under cotton and kharif jowar is reduced by 15.84 and 13.07 per cent respectively and soybean emerged as of major crop occupying 66.24 per cent of gross cropped of region. In Gondia district, there is a single crop domination i.e. Rice with 90.19 per cent of gross cropped area in the year 2015. There is a very little crop diversification in Gondia district. In Bhandara district, cultivation of rice is sole and major constituent of the cropping pattern. This crop occupies around 82.54 per cent of gross cropped area in 2015.
Keywords: *Climate change, crop production, impact*

INTRODUCTION

The effects of climate change on food production are not limited to crops. It will affect food production and food security via its direct or indirect impact another components of the agricultural production systems, especially livestock production which is closely linked with crop production. Livestock in India are raised under mixed crop-livestock systems deriving a substantial share of their energy requirements from crop by-product and residues. Any decline in crop area or production will reduce fodder supplies. Heat stress on animals will reduce rate of feed intake. The higher temperatures and changing rainfall patterns may cause increased spread of the existing vector-borne diseases and macro-parasites, alter disease pattern, give rise to new diseases and affect reproduction behavior. All these factors will affect performance of the livestock.Global climate change will affect all economic sectors to some degree, but the agricultural sector is perhaps the most sensitive and vulnerable. World agriculture, may be in developing or developed countries remains very dependent on climate resources. The impact of climate variability on agricultural production is important at local, regional, national, as well as global scales. Crop yields are affected by variations in climatic factors such as air temperature and precipitation, and the frequency and severity of extreme events like droughts, floods, hurricanes, windstorms and hail.

Indian agriculture is facing challenges due to several factors such as increased competition for land, water and labour from non-agricultural sectors and increasing climatic variability. The latter associated with global warming will result in considerable seasonal/annual fluctuations in food production. All agricultural commodities even today are sensitive to such variability. Droughts, floods, tropical cyclones, heavy precipitation events, hot extremes and heat waves are known to negatively impact on agricultural production, and farmers' livelihood. Therefore, the present study was undertaken to study the changes in temperature and rainfall and its impact and implications on farm level adjustment.

METHODOLOGY

The present study is based on secondary data. The data of area and production of these crops was taken from the Publication of Dept .of Agriculture, Govt. of Maharashtra. The data collected on weekly rainfall and temperature for the Akola, Washim, Gondia and Bhandara district for the years from 2001 to 2015 from the Meteorological Department Dr. PDKV. Akola.

Changes in Temperature and Rainfall

Mean and CV (%) for weekly rainfall and temperature data is calculated for the behavior of weekly rainfall and temperature in selected district.

$$CV\ (\%) = \frac{\text{SD}}{\text{Mean}} X\ 100$$

where,

CV (%) = Coefficient of Variation
SD = Standard Deviation

Impact of climate change on yield

Yield(Y) is dependent variable, whereas rainfall and temperature at three crop stages, are independent variables. The three crop stages of Sorghum are taken such as seedling, flowering and grain filling stage, And for Paddy such as seedling, flowering and grain filling stage.

$$Y=a+b_1X_{1tmin}+b_2X_{2tmax}+b_3X_{3r}+b_4X_{4tmin}+b_5X_{5tmax}+b_6X_{6r}+b_7X_{7tmin}+b_8X_{8tmax}+b_9X_{9r}$$

Where,

Y = Yield per ha.
a = Intercept
X_{1tmin} = Minimum temperature at seedling stage
X_{4tmin} = Minimum temperature at flowering stage
X_{7tmin} = Minimum temperature at grain filling stage
X_{2tmax} = Maximum temperature at seedling stage
X_{5tmax} = Maximum temperature at flowering stage
X_{8tmax} = Maximum temperature at grain filling stage
X_{3r} = Rainfall at seedling stage
X_{6r} = Rainfall at flowering stage
X_{9r} = Rainfall at seedling stage

RESULTS AND DISCUSSION

The present study is undertaken in Akola and Washim district from which data related to Sorghum is obtained .The data related to rainfall and temperature for Paddy is studied for Bhandara and Gondia districts. The above area are selected for study because Sorghum and Paddy are major crops grown in this region and part of daily diet in study area.

Changes in rainfall

The wide variability was observed in all the 20 weeks most of the weeks have zero minimum rainfall while the maximum rainfall over the weeks ranges between 45 to 231.9(mm). The inconsistency within week over the years is revealed by CV (%) ranging between 48.41 to 265.52 % indicating unreliability of average the years (Table 1). It is also revealed that wider variability was observed in all the 20 weeks most of the weeks have zero minimum rainfall while the maximum rainfall over the weeks ranges between 26.5 to 391(mm). The inconsistency within week over the years is revealed by CV (%) ranging between 59.21 to 239.14 % indicating unreliability of average the years.

Gondia district also witnessed wider variability in all the 20 weeks and most of the weeks have zero minimum rainfall while the maximum rainfall over the weeks ranges between 3 to 220.40 (mm). The inconsistency within week over the years is revealed by CV (%) ranging between 55.76 to 294.55 % indicating unreliability of average the years.Similarly, BhandaraDistrict also witnessed wider variability in all the 20 weeks with most of the weeks have zero minimum rainfall while the maximum rainfall over the weeks ranges between 18 to 337.2 (mm). The inconsistency within week over the years is revealed by CV (%) ranging between 51.32 to 254.50 % indicating unreliability of average the years (Table 1).

Changes in Maximum Temperature

In Akola, Washim, Gondia and BhandaraDistrict, consistency in maximum temperature observed within week over the period 2001-2015 in all four districts (Table 2).

Changes in Minimum Temperature

In Akola, Washim, Gondia and Bhandara district, consistency in minimum temp. observed within week over the period 2001-2015 in all four districts (table 2).

Contribution of weather parameter in yield of sorghum in Washim district

The regression line for Washim district described 70% yield, irrespective of the effect of the weather. The major influence in parameter was the rainfall at seedling stage in sorghum which adversely affects the crop yield,while the minimum temperature and rainfall at crop stage 3rd or at grain filling stage found to be major yield contributor. All nine variable taken together and explain 81.37% contribution in describing the crop yield. The value of coefficient of determination the rainfall at seedling stage, minimum temperature and rainfall at grain filling stage are the major contributor.The regressionbetween yield of sorghum and weather parameter of (22-41MW) for Akola districtover a period of 15 years is presented in the Table which shows that sorghum yield and weather parameter related to (22-41MW) did not show any significant regression.

Contribution of weather parameter in yield of Paddy in Gondia district

The constant of the regression line for Gondia district described 70% yield, irrespective of the effect of the weather. The major influence in parameter was the rainfall at seedling stage in paddy which adversely affect crop yield. All nine variable taken together and explain 66.62% contribution in describing the crop yield. The value of coefficient of determination the minimum and maximum temperature at flowering stage is the major contributor. For Bhandara district, the regression between yield of Paddy and weather parameter of (22-41MW) over a period of 15 years is presented in Table which shows that paddy yield and weather parameter related to (22-41MW) did not show any significant regression.

Changes in cropping pattern

In Akola district, cotton and other pulses were major crops of the District during 2000-2001 constituting 67.50 per cent of total cropped area. In the span of 15 years cropping pattern has changed substantially in the district. The proportion of area under cotton has rseduced by 14 per cent. In case of kharifjowar, its share over gross cropped area has fallen to the level of 2.82 per cent in 2015 from 10.93 per cent in 2001. Soybean crop is emerging as one of the major crops of the region occupying 43.50 per cent of gross cropped area of the region.

Consistency in minimum temperature observed within a week (2001-2015)

The changes in the cropping pattern in Washimdistrict for 2001-2015 are presented in Table 18. Cotton and Other pulses were major crops of the District during 2000-2001 constituting 66 per cent of Total cropped area. The proportion of area under Tur over gross cropped area is found to be constant for the period 2001-2005 and maintained a level in the neighborhoods of ten per cent. The area of kharifjowar

Table 1: Changes in weekly average, maximum and minimum rainfall in akola, washim, bhandara and gondia District

	Akola Rainfall				Washim Rainfall				Bhanadar Rainfall				Gondia Rainfall			
Weeks	**Mean**	**CV**	**MIN**	**MAX**	**Mean**	**CV**	**MIN**	**MAX**	**Mean**	**CV**	**MIN**	**MAX**	**Mean**	**CV**	**MIN**	**MAX**
22	6.47	265.5	0	45	4.59	206.7	0	26.5	3.34	194.2	0	18	0.36	265.8	0	3
23	15.09	163.3	0	47.3	24.07	127.1	0	92.21	12.09	133.4	0	42.31	10.01	133.1	0	45.41
24	40.29	112.3	0	138	84.07	108	0	284.2	59.96	145.4	0	315.2	41.38	143.8	0	186.4
25	26.29	72.63	1.52	59.4	37.79	83.88	0	76.84	41.98	86.75	3.4	124.1	33.18	76.85	0	72.61
26	48.59	120.1	0	195	81.89	108.7	0	296	99.51	94.41	1.81	235.4	56.8	82.65	0	152.6
27	47.33	109.5	0	144	62.98	101.2	0	225	72.14	79.16	0	201	54.65	73.05	0	136.4
28	20.28	81.84	0	48.6	47.17	91.31	0	106	58.71	83.08	0	151.4	63.98	83.09	2.21	169.8
29	38.61	48.41	13	68.9	66.41	84.76	12	226.5	98.65	51.32	43.44	238.9	62.84	75.62	3.42	179.8
30	63.05	73.86	1.81	89.7	84.85	86.66	0	182	93.57	60.97	11.61	181	112.3	55.76	21.4	220.4
31	60.97	111.3	0.52	185	105.3	81.88	0	256.6	81.07	77.86	0	224.6	84.69	74.9	0	211.4
32	42.63	131.1	4.21	231.9	67.87	142.6	0	391	107	68.02	30	293.6	78.95	83.01	16.61	2911
33	22.44	115.8	0	100.4	26.19	91.69	0	65	85.91	79.05	7.21	258.6	67.09	82.08	0	157.8
34	28.15	86.38	0	69.62	60.31	131.9	0	203	68.98	97.92	3	191.2	39.07	66.94	0	103.8
35	29.77	101.2	0	82.12	62.33	101.3	0	204.9	63.77	103.5	0	255.2	61.09	96.65	0	184
36	51.86	65.93	0	109.1	51.63	59.21	0	102.6	87.95	104.2	0	337.2	49.81	115.2	0	218.8
37	30.08	139.2	0.6	145.6	26.82	153.4	0	155.2	45.28	126.3	0	186	32.69	156.5	0	150
38	27.79	118.6	0	104.3	43.39	104.9	0	127	32.09	96.27	0	109.9	25.31	112.3	0	100.6
39	17.47	154.7	0	74	18.91	139.3	0	55	20.71	126.7	0	85.84	10.31	172.5	0	64.21
40	26.05	133.1	0	103.1	30.1	175.4	0	191.2	27.22	147.9	0	153	15.26	125.6	0	53.61
41	4.15	160.6	0	18	11.57	239.1	0	106.3	3.85	254.5	0	35.83	4.16	294.6	0	45.64

Table 2. Changes in maximum temperature in Akola, Washim, Bhandara and Gondia district

	Akola Max Temp.				Washim Max Temp				Gondia Max Temp				Bhandara Max Temp			
Weeks	Mean	CV	MIN	MAX	Mean	CV	MIN	MAX	Mean	CV	MIN	MAX	Mean	CV	MIN	MAX
22	41.58	3.86	37.16	43.71	36.6	4.39	36.66	43.2	41.42	3.28	37.2	43.21	40.33	4.95	36.66	42.73
23	39.63	5.48	35.33	43.03	35.01	6.2	34.83	42.5	39.2	5.51	34.8	42.87	39.06	6.81	34.09	42.87
24	37.14	8.73	31.1	41.56	32.96	9.84	30.6	41.1	37.81	7.35	30.8	41.56	36.63	8.1	31.1	40.86
25	35.21	7.87	32.06	40.8	31.32	8.85	31.56	40.3	35.63	8.3	32.1	40.8	34.95	8.12	31.56	39.96
26	33.54	9.18	29.03	38.23	29.86	10.31	28.53	37.7	33.46	8.04	28.7	37.73	32.37	7.96	28.53	36.93
27	32.76	6.44	29.91	36.43	29.04	7.26	29.41	35.9	32.24	6.47	29.9	35.93	32.42	4.36	29.91	34.44
28	32.55	6.5	30.07	35.99	28.88	7.33	29.57	35.5	31.64	5.1	29.7	35.31	32.43	6.75	29.26	35.99
29	31.37	6.91	27.44	34.64	27.78	7.8	26.94	34.1	31.37	7.43	26.9	34.64	31.09	7.23	27.59	34.64
30	29.82	5.47	26.71	32.83	26.33	6.19	26.21	32.3	29.66	5.64	26.2	32.83	30	4.84	28.33	32.83
31	30.18	5.51	26.8	32.23	26.63	6.24	26.3	31.7	29.8	5.53	26.3	32.17	30.27	5.25	28	33.3
32	29.28	5.25	26.26	32.23	25.83	5.95	25.76	31.7	29.1	6.07	26.3	32.09	28.77	5.11	25.76	31.94
33	30.33	5.08	27.8	33.61	26.78	5.75	27.3	33.1	30.62	4.45	28.2	33.11	29.49	4.28	27.3	31.14
34	30.29	7.67	25.13	33.83	26.81	8.67	24.63	33.3	30.8	6.74	24.6	33.33	29.41	5.26	26.56	32.46
35	30.52	5.08	28.29	34.04	26.97	5.74	27.79	33.5	30.35	4.99	28	34.04	30.43	6.39	27.79	34.04
36	30.6	5.83	26.93	33.39	27.02	6.61	26.43	32.9	30.37	4.24	28.3	32.36	30.34	6.88	26.43	33.39
37	31.65	4.73	29.91	34.29	27.97	5.35	29.41	33.8	31.28	4.78	29.4	33.79	31.28	3.38	29.7	33.56
38	31.62	5.37	29.54	35.24	27.98	6.07	29.04	34.7	31.32	5.84	29.2	35.24	31.34	5.88	29.04	34.33
39	32.78	4.97	30.11	35.51	29.02	5.69	29.61	35	32.51	3.7	30.7	34.3	32.32	6.23	29.61	35.51
40	33.54	6.1	29.76	37.31	29.65	6.89	29.26	36.8	33.4	4.97	29.8	36.01	32.93	7.08	29.26	37.31
41	34.16	4.79	31.53	37.03	30.16	5.42	31.03	36.5	34.12	4.4	31	36.53	33.6	3.71	31.07	35.26

Consistency in Maximum Temperature observed within week over the period 2001-2015

Table 3. Changes in minimum temperature in Akola, Washim, Bhandara, Gondia district

	Akola Min Temp.				Washim Min Temp				Gondia Min Temp				Bhandara Min Temp			
Weeks	Mean	CV	MIN	MAX	Mean	CV	MIN	MAX	Mean	CV	MIN	MAX	Mean	CV	MIN	MAX
22	28.6	4.37	28.6	30.2	28.4	4.4	24.9	30	26.8	14	18.8	30	25.6	12.7	18.8	29.7
23	27.3	6.66	27.3	29.6	27.1	6.71	23.8	29.4	27.5	5.03	25.2	29.2	26.7	6.89	23.6	29.6
24	25.8	6.82	25.8	28.9	25.6	6.87	23.1	28.7	26.8	6.22	24.3	28.9	25.4	5.55	23.3	28.1
25	25.6	5.31	25.6	28.1	25.4	5.35	23.4	27.9	25.9	5.47	24	28.1	24.8	4.49	22.7	27.1
26	24.9	4.41	24.9	26.8	24.7	4.45	22.5	26.6	24.6	2.9	23.5	25.7	24.7	3.9	23.4	26.8
27	24.5	2.94	24.5	26.3	24.3	2.96	23.3	26.1	24.3	1.65	23.5	24.7	24.4	3.43	23.1	26.3
28	24.5	2.93	24.5	26.2	24.3	2.95	23.3	26	24.5	2.75	23.6	26.1	24.1	4.43	22.4	26.2
29	24.1	3.61	24.1	26.1	23.9	3.64	22.7	25.9	24.2	3.75	23.3	26.1	23.9	2.48	22.9	25
30	23.4	1.81	23.4	23.9	23.2	1.83	22.5	23.7	23.5	1.45	22.8	24	23.4	2	22.7	24
31	23.4	2.52	23.4	24.2	23.2	2.54	22.1	24	23.4	1.94	22.8	24	23.3	3.01	22.2	24.3
32	23.3	2.33	23.3	24.3	23.1	2.35	22	24.1	23.4	2.03	22.7	24.1	23.3	2.26	22	24.1
33	23.4	2.82	23.4	24.9	23.2	2.85	21.8	24.7	23.6	2.97	22.5	24.9	23.2	2.09	22.2	24
34	23.1	2.52	23.1	24	22.9	2.54	21.6	23.8	23.2	2.18	22.5	24	23	2.99	21.4	23.7
35	23	2.65	23	23.7	22.8	2.67	21.2	23.5	23.2	1.82	22.3	23.7	22.9	2.59	21.2	23.6
36	22.9	2.63	22.9	23.5	22.7	2.65	21	23.3	23.1	1.6	22.4	23.5	22.8	3.15	20.6	23.5
37	22.8	2.92	22.8	23.5	22.6	2.95	20.4	23.3	23	1.28	22.4	23.5	22.9	2.34	21.8	23.9
38	22.8	2.5	22.8	23.9	22.6	2.52	21.6	23.7	22.8	2.68	21.6	23.7	22.6	2.83	21.6	23.6
39	22.5	4.15	22.5	24.5	22.3	4.26	20.5	24.3	22.4	4.95	20.8	24.5	21.7	5.31	19.4	23.4
40	21.7	5.12	21.7	23.7	21.5	5.16	19.2	23.5	21.2	8.28	17.1	23.7	21	7.54	17.1	23.1
41	20.4	2.4	20.4	22.7	20.2	7.48	16.9	22.5	19.4	8.59	15.2	21.8	19.3	9.78	15.2	22.3

Table 4. Contribution of weather parameter in yield of Sorghum in Washim,Akola,Bhandaraand Gondiadistricts

	Washim		Akola		Bhandara		Gondia	
	Coefficient	S. Error	Coefficient	S. Error	Coefficient	S. Error	Coefficient	S. Error
Intercept	1164.62	8398.06	1164.62	8398.06	-9158.7	11020	-51978.8	27095.71
X_{1tmin}	-50.17	95.74	-50.17	95.74	-313.53	220.322	4.147414	100.5417
X_{2tmax}	-14	34.81	-14	34.81	-5.8708	62.2653	123.1073	88.66759
X_{3r}	2.60*	1.18	2.60*	1.18	-13.547	8.67497	8.278647	5.989939
X_{4tmin}	-104.3	290.25	-104.3	290.25	365.477	365.935	1148.70*	574.4391
X_{5tmax}	35.97	107.06	35.97	107.06	-117.18	155.343	229.77**	99.13896
X_{6r}	-0.94	2.42	-0.94	2.42	6.80407	4.50325	5.669168	3.420147
X_{7tmin}	158.57**	57.84	158.57**	57.84	587.474	341.149	436.1422	556.256
X_{8tmax}	-8.25	59.95	-8.25	59.95	-3.1303	73.4842	130.1871	132.4781
X_{9r}	5.88**	2.38	5.88**	2.38	1.21533	1.95631	0.736323	2.540686
R^2	0.8137**	0.5023*	0.4953*	0.6662**				

**Significant at 10%, ** Significant at 5%*

and cotton drastically decreases. Soybean crop is emerging as one of the major crops of the region occupying 66.24 per cent of gross cropped area of the region. Gondiadistricthas a single crop domination i.e. Rice with 90.19 per cent of gross cropped area in the year 2015.The cultivation of other pulse crops is second choice of the farmer of the district. There is very little crop diversification in this district. It is typical case of concentrated cultivation with one or two crops. The changes in the cropping pattern for Bhandara districtare presented in Table 5. Cultivation of rice in this district is sole and major constituent of the cropping pattern of the district. This crop occupies around 82.54 per cent of Gross Cropped Area in 2015. Other pulses like tur and gram are grown in scattered manner covering 17.50 per cent.

CONCLUSION

In Akola district, rainfall had inconsistency within weeks over the period of 2001-2015 as revealed by C.V. ranging between 48.41 to 265.52 per cent.In Washimdistrict, rainfall had inconsistency within weeks over the period 2001-2015 as revealed by C.V. ranging between 59.21 to 239.14 per cent.In Gondiadistrict, rainfall had inconsistency within weeks over the period 2001-2015 as revealed by C.V. ranging between 55.76

Table 5: Changes in Cropping Pattern in Akola,Washim,Bhandara and Gondia District during 2001-2015 (in "00" ha)

CROP	Akola				Washim			
	2001	2005	2009	2015	2001	2005	2009	2015
Cotton	3296	3240	2845	1470	882	678	524	202
	(41.84)	(39.97)	(40.48)	(27.44)	(20.35)	(13.88)	(11.09)	(4.51)
KhaifJowar	861	822	465	151	663	525	299	100
	(10.93)	(10.14)	(6.62)	(2.82)	(15.30)	(10.74)	(6.33)	(2.23)
Tur	734	844	509	501	401	474	494	523
	(9.43)	(10.41)	(7.24)	(9.35)	(9.25)	(9.70)	(10.45)	(11.68)
Soybean	778	1244	1515	2331	833	1851	2264	2965
	(9.88)	(15.35)	(21.56)	((43.50)	(19.22)	(37.88)	(47.91)	(66.24)
Other Pulses	2016	1880	1618	822	1555	1358	1145	686
	(25.59)	(23.19)	(23.02)	(15.34)	(35.88)	(27.79)	(24.23)	(15.33)
	Gondia				Bhandara			
CROP	2001	2005	2009	2015	2001	2005	2009	2015
Paddy	1818	1625	1819	1747	1424	1641	1751	1886
	(94.20)	(94.09)	(92.38)	(90.19)	(90.13)	(90.31)	(88.26)	(82.54)
Tur	40	45	54	65	57	72	77	116
	(2.07)	(2.61)	(2.74)	(3.36)	(3.61)	(3.96)	(3.88)	(5.08)
Other Pulses	46	40	61	73	61	79	80	118
	(2.38)	(2.32)	(3.10)	(3.77)	(3.86)	(4.35)	(4.03)	(5.16)
Gram	26	17	35	52	38	25	76	165
	(1.35)	(0.98)	(1.78)	(2.68)	(2.41)	(1.38)	(3.83)	(7.22)

Figures in parenthesis are percentages over gross crop area

to 294.55 per cent.In Bhandaradistrict, rainfall had inconsistency within weeks over the period 2001-2015 as revealed by C.V. ranging between 51.32 to 254.50 per cent.In Akola, Washim, Gondia and Bhandaradistricts the consistency in minimum and maximum temperature observed within weeks over the period 2001-2015.In Washimdistrict, rainfall at seedling stage, minimum temperature and rainfall at grain filling stage affected the crop yield of sorghum during 2001-2015.In Akola district, rainfall, minimum and maximum temperature did not affect the crop yield at seedling, flowering and grain filling stage of sorghum crop during 2001-2015.In Gondiadistrict, minimum and maximum temperature at flowering stage affected the crop yield of paddy during 2001-2015.In Bhandaradistrict, rainfall, minimum and maximum temperature did not affected the crop yield at seedling, flowering and grain filling stage of paddy crop during 2001-2015.In Akola district, cotton and other pulses were major crops of the District during 2000-2001 constituting 67.50 per cent of total cropped area but during span of 15 years the area under cotton reduced by 14 per cent and soybean emerged as of major crop occupying 43.50 per cent of gross cropped area of region.In Washimdistrict, cotton and other pulses were major crops of the District during 2000-2001 constituting 66 per cent of total cropped area. but during span of 15 years the area under cotton and kh.jowar is reduced by 15.84 and 13.07 per cent respectively and soybean emerged as of major crop occupying 66.24 per cent of gross cropped of region.In Gondiadistrict, with a single crop domination i.e. Rice with 90.19 per cent of gross cropped area in the year 2015. There is very little crop diversification in Gondiadistrict.In Bhandaradistrict, cultivation of rice is sole and major constituent of the cropping pattern. This crop occupies around 82.54 per cent of gross cropped area in 2015.

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Impact of emerging technologies, digitization on agricultural universities in India

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ABSTRACT

This research paper describes the management of technological change with in the staff of libraries of State Agricultural Universities in North India. It describes how much comfortable staff is with the technology and how much they resist change and reasons for their resistance. It also describes librarians' role and strategies adopted by him to manage technological change. It further describes the role of communication in managing technological change. Communication can be regarded as an effective tool in digitized environment to lead staff and change efficiently and successfully.

Keywords: *Agricultural libraries, change management strategies and models*

INTRODUCTION

In this ICT era the relevance of change can not be ignored. Today each and every field is highly influenced by the technology and its tools. Technology and innovations has revolutionized the way we operate our daily activities. It has also changed the way information is stored, disseminated and accessed. Libraries of agricultural institutions are also facing the same challenges with the rapid advancement in ICT and its tools. The management of these enormous changes requires library managers and staff to be flexible and competent enough in developing, adapting and adopting new skills and competencies to manage these changes successfully. It is necessary to grow and succeed in future to meet the demands of the technology dependent society. Librarians or Library managers have to better understand technology, change and innovation to lead staff and manage change successfully in libraries of the select State Agricultural Universities. Staff of agriculture libraries must also learn to manage all library related and information handling activities successfully using modern equipments. All these require is timely planning, awareness and knowledge of change by both. This Change is undoubtedly constant and inevitable and therefore it requires the same constant and inevitable life long learning skills. Librarian can play a vital role here by making staff aware of these changes timely through proper channels of communication. Effective and timely communication of these changes is necessary here. Staff also needs to be patient listeners and develop life long learning habits to cope with these changes. According to Linda (2004) emerging skills in the electronic information environment are communication, negotiation and collaboration, with information professionals being called upon to teach new skills.

A Librarian being a leader or manager of the library must develop the ability to speak clearly, expressively and effectively so that he can communicate his ideas, thoughts, views and commands to library staff for the execution of plans to produce better results and services. Staff must be well aware of changing patterns of information services, products and equipments (such as computer, printer, RFID, FAX machine, Xerox machine, library mangement softwares etc.) available, how they function, and the benefits of these resources to different groups of users. Here, communication plays an important role in removing doubts and uncertanities developing among staff due to fear of unknown. "Effective communication involves receiving and acting on information as well as sending it. In addition to responding to users, it is equally important to receive and act on internal information as library staff often receive front-line responses and other internal staff, such as fund holders, respond from their viewpoints. Thus, the establishment of an effective communications network is vital." (Linda, 2004). The present study has been carried out among the libraries of State Agriculture Universities of North India to know how librarian and staff communicate, adapt and manage changes together.

METHODOLOGY

A total of 80 pre-structured questionnaires were distributed personally among the Librarians and professional staff of the library only. The State Agricultural Universities(SAU) undertaken for the study are Chaudhary Charan Singh Haryana Agricultural University(CCSHAU), Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vidyalaya (CSKHPKV), Dr. Yashwant Singh Parihar University of Horticulture and Forestry (YSPUHF), Punjab Agriculture University (PAU), Sher-e- Kashmir University of Science and Technology-Jammu (SKAUST-J), Sher-e- Kashmir University of Science and Technology-Kashmir (SKAUST-K). The information was collected from the filled up questionnaires as well as personal observations.

Data Analysis

After receiving all the filled questionnaire, data was analysed, tabulated and graphs are given to reveal a clear picture. Out of 80 staff only 60 responds positively. Thus the total response rate is 75%.

Table 1. Technology comfort

Name of Universities	Technology Comfort				
	To Great Extent	To Some Extent	To Moderate Extent	Not at All	Total
CCSHAU	9	2	4	0	15
CSKHPKV	6	3	6	0	15
YSPUHF	5	4	1	0	10
PAU 2	0	0	0	2	
SKAUST-J	4	2	0	0	6
SKAUST-K	5	7	0	0	12
Total	31	18	11	0	60
%age	51.7	30	18.3	0	100

In Table 1, When staff is asked how much comfortable do they feel with the technological innovations then majority(51.7%) of the respondents says that they are comfortable to a great extent with technological innovations, followed by 30% to some extent, 18.3% to a moderate extent.

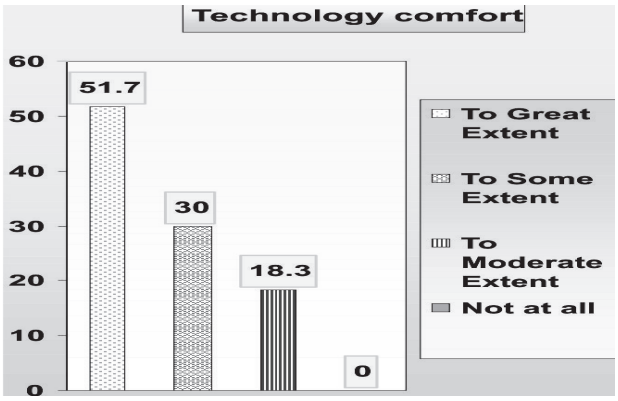
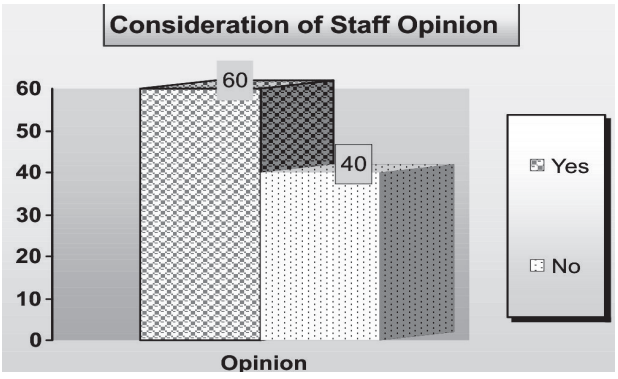


Table 2. Consideration of staff opinion

Name of Universities	Opinion Considered		Total
	No	Yes	
CCSHAU	10	5	15
CSKHPKV	6	9	15
YSPUHF	7	3	10
PAU	0	2	2
SKAUST-J	0	6	6
SKAUST-K	1	11	12
Total	24	36	60
% age	40	60	100



The Table 2 shows that when staff is asked about how much their opinion is considered before or while enacting change then out of 60 respondents, 36(60%) says that their opinion is considered before/while implementing change where as 24(40%) says they are not considered.

Table 3. Favor technological change

Name of Universities	Favor Technological Change		Total
	Always	Sometimes	
CCSHAU	8	7	15
CSKHPKV	7	8	15
YSPUHF	5	5	10
PAU	1	1	2
SKAUST-J	0	6	6
SKAUST-K	12	0	12
Total	33	27	60
%age	55	45	100

In Table 3 when staff is asked about their attitude towards technological changes and how much they are in favor of these changes then out of 60 respondents, majority (55%) of the respondents says they always favor whereas others (45%) says they favor sometimes.

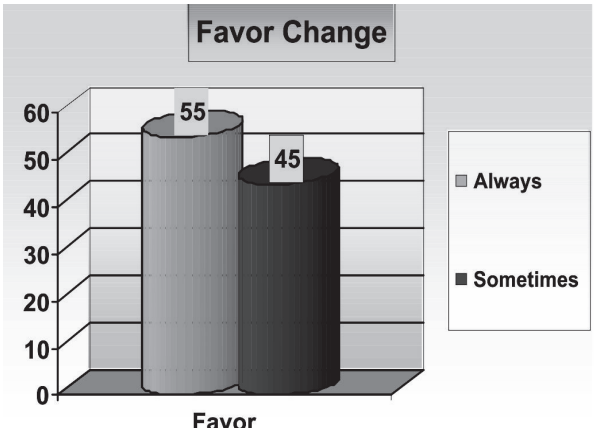


Table 4. Active participation of staff

Name of Universities	Active Participation				Total
	To a Great Extent	To Some Extent	To a moderate extent	Not at All	
CCSHAU	10	4	1	0	15
CSKHPKV	2	6	0	7	15
YSPUHF	4	3	1	2	10
PAU	1	1	0	0	2
SKAUST-J	0	6	0	0	6
SKAUST-K	8	3	1	0	12
Total	25	23	3	9	60
%age	41.7	38.3	5	15	100

In Table 4, when staff is asked how actively they participate at the time of implementation of technological changes, majority (41.7 %) of the respondents says to a great extent, followed by 38.3% to some extent, 15% not at all and 5% to a moderate extent.

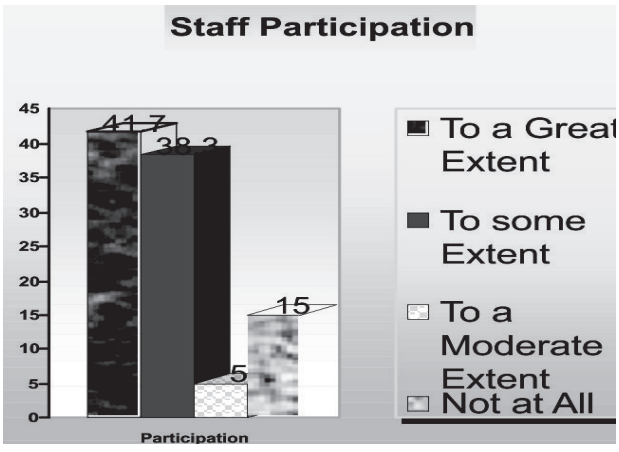


Table 5. Resistance to technological change

Name of Universities	Resist Technological Change		Total
	No	Yes	
CCSHAU	6	9	15
CSKHPKV	6	9	15
YSPUHF	7	3	10
PAU	0	2	2
SKAUST-J	6	0	6
SKAUST-K	8	4	12
Total	33	27	60
% age	55	45	100%

In Table 5, when staff is asked do they resist technological changes then 55% respondents has admitted of not resisting change, whereas 45 % says they resist..

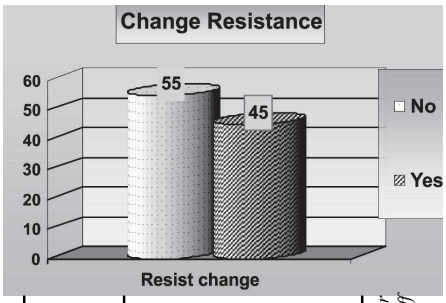
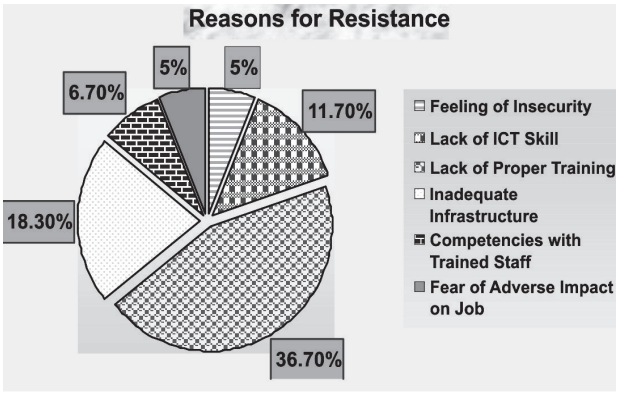


Table 6. Reasons for resisting technological change

Name of University &Institutes	Feelng of Insecurity		Lack of ICT Skills		Lack of Proper Training		Inadequate Infrastructure		Competencies with Trained staff		Fear of Adverse Impact on job	
	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
CCSHAU	15	0	12	3	9	6	14	1	14	1	15	0
CSKHPKV	15	0	13	2	12	3	13	2	14	1	15	0
YSPUHF	7	3	8	2	7	3	6	4	8	2	7	3
PAU	2	0	2	0	2	0	2	0	2	0	2	0
SKAUST-J	6	0	6	0	0	6	6	0	6	0	6	0
SKAUST-K	12	0	12	0	8	4	8	4	12	0	12	0
Total	57	3	53	7	38	22	49	11	56	4	57	3
% age (60)	95	5	88.3	11.7	63.3	36.7	81.7	18.3	93.3	6.7	95	5

In Table 6, when staff is asked about reasons behind their resistance to technological changes then majority (36.7%) of the respondents has told 'Lack of proper training' the main reason behind their resistance, followed by Inadequate Infrastructure 18.3%, lack of ICT Skill 11.7%, Competencies with already trained staff 6.7% and Feeling of insecurity & Fear of adverse impact on their job 5%.



Librarians' role

Librarian or Deputy Librarian of each university was approached with a separate Questionnaire regarding how they implement change and what strategies and models they are using to enact technological change as a top level manager in the library in this digital era.

Table 7. Plan well in advance

Strategy	Plan well in advance				Total
	To a great extent	To some extent	To a moderate extent	Not at all	
	2	4	0	0	6
% age	33.3%	66.7%	0%	0%	100%

In Table 7, when librarians are asked whether they plan change well in advance for its successful implementation then majority of them i.e. 66.7% says to some extent, followed by 33.3% to great extent and 0% responds not at all.

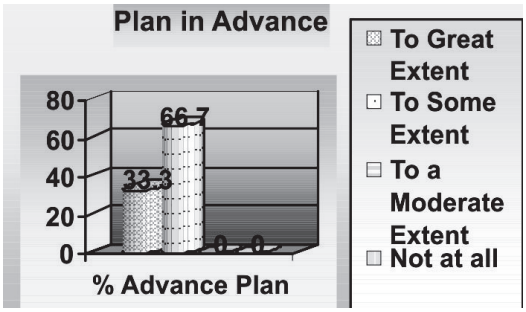


Table 8. Staff consideration

Strategy	Staff Considered Before Change				Total
	To a great extent	To some extent	To a moderate extent	Not at all	
	5	1	0	0	6
% age	83.3%	16.7%	0%	0%	100%

The Table 8 indicates that when librarians are asked how much they consider staff's opinion before/while enacting technological change then majority (83.3%) of librarian says they consider to a great extent and 16.7% says to some extent.

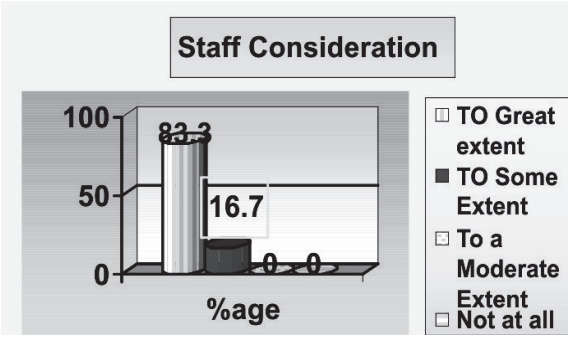
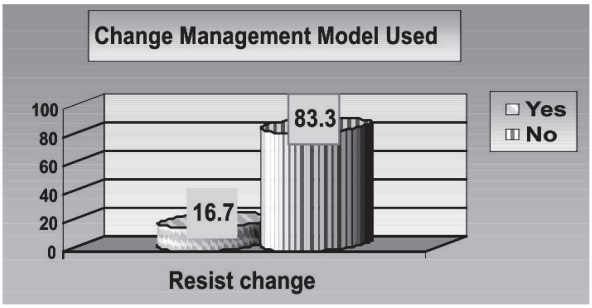


Table 9: Change Management model used

	Change management model used		Total
	Yes	No	
	1	5	6
% age	16.7%	83.3%	100 %

The Table 9, shows that when librarians were asked, do they consider any change management model for implementing change then nobody says 'yes' except SKAUST-K.



CONCLUSION

The majority of the staff has admitted that they are comfortable with the technological innovations as it is the demand of today, so librarians need not to prepare them for change but they must win their support by communicating and involving them in change processes. The majority of respondents from library staff has admitted that their opinion is considered before/ while implementing change. Merely taking their opinions under consideration is not sufficient each staff member should be involve and trained for implementing changes. Despite of knowing that technological change is necessary 48% respondents says that they resist change. Lack of proper training is emerged out as the major reason behind their resistance followed by Inadequate Infrastructure, lack of ICT Skill, Competencies with already trained staff and Feeling of insecurity & Fear of adverse impact on their job. So proper training must be provided with practical demonstration by providing adequate infrastructure to work. Librarians need to communicate effectively with staff about their doubts and fears regarding changes on regular intervals. Even though majority of the Librarians plans technological change well in advance before implementing it but no librarian is adopting any change management model for implementing technological change in their libraries except SKAUST-K. Librarians of these universities must consider and adopt change management model such as ADKAR model, Kurt Lewin's Three Stage Model etc. to understand change processes, strategies and methods for implementing change successfully.

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Impact of improved production technology of paddy in Maharashtra

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ABSTRACT

The present investigation was carried out to analyze the impact of production technology of paddy in Maharashtra. The study was based on primary data collected for the year of 2013-14.State as a whole, per hectare Cost 'C' was worked out to Rs. 47,652.48 and with its B:C ratio was 1.27. Per hectare cost of production has increased with the increase in technology adoption however, per unit cost has decreased with increase in technology adoption. Further; there was a 19.07 per cent yield gap between actual yield and yield of demonstration plot. The composite index of technology adoption was 49.89 per cent, which indicated that the sample farmers adopted less than 50 per cent recommended paddy production technology and obtained 36.01q/ha yield. The contribution of different components on impact of paddy production technology was maximum in net returns (55.61%). The study has observed that yields can be increased on adoption and impact of improved paddy production technology. It indicates that, the farmers should adopt the improved production technology for paddy to the fuller extent for maximizing returns and minimizing per unit cost.The study revealed that the farmers were not fully aware of some of the components of improved paddy production technologies. Therefore, the efforts are required to be made to intensify extension education activity to increase awareness among the paddy growers so as to accelerate the process of adoption.
Keywords:*Production function, yield gap, decomposition model, adoption index*

INTRODUCTION

Paddy (*Oryza sativa L.*) is one of the important cereal crops of the world and forms the staple food for more than 60 per cent of the world people. Rice has shaped the culture, diets and economics of millions of people. India is one of the leading rice producing countries of the world with cultivated area of 43.97 M ha and production of 100 Mt in 2011-12. The leading states in rice cultivation are: West Bengal, Uttar Pradesh, Orissa, Andhra Pradesh and Panjab. Maharashtra is one of the major rice growing states in India. Paddy is grown on 15.40 million ha with an annual production of 35.00 million tonnes and productivity at 1821 kg/ha during the year 2011-12. Maharashtra ranks 12th in production and 13th in productivity among major rice growing states of the country. Paddy is the second largest important crop next to jowar in Maharashtra. The position of Maharashtra in rice production is comparatively poor. In the state, paddy is grown in districts with varying extent. However, the major rice growing districts are Thane and Raigad in Konkan region, Kolhapur and Nasik districts in Western Maharashtra region, Nanded and Parbhani districts in Marathwada region, Bhandara and Gondia districts in Vidarbha region. The present study is an attempt to analyze the impact of improved technologies on paddy production in Marathwada regions of Maharashtra. The study undertaken so far had mostly focused on the favorable effects of technological change. The reasons for the rate of adoption lagging behind expectation have been virtually unexamined. Therefore, a study which focuses on both aspects of technical changes i.e. its impact on yield, returns etc. as well as the reasons for non-adoption of improved technology assumes great importance. Considering the above facts it was necessary to analyzed the "Impact of Production Technology of Paddy in Maharashtra". With this background, present study was undertaken.

METHODOLOGY

The study was conducted in Maharashtra state as whole. Eight districts were selected on the basis of maximum area under paddy. From each district, 36 farmers were selected who were practicing improved production technology of paddy of cultivation on the basis of small, medium and large size group holding. The study was based on primary data which were collected of 288 paddy cultivators for the year 2013-14. The farmers were interviewed using specially prepared schedules. The farmers were also asked to prioritize the most important constraints they were facing in adopting improved method of paddy cultivation.

Cobb-Douglas type of production function

$$Y = aX_1^{b_1}X_2^{b_2}X_3^{b_3}X_4^{b_4}X_5^{b_5}X_6^{b_6}X_7^{b_7} \ldots\ldots X_n^{b_n}e^u$$

where,

Y = Output of main produce in quintals per hectare
a = Intercept
X_1 = Per hectare use of human labour in man days
X_2 = Per hectare use of Bullock in pair days
X_3 = Seed (kg) per hectare

X_4 = Per hectare use of Manure in quintals
X_5= Nitrogen (kg) per hectare
X_6 = Phosphorus (kg) per hectare
X_7 = Potash (kg) per hectare
e^u = error term

Technological Gap Analysis

The yield gap was worked out as the difference between demonstration plot yield and actual farmer's yield. The following Cobb-Douglas type of production function was used for this purpose. (*Gaddi et al, 2002)* [5]

$$Y = a_0 H^{a_1} B^{a_2} M^{a_3} N^{a_4} P^{a_5} e^u$$

where,

Y = Output of main produce in quintals per hectare
a_0 = Intercept
H = Per hectare use of human labour in man days
B = Per hectare use of Bullock in pair days
M = Per hectare use of Manure in quintals
N = Nitrogen (kg) per hectare
P = Phosphorus (kg) per hectare
e^u = error term
a_1 to a_5 elasticities of production.

The combination of different resources to yield gap was estimated with the help of Decomposition Model. The following functional form was used to work out the yield gap. *(Bisliah, 1977)*[4]. The Chow test was conducted for checking the production elasticity of the two functions.

$$\text{Log } (Y_2/Y_1) = [\text{Log } (b_o/a_0)] + [(b_1\text{-}a_1) \text{ Log } H_1 + (b_2\text{-}a_2) \text{ Log } B_1 + (b_3\text{–}a_3) \text{ Log } M_1 + (b_4\text{-}a_4) \text{ Log } N_1 + (b_5\text{-}a_5) \text{ Log } P_1] + [b_1 \text{ Log } (H_2/H_1) + b_2 \text{ Log } (B_2/B_1) + b_3 \text{ Log } (M_2/M_1) + b_4 \text{ Log } (N_2/N_1) + b_5 \text{ Log } (P_2/P_1)] + [U_2\text{-}U_1]$$

Technological Adoption Index

Technology Adoption Index (TAI) was worked out as per Kiresur *et al*. (1996) [6] with the help of following formula.

$$TAI = \frac{A_i}{M_i} \times 100$$

where,

Ai = Average adoption score registered by the farmer for particular component

Mi = Maximum adoption score registered by the farmer for particular component.

RESULTS AND DISCUSSION

Resource use gap of paddy in Maharashtra

For the State as a whole, per hectare resource use gap between yield on sample cultivators farm and demonstration plot was 19.07 per cent(Table 1). The inputs of human labour, bullock power, manures and potash were utilized less than the demonstration plot, while in case of sample cultivators farm, the per hectare use of seed, nitrogen and phosphorous were utilized more than the demonstration plot, for poor germination, flooding condition, maintaining the plant population and to increase the grain production. It can be concluded that, for obtaining the desirable yield, resources should be used at optimum level. Similar findings were noted by Gaddi (2002), Kiresur (1996) and Reddy *et al.*(1996).

Cost of cultivation of paddy in Maharashtra

The Table 2 revealed that at the overall level, per hectare cost of cultivation of paddy *i.e.* Cost 'C' was ₹ 47,652.48. The total human labour, bullock labour, machine labour and rental value of land were the major item of cost in all size groups contributing nearby 70 to 75 per cent to the total cost. State as whole, at the overall level, per quintal cost of paddy was 1,202.83 and it was 1.27. B: C ratio. From the above discussion it is indicated that per unit cost of cultivation declined as size group increase and that results into more (1.30) profitability in medium size group. Therefore, this study suggests that, to make cultivation of paddy profitable, it is essential that the average yield should be raised and harvest prices should be remunerative.

Table 1. Resource use gap of paddy in MS (Per hectare)

Particulars	Demonstration plot	Sample cultivators	Absolute Gap	% Gap
Total Human labour (Days)	169.63	135.94	33.69	19.86
Bullock power (Pair days)	12.25	10.86	1.39	11.34
Seed (kg)	36.25	87.33	-51.08	-140.91
Manures (q)	93.75	17.07	76.68	81.79
Fertilizers (kg)				
N	95.00	103.46	-8.46	-8.91
P	50.00	96.62	-46.62	-93.24
K	50.00	20.96	29.04	58.08
Yield (q)	44.50	36.01	8.49	19.07

-Gap indicates excess use than recommendation

+ Gap indicates low use than recommendation

Cobb-Douglas production function estimate for demonstration plot and sample farms in Maharashtra

The Cobb-Douglas type of production function was fitted to the observations for the estimation of elasticity of important variables contributing to the yield of paddy in both demonstrations plot and sample farms. The analysis of variance in respect of the production function showed a significant variance, indicating the overall significance of the estimated production function (Table 3). The value for the coefficient of multiple determination (R^2) for demonstration plot was 0.69, which indicated that the seven resources included in the production function had jointly explained as high as 69 per cent of total variation in the demonstration plot, whereas it was 75 per cent ($R^2 = 0.75$) for the sample farms.It showed that the variables taken into consideration were more crucial factors in demonstration plot than on the sample farms. In case of demonstration plot method, human labour, seed and manures were found positively significant.

Table 2. Item wise cost of cultivation of paddy in Maharashtra (₹/ha)

Cost items	Small			Medium			Large			Overall		
	Qty	Value	Percent	Qty	Value	Percent	Qty	Value	Percent	Qty	Value	Percent
Hired Human labour (Man days)												
a. Male	25.19	3779.18	7.59	25.80	3869.35	8.35	28.89	4483.92	9.40	27.86	4179.50	8.77
b. Female	56.02	5602.49	11.26	58.55	5855.16	12.63	60.14	6013.84	12.60	58.85	5884.79	12.35
Total hired human labour	81.21	9381.67	18.85	84.35	9724.51	20.98	89.03	10497.76	22.00	86.71	10064.29	21.12
Bullock power (Pair days)	13.66	4098.59	8.23	10.76	3346.89	7.22	9.82	2945.56	6.17	10.86	3294.32	6.91
Machine power (hrs)	7.74	3868.55	7.77	6.70	3350.26	7.23	8.01	3997.59	8.38	7.55	3769.02	7.91
Seed (kg)	87.18	1687.50	3.39	84.12	1430.61	3.09	88.90	1593.44	3.34	87.33	1569.39	3.29
Manures (q)	28.73	2872.80	5.77	16.72	1671.66	3.61	13.09	1436.92	3.01	17.07	1774.90	3.72
Fertilizers (kg)												
N	104.22	1687.25	3.39	-	1699.62	3.67	102.09	1652.89	3.46	103.46	1675.09	3.52
P	90.52	1647.40	3.31	-	1711.27	3.69	100.10	1821.86	3.82	96.62	1758.43	3.69
K	18.19	178.29	0.36	-	213.68	0.46	21.64	212.07	0.44	20.96	205.44	0.43
Irrigation Charges (₹)	-	35.56	0.07	-	29.33	0.06	-	19.07	0.04	-	24.87	0.05
Plant protection charges (₹)	-	349.32	0.70	-	292.30	0.63	-	370.27	0.78	-	342.59	0.72
Incidental charges (₹)	-	227.09	0.46	-	303.11	0.65	-	260.00	0.55	-	266.74	0.56
Repairs (₹)	-	290.96	0.59	-	286.72	0.62	-	262.86	0.55	-	274.79	0.58
Working capital (₹)	-	26324.98	52.89	-	24059.96	51.92	-	25070.29	52.54	-	25019.87	52.50
Int.on Working Capital	-	1579.50	3.17	-	1443.60	3.11	-	1504.22	3.15	-	1501.19	3.15
Depre.on farm implements	-	3336.09	6.70	-	2169.55	4.68	-	2207.01	4.63	-	2380.97	5.00
Land revenue and taxes	-	35.17	0.07	-	45.00	0.10	-	60.75	0.13	-	51.57	0.11
Cost 'A'	-	31275.74	62.83	-	27718.11	59.81	-	28842.27	60.45	-	28953.60	60.76
Rental value of land	-	9625.21	19.34	-	10069.14	21.73	-	10282.86	21.55	-	10094.90	21.18
Int'on fixed capital	-	2325.00	4.67	-	2328.00	5.02	-	2400.00	5.03	-	2366.99	4.97
Cost 'B'	-	43225.95	86.84	-	40115.25	86.56	-	41525.15	87.03	-	41415.49	86.91
Family labour												
a. Male	29.32	4397.36	8.83	26.43	3964.76	8.56	25.31	3796.94	7.96	26.28	3942.51	8.27
b. Female	21.52	2151.79	4.32	22.64	2263.84	4.88	23.93	2393.07	5.01	22.94	2294.48	4.82
Total family labour	58.84	9381.67	18.85	49.07	6228.60	13.44	49.24	6190.01	12.97	49.22	6236.99	13.08
Cost 'C'	-	49775.10	100	-	46343.85	100	-	47715.15	100	-	47652.48	100
Output (q)												
a. Main produce	33.50	53513.88	-	34.61	56553.40		37.65	57645.58		36.01	56540.30	
b. Bye-produce	44.48	4448.37	-	41.31	4131.42		44.16	4416.09		43.38	4338.49	
Cost 'C' net of bye produce	-	45326.73	-	-	42212.43		-	43299.05		-	43313.99	
Per quintal cost	-	1353.04	-	-	1219.66		-	1150.04		-	1202.83	
B:C Ratio	-	1.16	-	-	1.30		-	1.29		-	1.27	

Table 3. Cobb-Douglas production function estimate for demonstration plot and Sample farms in Maharashtra

Particulars	Method of cultivation	
	Sample cultivator farms	Demonstration plot (Recommended)
Intercept	0.6048	0.9433
Human labour (X_1)	0.6863***(0.2375)	0.3210**(0.1389)
Bullock labour (X_2)	0.0629**(0.0243)	0.0185(0.6234)
Seed (X_3)	0.7945(0.9978)	0.2978*(0.1260)
Manures (X_4)	0.0993***(0.0331)	0.0331***(0.0114)
Nitrogen (X_5)	0.0049(0.0078)	0.0166(0.0168)
Phosphorus (X_6)	0.0026(0.0297)	0.0151(0.2174)
Potash (X_7)	0.0478**(0.0216)	0.0145(0.2241)
R^2	0.75	0.69
Observation	274	120
D.F.	266	112
F value 17.97***	13.6***	

Figures in parentheses are standard errors of respective regression coefficients

, ** and * indicates significance level at 10, 5 and 1per cent level, respectively*

This means that usage of less than the recommended dose of these inputs would result in a increase in production. On sample cultivators farm, human labour, bullock labour, manures and potash were positively significant. Thus, the sample cultivators' farms were more labour intensive and exhaustive as it responded more to labour usage, manures and application of chemical fertilizers. This result was in conformity with those of Bisaliah (1977) for Punjab wheat economy and Rao *(*2011) for SRI *Vs* Traditional method of paddy cultivations in North coastal zone Andhra Pradesh.

Results of decomposition analysis

It is depicted from Table 4, the results of decomposition analysis in Maharashtra. There was 19.07 per cent yield difference because of adoption of practicing new technology in paddy cultivation. In 19.07 yield gap measurably (11.24 %) was contributed by differences

in cultural practice, whereas remaining 7.83 per cent of yield was due to difference in use of input. The maximum positive difference of input use level was found from phosphorous followed by potash, bullock labour, manures and nitrogen. Whereas, seed (-5.18 %) and human labour (-0.07 %) were contributing negatively towards the yield gap. Thus, the total difference in output was measurably caused by difference in cultural practices, rather than differences in input level. Similar results were confirmed by Gonkar (2000), Kiresur *et al*. (1996) and Rao (2011).

Table 4. Results of decomposition analysis

Source of productivity difference	Percentage contribution
Total difference observed in output	19.07
Source of contribution	
1. Difference in cultural practices (Non neutral technological changes)	11.24
2. Due to difference in input use level (Neutral technological changes)	
a. Human labour	1.26
b. Bullock labour	3.39
c. Seed	-1.34
d. Manure	-0.57
e. Nitrogen	1.56
f. Phosphorous	2.54
g. Potash	1.04
Due to all inputs	7.83
Total estimated gap from all sources	19.07

Technology adoption index on sample farms in Maharashtra

At the overall level adoption index (Table 5) of method of sowing technology component was maximum (89.93 %) on sample farms. State as whole the composite index of technology adoption was worked out to 49.89 per cent indicated that the sample farmers adopted less than 50.00 per cent recommended paddy production technology obtaining 36.01q/ha yield. The positive relationship was observed in between composite index and yield obtained on sample farms *i.e.* increase in composite index resulted in increase in yield. These finding were confirmed by Borah *et al.* (1986), Gonkar (2000) and Rao (2011).

Impact of improved paddy production technology in Maharashtra

The contribution of component on impact of paddy production technology (Table 6) net returns was maximum (43.97 %). The per hectare yield has increased from 26.67 to 36.01 quintal per hectare over the difference level of adoption. The added yield was 10.96 q/ha over the local and improved method of adoption. Thus, for producing extra yield per hectare costs were also increased Rs.9,834.21 and added returns were also increased Rs. 17,189.51. It indicates that, the farmers should adopt the improved production technology for paddy to the fuller extent for maximizing returns and minimizing per unit cost.

Table 5: Technology adoption index of paddy in Maharashtra (%)

Component	Size group			Overall
	Small	Medium	Large	
Date of sowing	65.00	69.00	76.00	69.91
Seed rate	58.00	65.00	70.00	64.24
Variety	47.00	53.00	60.00	53.30
Method of sowing	87.00	91.00	92.00	89.93
Manures	24.00	35.00	40.00	32.98
Nitrogen	62.00	68.00	73.00	67.70
Phosphorous	53.00	65.00	68.00	62.04
Potash	16.00	20.00	30.00	21.76
Plant protection	11.00	18.00	22.00	17.01
Composite index	44.19	50.76	54.73	49.89
Yield (q)	33.50	34.61	37.65	36.01

Table 6. Impact of improved paddy production technology in Maharashtra

Particulars	Local Method	Improved Method	Percent impact
Employments			
Total human labour (Man days/ha)	112.99	135.94	16.88
Bullock labour (Pairs days)	7.78	10.86	30.21
Machine power in hrs	4.81	7.55	36.17
Yield (q/ha)			
Main produce	26.67	36.01	30.43
By-produce	33.62	43.38	23.07
Economics (Rs./ha)			
Gross returns	43689.38	60878.79	28.24
Cost of cultivation	37818.26	47652.48	20.64
Net returns	5871.13	13226.42	55.61
B:C ratio	1.16	1.27	
Cost effectiveness of improved paddy production technology			
Added returns	-	17189.51	-
Added cost	-	9834.21	-
Added yield (q)	-	10.96	-
% increase in yield	-	43.74	-
Cost (Rs./q)	1509.70	1323.40	-
Unit cost reduction (Rs./q)	-	186.29	-
% reduction	-	12.34	-
ICBR ratio	-	1.75	-

CONCLUSIONS

The composite index of technology adoption for the state as a whole was worked out to 49.89 per cent indicated that the sample farmers adopted less than 50.00 per cent recommended paddy production technology obtaining 36.65 q/ha yield.The impact ofpaddy production technology on per hectare net returns was maximum(55.61 %) followed by bullock labour and machine labour.The yield has increased from 26.67 to 36.01quintal per hectare over the difference level of adoption. The added yield was 10.96q/ha over the local and improved methodof adoption. Thus, for producing extra yield per hectare costs were also increased ₹ 9,834.21 and added returns were also increased 17,189.51 with 1.75 ICBR ratio. This indicated that the adoption of improved crop production technology helped to reduce the cost and increases the returns. The study indicates that majority of the farmers yield levels remained obviously low. To increase their yield levels, there is a need to increase adoption of recommended technologies like use of HYV and hybrid varieties,

fertilizers, plant protection and other technologies given by the University for increasing the rice productivity. There is a scope for extension agencies to educate the farmers for adopting recommended technologies.

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Impact of major cropping sequences in Pune district of Maharashtra

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ABSTRACT

The economics of major cropping sequences in Pune district of Maharashtra was assessed based on the primary data of 90 cultivators for the year 2 013-14 spread over the six randomly selected villages of three tehsils. Out of existing sixteen cropping sequences three major cropping sequences viz., Pearl millet-Coriander-Rabi Onion cropping sequence (CS-I) was the dominant cropping sequence followed by Pearl millet-Rabi Sorghum (CS-II) and Cauliflower-Rabi Potato-Fenugreek (CS-III). The employment generation was more in cropping sequence I. Highest annual income produced in crop production by cropping sequences I was Rs. 179450.72 followed by income produced by cropping sequences II and III in crop production were Rs. 52465.28 and Rs. 171105.68, respectively. In all, six variables included in income function have jointly explained 76.00 per cent, 75.00 per cent and73.00 per cent variation for cropping sequence I, II and III, respectively. The highest annual expenditure spends on cropping sequences III was Rs. 315695.60 per farm which have major contribution by crop production and livestock activity (31.25 and 22.56 per cent share, respectively). Expenditure spends on cropping sequences I and II are Rs. 298761.18 and Rs. 241850.69, respectively.

Keywords: *Cropping sequence, economics, employment*

INTRODUCTION

The agricultural sector occupies the place, prime importance in the Indian economy. This is because 61 per cent Indian population still depends on agriculture for its livelihood. Agriculture is the main occupation and backbone in developing country like India and is a bottleneck in the economic development of the country. Over the period of time, population dependent on agriculture is increasing. This has resulted into continuous decrease in average size of holding with more and more fragmentation of land and unemployment. Land being the most limiting factor, dependence on it has touched its climax.There is the way to increase agriculture production on the small or marginal unit of the farming is to increase the productivity per unit and area. This may be achieved by breeding efficient crop varieties and by improving management practices like fertilizer use, weed and paste control, irrigation application, cropping sequences, cropping system etc.Cropping Sequence can be defined as growing of two or more crops in sequence on the same piece of land in an Agricultural year (Reddy, 2000). Depending on the number of crops grown in the year, it is called as double, triple and quadruple cropping involves two, three and four crops, respectively.

METHODOLOGY

The present study utilizes both types of data i.e. primary as well as secondary level macro data obtained from the records of Government office such as Agriculture, Animal's husbandry, Co-operatives, etc. The micro level data were obtained by personal interview from the selected 90 sample families for the year 2013-14.The primary unit of sample was tahsil and the record of revenue as well as department of agriculture was referred for the same. The village, being the secondary unit of sample, randomly two villages were selected from each tahsil by listing them in ascending order, having maximum cropped area. The tertiary and ultimate unit of sample was the farmer. The list of the farmers having the cropped area were prepared from revenue record of villages and were categorized into three size groups on the basis of the operational holdings viz., holding size below 1.00 ha., 1.01 ha to 2.00 ha and above 2.01 ha were designated as small, medium and large size groups, respectively. Then, thirty cultivators were selected randomly from each size groups. Thus, the total sample consisted of 90 farms.

Estimation of employment function

$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + e_u$

Where,

Y = Annual total family employment (man-days)
a = Intercept
X_1 = Number of Earners (Number per family.)
X_2 = Number of Milch animal (Number per family.)
X_3 = Area under Vegetables
X_4 = Area under cash crops
X_5 = GIA (Gross Irrigated Area) in hectare
X_6 = GCA (Gross Cropped Area) in hectare
$b_{i's}$ = Regression coefficient
e_u = Error term

Estimation of income function

$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + e_u$

Where,

Y = Annual total family Income (Rs.)
a = Intercept
X_1 = Number of earners (Number per family.)

X_2 = Number of milch animal (Number per family.)
X_3 = Area under vegetables
X_4 = Area under cash crops
X_5 = GIA (Gross Irrigated Area) in hectare
X_6 = GCA (Gross Cropped Area) in hectare
bi's = Regression coefficient
eu = Error term

RESULTS AND DISCUSSION

Table 1. Existing cropping sequences observed on farm of sample farmers

Cropping Sequences	Group			Total	Percent
	Small	Medium	Large		N=90
Pearl millet-Coriander-Rabi Onion	8	6	7	21	23.33
Green gram-Rabi Sorghum	4	6	3	13	14.44
Pearl millet-Wheat-Summer Groundnut	1	2	5	8	8.88
Green gram-Rabi Onion	-	2	5	7	7.77
Black gram-Gram	4	1	6	11	12.22
Groundnut-Rabi Potato-Fodder Jowar	3	5	5	13	14.44
Pearl millet-Rabi Sorghum	6	7	7	20	22.22
Maize-Wheat- Summer Pearl millet	-	4	5	9	10.00
Maize-Rabi Sorghum-Chilli	5	4	3	12	13.33
Onion-Wheat-Watermelon	3	2	3	8	8.88
Tomato-Coriander-Fenugreek Clusterbean	1	1	6	8	8.88
Tomato-Fodder Jowar	2	2	2	6	6.66
Tomato-Wheat-Cabbage	2	5	2	9	10.00
Capsicum-Marigold-Tomato	2	2	3	7	7.77
Cauliflower-Rabi Potato -Fenugreek	4	6	8	18	20.00
Onion-Coriander -Fenugreek-Summer Groundnut	3	1	4	8	8.88

The information given in above table, existing sixteen cropping sequences three were select as major cropping sequences viz., Pearl millet-Coriander-Rabi Onion cropping sequence (CS-I) is the dominant cropping sequence which is adopted by 21 farmers (23.33 per cent) followed by Pearl millet-Rabi Sorghum (CS-II) by 20 farmers (22.22 per cent), Cauliflower-Rabi Potato-Fenugreek (CS-III) by 18 farmers (20.00 per cent). These cropping sequences were selected on the bases of per cent to the total number of sample

Table 2. Average per farm annual Employment of farm Families (Man days)

Particular	Cropping Sequence		
	I	II	III
Own farm employment			
Crop Production	110.22 (28.19)	57.35 (16.31)	65.82 (20.25)
Livestock activity	149.38 (38.21)	154.00 (43.78)	137.34 (42.25)
Total own farm employment	259.60 (66.41)	211.35 (60.09)	203.16 (62.49)
Off-farm Employment			
Wage earning	45.14 (11.55)	45.00 (12.79)	44.86 (13.80)
Services/Business	86.19 (22.05)	95.37 (27.12)	77.08 (23.71)
Total off farm employment	131.33 (33.59)	140.37 (39.91)	121.94 (37.51)
Total employment	390.93 (100.00)	351.72 (100.00)	325.10 (100.00)

Figures in parentheses indicate percentage to the total employment

cultivar.

Above table show that, total employment generated was 390.93, 351.72 and 325.10 man days in cropping sequence I, II and III, respectively. Of the total employment generated in cropping sequence III, 20.25 per cent employment was generated through crop production activity and 42.25 percent through livestock activity, but in cropping sequence II, 16.31 per cent employment generated through crop production activity and 43.78 percent through livestock activity. While employment generated through crop production 28.19 per cent followed by livestock activity 38.21 percent, in cropping sequence I.

The results of employment function of three

Table 3. Regression analysis of employment function

Particular	Cropping Sequence		
	I	II	III
Sample size	21	20	18
Constant (a)	301.54	243.81	417.41
No. of Earners (X_1)	15.1391	117.346***	148.919***
	(30.62)	(32.4994)	(45.4847)
No. of Milch animal (X_2)	69.6251***	97.3483***	92.6335**
	(17.0992)	(27.7087)	(31.4137)
Area under Vegetable (X_3)	6.5712	160.8511	1.1497
	(95.7655)	(108.162)	(148.349)
Area under Cash Crop (X_4)	93.7999**	108.090***	261.526***
	(32.0639)	(30.1520)	(113.754)
Gross Irrigated Area (X_5)	86.2571***	98.8993**	317.3894
	(22.4795)	(41.1393)	(188.944)
Gross Cropped Area (X_6)	28.6734	2.3199	210.0580
	(43.9283)	(16.4010)	(141.053)
R^2	0.78	0.70	0.69

Figures in the parentheses are the standard errors of the respective regression coefficient
, ** and * indicate significance at 10, 5 and 1 per cent level*

cropping sequences indicate that the variables included in the model were a number of earner, number of milch animal, area under vegetable, area under cash crop, gross irrigated area and gross cropped area. In all, six variables included in employment function have jointly explained 78.00 per cent, 70.00 per cent and 69.00 per cent variation for cropping sequence I, II and III, respectively. The highest contribution came from number of milch animal (X2) for cropping sequence I and II and earners (X1) for cropping sequence II and III.

Highest annual income produced by cropping

Table 3. Per farm average annual income of farm families (₹)

Particular	Cropping Sequences		
	I	II	III
Crop production	179450.72	52465.28	171103.68
	(46.28)	(21.83)	(46.64)
Livestock	99061.90	110100.00	104333.33
	(25.55)	(45.80)	(28.44)
Wages	15476.19	11425.00	9455.56
	(3.99)	(4.75)	(2.58)
Service/Business	57409.52	38340.00	40566.67
	(14.80)	(15.95)	(11.06)
Loan	36380.95	28050.00	41388.99
	(9.38)	(11.67)	(11.28)
Total Income	387779.28	240380.28	366848.23
	(100.00)	(100.00)	(100.00)

Figure in parentheses is the percentage to the total income

sequences I (Rs. 3,87,779.28) which have major contribution by crop production and livestock activity (46.28 and 25.55 per cent share, respectively). Income produced by cropping sequences II and III are Rs.

2,40,380.28 and Rs. 3,66,848.23, respectively.

The results of income function of three cropping sequences indicate that In all, six variables included in employment function have jointly explained 76.00 per cent, 75.00 per cent and 73.00 per cent variation for cropping sequence I, II and III, respectively. The variables viz., number of earners (X1) was significant at ten per cent level in all cropping sequences. Number of milch animal was significant at five per cent level in cropping sequence I and III, but it was non-significant in cropping sequence II. Area under vegetable and gross irrigated area was highly significant at one per cent level in cropping sequence I while it was significant at five per cent level in cropping sequence II, but it was non-significant in cropping sequence III.

Table 4. Regression analysis of income function

Particular	Cropping Sequence		
	I	II	III
Sample size	21	20	18
Constant (a)	195301.056	79081.96	131628.57
No. of Earners (X_1)	43698.8*	22816.79*	43141.57*
	(21231.30)	(11230.01)	(21852.93)
No. of Milch animal (X_2)	28141.40**	5857.15	92.6335**
	(11270.35)	(4335.68)	(12244.45)
Area under Vegetable (X_3)	67309.81***	50845.28**	33759.4
	(21345.44)	(18201.52)	(131282.1)
Area under Cash Crop (X_4)	199211.20	124625.97**	3708.44*
	(294222.12)	(49393.69)	(1800.04)
Gross Irrigated Area (X_5)	42101.56***	56684.27**	253746.6
	(22.4795)	(20843.31)	(151424.3)
Gross Cropped Area (X_6)	8075.70	30892.49	45716.75***
	(66150.92)	(17306.44)	(14923.38)
R^2	0.76	0.75	0.73

Figures in the parentheses are the standard errors of the respective regression coefficient

, ** and * indicate significance at 10, 5 and 1 per cent level*

The highest annual expenditure incurred on cropping sequences III (Rs. 3,15,695.60) per farm which have major contribution by crop production and livestock activity (31.25 and 22.56 percent share, respectively). Expenditure spend on cropping sequences I and II are Rs. 2,98,761.18 and Rs. 2,41,850.69 per farm, respectively.

Table 5. Per farm average annual expenditure (Rs.)

Particular	Cropping Sequence		
	I	II	III
Crop production	110310.28	49926.69	98656.00
	(36.92)	(20.64)	(31.25)
Livestock activity	54450.00	63387.50	71225.00
	(18.23)	(27.21)	(22.56)
Family expenditure	38944.40	36100.00	40298.70
a)Food consumption	(13.04)	(14.93)	(12.77)
b)Education	32789.90	30305.00	33522.10
	(10.98)	(12.53)	(10.62)
c) Health	10292.70	12355.00	15313.40
	(3.45)	(5.11)	(4.85)
d) Other	8163.10	8609.50	10885.50
	(2.73)	(3.56)	(3.85)
Business Expenditure	27080.90	21175.00	25526.80
	(9.06)	(8.76)	(8.09)
Land Development	7463.50	9327.50	8060.50
	(2.50)	(3.86)	(2.55)
Other	9266.40	10664.50	12207.60
	(3.10)	(4.41)	(3.87)
Total Expenditure	298761.18	241850.69	315695.60
	(100.00)	(100.00)	(100.00)

Figure in parentheses are the percentage to the total

The scarcity of water in summer, irregular supply of electricity with low voltage, high wage rate and non-availability of input (*i.e*. planting material, manures, chemical fertilizer and pesticides *etc.*) are the major problem faced by farmer in adoption of major cropping sequences. During marketing, the problem faced by the farmer high transportation cost, high price fluctuation, high marketing cost and lack of market intelligence (Table 6).

Table 6. Constraints in adoption of major cropping sequences

Constraints	Cropping Sequences		
	I N=21	II N=20	III N=18
Constraints in Crop production			
High wage rate	3(14.28)	4(20.00)	5(27.80)
Shortage of Labour	11(52.36)	11(55.00)	8(44.48)
Non availability of seed or planting material at time	7 (33.32)	10 (50.00)	9 (50.04)
High cost of fertilizer	10 (47.60)	11 (55.00)	10 (55.60)
Shortage of water in summer	13 (61.88)	13 (65.00)	11 (61.16)
Electricity failure or irregular supply of electricity	11 (52.36)	12 (60.00)	10 (55.60)
Lack of technical assistance	5 (23.81)	4 (20.00)	4 (22.24)
Constraints in Marketing			
High transportation charges	10 (47.60)	11 (55.00)	8 (44.48)
High price fluctuations	11 (52.36)	5 (25.00)	8 (44.48)
High marketing cost	9 (42.84)	8 (40.00)	4 (22.24)
Lack of market intelligence	8 (38.08)	7 (35.00)	9 (50.04)
Financial Constraints			
Scarcity of own funds	8 (38.08)	7 (35.00)	4 (22.24)
Lengthy process of loan sanction in bank	6 (28.56)	7 (35.00)	5 (27.80)
No easy access for credit	7 (33.32)	7 (35.00)	3 (16.68)

Figures in the parentheses indicate percentage to the total number of farmer

CONCLUSION

The analysis of employment pattern indicate that there existed a scope to increase the total annual employment with increase in number of milch animaland area under cash crop in all cropping sequences. The number of milch animal, number of earner, area under cash crop and gross irrigated area have significant influence on the annual employment. The proportion of crop production expenditure in total expenditure was higher in case of cropping sequences I and III. In case of cropping sequence II, livestock activity contributed major share in expenditure compare with remaining two cropping sequence expenditure on livestock activity. Total annual expenditure in cropping sequence III was highest than cropping sequence I and cropping sequence II. The scarcity of water in summer is major constraints in adoption of cropping sequences, electricity failure/irregular supply of electricity second most important constraints.

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Impact of production technology of cotton in Vidarbha region of Maharashtra

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ABSTRACT

The study conducted the economic analysis and impact assessment of production technology of cotton cultivation in Vidarbha region of Maharashtra for the year 2013-14, based on the data of cost and return of crop. Apart from benefit-cost ratio (BCR), yield gap analysis, resource use efficiencies, adoption index and impact of improved cotton technology have been estimated in the study. It has shown that, per hectare cost 'C' was Rs. 42161.58 and B:C Ratio is 1.03. Further, there was a 31.58 per cent yield gap between actual yield and yield of recommended plot, in which cultural practices (10.62) have shown a stronger effect than input use (20.96). The composite index of technology adoption was worked out to 50.93 per cent indicated that the sample farmers adopted less than 49 per cent recommended cotton production technology and obtained 10.40 q/ha yield. Among, in medium adopters, the per hectare economic impact of cotton production technology on gross return, cost of cultivation and net returns was 6.53, 4.89 and 21.67 per cent.The most important constraint in improved method of cotton cultivation has been identified as high cost of seed, fertilizers and labour charges, lack of knowledge about fertilizers application, seed treatment small fragmented holding and low price to produce. The improved cotton production technology method being more skill oriented, the study has observed that yields can be made on adoption and impact sustainable if constraints are addressed on war-footing basis.
Keywords:*Cotton, production technology, impact*

INTRODUCTION

Cotton is considered as one of the most important cash crops which plays a vital role in the economy of the country. Cotton, the king of fibers is often quoted as 'White Gold' because it's higher commercial values. Cotton is cultivated in more than 80 countries of the world introducing production of cotton. China (27.10 per cent) is the largest producer of cotton in the world, whereas, India (21.83 per cent) is second largest followed by United States (12.67 percent), Pakistan (8.58 per cent) and Brazil (7.52 per cent). In the present study an attempt has been made to analyze the adoption and impact of improved technologies on cotton production in Vidarbha region of Maharashtra to study the resource use efficiency and cost and returns of cotton in Vidarbha; to study technology adoption and its impact on production of cotton in Vidarbha and to examine the constraints in adoption of cotton production technologies in Vidarbha.

METHODOLOGY

The study was conducted in the Vidarbha region of Maharashtra. Two districts from the region *viz.,*Buldhana and Yevatmaland from each district two tahsils were selected on the basis of maximum area under study. Two villages from each tahsil were selected. Among each village, 4 samples growers were selected as per the size group of small (0.1 to 2 ha), medium (2.01 to 4 ha) and large (4.01 to above ha). The study was based on primary data for the year 2013-14. From each district, 48 farmers were selected who were practicing improved production technology of cotton cultivation. Thus, there were a total of 96 farmers. The farmers were interviewed using specially prepared schedules. The farmers were also asked to prioritize the most important constraints they were facing in adopting improved method of cotton cultivation.

Cobb-Douglas Type of Production Function

To identify the important factors affecting the cotton production technology for cotton cultivation, following Cobb-Douglas type of production function was employed.

$$Y = aX_1^{b_1}X_2^{b_2}X_3^{b_3}X_4^{b_4}X_5^{b_5}e^u$$

Where,

Y = Output of main produce in quintals per hectare

a = Intercept

X_1= Per hectare use of human labour in man days

X_2= Per hectare use of Bullock in pair days

X_3= Per hectare use of Manure in quintals

X_4= Nitrogen (kg) per hectare

X_5 = Phosphorus (kg) per hectare

e^u = error term

Technological gap analysis

Yield gap was worked out as the difference between demonstration plot yield and actual farmer's yield. The following Cobb-Douglas type of production function was used for this purpose. (*Guddi et al, 2002)*

$$Y = a_0 H^{a_1}B^{a_2}M^{a_3}N^{a_4}P^{a_5}e^u$$

Where,
Y = Output of main produce in quintals per hectare
a_0 = Intercept
H = Per hectare use of human labour in man days
B = Per hectare use of Bullock in pair days
M = Per hectare use of Manure in quintals
N = Nitrogen (kg) per hectare
P = Phosphorus (kg) per hectare
e^u = error term
a_1 to $a_5$elasticities of production.

The combination of different resources to yield gap was estimated with the help of **Decomposition model**. The following functional form was used to work out the yield gap. *(Bisliah, 1977)* The Chow test was conducted for checking the production elasticity of the two functions.

$$\text{Log } (Y_2/Y_1) = [\text{Log } (b_o/a_0)] + [(b_1\text{-}a_1) \text{ Log } H_1 + (b_2\text{-}a_2) \text{ Log } B_1 + (b_3\text{–}a_3) \text{ Log } M_1 + (b_4\text{-}a_4) \text{ Log } N_1 + (b_5\text{-}a_5) \text{ Log } P_1] + [b_1 \text{ Log } (H_2/H_1) + b_2 \text{ Log } (B_2/B_1) + b_3 \text{ Log } (M_2/M_1) + b_4 \text{ Log } (N_2/N_1) + b_5 \text{ Log } (P_2/P_1)] + [U_2\text{-}U_1]$$

Technological adoption pattern on sample farm

In order to measure the technology adoption, index the adoption of cotton production technology viz; date of sowing ,method of sowing, seed rate, manures, application of FYM and chemical fertilizers and plant protection measures, etc; were considered. The Technology Adoption Index (TAI) in percentage was estimated by using the following formula.

$$TAI = \frac{A_i}{M_i} \times 100$$

Where,

Ai = Average adoption score registered by the farmer for particular component
Mi = Maximum adoption score registered by the farmer for particular component.

RESULTS AND DISCUSSION

Per hectare resource use levels of cotton in Vidarbha region

The per hectare utilization of physical quantities of different inputs are presented in Table 1.The quantities of various inputs used directly affected the cost of cultivation and therefore, utilization inputs such as human labour, bullock labour, seeds, manures, fertilizer etc., have been studied in per hectare physical and monetary terms. Inputs played a significant role for boosting production of cotton. The production and productivity of cotton depend on the judicious and the balanced use of inputs.

Per hectare resource use gap of cotton in Vidarbha region

The per hectare resource use gaps of cotton cultivation in recommended and actual use levels of input and output as per the adoption level is presented in Table 2. The Agricultural Universities research institutes recommended the input use for higher production of the crops. This differs usually from the actual use of inputs by the farmers.

Per hectare resource use gap of cotton in Vidarbha region

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Table 1. Per hectare resource use levels ofcotton in Vidarbha

Particulars	Small	Medium	Large	Overall
Total Human labour (days)	118.59	106.61	132.19	121.32
Male	53.48	51.76	66.25	59.19
Female	65.11	54.85	65.94	62.14
Bullock power (pair days)	8.01	8.88	6.15	7.38
Machine power in hrs.	3.56	4.76	5.07	4.69
Seed (kg)	1.60	1.70	1.60	1.63
Manures (q)	15.36	6.95	9.19	9.56
Fertilizers (kg)				
N	120.19	110.12	156.23	134.58
P	55.60	45.80	75.60	62.20
K	60.12	48.90	62.13	57.41
Irrigation Charges (Rs.)	712.34	1009.26	996.59	949.83
Plant protection charges (Rs.)	1125.12	1036.35	694.93	884.51

At the overall level in Vidarbha region, the inputs viz; human labour, bullokpower,seed, maures and potash were utilized less than the recommended. At the overall level, excess use of nitrogen and phosporus was more than recommendation in Vidarbha region. In case of manures, the recommendation is 75 qt/ha for the crop but the farmers used the less than recommended dose due to the unavailability and increasing cost. The gap between actual and recommended yield was 31.58 per cent.

Table 2. Per hectare resource use gap of cotton in Vidarbha region (Per ha.)

Particulars	Actual	Recommended	Gap	% Gap
Total Human labour (days)	121.32	140.15	18.83	13.43
Bullock power (pair days)	7.38	9.15	1.77	19.31
Seed (kg)	1.63	2.5	0.87	34.68
Manures (q)	9.56	75	65.44	87.26
Fertilizers (kg)				
N	134.58	120	-14.58	-12.15
P	62.20	60	-2.20	-3.66
K	57.41	60	2.59	4.32
Yield (q)	10.26	15	4.74	31.58

-ve sign indicates excess use

Cost, returns, gross income and B:C ratio of cotton in Vidarbha

The detail information regarding on per hectare cost and returns, gross returns of the produce and net profit in cotton cultivation in different size group of holdings in Vidarbha region is given in Table 3.

The yield obtained from cotton at the overall level was 10.26 quintals. Among the size group of holdings

Table 3: Costs and return structure of cotton in Vidarbha (per ha)

Particulars	Unit	Size groups			
		Small	Medium	Large	Overall
Total cost					
Cost 'A'	Rs.	24274.55	22193.29	25882.43	24378.84
Cost 'B'	Rs.	32543.35	30811.84	33068.49	32230.90
Cost 'C'	Rs.	42386.95	40665.64	43082.49	42161.58
Profit at					
Cost 'A'	Rs.	18411.45	20743.31	18170.46	19061.31
Cost 'B'	Rs.	10142.65	12124.76	10984.39	11209.25
Cost 'C'	Rs.	299.05	2270.96	970.39	1278.57
Production	Qtls	10.00	10.11	10.46	10.26
Gross income	Rs.	42686.00	42936.60	44052.88	43440.15
B:C ratio					
Cost 'A'		1.76	1.93	1.70	1.78
Cost 'B'		1.31	1.39	1.33	1.35
Cost 'C'		1.01	1.06	1.02	1.03

per hectare yield was 10, 10.11 and 10.46 quintals in small, medium and large size groups, respectively. It indicates that per hectare yield of cotton increased with an increase in the size of holdings. The gross income received from cotton was observed to be Rs. 42,686, 42,936.60 and 44,052.88 in small, medium and large size groups, respectively. At the overall level, it was 43440.15. The gross returns also depicted the similar trend as that of per hectare yield. The per hectare net profit at Cost 'C' was the highest (2270.96) in medium size group followed by large group (970.39) and small group (299.05). The B: C ratio was highest in medium size group (1.06), followed by large (1.02) and small groups (1.01).

Results of Cobb-Douglas production function of cotton in Vidarbha

The analysis of variance in respect of the production function showed a significant variance, indicating the overall significance of the estimated production function (Table 4).

Decomposition analysis of cotton for Vidarbha region

In the present study, the yield gap between actual farms and demonstration methods was to the tune of 31.58 per cent (Table 5).

In 31.58 yield gap measurably (10.62 per cent) was contributed by differences in cultural practice, whereas remaining 20.96 percent of yield was due to difference in use of input. The maximum positive difference of input use level was found from manures (6.12 per cent) followed by nitrogen (4.02 per cent), phpophorus (3.80 per cent), potash (3.09 per cent), human labour (2.71 per cent) and seed (2.34 per cent). Patole *et al.* (2008) by using the Bislaih (1977) model of decomposition, had estimated that yield gap in chickpea in the Ahmednagar district of Maharashtra was 53 per cent, of which, input use (29%) had a higher role than cultural practices (24%).

Technology adoption index on sample farm in Vidarbha region

The detail procedure of constructing the technology

Table 4. Results of Cobb-Douglas production function for Vidarbha region

Particulars	Small	Medium	Large	Overall
Intercept	1.6801	0.4939	1.5333	1.7001
Human labour in days (X_1)	0.2985**(0.1126)	0.6635***(0.2285)	0.8117**(0.2761)	0.3320***(0.1036)
Bullock labour in days (X_2)	0.2235*(0.1142)	0.0435(0.2463)	0.1228(0.4613)	0.0376(0.0388)
Machine labour in hr ($X_{3)}$	0.2023(0.2007)	0.0729(0.0656)	0.0923(0.0858)	0.1249(0.1166)
Seed in kg (X_4)	0.0560(0.0936)	0.8764(0.9109)	0.6458(0.8245)	0.4959(0.3731)
Manures in q (X_5)	0.0278**(0.0126)	0.3239**(0.1290)	0.3614***(0.1249)	0.2765*(0.1331)
Nitrogen in kg (X_6)	0.0332**(0.0132)	0.2831**(0.1164)	0.0120(0.2714)	1.1796***(0.4318)
Phosphorus in kg (X_7)	0.0021(0.1449)	0.0014(0.1897)	0.0967**(0.0345)	0.0120(0.2024)
Potash in kg (X_8)	0.1431***(0.0464)	0.3658***(0.1074)	0.6178***(0.1590)	0.0267(0.0849)
R^2	0.68	0.65	0.73	0.74
Observation	32	32	32	96
D.F.	23	23	23	87
F-value	23.53***	24.18***	19.33***	21.50***

Figures in parentheses are standard errors of respective regression coefficients
, **, * are significant at 10, 5, and 1 per cent level.*

Table 5: Results of decomposition analysis for Vidarbha region

Source of productivity difference	Percentage contribution
Total difference observed in output	31.58
Source of contribution	
Difference in cultural practices	10.62
Due to difference in input use level	
Human labour	2.71
Bullock labour	-1.12
Seed 2.34	
Manure	6.12
Nitrogen	4.02
Phosphorous	3.80
Potash	3.09
Due to all inputs	20.96
Total estimated gap from all sources	31.58

Table 6: Technology adoption index on sample farm for Vidarbha region (per cent)

Component	Size group			Overall
	Small	Medium	Large	
Date of sowing	72.92	75.00	76.04	74.65
Seed rate	60.42	61.46	63.54	61.81
Variety	63.54	64.58	65.63	64.58
Method of sowing	82.29	84.38	85.42	84.03
Manures	25.00	28.13	31.25	28.13
Nitrogen	43.75	44.79	50.00	46.18
Phosphorous	33.33	34.38	35.42	34.38
Potash	30.21	33.33	35.42	32.99
Plant protection	25.00	31.25	38.54	31.61
Composite Index	48.50	50.81	53.47	50.93
Yield (q)	12.45	9.19	16.46	10.40

adoption index was given in methodology chapter and the information are presented in Table 6. The technology adoption of index gives the clear cut idea about the adoption of a particular technology component whereas the magnitude of composite index gives the aggregate percentage of adoption of all components of technology.

The result indicated that at the overall level, the adoption of method of sowing technology component was observed maximum (84.03%) to be on sample farms followed by date of sowing (74.65%), variety (64.58%),and seed rate (61.81%).The lowest technology was noticed in case of manures,fertilizers and plant protection.The Composite Index of technology adoption was worked out to 50.93 per cent indicated that the sample farmers adopted less than 50 per cent recommended cotton production technology obtaining yield of 10.40 q/ha. The positive relationship was observed in between composite index and yield obtained on sample farms i.e. increase in composite index resulted in increase in yield. It was also noticed that the magnitude of composite index increased as size of holding increased. The same trend was observed in adoption of method of sowing, date of sowing, seed rate, nitrogen and potash component of technology.

Impact of improved cotton production technology for Vidarbha region

The impact of improved cotton production technology in Vidarbha was presented in Table 7. It is seen from the table that, the impact on per hectare yield of main produce was found to be 12.58 and 8.94 per cent in the medium adopters and high adopters, respectively. Among, in medium adopters, the per hectare economic impact of cotton production technology on gross return, cost of cultivation and net returns was 6.53, 4.89 and 21.67 per cent, as compared to the low adopters, whereas in high adopters over the medium adopters, it was 3.98, 2.73 and 19.61 per cent, respectively.

Constraints in adoption of improved production technology of cotton

The farmers were asked to offer opinions as per priority-wise major constraints they were facing in

Table 7: Impact of improved cotton production technology for Vidarbha

Particulars	Low adopters	Medium adopters	Low to Medium % impact	High adopters	Medium to High % impact
Adoption %	42.92 (Below 50)	57.92 (50-70)	-	72.93 (Above 70)	
Yield (q/ha)					
Main produce	9.52	10.89	12.58	11.96	8.94
By-produce	5.86	6.74	13.06	7.10	17.46
Economics (Rs./ha)					
Gross returns	40246.00	43057.00	6.53	44542.00	3.98
Cost of cultivation	36946.00	38844.00	4.89	39437.00	2.73
Net returns	3300.00	4213.00	21.67	4105.00	19.61
B:C ratio	1.09	1.11	-	1.12	
Cost effectiveness of improved cotton production technology			-	-	
Added returns	-	2811.00	-	1785.00	-
Added cost	-	1898.00	-	1093.00	-
ICBR ratio	-	1.48	-	1.63	-
Cost (Rs./q)	3880.88	3566.94	-	3339.21	-
Unit cost reduction (Rs./q)	-	313.94	-	227.73	-
% reduction	-	8.09	-	6.28	-
Added yield (q)	-	1.37	-	1.07	-
% increase in Yield	-	14.40	-	9.94	-

Table 8. Constraints in adoption improved production technology of cotton for Vidarbha

Particulars	Group			Overall(N=96)
	Small (N=32)	Medium (N=32)	Large (N=32)	
Rainfall				
Abnormal distribution of rainfall	53.13	43.75	37.50	44.79
Inadequate	46.88	40.63	37.50	41.67
Seed rate				
High cost	62.50	56.25	56.25	58.33
Lack of awareness	40.63	40.63	37.50	39.58
Time of sowing and variety				
Lack of awareness	43.75	40.63	37.50	40.63
Non-availability of proper variety seed	62.50	59.38	59.38	60.42
Method of Sowing				
Recommendation not known	46.88	37.50	40.63	41.67
Expensive and more labour required	65.63	62.50	59.38	62.50
Seed treatment				
Unawareness	46.88	68.75	65.63	60.42
High cost	59.38	50.00	46.88	52.08
Fertilizer application				
High cost of fertilizer	81.25	78.13	75.00	78.13
Inadequate supply	50.00	43.75	40.63	44.79
Lack of knowledge about fertilizers	46.58	50.00	50.00	48.96
Irrigation				
Unavaibility of irrigation sources	68.75	56.25	53.13	59.38
lack of irrigation technology	75.00	62.50	59.38	65.63
Labour				
Inadequate	43.75	37.50	31.25	37.50
High wage rates	84.38	78.13	75.00	79.17
Non-availability at peak period	62.50	68.75	65.63	65.63
Plant protection				
Inadequate supply	34.38	37.50	34.38	35.42
Higher cost	65.63	65.63	62.50	64.58
Improved implements				
High cost	37.50	43.75	40.63	40.63
Poor economic condition	65.63	46.88	43.75	52.08
Small and fragmented land holding	65.63	56.25	53.13	58.33
Lack of technical know-	50.00	53.13	46.88	50.00
Low price to produce	78.13	75.00	71.88	75.00

adoption improved production technology of cotton cultivation in Vidarbha region.All these were sorted and screened and finally major constraints were identified and are presented in Table 8. At the overall level, the major constraints was opined were high cost of seed, untimely supply of fertilizers, expensive and more labour required, high cost of plant protection measures, high wage rates, unawareness, low price to produce, labour require more and high cost of fertilizer were reported by farmers, respectively.

CONCLUSION

The variables namely, human labour, manures and nitrogen were significant variables for which the output is responsive.The decomposition analysis revealed that, the contribution to the difference in total productivity due to cultural practices was 10.62 per cent while due to input use level, it was 20.96 per cent for the Vidarbha region.At the overall level, the technology adoption index (TAI) was found high for method of sowing fallowed by date of sowing, variety and seed rate. At the overall level, technology composite index was worked out to 50.93 per cent. For the output maximization and cost reduction, it is concluded that the farmers should not adopt the recommended package of practice. The major constraint were reported in cotton production technology namely; high cost of inputs, unawareness and low price to produce.

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Impact of varietal demonstrations of wheat HD-2967 in Kathua

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ABSTRACT

The present study was carried out in the adopted villages located in the operational area of Krishi Vigyan Kendra, Kathua with the objective to identify the yield gaps as well as to work out the monetary returns under front line demonstrations and farmers' (traditional) practices. KVK Kathua conducted Front Line Demonstrations (FLD) in the cultivation of wheat (HD-2967) with the apparent objective to prepare the farmers of the district to achieve higher productivity in wheat. Each demonstration consisted of both scientific and local practice having approximately 0.4 hectare area. The farmers were provided with critical input. The results of field performance of HD-2967 under frontline demonstrations strongly narrate its superiority, in terms of higher net returns and B:C ratio (3.37) over local check wheat varieties (B :C ratio of 2.19).

Keywords: *HD-2967, horizontal expansion, technological gaps*

INTRODUCTION

Agriculture in India happens to face several constraints and challenges, especially in the areas of application of advanced farm technology to increase crop yield potential, farm profitability, soil health and food self-reliance while minimizing adverse environmental impacts (Choudhary*et al.,* 2012). Kathua district, the gate way of Jammu & Kashmir, is located in the extreme south of the state. It lies between $17^0$and 55^0 North latitude and 70^0 and 16^0 East longitude. The district is surrounded by Punjab in the south – east, Himachal Pradesh in north-east, district Doda and Udhampur in North and north–west, Samba in the West and Pakistan in the south-west. The district headquarter is located at Kathua.The district comprises of nineteen blocks. There are 512 villages and 244 Panchayats in the district. The district is predominantly rural (95%) in its demography with a spread of over 2502 sq. kms. The overall literacy percentage of the district is 73.50% with female literacy of 64.0%.The main occupation of the people of Kathua district is agriculture, allied and agro-based activities. The agriculture in Kathua is mostly rain-fed except in small pockets where canal irrigation is available. Agriculture production measured in terms of crop yield perhectare in Kathua is comparatively low to the other districts of the state. The district is classified into three agro-climatic zones namely: Sub-Tropical (up to 800m) which includes Plain areas with water logging conditions, Intermediate lower (800 to 1500m) which include Sloppy lands with problem of soil erosion and Intermediate higher (Above 1500 m) which include High hills with gully erosion.

The farmers in plains areas of Kathua district are mainly practicing rice-wheat cropping system. The lands are suitable for such system, as the system prevails in similar proportions in both rainfed as well as irrigated conditions. Being a highly reliable system, farmers are engaged in cultivation of wheat and rice for their own consumption and also contributing to the marketed surplus of these crops. Due to the sole dependency on this system, farmers' income is largely dependent upon the productivity of rice and wheat. KVK Kathua is, therefore, concentrating its activities on increasing the productivity of system through introduction of improved/ hybrid varieties of wheat and rice for economic upliftment of the farmers.

METHODOLOGY

The present study was carried out in the adopted villages located in the operational area of Krishi Vigyan Kendra, Kathua with the objective to identify the yield gaps as well as to work out the monetary returns under front line demonstrations and farmers' (traditional) practices. The FLD programme is a form of applied research under close supervision of farm scientists using the latest recommended cultivars with a full package of practices on selected farmers' fields to demonstrate the potential of farm technology as well as to analyze production constraints and assess the performance of improved technology under varied farming situations (Kumar, et al., 2017).

After ascertaining the demands of local farmers, Krishi Vigyan Kendra (KVK), Kathua procured seed of HD-2967 from IARI, New Delhi in the year 2009. After conducted several On-farm trials, KVK standardized and refined the recommended technology for farmers of Kathua district. Through well framed annual action plans, KVK Kathua conducted Front Line Demonstrations (FLD) in the cultivation of wheat (HD-2967) with the apparent objective to prepare the farmers

of the district to achieve higher productivity in wheat. Each demonstration consisted of both scientific and local practice having approximately 0.4 hectare area. The farmers were provided with critical input (seed only) to be applied as per the recommended package of practices.Farmer'-Scientist Interaction, field days, film shows, radio talks and frequent print media coverage were also employed to get the maximum impact.

Production of Truthful seed of HD-2967

An important factor in restricting the horizontal expansion of agricultural technology, especially of field crops is the non-availability of seed. Therefore, under a systematic plan, KVK, Kathua after the year 2010, concentrated its farm activities towards production of Truthful seed of HD-2967 in every rabi season for distribution to the farmers of the district.

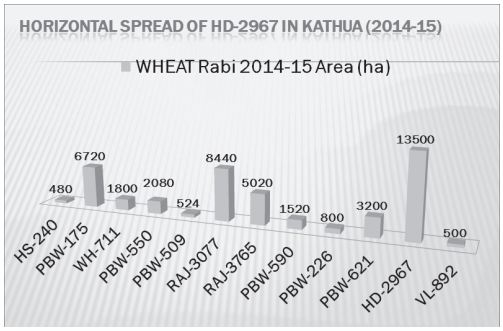
RESULTS AND DISCUSSION

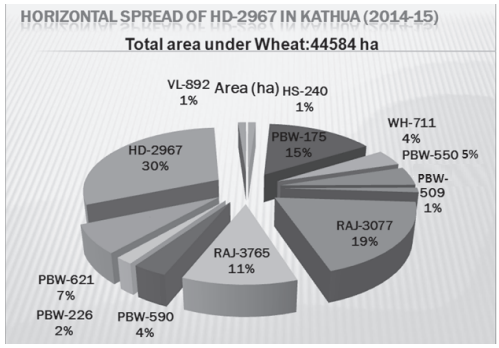
KVK Kathua has gavemajor thrust on HD-2967 by continuously conducting Frontline demonstrations over an average area of 10 hectares every year. This has resulted in massive expansion of area under HD-2967 of wheat variety in Kathua district. The performance of HD-2967 in comparison to farmer's local varieties over the years is presented in the Table 1.

Table 1: Economics of HD-2967 wheat variety in comparison to local check

Year	Local check wheat variety				HD-2967			
	Yield (q/ha)	Price (Rs./q)	Net income	B:C Ratio	Yield (q/ha)	Price (Rs./q)	Net income	B:C Ratio
2013-14	28.6	1650	37200	2.12	37.8	1650	50645	3.32
2014-15	28.1	1670	35615	2.14	36.6	1670	60,215	3.35
2015-16	29.4	1750	42346	2.19	37.5	1750	53532	3.44
Average of 3 years	28.7	1690	38387	2.15	37.3	1690	54797	3.37

The results of field performance of HD-2967 under frontline demonstrations strongly narrate its superiority, in terms of higher net returns and B:C ratio (3.37) over local check wheat varieties (B :C ratio of 2.19). Enhanced monetary returns in terms of gross, and net returns as well as enhanced BCR through improved farm technology have also been reported by various workers (Sagar and Chandra 2004; Vednaet al., 2007; Choudharyet al., 2009).This has led to the sharing of farm saved seed among the farmers which further leads to the speedy spread of HD-2967. On the recommendations of KVK Kathua, the State Department of Agriculture has also procured the seed for large scale distribution to the farmers of the district, which further enhances the area under improved variety of wheat in rice-wheat cropping system. The spread of HD-2967 in Kathua district over the last few years has been depicted in Figure 1. The impact clearly shows the unprecedented increase in the area under HD-2967 in the year 2014-15 (13500 ha) as compared to other traditional varieties viz., HS-240 (480 ha), PBW-175 (6720 ha), WH-711 (1800 ha), PBW-550 (2080 ha), PBW-509 (524 ha), RAJ-3077 (8440 ha), RAJ-3765 (5020 ha), PBW-590 (1590 ha), PBW-590 (1520 ha), PBW-226 (800 ha), PBW-621 (3200 ha) and VL-892 (500 ha). The area under HD-2967 increased up to 30% which has virtually occupied one-third area under this variety.





CONCLUSION

It is concluded that KVK Kathua has gave major thrust on HD-2967 by continuously conducting Frontline demonstrations over an average area of 10 hectares every year. This has resulted in massive expansion of area under HD-2967 of wheat variety in Kathua district. However, there exists a wide gap in potential yields, demonstration yields, and farmers' plot yields under wheat crop due to technological sand extension yield gaps.

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Impact of vocational training programmes in Reasi district of J&K

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ABSTRACT

Krishi Vigyan Kendras (KVKs) also called as Farm Science Centres have been established by the Indian Council of Agricultural Research(ICAR) in various districts of India. The major thrust areas of KVKs are assessment, reûnement, demonstration of technologies and also to train the farmers and extension functionaries. Imparting vocational trainings in agriculture and allied sectors for the rural youth is one of the most important mandates of KVKs. The present study was undertaken to assess theimpact various vocational training programmes imparted by KVK, Reasi in hilly districts Reasi and Udhampur of Jammu and Kashmir. Krishi Vigyan Kendra (KVK) imparts need-based and skill oriented training to increase the agricultural production and to create the employment for the rural youths/farmers. The rural youths not only required knowledge of the technologies but also skills in various agricultural and allied operations to increase their knowledge. The training programmes are designed to impart the latest knowledge to the farmers through work experience. The KVK provides the trainings not only in agriculture and allied vocations but also in other income-generating activities that increase the income of farm families. The present study was conducted in hilly districts Reasi and Udhampur of Jammu and Kashmir which was selected purposively as the KVK is catering the needs of the farmers of both the districts.428 trained rural youths/farmers were selected for the study purpose. Impact analysis was done to find out the increased income of the participants after training.Study revealed that vocational training programmes had a positive impact on the knowledge gained by the rural youths andthere was increase in the income of the respondents after training. Rural youths responded that vocational trainings played an important role in developing their skills and also benefitted for their income generation.

Keywords: *Krishi Vigyan Kendras, vocational trainings, hilly areas, rural youths, knowledge.*

INTRODUCTION

Krishi Vigyan Kendra (Farm Science Centre) is an innovative science–based institution which plays an important role in bringing the research scientists in direct contact with farmers.Krishi Vigyan Kendras (KVKs) impart need based and skill oriented vocational training to various categories of farming communities. The major objective of KVKs is to increase the production and productivity of the needy and deserving weaker sections of the community like tribals, small and marginal farmers, hilly areas farmers,disasters affected people and other weaker sections of the society. KVK trainings are also designed on the basis of the most important needs of the clientele, their resources, constraints and nature of the eco-system.The main aim of Krishi Vigyan Kendra is to reduce the time lag between generation of technology at the research institution and its transfer to the farmers for increasing productivity and income from the agriculture and allied sectors on sustained basis. KVKs are grass root level organizations meant for application of technology through assessment, refinement and demonstration of proven technologies under different 'micro farming' situations in a district (Das, 2007). Vocational training refers to a type of training whose main objective is to prepare people for work so that they can start their entrepreneurships. Vocational trainings for the rural youths/farmers are proved as the significant input in accelerating farm production.Krishi Vigyan Kendra designs different kinds of training courses for the farmers'/farm women/rural youths. Courses are based on the information received through family and village survey. No specific qualification is needed to be the participant of the training programmes. No certificate is awarded after training programmes(Desai, 1996). After conducting the training programmes follow-up programmes are organized for converting the obtained skills of the trainees into practice. While designing the training programmes, the concept of farming system is taken into account to make the enterprises commercially viable(Dipak&Basvaprabhu, 2005). The training starts from farmer's/rural youths' production units such as fields, dairy units, poultry units, mushroom unit, beekeeping unit, sericulture unit, nursery raising etc. and closes with discussion. The vocational training programmes take into account all methods and means which will result in skill development in rural youths in the areas of their interest.The KVK being an educational institution of the farmers, offers a very real opportunity by organizing trainings to work closely with trainees in developing a more skilled and educated work force. The training programmes of KVK are multipurpose one to cover not only the various needs of farmers but also the entire needs of village and community (Ingle &Kubde, 1995; Yadkikar, 1999;Tandon& Seth, 1999 & Sharma et al., 2013). Keeping in mind the impact of vocational training

programmes imparted by the KVK, a study on "Impact of vocational training programmes on income of the rural youths" was undertaken to study the impact of vocational training programmes on income of the rural youths/farmers of hilly areas of Jammu &Kashmir, India.

MATERIALAND METHODS

The present study was conducted in hilly districts Reasi and Udhampur of Jammu and Kashmir which were selected purposively as the KVK was catering the needs of the farmers of both the districts. A sample of 428 rural youths trained by the KVK, Reasi was selected purposively. Different vocational training programmes were imparted by the KVK scientists. These were on commercial organic farming, commercial floriculture, entrepreneurship development in agriculture, backyard poultry,poultry farming as an entrepreneurship, value addition in fruit and vegetables and scientific mushroom/ dhingri cultivation. Several lectures with different visual aids were delivered. Flash cards/charts/posters were prepared and demonstration was given in different steps included in each activity. A pre-post -test performa was developed for the trainings which was filled up to assess the income of the rural youths participated in the training programmes.The data collected was carefully scrutinized and condensed into master chart and tabulated in terms of statistical tools to represent in a meaningful way. Appropriate statistical tools were used to reveal the results. Literature was collected from journals, annual progress reports, symposia/seminar compendium etc.

RESULTS AND DISCUSSION

The vocational training programmes pertaining to agriculture and allied fields for the duration of 4 days has been conducted by KVK Reasi (Table 1). The participants were rigorously trained keeping in view their income. The number of participants were 72in case of commercial organic farming,66 in case of commercial floriculture,26 in caseof entrepreneurship development in agriculture,40 in case of backyard poultry farming,30 in case of poultry farming as an entrepreneurship,26 in case of processing of fruits and vegetables,123 in case of processing of fruits and vegetables and 45 incase of scientific mushroom cultivation.

There was change in the annual income of the participants after training.In case of commercial organic farming the participants' annual income was Rs. 73,000/ ha before the training which increased to Rs. 2,55,000/ ha after training.In case of commercial floriculture, the participants' annual income was Rs.60,000/ha before the training which increased to Rs.1,10,000/ha after training. In case of entrepreneurship development in agriculture the participants' annual income was Rs.65,000/ha before the training which increased to 1,75,000/ha after training. In case of backyard poultry, the participants' annual income was 40,000-50,000/per year/per/1000 birds before the training which increased to Rs. 80,000-100000/per year/per 1000 birds'unit (6-7 lots per year) after training. In case of poultry farming as entrepreneurship the participants' annual income was 30,000-40,000/per year/per 1000birds'unit (6-7 lots per year) before the training which increased to Rs.75,000-80000/per year/per 1000 bird unit (6-7 lots per year) after training. In case of processing of mango and other locally available fruits the participants were not generating any income before the training and they were utilizing the processed fruit products for household purpose but after training they started generating Rs.

Table 1: Impact of vocational training programmes on income of the rural youths/farmers

Title	Duration	Participants	Percentage Adoption	Change in annual income (Rs.) before training	Change in annual income (Rs.) after training
Training programme on commercial organic farming	4 days	72	45	73,000/ha	2,55,000/ha
Training programme on commercial floriculture	4 days	66	45	60,000/ha	1,10,000/ha
Entrepreneurship development in agriculture	4 days	26	30	65,000/ha	1,75,000/ha
Training programme on backyard poultry as an entrepreneurship	4 days	40	20	40,000-50,000/per year per 1000 bird unit	80,000-100000/per year/ per 1000 bird unit (6-7 lots per year)
Poultry farming as an entrepreneurship	4 days	30	33	30,000-40,000/per year per 1000 bird unit (6-7 lots per year)	75,000-80000/per year per 1000 bird unit (6-7 lots per year)
Processing of mango and other locally available fruits	4 days	26	30	For household use	54,000/unit/year
Processing of fruits and vegetables	4 days	123	36	For household use	62,000/year
Training programme on scientific cultivation of mushroom/dhingri	4 days	45	21	–	58,500/ unit/year

54,000/unit/year.Incase of processing of fruits and vegetables there was no income generation by the participants before the training as they were utilizing the processed fruits and vegetables for household purpose but after training they started earning Rs. 62,000 peryear. In case of scientific mushroom cultivation, they were not aware about the scientific cultivation of mushroom but they started earning Rs.

Table 2: Interest of rural youths/farmers for further vocational training programmes

Vocational training programmes	Frequency	Percentage
Cultivation of aromatic and medicinal plants	112	42.42
Candle/Agarbati making	43	14.01
Cutting and stitching	34	12.87
Toy making	13	4.92
Bag making	149	56.43.
Raincoat making	57	21.59
Vermicomposting	61	23.10

The Table 2 reveals that 56.43 per cent rural youths said that they liked to be trained in bag making followed by cultivation of aromatic and medicinal plants(42.42 per cent),vermicomposting (23.10 per cent), raincoatmaking (21.59 per cent),candle/agarbatimaking (14.01 per cent),cutting and stitching (12.87 per cent)and toy making (4.92 per cent).

58,500/small unit after training. The findings are in accordance with Ingle & Kubde (1995), Desai *et al* (1996). Choudhary (1999), Dipak & Basvaprabhu (2005) and Sharma *et al* (2013).

CONCLUSION

It can be concluded that vocational training programmes had a positive impact on the income of the rural youths/ farmers. Vocational trainings play an important role in developing the skills among the rural youths and also benefiting the rural women for generation of income. The positive change in their living status was also observed. Hence, vocational training programmes organized by KVK especially for rural youths havea great impact in hilly areas. Such training programmes can be replicated elsewhere and some more need based vocational training programmes may be incorporated so that the rural youths can earn their livelihood.

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In vitro anticancer and antifungal potential of *Tinospora cordifolia*

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ABSTRACT

Cancer is the major cause of mortality in the world and cancer cases are on rise in Jammu and Kashmir with summer capital Srinagar tops the number with 898 cancer patients while the number stands at 853 in Jammu and 62 in Leh / Kargil districts of the Ladakh region. Fungal diseases presently also destroying a huge quantity (tonnes) of the top five food crops - rice, wheat, maize, potato, soybean, each year, in the State which could otherwise be used to feed those who do not get enough to eat. In vitro anticancer and antifungal potential of T. cordifolia has been evaluated in the present research and results revealed that the methanolic extract from stem part of T. cordifolia at 100 µg/ml showed significant results against prostate (PC-3) and colon (HCT-116) cancer cell lines as 77% growth inhibition was observed in the former and 71% growth inhibition was observed in the later case. The extract also showed remarkable activity against B. specifera with IC_{50} values of 0.70±0.02 mg/mL. However, less activity was observed against C. lunata and A. alternate with IC_{50} values of 1.2±0.12 and 1.35±0.07 mg/mL respectively.

Keywords:*Tinospora cordifolia, potential, anticancer, antifungal*

INTRODUCTION

Cancer is a multifactorial, multifaceted and multimechanistic disease requiring a multidimensional approach for its treatment, control and prevention (Jemal*et al*., 2003). *Tinospora cordifolia* (Giloy) also named as 'heavenly elixir' belonging to the family Menispermaceae, is found throughout India and also in Srilanka, Bangladesh, China (Raghu *et al.,* 2006). Giloyis responsible for decreasing the tissue damage caused by radiation (Subramanian *et al*., 2002) and the side effects of some forms of chemotherapy (Mathew and Kuttan, 1998). Various bioactive components have already been isolated from *T. cordifolia* which belongs to different classes of compounds such as alkaloids, diterpenoid, lactones, glycosides, steroids, sesquiterpenoid, phenolics, aliphatic compounds and polysaccharides. Giloye stem has anti-cancer (Singh *et al*., 2005), anti-diabetic (Stanely*et al.,* 2003;Wadood*et al.,* 1992), antioxidant (Onkar*et al*., 2012), antipyretic (Rege*et al.,*1984), immune stimulating (Nair and Rodriguez,2004), cholesterol-lowering and liver-protective (Rathi*et al*., 2002)properties. The plant has been evaluated for its role as an anti-neoplastic agent and it has also been found that giloy can kill HeLa cells very effectively *in vitro* (Verma*et al.,* 2011; Jagetia*et al.,*1998). Aqueous, methanolic and dichloromethane extracts of *T. cordifolia*showed dose-dependent increase in lethality of HeLa cells *in vitro* and the most potent activity was found in the dichloromethane extract (Neeraja and Margaret, 2013).The antibacterial activity of the aqueous, ethanolic and chloroform extracts from the stem of *T. cordifolia* was studied using disc diffusion method against *E. coil*, *P. vulgaris*, *E. faecalis*, *S. typhi*, *S. aureus*and *S. marcesenses*. Results suggest that the ethanolic extract has significant antibacterial activity against tested bacterial strains. The present study justified the use of plant in the traditional system of medicine to treat various infectious diseases like fever, inflammation, skin and urinary infections (Shanthi and Nelson, 2013). In the present research work, *in vitro* anticancer and antifungal potential of Giloy has been investigated against various human cancer cells and fungal strains

METHODOLOGY

Chemicals used

RPMI-1640 medium, dimethyl sulfoxide (DMSO), EDTA, fetal bovine serum (FBS), sulphorhodamine blue (SRB) dye, phosphate buffer saline (PBS), trypsin, gentamycin, penicillin and 5-flurouracil were purchased from Sigma Chemical Co., USA. All other chemicals were of high purity and obtained locally with the brand Sigma-Aldrich Chemicals Pvt. Ltd. and S.D. Fine Chemicals Pvt. Ltd. from Ramesh Traders, Panjthirthi-Jammu, J&K.

Plant material and preparation of extracts

Stem part of *T.cordifolia* was collected and chopped, shade-dried / ground into powdered form. The methanolic extract was prepared by percolating the dried ground plant material (100 g) with 99% methanol and then concentrating it to dryness under reduced pressure. Stock solutions of 20 mg/ml were prepared by dissolving methanolic extract in DMSO (Kandil *et al*., 1994). Stock solutions were prepared at least one day in advance and were not filtered. The microbial contamination was controlled by addition of

1% gentamycin in complete growth medium *i.e.* used for dilution of stock solutions to make working test solutions of 200 ìg/ml.

Cell lines / cultures and positive controls

The human cancer cells were obtained from National Centre for Cell Science, Pune, India and National Cancer Institute, Frederick, USA. These human cancer cells were further grown and maintained in RPMI-1640 medium. Doxorubicin, 5-Fluorouracil, Mitomycin-C, Paclitaxel and Tamoxifen were used as positive controls.

***In vitro* assay for cytotoxic activity**

Extracts were subjected to *in vitro* anticancer activity against various human cancer cell lines (Monks *et al.,* 1991). In brief, the cells were grown in tissue culture flasks in growth medium at 37°C in an atmosphere of 5% CO_2 and 90% relative humidity in a CO_2 incubator (Hera Cell, Heraeus; Asheville, NCI, USA). The cells at sub-confluent stage were harvested from the flask by treatment with trypsin (0.05% trypsin in PBS containing 0.02% EDTA) and suspended in growth medium. Cells with more than 97% viability (trypan blue exclusion) were used for determination of cytotoxicity. An aliquot of 100 ìl of cells (10^5 cells/ml) was transferred to a well of 96-well tissue culture plate. The cells were allowed to grow for 24 h. Extracts (100 ìl/well) were then added to the wells and cells were further allowed to grow for another 48 h.

The anti-proliferative SRB assay which estimates cell number indirectly by staining total cellular protein with the dye SRB was performed to assess growth inhibition. The SRB staining method is simpler, faster and provides better linearity with cell number. It is less sensitive to environmental fluctuations and does not require a time sensitive measurement of initial reaction velocity (Skehan *et al.,* 1990). The cell growth was stopped by gently layering 50 ìl of 50% (ice cold) trichloroacetic acid on the top of growth medium in all the wells. The plates were incubated at 4°C for 1 h to fix the cells attached to the bottom of the wells. Liquid of all the wells was then gently pipetted out and discarded. The plates were washed five-times with distilled water and air-dried. SRB 100 ìl (0.4% in 1% acetic acid) was added to each well and the plates were incubated at room temperature for 30 min.

The unbound SRB was quickly removed by washing the cells five-times with 1% acetic acid. Plates were air-dried, tris buffer (100 ìl, 0.01 M, pH 10.5) was added to all the wells to solubilize the dye and then plates were gently stirred for 5 min on a mechanical stirrer. The optical density (OD) was recorded on ELISA reader at 540 nm. Suitable blanks (growth medium and DMSO) and positive controls (prepared in DMSO and distilled water) were also included. Each test was done in triplicate and the values reported were mean values of three experiments.The cell growth was determined by subtracting average absorbance value of respective blank from the average absorbance value of experimental set. Percent growth in presence of test material was calculated as under:

· OD Change in presence of control = Mean OD of control – Mean OD of blank

· OD Change in presence of test sample = Mean OD of test sample – Mean OD of blank

· % Growth in presence of control = 100/OD change in presence of control

· % Growth in presence of test sample = % Growth in presence of control × OD change in presence of test sample

· % Inhibition by test sample = 100 – % Growth in presence of test sample

The growth inhibition of 70% or above was considered active while testing extracts, but in testing of active ingredients at different molar concentrations, the growth inhibition of 50% or above was the criteria of activity.

Determination of antifungal activity

The antifungal activity of the test samples was determined by Poisoned Food Technique (a type of agar dilution method) against three pathogenic fungal strains *viz.,Alternariaalternata, Curvularialunata* and *Bipolarisspecifera*(procured from Division of Plant Pathology, SKUAST-Jammu). Different concentrations of test component were prepared in sterilized potato dextrose agar and poured in 9 cm petri plates. After this, 5 mm bit of test fungus was inoculated in the center of the agar plate (mycelia surface of the bit was placed upside down) followed by incubation of petri plates at 26 °C. The extension diameter (mm) of hyphae from the center to the dish was measured at 24 h interval, till the growth of fungus in the plate without test component (control) reached the edge of the plates. The experiment was repeated thrice and results were expressed as average of three replicates. Fungal growth diameter in each plate containing concentrations of test component was determined to calculate per cent growth inhibition. The antifungal indices was calculated as:

Antifungal index (%) = $(1-D_a/D_b) \times 100$

D_a = Diameter of growth zone in the experiment dish (mm)

D_b = Diameter of growth zone in the control (mm)

RESULTS AND DISCUSSION

The methanolic extract from stem part of *T. cordifolia*at 100 µg/ml showed significant results against prostate (PC-3) and colon (HCT-116) cancer cell lines as 77% and 71% growth inhibition was observed respectively. The extract did not exhibit any *in vitro* cytotoxic effect at lower concentrations (Table 1). The extract of *T. cordifolia*showed activity against *B. specifera*with IC_{50} values of 0.70 ± 0.02 mg/mL. However, less activity was observed against *C. lunata* and *A. alternata*with IC_{50} values of 1.2 ± 0.07 and 1.35 ± 0.012 mg/mL respectively (Table 2). Cancer is

one of the most deadly diseases facing the humanity today. The estimation of 1.1 million new cancer cases, indicates India as a single country (of 184 total) contributing to 7.8% of the global cancer burden. There is an increase in the number of cancer patients in the State from last five years with Srinagar at top in year 2015. According to official figures, 4556 cases of cancer were reported in 2011, 4848 in 2012, 5068 in 2013, 5568 in 2014 and 6358 in 2015. Despite the recent advances in surgery and various cancer therapies, it is considered that the management of cancer is still not up to the mark and we are in emergent need of drugs for the treatment of cancer having no side effects.

be of great importance in therapeutic treatments. Some of the herbal plants are traditionally used in formulations as antimicrobial agents and it is reported that these plants showed analgesic, anticancer, antiviral, antimalarial, antibacterial, antifeedent and antifertility activity. Therefore, in the search of potential anticancer and antimicrobial agents from medicinal plants, the present research work was carried out to examine *in vitro* anticancer and antifungal effect of giloy from Jammu region. Our data indicated that the methanolic extract of giloyshowed significant inhibition in proliferation of the prostate and coloncancer cells. Although, we need further study of chemotherapeutic effect of this plant,

Table1: Growth inhibitory effect of *Tinosporacordifolia*stem on human cancer cell lines

Extract	**Conc.(µg/ml)**	**Human cancer cell lines from six different tissues**							
		Breast MCF-7	**Breast T-47D**	**Colon SW-620**	**Colon HCT-116**	**Lung A-549**	**Melanoma MDA-MB-435**	**Ovarian OVCAR-5**	**Prostate PC-3**
		Growth Inhibition (%)							
Methanolic	100	25	43	48	71	58	00	37	77
	50	*	*	*	00	*	*	*	34
	10	*	*	*	00	*	*	*	16
	1	*	*	*	00	*	*	*	10
	IC_{50}	*	*	*	>50	*	*	*	>50
Positive controls	**Conc.(µM)**	**Growth Inhibition (%)**							
Doxorubicin	1	-	-	71	-	-	-	-	-
5-Fluorouracil	20	-	-	-	65	-	-	70	-
Mitomycin-C	1	-	-	-	-		-	-	63
Paclitaxel	1	77	72	-	-	71	-	-	-
Tamoxifen	1	-	-	-	-	-	75	-	-

Growth inhibition of 70% or more in case of extracts has been indicated in bold numbers
Mark (-) indicates that particular human cancer cell line was not treated with that particular positive control
Symbol (*) means not further evaluated / calculated

Table 2: Growth inhibitory effect of *Tinospora cordifolia* stem on fungal strains

Extract	**Conc. (mg/mL)**	**Phytopathogenic fungi**		
		Alternaria alternata	***Curvuleria lunata***	***Bipolaris speciferas***
	Growth Inhibition (%)			
Methanolic	0.5	33	35	45.6
	1	43.75	43.75	56.25
	2	62.25	68.75	70
	IC_{50}	1.35±0.012	1.2 ±0.07	0.70±0.02
Amphotericin B (positive control)		Conc. (µg/mL)	Growth Inhibition (%)	
	10	48.5	46.20	50.75
	20	65.00	61.00	71.50
	40	83.60	81.60	85.69
	IC_{50}	9.5±0.1	12.1±0.4	5.7±0.2

Maximum growth inhibition by test material as indicated by IC_{50} value is given in bold numbers

On the other hand, there is a continuous / urgent need to discover new antimicrobial compounds with diverse chemical structures and novel mechanism of action due to an alarming increase in the incidence of new and re-emerging infectious diseases and development of resistance to the antibiotics in current clinical use. Therefore, screening of plant extracts has been of great interest to scientists and plants extracts / phytochemicals with known anticancer and antimicrobial properties can

the results raise the possibility that the extract of giloy might be suitable chemotherapeutic agent for treatment of cancer. The present paper reviews the pharmacological and phytochemical aspects of the herb and its usage in different medicinal systems. Further investigation is required to isolate and identify active molecule (s) responsible for the observed activity and the molecular mechanism of these activities of *T.cordifolia*is to be elucidated.

CONCLUSION

The methanolic extract from stem part of T. cordifoliaat 100 µg/ml showed significant results against prostate (PC-3) and colon (HCT-116) cancer cell lines as 77% growth inhibition was observed in the former and 71% growth inhibition was observed in the later case. The extract also showed remarkable activity against B. specifera with IC_{50} values of 0.70 ± 0.02 mg/mL. However, less activity was observed against C. lunata and A. alternatawith IC_{50} values of 1.2 ± 0.12 and 1.35 ± 0.07 mg/mL respectively. Thus, it can be concluded that Tinosporacordifolia possess *in vitro* anticancer and antifungal potential.

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Intercropping model in Banana: Way to doubling the farm income

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ABSTRACT

The field experiment was conducted at AgricultureResearch Station, Anand Agricultural University, Jabugamwhich comes under Middle Gujarat Agro-Climate Zone-III during two consecutive years 2014-15and 2015-16.Main objective of the study was to explore the possibility of increasing monetary return from banana based intercropping system by optimizing vegetables. The experiment consisted of five treatments viz. T_1:Banana sole, T_2: Banana+ Cabbage, T_3: Banana+Cauliflower, T_4: Banana+Onion and T_5: Banana+Garlic. The experiment was conducted in RBD with four replications. The soil of the experimental field was sandy loam in texture. The banana cv. Grand Nainewas planted at 1.80 m x 1.80 m spacing with one plant per hill.The economic assessment of the intercropping system indicated that banana with cauliflower (T_3) or cabbage (T_2) were most profitable system, which recorded higher banana equivalent yield, net realization and benefit cost ratio, as compared rest of the treatments.
Keywords:*Banana, Intercrops, Banana equivalent yield, economics*

INTRODUCTION

Banana is known as apple of paradise. In India, banana is fourth important food crops in terms of gross value and is exceeded only by paddy, wheat and milk products. Globally banana production was 145 million tonnes during 2012-13. India is the largest banana consumer and producing country in the world followed by Brazil, contributingabout 20 per cent of the total world production (www.worldlistmania.com). Among the fruits, banana holds first position in production and productivity in India. It ranks second in area after mango. In India, annual production of banana was 26.51 million tonnes from an area of 7.76lakh hectarewith the productivity of 34.16 ton ha^{-1}spread all over the country (Dept. of Agri. & cooperation, 2013). Banana covers 12.50 per cent of the total area under fruits, contributing nearly one third of total fruit production in the country. In India, Tamil Nadu, Karnataka, Andhra Pradesh, Maharashtra, and Gujarat are the leading banana producing states. The highest productivity is 66.0 tones/ ha in Madhya Pradesh followed by Gujarat 64.09 t/ha in the year 2012-13. Area and Production of banana in Gujarat state were 67.02 thousand ha and 4.3 million metric tonnes, respectively (Dept. of Agri. & cooperation, 2015). In Gujarat, Bharuch district had maximum area (15420 ha) and production (1.08 million metric tonne) followed by Anand and Vadodara district (Directorate of economics and statistics, Govt. of Gujarat,Gandhinagar, 2015). Banana is a long duration crop and generally grown at wider spacing hence there is a possibility to take intercrops having short duration in nature, which can gave additional income without reducing the yield of major crop. Initial growth of banana is slow which offers an opportunity to take short duration intercrop like cauliflower, cabbage, onion, garlic, turmeric, ginger, bottle guard etc. There has been an increase in the grower interest in using intercropping, growing two or more crops simultaneously on the same land in the development of new cropping system for their land. Intercropping could reduce management inputs and results in sustainable systems that more effectively use and even potentially replenish natural resources used during crop production for long term management of farmland. Some benefits of intercropping to grower are risk minimization, effective use of available resources, efficient use of labours, and increased production per unit area of land, control erosion and food security. With adoption of drip method of irrigation in banana, it is possible to grow intercrop in between the rows. Our Prime Minister dream, "To double the income of farmers" will successfully fulfil by intercropping technology. So, there is need to develop intercropping system in drip irrigated banana which will enhance the water use efficiency as well as net income. Keeping this aim in mind an oriented research has been carried out on popular variety of banana cv. GRAND NAINE.

METHODOLOGY

An investigation was carried out at Agricultural Research Station, Anand Agricultural University, Jabugam,Middle Gujarat Agro-Climate Zone-III during two season of the year 2014-15 and 2015-16.The soil of the experimental field was sandy loam in texture. A field experiment was conducted in Randomized Block Design with four replications which included five treatmentscomprising Banana sole (T_1), Banana+ Cabbage (T_2), Banana+Cauliflower (T_3), Banana + Onion (T_4) and Banana+Garlic (T_5). Spacing of banana was 1.8 m x 1.8 m, while spacing for intercrops viz. cabbage 30cm x 30cm (4 line between banana), cauliflower 30cm x 30cm (4 line between banana), onion 15cm x 10cm (7 line between banana) and garlic 15cm x 10cm (7 line between banana). Sowing date of banana in 2014-15 and 2015-16 was 01-08-2014 and 07-08-2015, respectively while, sowing date of all intercrop in 2014-15 and 2015-16 were 22-10-2014 and 16-10-

2015, respectively. Effects of intercropping pattern were assessed by recording influence of treatments on economics. Each plant of banana was fed with 10 kg FYM; 300g N; 100g P_2O_5; 200g K_2O (Recommended dose of NPK g/plant). Complete dose of phosphorus,potassium and 20 per cent nitrogen were applied as basal while remaining dose of nitrogen was applied in four equal split as 20%each at 30, 60, 90 and 120 days after completion of monsoon.Fertilizer doseforcabbage, cauliflower, onion and garlic were 200:75:00, 200:75:37.5, 100:60:50 and 50:50:50 NPK kg/ha, respectively. The Banana equivalent yield is calculated as the yields of different intercrops/crops are converted into equivalent yield of any one crop based on price of the produce.

$$\text{Banana Equivalent Yield (kg/ha)} = \frac{\text{Yield of intercrop (kg/ha) x Price of intercrop (₹/kg)}}{\text{Price of banana (₹/kg)}}$$

RESULTS AND DISCUSSION

Banana equivalent yield: The year wise and pooled data of banana equivalent yield (kg/ha) as influenced by different cropping systems are presented in Table 1. The data indicates that banana equivalent yield was significantly influenced by different inter cropping treatments during individual years as well as in pooled. The treatments T_3 (Banana + Cabbage) and T_2 (Banana + Cauliflower) were at par and produced significantly higher yield as compared to rest of the treatments. Treatments T_4 (Banana + Onion) and T_5 (Banana + Garlic) also found to be comparable with each other and also recovered significantly higher banana equivalent yield as compared to sole crop of banana.

Economics: The data on economics of different intercroppingsystems of banana with cabbage, cauliflower, onion and garlic arepresented in Table 2. Considering the gross income and costof cultivation with all respects including cost of inputs, netincome was worked out for experimental period. The benefit cost ratio was also worked out considering gross return andcost of cultivation.The data existing in Table 2 clearly indicated thattreatment T_3 (Banana+cauliflower) secured the maximum netrealization and BCR (1.5,63,310.00/ ha with BCR 3.37) which was followed by treatment T_2(Banana+cabbage)(¹ .5,43,734.00/ha with BCR 3.25). Economics of various intercropping system (Table 1)revealed that T_3 (Banana + cauliflower)and T_2(Banana + cabbage)recorded maximum netrealization. Thismight be due to $T_3$and T_2intercropping pattern covers more areaunder intercrop which produces more yield and also price ofcauliflowerand cabbage per kg was reliable as compared to onion and garlicultimately resulted in higher net realization. Das and Maharana(1995) were found that rising intercrops of vegetables underbanana like onion, tomato and chilli at initial stage of plantingincrease the total profit from plot without affecting bananayield. Chundawat*et al.*(1982) reported that the intercroppingof banana with turmeric would prove profitable to the bananafarmers of South Gujarat. Singh (2010) also observed thatintercropped banana gave higher economic return than solebanana.

Table 1. Banana equivalent yield (t/ha) as influenced by different cropping systems

Treatments		Equivalent yield (t/ha)		
		2014-15	2015-16	Pooled
T_1	Banana as sole crop	76.63	77.93	77.28
T_2	Banana + Cabbage	123.85	116.99	120.42
T_3	Banana + Cauliflower	125.53	119.91	122.72
T_4	Banana + Onion	103.59	96.42	100.01
T_5	Banana + Garlic	94.45	91.52	93.48
	S. Em. ±	4.76	4.01	2.97
	C.D. at 5 %	14.67	12.52	8.58
	C.V.%	9.07	8.08	8.60

CONCLUSION

The economic assessment of the intercropping system indicated that banana with cauliflower (T_3) or banana with cabbage (T_2) proved as most profitable inter cropping model, which recorded higher banana equivalent yield, net realization and benefit cost ratio as compared to rest of the treatments.

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Table 2: Economics of different treatments

Treatments	Equivalent yield (t/ha)	Gross Income¹/ha	Cost of Banana cultivation¹/ha	Cost of Inter crop¹/ha	Total Cost of cultivation¹/ha	Net Income¹/ha	B:C Ratio
T_1 Banana as sole crop	77.28	504252	210650	0	210650	293602	2.39
T_2 Banana + Cabbage	120.42	785741	210650	31357	242007	543734	3.25
T_3 Banana + Cauliflower	122.72	800748	210650	26788	237438	563310	3.37
T_4 Banana + Onion	100.01	652565	210650	23191	233841	418724	2.79
T_5 Banana + Garlic	93.48	609957	210650	60042	270692	339265	2.25

Selling price: Banana ¹ .6525/t

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Marigold cultivation:A potential enterprise for transforming lives of farmers in Jammu

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ABSTRACT

Marigold cultivation is now a profitable enterprise to the farmers, but the socioeconomic data and information of this flower are very scarce. Therefore, the study was conducted to identify agronomic practices, analyze relative profitability, and B:C ratio. Primary data were collected from 50 randomly selected farmers from R.S. Pura and Nagrota blocks of Jammu district. The results indicated that 45% farmers cultivated open pollinated varieties and only 55% farmers' cultivated hybrid variety of marigold. The per hectare costs of marigold cultivation were Rs 31000 and 60000, respectively.Marigold cultivation in district Jammu is on increase. Various Governments Incentives along with efforts of University and regular interventions of Krishi Vigyan Kendra Jammu has resulted in quantum Jump in production and productivity of marigold in the area. The benefit cost ratio of 2.87 and 4 is also very encouraging which will help in promotion of this crop in the district.
Keywords:*Marigold, B:C ratio, cultivation cost*

INTRODUCTION

Evidences from all civilizations reveal that mankind has historical interest in gardening and culturing flowers to satisfy aesthetic need. But, in the present world, flower becomes important not only for its aesthetic social values, but also for its economic contribution (Aditya, 1992; Dadlani, 2003). The agro-climatic condition of Jammu provides an ideal condition for growing marigold in open condition. Jammu is known as city of temples and also it is the base camp for many religious places including world famous shrines of Vaishno Devi, Shiv Khori etc. The location of Jammu is thus most ideal for cultivation of marigold as a commercial crop. Farmers can get ready market for their produce. Due to the rich Dograculture religious festivals and family functions arealso celebrated with high fervours and gaiety thereby providing great opportunity for flower growers to sell their produce and get high value realisation.Keeping these opportunities in mind Krishi Vigyan Kendra, Jammu during the past few years have been promoting this as an enterprise for farmers of the District. KVK through regular trainings,on farm trials and Successful front line demonstrations has helped the farmers of the district to adopt marigold cultivation on commercial basis.Demonstration plots at farmers' fields have been source of inspiration for farmers. The department of floriculture has provided incentives for cultivation of Marigold. An incentive of Rs 20,000/- per hectare has enormously encouraged the farmers in the past. However, with rising costs of cultivation this incentive has to be revised soon so as to promote this enterprise further.

METHODOLOGY

Krishi Vigyan Kendra has laid out demonstrations in R.S. Puraand Nagrota Blocks of District Jammu. More than 60 demonstrations were laid out at farmer fields during the past two seasons. Efforts were made to increase the number of crops during a year. The Major season of area is July sowing with produce coming near Diwali which also fetches higher prices. Efforts of KVK has also popularised February sowing crop with yields in summer months for meeting demand during festive summer months. Open pollinated cultivars especially, Pusa Narangi and Pusa Basanti have been successful in crop demonstrations and farmers have readily accepted these varieties. But there is a limitation that these varieties are not suited for summer season crop. Thus, Commercial hybrids are now being explored by the farmers. These hybrids fetch higher yields and have better quality and also produce flowers for longer period. However, the major bottleneck is thatthe cost of seed is very high and farmer has to pay almost Rs 1600/- per 10 g pack.Efforts were made to calculate the cost of cultivation and net returns on actual basis.

RESULTS AND DISCUSSION

The study is based on field demonstrations and observations made in the farmer fields. The rates for various operations have been kept on actual basis which were in vogue at the time of study. As presented in Table 1, the average cost of cultivation for marigold in Jammu is Rs 31,000/- per hectare for open pollinated varieties and Rs 60,000 per hectare for hybrid varieties. The average yield of open pollinated varieties is 80-100 q/ha on fresh weight basis and yield of hybrid varieties range between 120-150 q/ha. The average selling price of marigold in local market is about Rs 1500-2000/q (table-1). At this rate a farmer can get on an average Rs 120,000 to Rs 300,000 per hectarei.e.for open and hybrid cultivars, respectively.The Net benefit for farmer

is between 89,000 to 2, 40,000/- per ha. The B: C ratio for open pollinated varieties is 2.87 and for hybrid variety is 4.0. Therefore, if a farmer plans his calendar of activitiesfor the year keeping the local market in mind,

Table 1: Cost of cultivation and Net-returns for cultivation of Marigold

Activity	Open pollinated/ha	Hybrid cultivars/ha
Nursery preparation (Rs)	1000	1000
Cost of seed (Rs)	7000	32000
Land preparation (Rs)	6,000	6000
Transplanting (Rs)	5000	5000
Manures and Fertilisers (Rs)	2000	2000
Irrigation (Rs)	2000	2000
Plant protection (Rs)	3000	5000
Picking & Harvesting (Rs)	5000	7000
Total	31,000	60,000
Yield q/ha	80	150
Selling price (Rs/q)	1500	2000
Gross returns (Rs.)	120000	300000
Net returns (Rs)	89000	240000
Benefit: Cost Ratio	2.87: 1	4.0:1

this is an enterprise which can raise his income substantially and will help the government initiative of doubling the farming income.

CONCLUSION

The farm level cultivation of marigold flower is highly profitable because of its higher demand compared to its production. Its cultivation is also profitable compared to its competitive cereal and vegetables. The marigold farmers face various problems during production and marketing of their produces. The major problems are high seed cost, transportation facility, insects and diseases infestation and lack of technical know-how.

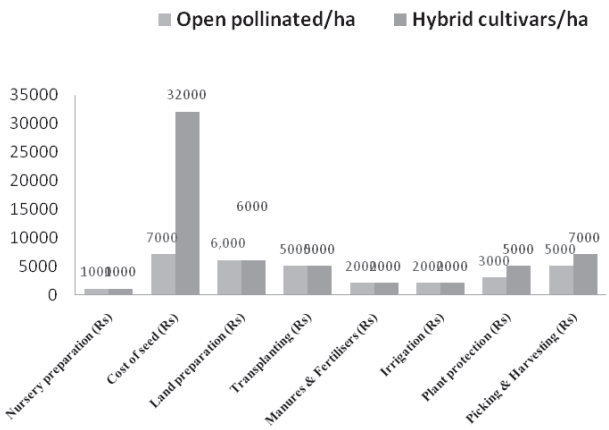

Figure 1: Cost of various components for cultivation of Marigold

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Pattern of crop concentration and crop diversification– An economic analysis

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ABSTRACT

The present study has examined the trend in crop concentration and diversification and advantageous crops in different districts of Western Vidarbha region of Maharashtra based on the secondary data of 45 years i.e. from 1970-71 to 2014-15. Herfindahl index and Simpson Diversity Index have been estimated to study crop diversification. In order to work out the advantageous crops, land concentration ratio in different districts with comparative advantage was computed for last 10 years i.e. from 2004-05 to 2014-15. Area under jowar has reduced by 77.86 per cent in western vidarbha regionduring the period of 1990-91 to 2014-15. The proportion of area under cotton has reduced by 29.18 per cent in western vidarbha region. Soybean is found to be more advantageous crop over other crops in Akola, and Buldhana district in western vidarbha region. Cotton is noticed to be more advantageous over jowar, soybean and tur in Amravati and Yavatmal district of western vidarbha region. Over the period of study, crop diversification has been increased significantly in western vidarbha region. Crop concentration analysis revealed that, sugarcane, other oil seed, other high value crop and wheat are emerging as most concentrated crops in Yavatmal, Buldhana, and Amravati district and concentration of bajarajowar, mung, rice etc is being reduced because the farmers are gaining more profit in production of the high value crops as compared to other food grain crops like bajra, jowar, mung, rice. The diversification was occurred in all most all the districts of Western Vidarbha region. The area under cereals and pulses has observed a declining trend during the period of 1970-71 to 2014-15. It is recommended that, while framing the policy on cropping plan for these region, government should concentrate to motivate the farmers for cultivating food crops through state department of agriculture for increasing the area and production of food crops by providing good remuneration prices, better marketing facilities, providing new agricultural technology at cheaper cost.

Keywords:*Crop concentration, diversification indices, advantageous crop,herfindahl index*

INTRODUCTION

Agriculture remains the main pillar of Indian economy, in spite of concerted efforts towards industrialization in the last decades. Agriculture contributes a high share of gross domestic product by sectors in India. India with only 2.3 per cent of world's total land area supports around 18 per cent of human and 15 per cent of livestock population in the world. The final outcome from agriculture depends on the efficiency of resource use and genuine technological progress in the sector with an appropriate cropping pattern. Cropping pattern denotes the distribution of area under different crops in different seasons expressed in percentage of total crop area. A change in cropping pattern implies a change in proportion of area under different crops. The change in cropping pattern occurs periodically depending upon the market forces and agro climatic conditions. These changes bring about a chain of effects on different aspects of farming and it's economy along with some changes in social and economic aspects of farming families. Systematic understanding of changes in cropping pattern over the years is very important, for the farmers to get better returns, for the entrepreneurs to decide the optimal locations and capacities of new agro-based plants, for the policy makers to check the over or under production some farm products, thus ensuring the required overall balance.

In fact, it is obvious that greater the number of crops in combination, greater will be the degree of diversification. Crop concentration and crop diversification are the two fundamental elements of agricultural geography because these two indices help to know cropping pattern of a region in a very detail way. Consequently, knowledge about concentration and diversification in a region may be considered very useful in proper agricultural land use planning. Crop concentration refers to the spatial density of individual crop or it may be stated as the variation in the density of any crop in a region at a fixed time span. On the other hand, crop diversification means cultivation of various crops from the soil. Thus, it refers to growing of varieties of crops either in a region or in the same agricultural field. Basically, during the period of the green revolution in the late sixties, there was a surge for diversified agricultural system to rejuvenate agricultural economy and for that purpose, it became necessary to diversify cropping pattern to country's growing demand and to increase income by earning foreign exchange. Therefore, crop concentration and diversification do not only provide the idea of a region

dominated by particular crop but also play a role of guide to strengthen agricultural economy and land use planning. Keeping these issues in view, study was conducted in Western Vidarbha region to examine the crop diversification level and pattern of crop concentration of WesternVidarbha region of Maharashtra.

METHODOLOGY

The object of any investigation is to draw the useful conclusion in the light of objectives of the study in order to arrive the meaningful conclusion. It is essential to the investigator to adopt appropriate method and procedure, keeping in view, the present study aimed at analysing the crop concentration and diversification in different districts of western Vidarbha region of Maharashtra.

Selection of Crops

The major food grain and non food grain crops in different districts of western vidarbha region of Maharashtra were selected for the present study. Selected crops occupied more than 80 per cent gross cropped area of districts selected in westernvidarbha region of Maharashtra. Thus, present study was confined to major crops with an assumption that excluded crops do not affect cropping pattern and in turn would not vitiate main conclusions of the study. The eleven crops were selected purposively for present study like Rice, Wheat, Soybean, Cotton, Jowar, Bajra, Gram, Tur, Mung, Groundnut and Sugarcane.

Data Collection

For the present study the secondary data were collected from various published sources. Time series secondary data on the area of selected crops, farm harvest prices and other agricultural data were obtained from various published sources. To fulfill the 1st objectives the data were collected for the period of 1970-71 to 2014-15 and to fulfill the 2ndobjective the data were collected for the period of last 10 years. Similarly 3rdobjectives, the data were collected for two different point of time i.e. 1990-91 to 2014-15. The secondary data were collected from official publications like district socio-economic reviews of Buldana district, Akola district, Amravati district, and Yavatmaldistrict (1970-71 to 2014-15), seasons and crop reports, agriculture department, Maharashtra State (1970-71 to 2014-15), Publications of department of Agriculture, Maharashtra. In order to estimate the land concentration ratios of selected crops data was collected from Agricultural Prices and Costs Scheme (APC), Department of Agricultural Economics and Statistics, Dr.PDKV, Akola. Besides, several websites including www.indiastat.com were also consulted.

Analytical tools and technique

Analysis for the extent of crop diversification

Crop diversification is a concept which is opposite to crop specialization. It refers to the growing of several crops in the holdings in an agricultural year. The level of crop diversification largely depends on the geo-climatic/socio-economic conditions and technological development in a region. In general, higher the level of agricultural technology, lesser the degree of diversification (Husain, 1996). In a developing country like India where the man-land ratio is high, the concept of crop diversification is very much significant as it is an important way to enhance agricultural output. There are different methods of measuring crop diversification. The important ones are Crop Diversification Index of Bhatia, Herfindahl Index, Simpson's Diversification Index (modified version of Harfindahl Index), Ogive Index, Entropy Index, Berry's Index etc. Considering objective of the study of assessing the extent of diversification in crops, HerfindahlIndex and the Simpson Diversity Index has been used.

The extents of crop diversification were studied by using following diversification index.

Herfindahl index (HI)

Herfindahl index was computed by taking the sum of squares of acreage proportion of each crop to the total cropped area.

Herfindahl Index (HI) $=\sum_{i=1}^{N} Pi^2$

Where,

N= The total number of crops.

Pi = Ai / Ai,

Pi = is the proportion of area under i^{th} i=1 i=1 crop to total cropped and

Ai = is the actual under i^{th} crop.

The index is defined as a sum of squares of all 'n' proportions and is a measure of concentration.

When the value of HI falls, it indicated rising diversification and vice-versa. The value of HI is bounded by zero (perfect diversification) and one (perfect specification). The value of HI approaches zero as 'N' becomes large and takes value one when only one crop is cultivated.

Simpson's Diversification Index(SDI)

The Simpson Diversity Index is calculated as follows:

5ØFÜ5Ø7Ü5Ø<Ü=1"

Where,

SDI=Simpson's Diversification Index

Pi= Proportionate area of the i^{th} crop in the total cropped area

The index ranges between '0' and '1'. If there is specialization then the index moves towards zero. In the other wards for = 1, there will be complete specialization.

Analysis of economics of crop diversification

Land concentration ratio

To examine the benefits of diversification, land concentration ratio in the selected districts of Western

Vidarbha region in Maharashtra with comparative advantages was computed based on the sample for last 10 years. The comparative advantage is here approximated by the per hector net revenue of each crop relative to the average revenue of the remaining crops (Takashi Kurosaki, 2003).

(The sum of the areas under the crop of concern in districts that will be ranked the top four in terms of comparative advantage in yield disparity ranking) / (the sum of the areas under the crop of concern in districts that will be ranked the bottom four).

Crop Concentration Index

Crop concentration refers to the variation in the density of crops cultivated in an area at a given point of time. The concentration of a crop in an area largely depends on its types of soil, terrain, moisture, climate, income and price, government policy, social factors and many others (Punithavathi, et al., 2012). Several researchers applied location Quotient method to perform degree of the Crop Concentration in particular study area which is most common method is the Location Quotient method to study Crop Concentration (Sajjad and Parasad, 2014; Chouhan, 1987; Hall and Tideman, 1967 & Singh, 1976). In the study of cropping pattern, it is essential to know the areas where different crops dominate. This helps to take decision in future agricultural planning. For this purpose, the following formula has been used to delineate crop concentration (according to 'Location Quotient Method')areas of the study area-(Sajid and Prasad,2014, Chouhan,1987, Hall and Tideman,1967 and Singh,1976).

where,

$$CCI \text{ (Crop Cpmcemtration Index)} = \frac{A_{i,j}/A}{\sum_{i=1}^{n} A_{i,j}/\sum A}$$

$A_{i,j}$= Area under i^{th} crop in j^{th} district

A= Gross cropped area in j^{th} district in the entire study period

$\Sigma A_{i,j}$= Area in the i^{th} crop in the province in the region

Here, the high index values represent high concentration and low values show lower level of concentration. Using the mentioned method, the crop concentration indices for all selected district in Western Vidarbha region of Maharashtra state have been calculated for selected all crops in the study area.

RESULTS AND DISCUSSION

Crop diversification in Western Vidarbha Region

Crop diversification is a concept which is opposite to crop specialization. It refers to the growing of several crops in the holdings in an agricultural year. The analysis of changes in cropping pattern indicates that diversification took place in selected districts of western vidarbha region. The level of crop diversification varies in selected districts of western vidarbha regionbecause of varied agro-climatic conditions and resource endowment of the farms. Hence an attempt was made to examine the level of crop diversification in selected districts of western vidarbha regionat different points of time.Considering objective of the study of assessing the extent of diversification in crops the Herfindahl index and Simpson Diversity Index has been used to measure the level of crop diversification in present study. Accordingly it is presented in Table 1

Measurement of crop diversification by Herfindahl Index and Simpson Diversification Index

Herfindahl Index is also a measure of concentration. The value of Herfindahl Index varies from zero to one. It takes the value one when there is complete specialization and value zero when there is perfect diversification.

The Table 1 revealed that in Akola, Amravati, Buldhana and Yavatmal districts of western vidarbha region and as a whole western vidarbha region, the value of Herfindahl Index were found low i.e. less than 0.5 it means in all selected districts diversification took place. The diversification from subsistence crop to more commercial crops were took place in these districts. Therefore, from the following analysis that, the hypothesis has been proved respectively crop diversification are took place over a period of time.

Table 1. Measurement of crop diversification

Year	Akola		Amravati		Buldhana		Yavatmal		Overall	
	HI	SDI	HI	SDI	HI	SDI	HI	SDI	HI	SDI
1970-71	0.26	0.74	0.30	0.70	0.21	0.79	0.26	0.74	0.25	0.75
1980-81	0.24	0.76	0.26	0.74	0.21	0.79	0.30	0.70	0.25	0.75
1990-91	0.18	0.82	0.19	0.81	0.17	0.83	0.25	0.75	0.19	0.81
2000-01	0.17	0.83	0.17	0.83	0.17	0.83	0.21	0.79	0.18	0.82
2014-15	0.18	0.82	0.19	0.81	0.15	0.85	0.21	0.79	0.18	0.82

Measurement of crop diversification by Simpson Diversification Index

As per Simpson Diversity Index, high crop diversifications were found in all four district of the western vidarbha region (Table 2). The factors which are responsible for the crop diversification that most of the farmers were moved towards low value crop to high value crop for sustaining the economic prosperity and generate alternate source of income (Sandipan Ganguly; Palash Patra, 2015).

Table 2: Crop Diversification Categories by Simpson Diversification Index of Western Vidarbh region

Categories	Range of SDI	No of District
Low	<0.40	-
Medium	0.40 -0.60	-
High	>0.60	4

Advantageous crops

Advantageous crops in different districts of Western Vidarbha Region of Maharashtra

In order to examine the benefits of diversification, land concentration ratios of selected districts of Western Vidarbha Region of Maharashtra were computed and presented in Table 3.

Land concentration ratios of major crops in Akola district

The land concentration ratio of soybean showed increasing trend over a period of study. It means soybean is most advantageous crop in Akola district over other selected crops i.e. jowar, cotton and tur in Akola district in Western Vidarbha Region of Maharashtra (Table 3).

Land concentration ratios of major crops in Amravati district

Land concentration ratios of major crops in Amravati district were presented in Table 3 which revealed that the land concentration ratio of cotton showed increasing trend over a period of study. It means cotton is most advantageous crop in Amravati district over other selected crops i.e. jowar, soybean and tur in Amravati district of western vidarbha region. Similarly, in the last decade soybean also showed increasing trend in land concentration ratios. Therefore soybean is also a advantageous crop during the last decade.

Land concentration ratios of major crops in Buldhana district.

Land concentration ratios of major crops in Buldhana district were presented in Table 3. The land concentration ratio of soybean showed increasing trend over a period of study. It means soybean is most advantageous crop in Buldhana district over other selected crops i.e. jowar, cotton and tur in Buldhana district in western vidarbha regionfor the study.

Land concentration ratios of major crops in Yavatmal district.

Land concentration ratios of major crops in Yavatmal district were also presented in Table 3. The land concentration ratio of cotton showed increasing trend over a period of study. It means cotton is most advantageous crop in Yavatmal district over other selected crops i.e. jowar, soybean and tur in Yavatmal district of western region of maharashtra. Similarly in the last five years i.e. 2010-11 to 2014-15 soybean also showed increasing trend in land concentration ratios. Therefore soybean is also an advantageous crop during the last five years.

Table 3. Land concentration ratios of major crops in selected districts of Western Vidarbha Region of Maharashtra

Year	Akola district				Amravati district				Buldhana district				Yavatmal district			
	Jowar	Cotton	Soybean	Tur	Jowar	Cotton	Soybean	Tur	Jowar	Cotton	Soybean	Tur	Jowar	Cotton	Soybean	Tur
2005-06	0.55	4.67	0.29	0.52	0.22	4.52	0.37	0.86	0.51	2.36	1.09	0.52	0.24	3.93	0.48	0.85
2006-07	0.63	2.72	0.44	0.86	0.27	1.31	1.43	1.23	0.43	2.32	1.44	0.38	0.25	1.12	1.69	1.22
2007-08	0.39	6.82	0.33	0.30	0.27	1.64	1.83	0.69	0.24	3.12	1.26	0.41	0.13	3.36	1.01	0.65
2008-09	0.43	4.16	0.64	0.40	0.18	2.03	1.86	0.56	0.15	3.82	1.27	0.31	0.08	6.47	0.63	0.39
2009-10	0.38	8.19	0.29	0.22	0.11	1.81	1.36	1.16	0.20	7.90	0.46	0.26	0.09	8.76	0.42	0.35
2010-11	0.18	2.48	1.12	0.84	0.10	1.12	1.99	1.27	0.17	2.72	1.08	0.78	0.07	3.58	0.80	0.86
2011-12	0.07	3.08	1.50	0.48	0.08	1.52	3.03	0.47	0.08	2.71	2.15	0.26	0.04	7.19	0.62	0.37
2012-13	0.27	5.24	0.93	0.14	0.10	1.63	2.31	0.66	0.14	3.21	1.80	0.20	0.08	7.67	0.65	0.25
2013-14	0.11	2.40	1.84	0.49	0.05	2.38	2.03	0.48	0.11	1.74	3.27	0.20	0.05	5.13	1.03	0.32
2014-15	0.02	2.02	2.35	0.53	0.01	2.12	2.05	0.64	0.02	2.10	3.32	0.18	0.02	5.40	1.02	0.32

Crop concentration Index

Crop concentration is the best way to explain which area is well suitable for particular type of crop growth and increase their production. It gives accurate and brief information about area come under particular crop in large quantity and because of that, It helps to increase the land under that particular crop for farmers.The district wise drop concentration ratio in Western Vidarbha Region of Maharashtra is presented in Table 4 and 5.

Table 4: District wise crop concentration ratios in Western Vidarbha Region

Crops/	Akola		Amravati		Yeotmal		Buldana	
District	1990-91	2014-15	1990-91	2014-15	1990-91	2014-15	1990-91	2014-15
Rice	0.97	0.00	1.71	0.00	1.00	0.00	0.43	0.00
Wheat	0.85	0.99	1.03	0.54	0.61	0.58	2.02	1.98
Jowar	0.93	0.17	0.79	0.12	1.17	1.01	1.31	1.02
Bajra	0.95	0.18	0.41	0.00	1.34	1.01	1.45	0.37
Gram	1.10	1.07	1.39	1.24	0.60	0.23	0.60	1.22
Tur	0.97	1.04	1.12	1.03	1.26	0.99	0.72	0.80
Mung	0.95	0.95	1.38	0.89	0.50	0.54	1.38	0.41
Sugarcane	0.98	0.86	0.47	0.15	1.80	3.42	0.76	0.06
Cotton	0.99	0.93	1.09	0.68	1.12	1.48	0.82	1.17
Soybean	0.54	1.16	1.77	1.18	0.73	0.54	2.48	0.56
Ground nut	1.02	0.96	1.67	0.69	0.42	1.94	0.88	0.53
Other oilseeds	1.47	0.68	0.11	0.06	0.51	1.56	0.42	2.90
Other cereals	0.68	0.09	1.75	0.13	0.94	0.03	1.65	0.08
Other pulses	1.49	1.63	0.26	0.05	0.44	0.23	0.24	0.06
Other Crops	1.45	0.99	0.82	2.82	0.24	0.02	0.08	0.03

Bhatia's Methods based on research by MisrilaChavan & Kailas Nile-2012

The Table 4&5 revealed that, other oil pulses (1.49) was highly concentrated followed by other oilseeds (1.47), other crops(1.45), gram(1.10) and groundnut (1.02) during the year 1990-1991 in Akola district. During the year 2014-15, it was highly crop concentrated in other pulses (1.63) followed by soybean (1.66), gram (1.07), tur (1.04), whereas, Soybean was the low crop concentrated during the year 1990-91. In case of Amravati district, it was observed in table 4 & 5 that, Soybean was highly concentrated cultivation crop (1.77) followed by other cereals rice (1.71), ground nut (1.67), gram (1.39), mung (1.38), tur (1.12 and cotton (1.09) during the year 1990-91 while during the year 2014-14, it was highly crop concentration cultivation observed in other crops (2.82)followed by gram (1.24), soybean (1.18) and tur crop (1.03). In case of Yeotmal district, Sugarcane crop was highly concentrated cultivation crop (1.80) followed by Bajara (1.34), Jawar (1.17) cotton (1.12) and rice crop (1.00) during the year 1990-91 while during the year 2014-14, it was highly crop concentration ration observed in, Sugarcane crop (3.42) followed by groundnut (1.94). Other oilseed crop (1.56), cotton (1.48), jawar and bajara of each 1.00. In case of Buldana, soybean crop was

highly concentrated cultivation crop (2.48) followed by wheat (2.02), other cereals (1.65) , Mung(1.38), Bajara (1.45) and Jawar (1.31) during the year 1990-91 while during the year 2014-14, it was highly crop concentration ration observed in , other oilseed crop (2.90) followed by wheat (1.98), gram (1.22), cotton (1.17) and jawar (1.02).

All the blocks of the district maintain almost uniform parity in low value crop concentration to very high value crop that ranges from below 1 to above 1.50. From the crop concentration analysis it can be found that the major portion of the district is experiencing a shift from low value crop cultivation to the cultivation of high value crops like Cotton, Soybean, Gram, wheat etc. It is also clear from the crop concentration analysis that sugarcane, other oil seed, other high value crop and Wheat are emerging as most concentrated crops in yavatmal, buldhana, and Amravati district and concentration of bajarajowar, mung, rice etc is being reduced because the farmers are gaining more profit in production of the high value crops as compared to other food grain crops like bajarajowar, mung, rice. It is also indicating a trend towards crop diversification of these districts in western vidarbha region of Maharashtra state.

CONCLUSION

The area under jowar has reduced by 77.86 per cent in western vidarbha regionduring the period of 1990-91 to 2014-15. The proportion of area under cotton has reduced by 29.18 per cent in western vidarbha region.Soybean is found to be more advantageous crop over other crops in Akola, and Buldhana district in western vidarbha region.Cotton is noticed to be more advantageous over jowar, soybean and tur in Amravati and Yavatmal district of western vidarbha region. Over the period of study, crop diversification has been increased significantly in western vidarbha region.Crop concentration analysis revealed that, sugarcane, other oil seed, other high value crop and Wheat are emerging as most concentrated crops in Yavatmal, Buldhana, and Amravati district and concentration of bajarajowar, mung, rice etc is being reduced because the farmers are gaining more profit in production of the high value crops as compared to other food grain crops like bajarajowar, mung, rice. It's indicated that, the trend move towards crop diversification of these districts in western vidarbha region of Maharashtra state.The diversification was occurred in all the districts of Western Vidarbha region.The declining area under cereals and pulses call for government interventions for providing farmers a remunerative price and market for food crops.

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Price analysis of garlic for selected markets of Maharashtra

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ABSTRACT

The present study aimed to study price movement of Garlic i.e. seasonal and cyclical variations, price volatility and co-integration among the major Garlic markets of Maharashtra. For study purpose the data related to monthly average prices of Garlic were collected from major APMCs markets of Maharashtra viz. Ahmednagar, Karad, Nagpur and Pune for the period 2005-2016. Moving average method was used to study seasonal variations. The econometric tools like ADF test, Johansen's Multiple Co-integration test, Granger Causality Test and ARCH-GARCH model were used to study price volatility and cointegration among different markets. The results of study showed that the prices of Garlic were higher in the month of September to January in all selected markets. The cyclical variations observed in the prices of Garlic in the selected markets. Except Nagpur market the price series of other markets showed the consequences of unit root and were stationary at first difference. The selected markets show long run equilibrium relationship and co-integration between them. Most of the markets showed bidirectional Causality and influences the prices of each other. All the selected markets showed that volatility shocks in Garlic prices are quite persistent in these markets.

Keywords: *ADF test, ARCH- GARCH, Co-integration, Granger Causality Test*

INTRODUCTION

India is one of the leading Garlic producing country. Spices account for 2.2% of total agricultural produce in India. The area under cultivation and production of Garlic in India is 2.02 lakh ha and 11.50 lakh tons (NHRDF, 2012). Research study reveals that the area and production of Garlic is increasing in most of the states. Madhya Pradesh, Gujarat, Rajasthan, Uttar Pradesh, Assam, Punjab, Maharashtra, West Bengal and Orissa are the main garlic growing states. Gujarat and Madhya Pradesh produce 40% of country's Garlic. Karnataka, Bihar, Tamil Nadu, Punjab, Haryana and Andhra Pradesh also produce sizeable quantity of Garlic in cooler regions of the states. Garlic in plains is grown from October to March. Himachal Pradesh, Uttaranchal and Jammu and Kashmir grow long day type garlic from September to June. Per unit yield of this type is high but due to limited area, total production is less. During 2014-2015 Madhya Pradesh tops the area with 81.17 thousand ha followed by Rajasthan, Gujarat, UP, Orissa, Assam, Punjab. Production is also highest in Madhya Pradesh with 424.50 MT, Gujarat with 318.20 MT followed by UP, Rajasthan and Assam (NHRDF, 2015). The major factors influencing on prices of Garlic are the arrivals in market, climatic conditions during the various growth stages, carry forward stocks, price movement over the period of time, crop condition throughout the country, export and import, global and domestic demand and supply, etc. Seasonal variations observed in prices of Garlic. In the peak arrivals months the prices of Garlic declined while in lean period they rises. The markets of Garlic in Maharashtra are co-integrated and they influences on prices of each other. For better marketing of any agricultural commodity the information regarding seasonality, seasonal variations, price volatility, price movement across the state and country, etc. is necessary. Analysing the past trend in the price of commodities is also useful in understanding the present scenario and to formulate appropriate strategies to improve the marketing system. The study of seasonal variations is considered to be important as a guide to the producer to market his products and to the consumer to purchase his needs at the right time. It also serves as a guide to the Government to operate its policy measures at the appropriate time. The present study has undertaken to study the seasonal and cyclical variations in prices of Garlic and to assess the price volatility and co-integration among the selected garlic markets in Maharashtra.

METHODOLOGY

The present investigation was carried out at the Department of Agricultural Economics and Statistics, Dr. PDKV, Akola during 2016-17. In the present study, an attempt has been made to analyze the market prices of Garlic critically so that it will be helpful to the farmers, consumers, traders and policy makers to take more informed marketing decisions. The study has been confined to the Maharashtra State. Four APMC major markets at four district places of Maharashtra namely Ahmednagar, Karad, Nagpur and Pune were selected purposively for the study. The study was based on secondary data. Secondary data consisting of monthly prices of Garlic were collected from the website www.agmarknet.nic.in. The monthly time series data on the prices of Garlic for the selected APMCs were collected for the period 2005 to 2016.

Tools of Analysis

The choices of the statistical and econometric tools of analysis were decided with reference to the objectives

of the study and the nature of data collected. The analytical techniques used in the study are presented below:

Estimation of seasonal indices of monthly price data

To measure the seasonal variations in prices, seasonal indices were calculated by employing twelve months ratio to moving average method.

Estimation of cyclical indices of price data

The residual method of estimating cyclical movement in time series was used for estimating cyclical indices, after eliminating the seasonal variations and trend components.

Testing of Stationarity in Price Series of garlic

Before analysing any time series data testing for stationarity is pre-requisite. The stationarity of time series data on Garlic prices was tested by applying the Augmented Dickey-Fuller test (ADF). The (ADF) test is the test for the unit root in a time series sample. A stationary series is one whose parameters are independent of time, exhibiting constant mean and variance and having autocorrelations that are invariant through time. If the series is found to be non-stationary, the first differences of the series are tested for stationarity. The number of times (d) a series is differenced to make it stationary is referred to as the order of integration, I(d). ADF unit root test are based on the following three regression forms:

Without constant and trend: "$\Delta Y_t = \square Y_{t-1} + u_t$

With constant: $\Delta Yt = \alpha + \beta T + \square Yt\text{-}1 + ut$

The hypotheses are: H_0: $\square = 0$ (Unit root)

H_1: $\square \neq 0$

If t* > ADF critical value then accept the null hypothesis, i.e. unit root exists.

If t* < ADF critical value then reject the null hypothesis, i.e. unit root does not exists.

Market Co-integration

Johansen's Multiple Co-integration test was employed to determine the long run relationship between the price series of selected markets. The test shows whether the selected Garlic markets are integrated or not. Johansen (1988) has developed a multivariate system of equations approach, which allows for simultaneous adjustment of both or even more than two variables. The multivariate system of equations approach is more efficient than single equation approach since it allows to estimating the co-integration vector with smaller variance.

Causality of price signals between selected markets

In order to know the direction of causation between the markets, Granger Causality test was employed. It is named after the first causality tests performed by Clive Granger (1969). It analyzes the extent to which the past variations of one variable explain (or precede) subsequent variations of the other. When a co-integration relationship is present for two variables, a Granger Causality Test can be used to analyze the direction of this co-movement relationship. Granger causality test come in pairs, testing weather variable x_t Granger-causes variable y_t and vice versa. All permutations are possible:

1) Univariate Granger causality from x_t to y_t or from y_t to x_t,

2) Bivariate causality or absence of causality.

Formally, the Granger causality test analyses weather the unrestricted equation

$y_t = \alpha_0 + \Sigma T_i = 1 \alpha_1 i\ y_{t-i} + \Sigma T_j = 1 \alpha_2 i\ x_{t-j} + \varepsilon_t$ with $0 \leq i, j \leq T$

Yield better results than the restricted equation.

$y_t = \beta 0 + \Sigma T_{i=}1\ \beta_1 i\ y_{t-i} + \varepsilon_t$ with $\Sigma T_j = 1\ \alpha_2 j\ x_{t-j} = 0$ (The null hypothesis)

i.e. if H_0, in which $\alpha_{21=}\ \alpha_{22=\ldots\ldots=}\ \alpha_2 T=0$, is rejected then one can state "variable x_t Granger causes variable y_t"

Theoretically, a variable is said to Granger-cause another variable, if the current value is conditional on the past value.

Presence of Price Volatility

To access the presence of price volatility the ARCH-GARCH analysis was carried out. Auto Regressive Conditional Heteroscedasticity (ARCH) models are specifically designed to forecast conditional variances. ARCH model introduced by Engel (1982) and generalized as GARCH by Bollersllev (1986). The ARCH model have two distinct specifications one for the conditional variance and the standard GARCH (1,1) specification is presented below:

$$Yt = \gamma_0 + \gamma_1 X_{1t} + \ldots\ldots\ldots + \gamma_k X_{kt} + e \quad \ldots\ldots\ldots 1$$

$$\sigma^2_t = \omega + \square\ e^2_{t-1} + \beta\ \sigma^2_{t-1} \quad \ldots\ldots\ldots 2$$

Equation (1) is the mean equation and equation (2) is the conditional variance equation. The ARCH component ($\square$) indicate the lag of the squared residual from the mean equation and the GARCH term (β) the last period's forecast variance and the resultant sum of these co-efficient ($\square + \beta$) are presented. The sum of co-efficient very close to 1 would indicate that the volatility shocks are quite persistent in the series.

RESULTS AND DISCUSSION

Seasonal indices for Garlic prices

The mismatch between round the year consumption and seasonality in the production of crop leads to seasonal variations in prices of agricultural commodities. These variations may be purely due to seasonal production, poor storage facilities and retention power of Garlic growers. The seasonal indices of monthly average prices of Garlic in Nagpur, Pune, Karad and Ahmednagar markets were worked out to study seasonal variations, which are presented in Table 1. In selected markets highest price indices were observed during September – January in all the markets. Prices began to decline slightly during June- August which is pre-harvest season. Price indices were lowest in February – May in all markets. This is due to heavy arrivals and post-harvest glut in the market. Due to

elastic nature of Garlic, prices fall at the time of harvest. A steady rise upward movement was natured for 5 months till September. Thereafter a steep rise in prices until reaching the peak in month of December.

Table 1. Seasonal indices of Garlic prices for selected markets

Month	Nagpur	Pune	Karad	Ahmednagar
Jan	198.52	113.64	117.73	114.11
Feb	74.15	83.65	101.58	86.31
Mar	54.81	58.35	72.68	63.88
Apr	62.21	69.33	76.30	60.17
May	73.86	79.48	79.81	69.66
Jun	83.23	90.34	85.85	96.27
Jul	91.51	97.99	94.63	100.85
Aug	100.01	106.09	97.35	105.44
Sep	106.96	114.26	107.05	115.719
Oct	110.56	118.04	111.29	127.36
Nov	120.28	130.90	121.88	127.15
Dec	98.05	137.87	133.80	133.03

Cyclical indices for Garlic prices

Cyclical variations in prices were analysed in order to know the variations in prices over the years. The cyclical indices for Garlic prices were worked out for the period 2005-2016 and are presented in Table 2. The cyclical variations were observed in the prices of Garlic in the selected markets. The higher prices were noted in the years 2006,2007,2010,2011 and 2016. The rise in prices might be attributed to less production due to bad weather and stock in the hands of middlemen.

Table 2. Cyclical indices of Garlic prices for selected markets

Year	Nagpur	Pune	Karad	Ahmednagar
2005	76.86	73.94	74.86	90.79
2006	151.35	137.73	116.94	119.29
2007	136.29	132.68	145.29	124.72
2008	51.31	56.06	64.24	55.04
2009	82.53	80.65	76.90	63.50
2010	162.53	179.09	164.66	199.31
2011	121.97	131.12	140.39	136.82
2012	32.01	33.38	34.12	33.23
2013	49.33	55.86	63.62	70.33
2014	67.19	67.83	88.38	70.90
2015	158.63	109.02	88.50	88.80
2016	109.94	142.59	142.02	147.21

Testing of stationarity in price series

The results for testing the unit roots in Garlic price series by Augmented Dick-Fuller (ADF) test to check whether Garlic prices are stationary in all selected markets are presented in Table 3. The test is applied for Nagpur, Pune, Karad and Ahmednagar markets. It is observed that at level with lag 1 the ADF value for Nagpur market is less than the critical value at 1 % level of significance indicated the existence of unit root which implied that the price series of Nagpur is stationary. The table further showed that at first order difference with lag 1 the ADF values of Pune, Karad and Ahmednagar market were lower than the critical value indicated that the price series of these markets become stationary.

Table 3. ADF test results of Garlic Prices for selected markets

Market	Level (ADF)	Critical Value (1%)	Stationary at
Nagpur	-9.655	-4.023	Original series
Pune	-9.131		1st order
Karad	-11.722		1st order
Ahmednagar	-11.356		1st order

Presence of price volatility

To assess the presence of price fluctuations in the prices of Garlic in selected markets, ARCH-GARCH analysis was carried out and the results are presented in Table 4.

The sum of Alpha and Beta ($\alpha+\beta$), indicated ARCH and GARCH effect for the given market. It was observed that among the markets, the sum of Alpha and Beta is nearer to 1 i.e. 1.01, 1.026, 1.053 and 1.042 for Nagpur, Pune, Karad and Ahmednagar markets, respectively, indicated that the volatility shocks in the prices of Garlic are quite persistent for a long time in these markets.

Table 4. Results of ARCH-GARCH analysis of Garlic prices for selected markets

Parameter	Nagpur	Pune	Karad	Ahmednagar
Alpha (α)	-0.097	1.087	1.055	1.134
Beta (β)	1.107	-0.061	-0.002	-0.092
Sum of α &β	1.01	1.026	1.053	1.042

Market Co-integration

Johansen multiple cointegration trace test was applied for indicating the long-run relationship between the price series of selected markets. Co-integration is used instead of regular regression method because of its capacity in dealing with non-stationary series. The most popular co-integration method, developed by Johansen (1988) is applied. The test shows whether the selected Garlic markets are integrated or not. The results of the test were presented in Table 5. The presence of at least two co-integration equations at 5 per cent level of significance confirms that there exists long run equilibrium relation in the markets. The results of Co-integration test showed two co-integration equations were significant at 5% level of significance which implied that there existed co-integration among the markets.

Table 5. Results of multiple co-integration analysis of Garlic prices for the selected markets

Hypothesized No. of CE (s)	Eigen Value	Trace Statistics	Critical Value5%	Prob.**	No. of Co-integrating Equation CE(s)
None *	0.285509	99.58635	63.8761	0	
At most 1 *	0.209989	52.52053	42.91525	0.0042	2
At most 2	0.097948	19.5213	25.87211	0.2511	
At most 3	0.035702	5.08963	12.51798	0.5836	

Causality of price signals between selected markets

Granger Causality Test is a statistical tool which used F-test to know the cause and effect relationship between the two time series and this technique is employed to know the relationship between the prices of selected Garlic markets. When a co-integration relationship is

present for two price series, a Granger Causality Test (Granger, 1969) is used to analyse the direction of this co-movement relationship. The results of the test showing the relationship between selected Garlic markets were presented in Table 6. There is bidirectional causality in Garlic prices between Pune and Ahmednagar. The prices of Ahmednagar market exhibited unidirectional casuality and affects the prices of Karad and Nagpur market respectively. Pune market also showing the unidirectional casuality and affected the prices of Karad and Nagpur markets. Karad market showing unidirectional casuality and affected the prices of Nagpur market.

Table 6. Results of Pair wise Granger Causality Test for Garlic prices

Null Hypothesis	Obs.	F-Statistic	Prob.
Karad does not Granger Cause Ahmednagar	142	0.22459	0.7991
Ahmednagar does not Granger Cause Karad		25.9436**	3.00E-10
Pune does not Granger Cause Ahmednagar	142	15.6159**	8.00E-07
Ahmednagar does not Granger Cause Pune		3.29414**	0.0401
Nagpur does not Granger Cause Ahmednagar	142	0.20793	0.8125
Ahmednagar does not Granger Cause Nagpur		8.05676**	0.0005
Pune does not Granger Cause Karad	142	28.4996**	4.00E-11
Karad does not Granger Cause Pune		1.22539	0.2968
Nagpur does not Granger Cause Karad	142	2.26873	0.1073
Karad does not Granger Cause Nagpur		9.2497**	0.0002
Nagpur does not Granger Cause Pune	142	2.00958	0.138
Pune does not Granger Cause Nagpur		11.8038**	2.00E-05

CONCLUSION

The prices of Garlic were higher from the month of September – January in selected markets i.e. Pune, Nagpur, Karad and Ahmednagar. The cyclical variations were observed in the prices of Garlic in the selected markets. The higher prices recorded during the year 2006, 2007, 2011 and 2016. The price series of Garlic in Nagpur market was stationary at original series and in other markets the price series became stationary after first order differencing. The selected Garlic markets having long run equilibrium relationship for the prices of Garlic and there exists co-integration among them as indicated by the results of Johansen's Multiple Co-integration Test. The results of ARCH-GARCH analysis showed that there was high variability in the prices of Garlic. In selected markets, volatility shocks in the prices of Garlic were quite persistent. There was bi-directional causality observed in Garlic prices between Pune and Ahmednagar. The prices of Ahmednagar and Pune markets exhibited unidirectional causality and affects prices of Karad and Nagpur respectively.

Policy Implications

In order to minimize the price risk and to protect the price security of farming community under Garlic crop of Maharashtra state which is very volatile commodity in terms of market prices, it is recommended that the long term procurement policy should be adopted to maintain price stability throughout the year by declaring the MSP and procurement by Nodal agencies at least for major markets of the state.

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Production of rice in India: A robust statistical approach

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ABSTRACT

In this study, an attempt has been made to estimate the parameters in order to obtain the relationship between production of rice and agricultural inputs. The study was based on secondary data of production of rice (RP) as endogenous variable with respect to area under rice (Mha), consumption of NPK(thousand ton), quality seeds of rice (lakh quintals), consumption of electricity (GWh), actual rainfall (mm), pesticide consumption (MT), sale of tractors in no., sale of power tillers in no. as exogenous variables. A statistical and an economical analysis have been done through Ordinary least squares (OLS) and quantile regression method by using Cobb-Douglas production function.Results indicated that coefficients estimated through OLS could be misleading in the presence of outliers, influential observations, multicollinearity and autocorrelation. Econometric analysis results revealed that all the variables except consumption of pesticide were contributed positively in order to increase the production of ricethrough elasticity as well as marginal physical product. But the results of statistical analysis showed that the variables area under rice, quality seeds of rice, actual rainfall,consumption of pesticide and sale of power tillers were positively significant whereas the variables consumption of NPK, electricity consumption and sale of power tractors were negatively significant. Moreover, on the basis of absolute value of Akaike information criterion (AIC=87.48) and Schwarz criterion (SBIC=76.88), 0.75thquantile regression model comes out to be best in order to increase the production of rice.

Keywords:*Ordinary least square, outliers, quantile regression,MPP, elasticity.*

INTRODUCTION

Regression analysis is the primary toolto predict or explain differences in values of the endogenous variable with information about the values of the exogenous variables.. In regression analysis, ordinary least square(OLS) estimators are sensitive to the presence of outliers, influential observations, multicollinearity, autocorrelation and heteroscedasticity. Under these conditions, different regression techniques are advisable but among them quantileregression is one which has the quality to overcome from these situations and requires no distributional assumption about error term**.** Quantile regression(QR) was first introduced by Koenker and Bassett (1978). In QR, analysis of distribution is based on median and able to describe the entire conditional distribution of the endogenous variable. In India, agriculture is one of the important economic sectors.At the time of our gaining independence, the first Prime Minister Jawaharlal Nehru Said, "everything else can wait, but not agriculture."In 1960's, India faced the deficiency of foodgrains. In 1970's,because of Green Revolution, India attained self-sufficiency in food grains. Attainment of food self-sufficiencyis an important landmark in the history of growth of Indian agriculture, but this has not meant the dilution of problems facing Indian agriculture. Problems of agricultural growth and rural development in general continue to remain, in the new millennium, as much as they were in the 1950's. The advent of Green Revolution was at a time when the availability of additional land had more or less reached its limits, the agricultural scenario changed from one of the land reclamation to one heavy dependent on modern inputs. The introduction and rapid spread of high yielding rice resulted in steady output growth for food grains.This increase in food grains production has helped the country to achieve considerable degree of self-sufficiency in terms of food requirements.According to Swaminathan, today we are in the era of diminishing grain reserves, escalating prices, and persistence of widespread undernutrition, while the government rejoices over a record food grain production there are doubts about the country's ability to produce enough to meet demand by 2020 if agricultural production does not remain above the population growth rate. In India there is a need to double annual food grain production from the present 210 million tons to 420 million tones within the next ten years i.e. by 2015 which is also a benchmark year for achieving the United Nations Millennium Development goals. On the basis of production, at least 160 million tons of rice from 40 million hectares and 100 million tons of wheat from 25 million hectare (Swaminathan, 2006). Our agriculture is at the crossroads economically, ecologically, technologically, socially and nutritionally. Now, because of crop failure, non-fulfillment of profit etc. farmers wassuiciding in several parts of the country, including the Punjab which is the heartland of intensive agriculture, (Government of India, 2004).So,by keeping above points in consideration our study on "developing

statistical model for production function of rice crop through quantile regression approach" has been taken. Toachieve these objectives, Cobb-Douglas production functionis used. As an econometric model; Ridge regression (RR)estimating procedures will be used.

METHODOLOGY

The recent time series data (1992 to 2015) have been procured from various online data portals like Directorate of Economics and Statistics, Govt. of India, Ministry of Agriculture, Govt. of India, RBI etc. The exogenous variables used to study the rice production (RP) are area under rice (AUR), fertilizer consumption (NPK), quality seeds of rice (QSR), electricity consumption in agriculture (EC), actual rainfall (AR), consumption of pesticide (CP), sale of tractors (ST) and sale of power tillers (SPT). For multicollinearity, heteroscedasticity and autocorrelation,variance inflation factor (O'brien, 2007), Breusch-Pagan test (Trevor Breusch and Adrian Pagan,1979)and Durbin Watson *d* statistic (Watson and Watson, 1950) have been used whereas outliers andinfluential observations have been tested through the studentized deleted residual and Cook's Distance (Cook, 1977) respectively. The estimation of parameters has been done through OLS and quantile regression method by using Cobb-Douglas production function. The functional form of Cobb-Douglas production functions (multiplicative) is used to represent the relationship of an output to inputs as

$$y_t = f(x_{k,t}|\beta) or y_t = A\sum_{k=1}^{K}\left(x_{k,t}^{\beta_k}\right)$$

Where, k=1…K is the number of inputs, cross-section *i*=1 … N, time-series *t*=1 … T and β1,…,βk are the input elasticities.

The OLS estimator is obtained by $\hat{\beta} = (X'X)^{-1}X'Y$ and the linear conditional quantile function can be estimated by $\hat{\beta}(\tau)$ =5ØNÜ5Ø_Ü5ØTÜ$min_{\beta\in\mathbb{R}^p}\sum_{i=1}^{n}\rho_\tau(y_i - x_i'\beta)$ for any quantile τ_ε (0,1). Here, as opposed to OLS, the minimization is done for each subsection defined byτ_τ and the quantity $\hat{\beta}(\tau)$ is known as the regression quantile.

The empirical model for quantile regression is

$$Q_\tau\left[\ln(y_t/x_{k,t})\right] = \beta_{0,t} + \beta_{k,t} lnx_{k,t}$$

where, *y* is an aggregate output $Q_\tau[\ln(y_t/x_{k,t})]$ is the ôth quantile of *y* conditional on covariate matrix *Xk*, that includes the quantities of exogenous variables. The coefficient $\beta_{k,t}$ represents the returns to covariates or inputs at the ôth quantile.

Moreover, elasticity of production, marginal physical productand marginal productivity has also been obtained. Elasticity is defined as the ratio of proportionate change in output to the proportionate change in a variable input and is expressed as

$$E_p = \frac{\Delta y/y}{\Delta x_i/x_i}$$

Where, Δ is change, y is output and x_i's are inputs. Marginal physical product is the change in total output as one additional unit of input is added to production and is expressed as

$$MP = \Delta y/\Delta x_i$$

Where, Δxi is the change in the firm's use of the input (conventionally a one-unit change) and Δy is the change in quantity of output produced (resulting from the change in the input). And the Marginal productivity is expressed as

$$MVP = coefficientofx_i * \frac{geometricmeanofy}{geometricmeanofx_i}$$

Where, y is output and x_i's are inputs.

RESULTS AND DISCUSSION

The data used in this study cover a period of 1992 - 2015.The descriptive statistics for endogenous and exogenous variables used in the estimation of production function. The variability can be seen maximum in SPT (65.95 percent) followed by QSR at 62.89 per cent whereas, minimum in area under rice (2.64 percent) followed by AR (7.42 percent). The variables AUR and AR showed consistent results with variations 2.64 and 7.42 per cent as compared to other variables (Table 1).

The estimated average value for aggregate output stood at 88.82 MT with a minimum value of 71.82MT in 1992 and a maximum of 106.54MT in 2015. The distribution around the mean of the aggregate output is 9.45 MT

Table 1: Summary statistics of exogenous variables affecting riceproduction in India

Variables	Unit	Mean	Minimum	Maximum	Standard deviation	Coefficient of variation (%)
RP(y)	million ton	88.82	71.82	106.54	9.45	10.64
AUR(x1)	million hectare	43.40	41.18	45.54	1.15	2.64
NPK(x2)	thousand ton	19871.00	12154.50	28122.21	5253.91	26.44
QSR(x3)	lakh quintals	38.73	13.58	92.92	24.36	62.89
EC(x4)	giga-watt hour	102010.00	63328.00	1.69E5	27172.81	26.63
AR(x5)	millimeter	1154.80	972.80	1297.30	85.79	7.42
CP(x6)	million ton	50336.00	39773.00	70794.00	8408.21	16.70
ST(x7)	numbers	331700.00	139000.00	697000.00	163547.00	49.30
SPT(x8)	numbers	26197.00	8376.00	60000.00	17278.27	65.95

Table 2: OLS estimates, MPP and elasticity of production for rice (1992 & 2015)

Variables	OLS	Marginal physical product	Elasticity
AUR(x1)	1.26**	9.82217	4.79
NPK(x2)	"0.17	0.00109	0.32
QSR(x3)	0.22**	0.65267	0.28
EC(x4)	"0.10	0.00041	0.47
AR(x5)	0.39**	0.25245	3.28
CP(x6)	"0.04	-0.00078	-0.44
ST(x7)	0.03	0.00003	0.24
SPT(x8)	0.01	0.00039	0.21

**= significant at 5% and **= significant at 1%*

The estimates of traditional OLS for the production function reveal a positive and significant effect of the area under rice, quality seeds of rice and actual rainfall on rice production. Elasticity of production and marginal physical product illustrated a positive effect of all the variables on rice production except consumption of pesticide (Table 2).

Table 3: Behaviour of rice data during 1992-2015

Multicollinearity								
Variable	AUR	NPK	QSR	EC	AR	CP	ST	SPT
VIF	1.33	32.36	9.63	11.39	1.41	3.32	19.77	53.71
Heteroscedasticity								
Breusch-Pagan test			Test statistic: LM = 0.964711 with p-value=P(Chi-square (8)> 0.964711) = 0.99					
Autocorrelation								
Durbin Watson test				D = 2.36841				
Outliers through Studentized deleted residual (observations)				Influential observations through Cook's distance				
10				20				
20								

According to VIF, the variables NPK, EC, ST and SPT showed multicollinearity in the data whereas Breusch-Pagan test and Durbin Watson test showed that there is no heteroscedasticity and no autocorrelation present in the data. As by studentizeddeleted residual, observations 10 and 20 arean outlier which has more affect on intercept and by Cook's distance, observation 20 is an influential observation that greatly affects the slope but observation 20 is both an outlier as well as influential observation which has adverse affect on both intercept and slope of the regression line (Table 3).

The representation of the parameter coefficient for OLS as well as quantiles 0.5, 0.75 and 0.90 is given in Table 4. The estimates of traditional OLS for the production function shows a positive and significant effect of the area under rice, quality seeds of rice and actual rainfall on rice production whereas quantile regression presents a complete picture at different points of a conditional distribution because they represent a way of describing the whole distribution (Martins and Pereira, 2004). Unlike traditional OLS, quantile regression illustrated a positive and statistically significant effect of area under rice(AUR), quality seeds of rice (QSR), annual rainfall, sale of tractors (ST) and sale of power tillers(SPT) on the production at quantiles 0.50^{th}, 0.75^{th} and 0.90^{th} with the exception of sale of tractors(ST) at the higher quantile (0.90^{th}) and sale of power tillers(SPT) is not significant at lower quantile (0.50^{th}); but showed a negative and statistically significant effect of consumption of fertilizer (NPK), consumption of electricity in agriculture (EC) and consumption of pesticide (CP) at quantiles 0.50^{th}, 0.75^{th} and 0.90^{th} with the exception of consumption of pesticide(CP) at higher quantile (0.90^{th}). These results illustrate the considerable differences between OLS estimates and the estimates for specific quantiles. The major distinction between the traditional OLS and quantile regression is the disparity presented by the quantile regression depicting a significant effect between the agricultural inputs (AUR, NPK, QSR, EC, AR, CP, ST and SPT) and total production. However, the result of OLS does not reveal any statistical significance between the agricultural inputs (NPK, EC, CP, ST and SPT) and total production. In addition to above, quantile regression reveals a clear representation by depicting 0.75^{th}quantile as best wherein each variable maintain a significant effect on rice production as compared to OLS.

Table 4: OLS estimates and quantile regression at different quantilesusing Cobb-Douglas production function

Variables	Regression coefficients			
	OLS	At π=0.50	At π=0.75	At π= 0.90
Constant	"0.9372	"1.1684	1.8827	"2.8305
AUR(ln x1)	1.2634**	1.3178**	0.9218**	1.8009**
NPK(ln x2)	"0.1799	"0.2175**	"0.2697**	"0.2296**
QSR(ln x3)	0.2246**	0.2115**	0.2093**	0.3486**
EC(ln x4)	"0.1050	"0.0776*	"0.0673**	"0.1510**
AR(ln x5)	0.3936**	0.4216**	0.2753**	0.3853**
CP(ln x6)	"0.0424	"0.0681*	"0.0688**	0.0976**
ST(ln x7)	0.0333	0.0502*	0.0312**	"0.0520**
SPT(ln x8)	0.0121	0.0114	0.0257**	0.0230**
|AIC|	87.7063	94.0112	87.4896	87.5874
|SBIC|	77.1039	83.4087	76.8872	76.9849

**= significant at 5% and **= significant at 1%*

The Table 5 revealed that, at 0.75^{th} quantile, marginal value product of all the resources are less than one except area under rice (AUR) which is greater than one. Therefore, the use of area under rice (AUR) should be expanded to increase the production of rice.

Table 5: Marginal productivity for quantile regression at 0.75^{th} quantile (1992-2015)

Variables	MVP(at 0.75th)
AUR(x1)	1.876890
NPK(x2)	-0.001241
QSR(x3)	0.569522
EC(x4)	-0.000060
AR(x5)	0.021120
CP(x6)	-0.005277
ST(x7)	0.0000092
SPT(x8)	0.000106

CONCLUSION

Quantile regression method at 0.75thquantile comes out to be best on the basis of AIC and SBIC for researchers who are estimating the regression parameters in the presence of outliers and influential observations. Our findings indicated that outliers and influential observations should receive special attention and careful examination to determine the cause of their peculiarities. On the basis of elasticity of production, marginal physical product and quantile 0.90th regression, all the exogenous variables are statistically significant in order to increase the rice production. So, by the result of Marginal value productivity (at 0.75thquantile) it is recommended to the farmers that they will use area under rice (AUR) variable more in order to increase the rice production. The proposed model for quantile regression at 0.75thquantile to study the rice production with respect to exogenous variables is given as

$Q_{0.75}[\ln(y/x_i)]$ =1.8827+0.9218AUR**"0.2697NPK** +0.2093QSR**"0.0673EC**+0.2753A** "0.0688CP**+0.0312ST**+0.0257SPT**.

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Production performance of Pigeon pea (Tur) in Solapur district of Western Maharshtra

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ABSTRACT

The study was conducted in Solapur districts of Western Maharashtra. The objectives of study also examine trends,costs and returns structure, resource use efficiency, marketing cost, seasonal fluctuations in arrivals and prices,and problems in production and marketing of pigeon pea in Solapurdistrict of Western Maharashtra.The study was based on the primary data of 90 pigeon pea cultivators for the year 2011-12.The secondary data on area, production and productivity for period 2000-01 to 2009-10. The functional analysis was also carried out by using Cobb-Douglas type of production function.The production of pigeon pea has increased due to productivity increases and area under pigeon pea also increases. The major items of cultivation cost were rental value of land, bullock power, human labour, seed, plant protection, fertilizer and manures.Per quintal cost of production was Rs. 2626.49 and net price realized was 3870.31.The input output ratio at cost C was 1.43. However, Producer-Wholesaler-Retailer-Consumer was the major marketing channel, per quintal cost of marketing was found to be 386.63. The major problems faced by farmers in the production of pigeon pea were incidence of high wages rate oflabour, high costs of inputs, non-availability of loan in time,non-availability of labour in peak period,while in case of marketing the major items of cost were commission, transport and packaging charges., lack of market intelligence and high market charges. The study suggests that the extension education programmes have to be strengthened for the spread the awareness of improved production technologies and modern cultivation of pigeon pea among the farmers in order to improve the productivity of pigeon pea.

Keywords:*Compound growth rates, price spread, indices of arrivals and prices.*

INTRODUCTION

In Indian agriculture, pulses play an important role in economy and human diet. Pulses are basic ingredients in the diets of a vast majority of Indian population as they provide a perfect mix of high nutritive value when supplemented with cereals. Importance of pulses is relatively more in our country as its contribution in nutrient supply is far more than that in Asia and World as a whole. Each plant of a pulse crop is virtually a nature's mini-nitrogen fertilizer factory, which enables it to meet its own requirement and also benefit the succeeding crops (Nene and Sheila, 1990). Pigeon pea is extensively used in making dal. Its green pods are occasionally used as a vegetable or used as table purpose after boiling. The green leaves and tops of the plants are fed to the animals or are utilized as green manures. The husk of pods and seeds and also the kernels constitute a valuable cattle feed. Dry stalks obtained after threshing are used for basket making or as a fuel or thatching material. Being deep rooted; it is also sown as a soil renovator to break the hard subsoil and as a hedge to check erosion. The heavy shedding of leaves adds considerable organic matter to the soil. It is also often grown as a crop in plantation. At present, In India, pigeon pea was grown on 3.18 million ha, with annual production of 3.02 million tones and average productivity of 806 kg/ha during the year 2012-13. Similarly in Maharashtra during the year 2012-13 area under pigeon pea cultivation was 10.81 lakh ha with annual production 9.09 lakh tones and productivity up to 841 kg/ha (Anonymous., 2013-14).

The area under pigeon pea in Maharashtra during 2013-14 was 10962 thousand hectares while production was 10356 thousand tones with an average productivity of 945 kg/ha (Table 1). Pigeon pea is the main pulse crop in the state which contributes 35.83 per cent of the total pulses production in the state and 28.71 per cent of total pulses area in the state. Pigeon pea is the most important crop of Solapur district. Besides other crops, pigeon pea constitutes major share in the total cropped area of the district. It has also become important constituents in the diet of farmers either in the form of whole kernels or splits. Hence, in this pocket of Maharashtra pigeon pea forms the major crop of the farmers. Farmers' economy depends on the production of pigeon pea and the total returns received from its sale.

Therefore, the present study was undertaken to analyze the performance of pulses in Solapur district, to estimate the compound growth rates, cost of production and marketing of pigeon pea, to know the trends in arrivals and prices realized in Solapur market and problems if any in the production and marketing of pulses faced by the pulse growers.

METHODOLOGY

Growth rates in area, production and productivity of Pigeon pea

The growth rates were estimated for two time period i.e. Period I-2000-2001 to 2005-2006 and Period II- 2006-2007 to 2009-2010 and overall 2000-01 to

2009-10 i.e for the period of 10 years.The following formula was used for estimating the annual compound growth rates.

$$Y = ab^t$$

Where,
Y= Area/production/productivity of Pigeon pea.
t= Time available in year.
a= Constant.
b= Regression coefficient.

Trends in arrival and prices for this compound growth rate was used,

% CGR = (Antilog b-1) X 100

Where,
b = Regression coefficient.

Resource use structure

The requirements of major inputs for Pigeon pea have been worked out on per hectare basis.

Production function analysis

$$\mathbf{Y = ax_1^{b1} x_2^{b2} x_3^{b3} x_4^{b4} x_5^{b5} x6^{b6} x7^{b7} e^u}$$

Where,
Y= Output of main produce (q/ha)
X_1= Human labour (Man days/ha)
X_2= bullock labour (Pair days/ha)
X_3= Machinery charges (‘)
X_4= Manures Quantity in (q)
X_5= N (kg)
X_6= P (kg)
X_7= K (kg)
a= constant / Intercept
b^i= Regressioncoeff. of respective resource variable
e^u= Error term

Estimation of marketing cost

It includes the grading and packing charges comprising the wages paid to the labour, value of packing material and other charges, transport cost includes transport charges including loading and unloading charges and market cost comprising hamali, weighing and commission charges. The cost actually paid by the selected farmers was considered and analyzed.

Marketing channels

The marketing channels are the routes consisting of various agencies through which the producer sells his produce to the ultimate consumer.The pathway by which the produce reaches to the consumer is called the marketing channel. In the present study, efforts were made to find out different marketing channels.

Problems in production and marketing

The problems in production and marketing were estimated with help of percentages.

RESULTS AND DISCUSSION

Growth rates in Area, Production and Productivity of pigeon pea in Solapur district

The annual compound growth rate in area under pigeon pea has shown increasing trend during overall period of 10 years and it increasing with a positive growth rate of 8 per cent which is significant at 5 per cent significance level per annum.The area under pigeon pea has increased during Period I while the drastic increase in the area under pigeon pea was observed during Period II.The production of pigeon pea has increased during overall period at the rate of 15 per cent per annum. The period wise analysis revealed that the production of pigeon pea has increased during Period I and Period II, respectively (Table 1).

Table 1. Growth rates of area, production and productivity of pigeon pea in Solapur district

Period	Compound growth rate		
	Area	Production	Productivity
2000 to 2005	24	21	14
2006 to 2010	21***	20***	-1*
2000 to 2010	8**	15***	9**

*,**,***= Significant at 10, 5 and 1 per cent significance level, respectively

Per hectare cost of cultivation of pigeon pea

At the overall level, per hectare cost of cultivation of pigeon pea (i.e. Cost ‘C’) was worked out to 26201.89. Among the different items of costs, total human labour was highest followed by rental value of land, bullock labour, interest on fixed capital, plant protection, interest on working capital, seed, machinery charges. The cost incurred in respect of land revenue and other taxes and depreciation were negligible in the cost of cultivation. Similar trend was observed among the different size groups of pigeon pea growers (Table 2).

Thus, from above forgoing discussion, it was noticed that the cost of cultivation varied among the groups of pigeon pea growers. The average per hectare productivity of pigeon pea was 9.07 quintals at the overall level. As a result, the cost required for the production of one quintal of pigeon pea was lowest in large size group (2551.38) followed by medium and small sized group of pigeon pea growers. This is because of appropriate production management practices adopted by large size group of pigeon pea growers. Per hectare gross returns were highest in small size group followed by medium and large size group of pigeon pea growers.

Results of Cobb-Douglas production function inpigeon pea

At the overall level, coefficient of multiple determination (R^2) turned out to be 0.70 indicating that 70.00 per cent variation in output is jointly explained by the above considered independent factors (Table 3). The regression coefficient of variables Human labour (X_1), Manure (X_4), nitrogen (X_5) and phosphorus (X_6) were turned out statistically significant. This indicated that, if we increases one unit of Manure (X_4) then the out put will increase 0.32 per cent. The other resources like bullock labour(X_2) machine (X_3) and potassium (X_7) were non-significant. In case of pigeon pea in all three groups and at the overall level, individual elasticity of

Table 2: Item wise cost of pigeon pea in Solapur district (Rs. per hectare)

Cost items	Small			Medium			Large			Overall		
	Qty.	Value	Percent	Qty.	Value	Percent	Qty.	Value	Percent	Qty.	Value	Percent
Hired Human labour (Man days)												
a. Male	12.51	2502.42	8.51	13.30	2660.30	10.21	12.15	2430.52	9.82	12.60	2519.48	9.62
b. Female	22.70	3404.46	11.58	19.44	2916.10	11.19	18.18	2727.27	11.02	19.59	2938.31	11.21
Bullock power (Pair days)	12.22	4277.40	14.55	10.16	4065.48	15.60	8.57	3857.75	15.59	9.89	4017.32	15.33
Machine power	11.12	889.23	3.02	11.01	770.91	2.96	8.76	306.72	0.00	10.00	584.01	2.23
Seed (Kg)	10.43	625.61	2.13	10.71	642.56	2.47	10.81	648.47	2.62	10.69	641.49	2.45
Manures (q)	13.68	1367.60	4.65	11.94	1193.72	4.58	12.48	1248.23	5.04	12.58	1257.58	4.80
Fertilizers (Kg)												
N	5.71	92.44	0.31	4.61	74.57	0.29	5.11	82.78	0.33	5.09	82.33	0.31
P	19.43	431.30	1.47	16.61	368.71	1.42	17.39	386.08	1.56	17.60	390.66	1.49
K	5.12	65.54	0.22	7.15	91.52	0.35	12.14	155.39	0.63	8.99	115.07	0.44
Irrigation Charges (Rs.)		0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00
Plant protection charges (Rs.)		1249.76	4.25		1114.32	4.28		1242.86	5.02		1203.61	4.59
Incidental charges (Rs.)		114.00	0.39		114.00	0.44		114.00	0.46		114.00	0.44
Repairs (Rs.)		218.00	0.74		218.00	0.84		218.00	0.88		218.00	0.83
Working capital (Rs.)		15237.77	51.82		14230.20	54.62		13418.09	54.22		14081.86	53.74
Int. on Working Capital		914.27	3.11		853.81	3.28		805.09	3.25		844.91	3.22
Depre. on farm implements		520.00	1.77		520.00	2.00		520.00	2.10		520.00	1.98
Land revenue and taxes		80.50	0.27		80.50	0.31		80.50	0.33		80.50	0.31
Cost 'A'		16752.53	56.97		15684.51	60.20		14823.67	59.90		15527.27	59.26
Rental value of land		6580.40	22.38		6054.31	23.24		6029.16	24.36		6160.15	23.51
Int .on fixed capital		1287.82	4.38		1310.70	5.03		1310.70	5.30		1305.59	4.98
Cost 'B'		24620.75	83.72		23049.52	88.47		22163.53	89.56		22993.02	87.75
Family labour											0.00	
a. Male	16.59	3317.17	11.28	10.37	2073.67	7.96	8.57	1714.55	6.93	10.93	2186.15	8.34
b. Female	9.80	1469.45	5.00	6.21	931.11	3.57	5.79	869.05	3.51	6.82	1022.73	3.90
Cost 'C'		29407.36	100		26054.29	100		24747.14	100		26201.89	100
Output (q)											0.00	
a. Main produce	9.56	37278.86		9.09	34529.20		8.83	34444.18		9.07	35103.74	
b. Bye-produce	13.43	2686.56		11.40	2279.67		11.07	2213.75		11.70	2340.18	
Cost 'C' net of byproduce		26720.81			23774.62			22533.38			23861.71	
Per quintal cost		2795.45			2616.44			2551.38			2626.49	

Figures in parentheses indicate percentage to the respective Cost 'C'

production for every resource is less than unity indicating diminishing marginal returns for the individual resource have set in.

Table 3: Results of estimate Cobb-Douglas type of production function

Particulars	Group			Overall
	Small	Medium	Large	
Intercept	1.0170	0.3966	0.6607	0.6539
Human labour (X_1)	0.4874*	0.8336**	0.9573**	0.8747**
	(0.2363)	(0.3468)	(0.3793)	(0.4332)
Bullock labour (X_2)	0.3172*	0.1278	0.4053***	0.0279
	(0.1654)	(0.1589)	(0.1428)	(0.0276)
Machine (X_3)	0.0239	0.2608	0.0837	0.7451
	(0.2693)	(0.1695)	(0.9511)	(0.7109)
Manure(X_4)	0.0836**	0.0618**	0.2876**	0.3282**
	(0.030)	(0.0242)	(0.1194)	(0.1454)
Nitrogen (X_5)	0.0471*	0.0848***	0.0025	0.0285**
	(0.0236)	(0.0314)	(0.4190)	(0.0139)
Phosphorus (X_6)	0.0121	0.0367***	0.2731**	0.0493***
	(0.0714)	(0.0130)	(0.1268)	(0.0178)
Potassium (X_7)	0.0022	0.0021	0.0013	0.0020
	(0.1135)	(0.0135)	(0.3453)	(0.0326)
R^2	0.7406	0.7212	0.6912	0.7086

, **, * = Significant at 10, 5 and 1 per cent significance level, respectively (Std. Err of coef.)*

Resource use efficiency in pigeon pea

The marginal value product to factor cost ratio (MVP/MC) was greater than unity in case of resource use efficiency likes Human labour (X_1), Manures (X_4), and Nitrogen fertilizers (X_5) and Phosphorus fertilizers (X_6) at the overall level implying the achievement of higher resource use efficiency in case above mentioned variable where as the MVP/MC ratio of Bullock labour (X_2), and potassium fertilizers (X_7) were found to be less than unity suggesting the inefficient use of these resources (Table 4).

Table 4. Resource use efficiency in pigeon pea (Overall)

Human labour	0.8747	0.1515	590.79	175.00	3.3759
Bullock labour	0.0279	0.0239	93.03	400.00	0.2326
Manures	0.3282	0.2938	1145.87	100.00	11.4587
N	0.0285	0.0338	131.70	16.19	8.1347
P	0.0493	0.0294	114.78	22.18	5.1750
K	0.0020	0.0022	8.48	11.30	0.7500

Marketing channels

In case of pigeon pea there are three major channels seen in selected study area.

These channels were namely.

Channel I ® Producer ® Wholesaler ® Retailer ® Consumer

Channel II ® Producer ® Village trader ® Retailer ® Consumer

Channel III ® Producer ® Retailer ® Consumer

The first channel i.e. P-W-R-C was most popular in selected study area as most of the farmers sold their pigeon pea through this channel I i.e. P-W-R-C.

Table 5: Marketing cost in different Marketing channels (Values in Rs.)

Particulars	Channel-I Solapur	Channel-II Local
Packing charges	60.12(15.55)	12.20(21.40)
Transport	135.12(34.95)	40.21(70.53)
Hamali	20.12(5.20)	4.60(8.07)
Tolai	11.15(2.88)	0.00(0.00)
Commission	160.12(41.41)	0.00(0.00)
Total marketing cost	386.63(100)	57.01(100)

Figures in the parentheses indicate the percentages of their respective total

Marketing cost in different Marketing channels

The average marketing cost in channel-I and channel-II was 386.63 and 57.01 respectively. In channel-I, the average cost of marketing in channel-I was higher than channel-II.The per cent share of commission charges (41.41 per cent), transport charges (34.95 per cent), packaging charges (15.55 per cent), hamali, tolai charges, was 5.20,2.28 per cent respectively in case of Solapur market. In case of local market the per cent share of transport charges (70.53 per cent), packaging charges (21.40 per cent), were hamali (8.07 per cent). There was no cost incurred on tolai, commission charges in case of local market.The results revealed that the marketing cost varied according to channels.

Market margin and price spread

Price spread is the good indicator for determining the producers share in consumer rupee. Price spread refers to the difference between the price paid by the consumer and price received by the producer for a unit quantity of farm produce. Intermediaries which ultimately determines the overall efficiency of marketing system. The price spread in marketing of pigeon pea is given in Table 6.

The price spread is made up of various cost incurred and margins of intermediaries in the various marketing process such as assembling, transport, wholesaling, retailing etc. The price spread per quintal of pigeon pea in the channel-I i.e. per quintal price paid by the consumer was 4379.36.Per quintal net price received by the producer was 3513.37 Thus producers share in consumer rupee was 80.23 per cent. The expense incurred by producer was 386.63 which accounted 8.83 per cent of total price paid by consumer. The commission of wholesaler and retailer in a consumer rupee was 0.47 and 0.92 per cent, respectively. The cost incurred by wholesaler and retailer were 0.28 and 0.48 per cent, respectively.While in channel II, per quintal price paid by the consumer was 2257.01 Per quintal net price received by the producer was 2142.99. Thus producers share in consumer rupee was 94.95 per cent. The expense incurred by the producer was 57.01 which accounted 2.53 per cent of the total price paid by the consumer. It is thus, clear that in the process of marketing of a pigeon pea producers are getting only 80.23 and 94.95 per cent of the consumer rupee in I and II channel.

Table 6. Price spread in marketing of pigeon pea (Values in ₹)

Particulars	Channel-I Solapur Rs./q	Channel-II Local Rs.q
Gross price received by the producers	3900(89.05)	2200(97.47)
Market expenses incurred by the producers	386.63(8.83)	57.01(2.53)
Net price received by the producers	3513.37(80.23)	2142.99(94.95)
Commission received by the wholesalers	20.40(0.47)	0.00(0.00)
Expenses incurred by the wholesalers	12.11(0.28)	0.00(0.00)
Margin of the wholesalers	8.29(0.19)	0.00(0.00)
Commission received by the retailers	40.12(0.92)	0.00(0.00)
Expenses incurred by the retailers	20.10(0.46)	0.00(0.00)
Margin of the retailers	20.02(0.46)	0.00(0.00)
Price paid by consumers in the market	4379.36(100)	2257.01(100)

Figures in parentheses are percentage to final price paid by the consumers

Trends in arrivals and prices of pigeon pea in Solapur Market

The month wise arrivals of pigeon pea revealed that the arrivals were highest in January and February months followed by December and May months and lowest arrivals were recorded during November month. The seasonal index of arrivals for January and February months was 360.16 and 264.03 and in month of November it was 4.39. It has been noticed that the arrivals of pigeon pea were relatively more in winter season (December to January months) followed by summer season (April and May months) and lowest in rainy season (July to September months). This reveals that the sellers mostly prefer this month for selling the red gram in Solapur market (Table 7). The month wise prices of pigeon pea, the minimum seasonal indices was noticed in January the seasonal indices of 94.30 and the maximum seasonal index was recorded in July that is 109.44. The lowest prices of pigeon pea were recorded in January and February, so that the arrivals of pigeon pea were at lower side in these two months. The prices of pigeon pea were at higher side in rainy season and it was followed by winter season. Refer this month for selling the pigeon pea in Solapur market.

Table 7: Month wise Indices of arrivals and prices of Pigeon pea

Month	Arrivals Seasonal Indices	Prices Seasonal Indices
January	360.16	94.30
February	264.03	96.57
March	62.33	96.67
April	67.65	95.57
May	98.66	97.83
June	47.98	104.72
July	26.27	109.44
August	13.68	108.07
September	11.22	99.81
October	8.49	99.56
November	4.39	101.63
December	235.14	95.85

Problems in production of pigeon pea

The maximum problems were observed in production of pigeon pea of incidence of pests and diseases (81.11 per cent) followed by high wage rates for the human labour (80 per cent), non-availability of loan in time (76.67 per cent) of farmers reported about, high cost of seed(78.90 per cent), non-availability of labour in peak period (74.44 per cent) and high cost of manures and fertilizers were the problem reported by (72.22 per cent) farmers (Table 8).

Table 8. Problems in production of pigeon pea (No.)

Problems	Production	Problems	Marketing
High cost of seed	71 (78.89)	High transport charges	74 (82.22)
High wages for labour	72 (80)	High market charges	63 (70.00)
Non-availability of labour in peak period	67 (74.44)	Malpractices followed in market	66 (73.33)
High cost of manures and fertilizers	65 (72.22)	High commission charges	75 (83.33)
Non-availability of loan in time	69 (76.67)	Lack of market intelligence	66 (73.33)
Incidence of pests and diseases	73 (81.11)	Problems of price variation in the market	77 (85.56)
Total	30 (100)	Total	90(100)

Figures in the parentheses indicate the percentages of their respective total

In case of marketing the major problems in price variation in the marketing of pigeon pea about 85.56 per cent followed byhigh commission 83.33 per cent, high transport 82.22 per cent charges, malpractices and lack of marketing intelligence about 73.33 per cent were major problem for farmers reported in marketing.

CONCLUSION

The growth rates in area, production and productivity of pigeon pea were increased positive and significant at the rate of 8, 15 and 9 per cent per annum, respectively during the period from 2000 to 2010 in Solapur district of Western Maharashtra.The cost of production of pigeon pea was 2,626.49 per quintal and the Benefit: cost ratio of paddy was greater than unity. Therefore, pigeon pea is profitable enterprise. Among the different marketing channels the Producer-Wholesaler-Retailer-Consumer was found more popular in marketing of pigeon pea. For the sale of one quintal of pigeon pea farmer has to pay Rs. 386.63 as marketing expenses. The maximum prices of pigeon pea were observed during the month of July. Thus, the sellers prefer these months for selling of pigeon pea in Solapur market.The important constraints faced by the sample pigeon pea cultivators were incidence of pests and diseases, high wages for labour, high costs of seed, non-availability of loan in time, non-availability of labour in peak period, high costs of manures and fertilizer. While, in case of marketing of pigeon pea, the problems faced by the farmers were price variation in the market followed by high commission charges, high transport charges, , and malpractices followed in market, lack of market intelligence and high market charges.

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Profitability and marketing of fruit and vegetable crops in Chenani block of Udhampur district

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ABSTRACT

Agriculture addresses the challenge of meeting the growing demand for food despite less opportunities for agricultural expansion on supplementary lands. This study which was conducted in Chenani block of Udhampur district shows preparedness of farmers to cultivate fruit and vegetable crops other than cereals and these fruits and vegetables provides profitability to the farmers of the area. The cost and return analysis revealed that respective gross returns were Rs.60700.35, Rs.30000.00, Rs.410000.00 and Rs.60000.00, Rs.200000.00, Rs.80000.00 and Rs.150000.00 respectively for maize, mustard, tomato, cucumber, raddish, beans and garlic. Per hectare net returns were found to be highest (Rs.258276.00) in tomato whereas lowest (Rs.1538.37) was observed in case of mustard. Producer's share in consumers' rupee in case of maize was found to be 96.03 per cent whereas in vegetables it ranges from 41.67 per cent in cucumber to 57.14 per cent in tomato and beans.

Keywords: *Crop diversification, fruits, vegetables, maize*

INTRODUCTION

The economic aspects of crop cultivation are not less important as well maintained and established orchards/ fields give better returns. It may also be mentioned that there are many factors which may enhance the production in a particular area but among them cost and return coupled with marketing are considered to be the key factors for increasing the production. The farmers before prioritizing the preferences for establishing any orchard or field/ farm ensures its cost and return factor, which is the main motivation factor for bringing more area vis-à-vis giving lot of attention. Therefore it also becomes imperative to workout payback period which helps to various financial institutions and policy planners to provide the credit support. Moreover, along with the production, the role of marketing opportunities is equally important, as the farmers can ensure the reasonable return for their produce and also a legitimate share in the price paid by the consumers. Under the existing marketing practice, before the produce reaches to the end user, it has to be handled and passed through a long chain of various intermediaries, with the result that the producers are getting a small share of consumers' rupee. Therefore, working out the price spread provides an opportunity to know the difference between the price received by the farmer and price paid by the consumer which comprises cost of undertaking and rendering market services. Therefore, evaluating profitability and marketingwill help the farmers of this area to a greater extent as how to make their cultivation and marketing more profitable besides will also act as a guideline for the planning of policy planners/ scientists. Keeping in view the importance of the above facts, a diagnostic study covering profitability analysis, price spread analysis and marketing system has been undertaken with the objectives to study the cost and returns of major crops and to study marketing channels, cost and price spread.

METHODOLOGY

Cost and Returns

To achieve the stipulated objectives, the required information was collected on farm implements, machinery, farm inputs and crop yields etc. so that to work out cost and returns as well as marketing behaviour. Various cost concepts of CACP were used to work out the costs.

Analysis of Marketing

The data collected were tabulated and analyzed for examining the marketing cost, margins, price spread and the marketing efficiency.

Marketing Margins, Costs and Loss

a) Net Farmers Price

$$NP_F = \{GP_F\} - \{C_F\} - \{L_F \times GP_F\} \quad \textbf{(1)}$$

Where NP_F is net price received by the farmers (Rs./kg),

GP_F is gross price received by the farmers or wholesale price to farmers (Rs./kg),

C_F is the cost incurred by the farmers during marketing (Rs./kg),

L_F is physical loss in produce from harvest till it reaches assembly market (per Kg or %).

b) Marketing Margins

Intermediaries Margin = Gross price – Price paid – Cost of marketing–Loss in value during wholesaling

Net marketing margin of the wholesaler is given mathematically by

$$MM_w = \{GP_w - GP_F\} - \{C_w\} - \{L_w \times GP_w\}$$

(2) Where MM_w is net margin of the wholesaler (Rs./kg),

GP_w is wholesaler's gross price to retailers or purchase price of retailer (Rs./kg)

C_w is cost incurred by the wholesalers during marketing (Rs./kg),

L_w is physical loss in the produce at the wholesale level (per kg)

Net marketing margin of retailer is given by:

$$MM_R = \{GP_R - GP_W\} - \{C_R\} - \{L_R \times GP_R\} \quad (3)$$

Where MM_R is net margin of the retailer (Rs./kg),

GP_R is price at the retail market or purchase price of the consumers (Rs./kg)

L_R is physical loss in the produce at the retail level (per kg),

C_R is the cost incurred by the retailers during marketing (Rs./kg).

Thus, the total marketing margin of the market intermediaries (MM) is calculated as

$$MM = MM_W + MM_R$$

Similarly, the total marketing cost (MC) incurred by the producer/ seller and by various intermediaries is calculated as

$$MC = C_F + C_W + C_R$$

Total loss in the value of produce due to injury/ damage caused during handling of produce from the point of harvest till it reaches the consumers is estimated as

$$ML = \{L_F \times GP_F\} + \{L_W \times GP_W\} + \{L_R \times GP_R\}$$

RESULTS AND DISCUSSION

The cost and return analysis of cereal crop and vegetables in Kosar village of Chenani block is presented in Table 1. Per hectare Cost A which included all the variable costs excluding the family human labour were found to be highest (Rs.55017.56) for the cultivation of garlic followed by tomato (Rs.43933.76) whereas raddish incurred lowest of Rs.25505.16. The cost B which included the fixed costs in addition to cost A were Rs.39594.50 for maize, Rs.25857.85 for mustard, Rs.47933.76 for tomato, Rs.35257.97 for cucumber, Rs.29505.16 for raddish, Rs.37022.51 for beans and Rs.59017.56 for garlic. The cost C i.e. total item wise per acre operational costs which also included the imputed value of family labour were found to be highest (Rs.137933.80/ha) in tomato and lowest of Rs.25857.85/ha in mustard. The cost C increases in case of tomato to such an extent only because of the addition of family labour. Cost C* was also calculated by adding 10 per cent of cost C as management cost to total cost. The Table further revealed that among per hectare working costs, the highest expenditure of Rs.90000.00 was incurred on family labour in case of tomato whereas in case of raddish and garlic, it was Rs.10000.00 and Rs.14000.00, respectively for land preparation. As far as beans and cucumber is concerned, it was found that highest cost was incurred on purchase of seed i.e., Rs.12000.00/ha and Rs.8861.54/ha, respectively. In cereal crops, highest expenditure of Rs.20000.00 and Rs.9000.00 was incurred on manure and hired labour for maize and mustard, respectively. The yield in quintals for tomato, cucumber, raddish, beans and garlic was found to be 205.00, 120.00, 200.00, 40.00 and 50.00, respectively. In case of maize, it was 43.68 quintals per hectare with by-product of 19.82 quintals per hectare. Mustard was having a yield of 10.00 quintals per hectare. The further perusal of data indicated that respective gross returns were Rs. 60,700.35, Rs.30,000.00, Rs.4,10,000.00, Rs. 60,000.00, Rs. 2,00,000.00, Rs. 80,000.00 and Rs. 150000.00, respectively for maize, mustard, tomato, cucumber, raddish, beans and garlic. Per hectare net returns were found to be highest (Rs. 2,58,272.86) in tomato whereas lowest (Rs. 14,616.23) was observed in case of cucumber.

The item wise and concept wise operational costs for fruit orchards of Kosar village are presented in Table 2. The total number of walnut, apricot and plum grown in the study area by the sample orchardists were found to be 155, 40 and14, respectively. Cost A which included all the variable costs excluding the family human labour were Rs.13569.31 for walnut plants, Rs.3587.23 for apricot plants and Rs.1443.78 for plum plants. The cost B which included the fixed costs in addition to cost A were Rs.21319.31 for walnut plants, Rs.4314.50 for apricot plants and Rs.1698.33 for plum plants. The cost C i.e. total item wise per acre operational costs which also included the imputed value of family labour were Rs.26419.31 for walnut plants, Rs.4914.50 for apricot plants and Rs.2598.33 for plum plants. Cost C* was also calculated by adding 10 per cent of cost C as management cost to total cost.

The Table further revealed that among the working costs, the highest expenditure of Rs.5100.00 was incurred on family labour in case of walnut whereas in case of apricot and plum, it was found to be Rs.1000.00 incurred on land preparation and Rs.900 on family labour, respectively. The yield for all walnut, apricot and plum was found to be 6.80 quintals, 2 quintals and 3 quintals, respectively. The further perusal of data indicated that respective gross returns were Rs.81600.00, Rs.6000.00 and Rs.3000.00, respectively for all walnut, apricot and plum plants. Net returns were found to be highest (Rs.55180.69) in walnut plants followed by apricot (Rs.1085.50) and plum (Rs.401.67).

The channel wise decomposition of marketing costs and price spread components for maize and vegetables in Kosar village of Chenani block are presented in Table 3.The table revealed that the major items of producer's expenses in all the channels included cost of bags, transportation cost and loading/unloading charges etc. In channel–I and II, commission of the forwarding/ commission agent was also added to the marketing cost in addition to other costs. Marketing costs incurred by producer varies from Rs.80.00 per quintal in garlic to Rs.590.00 per quintal in tomato.

The marketing costper quintal at retailer's level varies from Rs.86.43 in cucumber to Rs.245.00 in garlic. Post-harvest loss was also calculated and highest loss of Rs.20.00 per quintal was found in tomato whereas

Table 1. Cost and return analysis of cereal crop and vegetables in Kosar village of Chenani block (Rs./ha)

Items	Unit	Cereal	Oilseed	Vegetables				
		Maize	Mustard	Tomato	Cucumber	Raddish	Beans	Garlic
Land preparation	Rs.	8000.00	6500.00	10000.00	8000.00	10000.00	10000.00	14000.00
Seed	Rs.	1911.92	400.00	10750.00	8861.54	4593.75	12000.00	12000.00
Manure	Rs.	20000.00	3333.33	6666.67	6666.67	6666.67	6666.67	6666.67
Urea	Rs.	440.00	550.00	880.00	880.00	880.00	880.00	550.00
DAP	Rs.	1440.00	1400.00	2400.00	2400.00	2400.00	2400.00	2400.00
Herbicides	Rs.	0.00	0.00	0.00	3400.00	0.00	0.00	0.00
Hired Labour	Rs.	2671.05	9000.00	12000.00	0.00	0.00	0.00	18000.00
Depreciation	Rs.	605.50	351.50	587.82	587.82	587.82	587.82	587.82
Total	Rs.	35068.47	21534.83	43284.49	30796.03	25128.24	32534.49	54204.49
Interest on working capital @6% p.a for 3 months	Rs.	526.03	323.02	649.27	461.94	376.92	488.02	813.07
Cost A	Rs.	35594.5	21857.85	43933.76	31257.97	25505.16	33022.51	55017.56
Rental Value of Owned Land	Rs.	4000.00	4000.00	4000.00	4000.00	4000.00	4000.00	4000.00
Cost B	Rs.	39594.50	25857.85	47933.76	35257.97	29505.16	37022.51	59017.56
Family Labour	Rs.	13728.07	0.00	90000.00	6000.00	6000.00	6000.00	0.00
Cost C	Rs.	53322.57	25857.85	137933.80	41257.97	35505.16	43022.51	59017.56
Cost C*	Rs.	58654.83	28461.64	151727.14	45383.77	39055.68	47324.76	64919.32
Yield (quintals)	Product	43.68	10.00	205.00	120.00	200.00	40.00	50.00
	By product	19.82	0.00	0.00	0.00	0.00	0.00	0.00
Rate per quintal (Rs.)	Product	1208.00	3000.00	2000.00	500.00	1000.00	2000.00	3000.00
	By product	400.00	0.00	0.00	0.00	0.00	0.00	0.00
Total value of output (Rs.)	Product	52770.53	30000.00	410000.00	60000.00	200000.00	80000.00	150000.00
	By product	7929.82	0.00	0.00	0.00	0.00	0.00	0.00
Gross returns (Rs.)		60700.35	30000.00	410000.00	60000.00	200000.00	80000.00	150000.00
Net returns (Rs.)		2045.52	1538.37	258272.86	14616.23	160944.32	32675.24	85080.68

Table 2. Cost and return analysis of fruit crops in Kosar village of Chenani block (Rs./ha)

Items	Unit	Fruits		
		Walnut	Apricot Khubani	Plum Aloobukhara
Plants	No.	155.00	40.00	14.00
Land preparation	Rs.	3875.00	1000.00	350.00
Manure	Rs.	3875.00	1000.00	350.00
DAP	Rs.	1240.00	320.00	112.00
Herbicides	Rs.	1276.47	329.41	115.29
Hired Labour	Rs.	2100.00	300.00	0.00
Depreciation	Rs.	434.77	434.77	434.77
Total	Rs.	12801.24	3384.18	1362.06
Interest on working capital @6% p.a	Rs.	768.074	203.051	81.724
Cost A	Rs.	13569.31	3587.23	1443.78
Rental Value of Owned Land	Rs.	7750.00	727.27	254.55
Cost B	Rs.	21319.31	4314.50	1698.33
Family Labour	Rs.	5100.00	600.00	900.00
Cost C	Rs.	26419.31	4914.50	2598.33
Cost C*	Rs.	29061.24	5405.95	2858.16
Yield (quintals)	Product	6.80	2.00	3.00
Rate per quintal (Rs.)	Product	12000.00	3000.00	1000.00
Total value of output (Rs.)	Product	81600.00	6000.00	3000.00
Net returns (Rs.)		55180.69	1085.50	401.67

Table 3: Marketing Pattern and Price Spread analysis of cereal and vegetable crops in Kosar village of Chenani block (Rs./qtl)

Particulars	Producer to Local Retailer to consumer	Channel–II				Channel–III
	Maize	Tomato	Cucumber	Raddish	Beans	Garlic
Producer's sale price	1208.00	2000.00	500.00	1000.00	2000.00	3000.00
Producer's expenses						
Cost of gunny bags/ petti	10.00	250.00	125.00	100.00	100.00	10.00
Loading/unloading	0.00	100.00	100.00	133.32	80.00	0.00
Transport	25.00	100.00	100.00	133.32	80.00	70.00
Commission @7%	0.00	140.00	35.00	70.00	140.00	0.00
Total costs	35.00	590.00	360.00	436.64	400.00	80.00
Net sale price	1173.00	1410.00	140.00	563.36	1600.00	2920.00
Local Retailer's level						
Purchase price	0.00	0.00	0.00	0.00	0.00	3000.00
Local Retailer's Sale Price	0.00	0.00	0.00	0.00	0.00	3800.00
Transport	0.00	0.00	0.00	0.00	0.00	100.00
Loading/unloading	0.00	0.00	0.00	0.00	0.00	100.00
commission@ 7% to F/C agent	0.00	0.00	0.00	0.00	0.00	266.00
Total cost	0.00	0.00	0.00	0.00	0.00	466.00
Net sale price of local retailer	0.00	0.00	0.00	0.00	0.00	3334.00
Retailer's level						
Purchase price	1208.00	2000.00	628.57	1000.00	2000.00	3800.00
Commission@ 5% to F/C Agent	0.00	100.00	31.43	50.00	100.00	190.00
Transport	0.00	20.00	20.00	20.00	20.00	20.00
Loading/unloading	0.00	15.00	15.00	15.00	15.00	15.00
Rehri/ Shop rent	0.00	20.00	20.00	20.00	20.00	20.00
Total costs	0.00	155.00	86.43	105.00	155.00	245.00
Spoilage due to physical injury and rotting, etc. (PHL)	0.00	20.00	7.00	10.00	20.00	0.00
Marketing Margin	50.00	1325.00	478.00	885.00	1325.00	1955.00
Consumer price	1258.00	3500.00	1200.00	2000.00	3500.00	6000.00
Producers' share in consumers' rupee (%)	96.03	57.14	41.67	50.00	57.14	50.00

lowest of Rs.7.00 per quintal was observed in cucumber. There was no post-harvest loss in case of maize and garlic. As far as marketing margin of retailer is concerned, it was found to be highest (Rs.1955.00/ qtl) in case of garlic. Producer's share in consumers' rupee in case of maize was found to be 96.03 per cent whereas in vegetables it ranges from 41.67 per cent in cucumber to 57.14 per cent in tomato and beans.

CONCLUSION

As far as cereal crops are concerned, it does not provide much return to the farmers of the area. Moreover, vegetables are most profitable crops of the area and farmers are getting better returns from these. Cultivation of vegetables is increasing their standard of living also. Farmers of the area are also trying to get returns from the growing of fruit crops. Climate of the area is also suitable for growing walnut, bei, apricot, plum, apple etc. Moreover, area is famous for the production of amlook which is having religious importance as it is used in prashads. So, government can take initiative and promote cultivation of fruit crops in the area by providing subsidies under horticulture schemes. This will definitely help the farmers of the area to increase share of fruit crops in their income. Also, the people of the area are marketing their produce mostly to Jammu which is difficult for them and moreover they are not getting better price for their produce. Therefore, establishment of vegetables assembling centre will definitely help them to overcome the above problem.

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Sericulture in hills: contribution to economy of small and marginal farmers in hills of Jammu (J&K)

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ABSTRACT

The present study was conducted in Jammu division of Jammu and Kashmir State. Three districts namely Poonch, Reasi and Rajouri were selected for the purpose of study. Based on the number of silkworm rearers in a block, two blocks having maximum silk worm rearers from each district was selected purposively. Thus a total of six blocks was selected for the purpose of study. From each selected block four villages having maximum number of silkworm rearers were selected purposively. Thus, twenty four villages were selected for the purpose of study. The respondents were selected by proportionate random sampling with a sample size of 240 respondents. Majority of respondents belong to middle age, were low educated and even illiterate and were having 5-7 members in family. About half of the respondents mainly dependent on sericulture and agriculture. The average land holding was 0.83 ha and majority of them were marginal farmers. The average annual income was Rs.73647 and the average experience in sericulture was 20.19 years and having 85 average trees owned by silkworm rearers. The average distance from home to sericulture office and cocoon auction market was 3.87 km and 15.48 km, respectively. Majority of farmers were exposed to television and radio and were having good extension contact with the watcher of sericulture department had medium extension contact and mass media exposure. Majority of respondents were not trained and seeking information from family and friends.

Keywords: *Sericulture, socio-economics, small and marginal farmers.*

INTRODUCTION

In India sericulture is mostly a village based industry providing employment opportunities to a large section of the population and is considered as a subsidiary occupation. Technological innovation has made it possible to take it up on an intensive scale and thus enabling farmers to generate additional income. India is the second largest producer of the silk in the world after China and produces all the known varieties of the silk, viz Mulberry, Eri, Muga and Tasar (CSB-2012). Mulberry silk alone contributes more than 80% of the country, s silk production. In India, because of favourable climatic conditions, mulberry is cultivated mainly in five states, viz Karnataka, Andhra Pradesh, Tamil Nadu, West Bengal and Jammu and Kashmir. These five states collectively account for 97% of the total area under mulberry cultivation and 95% of raw silk production in the country.

In Jammu and Kashmir, sericulture industry, from rearing of worms to reeling of cocoons and weaving of silk is centuries old vocation. Agro based part of the industry is widely distributed whereas industrial portion is restricted in Kashmir valley only. Raw silk produced is worldwide known as Kashmir silk being superior bivoltine type. Although this trade is centuries old in our state but was introduced in Jammu division only about 100 years back. (Koul, 2009) In Jammu division three fourth of land area is rain fed supporting minor crops, horticulture trees and other agro forestry species including mulberry. Major crop in this area is maize. Land holding are small and fragmented. Farmers distribution are landless or marginal, who are unable to meet their all needs from land. These people generally resort to daily labour work during off season spread for about six months and some have taken up subsidiary occupation including silkworm rearing (Koul, 2009). The practice of sericulture has been of recent origin in subtropical climate belt of Jammu division of Jammu and Kashmir State starting in the beginning of last century. Bulk of the silkworm rearing is carried out on leaf obtained from the Government plantation on road sides, river bunds, wild plantation and government land. In spite of good returns in shortest possible time no attempts have been made to raise private mulberry gardens by the farmers mainly due to shortage of irrigated cultivable land and only single crop system of silkworm rearing (Annonymous,1988).

Under the subtropical, intermediate and temperate conditions of Jammu usually two commercial silkworm rearing are conducted Ist in February- march (spring) and the 2ndin August-September (autumn). However with the management of mulberry farm and by overlapping rearing, four silkworm rearing are possible in a year. The average green cocoon crop production per ounce of seed reared is 40 kg that costs Rs. 4000 with a labour of 20-22 days (Ram, 2010).Sericulture is a subsidiary occupation for about 29300 rural families in the state. Most of these families belong to economically backward section of the society. About 1021 MTs of cocoons are produced annually in the State generating anannual income of about Rs 2026.00lacs for these silkworm rearers. (Economic Survey, J&K

2013-14). Keeping in view of the above facts a study was conducted to know the socio economic status of the silkworm rearers of Jammu region.

METHODOLOGY

The present study was conducted in Jammu division of Jammu and Kashmir State. The Jammu division comprises of ten districts. The silk worm rearers are found in all these districts. On the basis of number of silkworm rearers in each districts, the districts were categorized into three categories with i) Less than 500 rearers ii) 500-1000 rearers iii) Above 1000 rearers. From each of these categories, one district having highest number of silkworm rearers was selected. In this way, three districts namely Poonch, Reasi and Rajouri were selected from these categories for the purpose of study. Based on the number of silkworm rearers in a block, two blocks having maximum silk worm rearers from each district was selected purposively. Thus a total of six blocks was selected for the purpose of study. From each selected block four villages having maximum number of silkworm rearers were selected purposively. Thus, twenty four villages were selected for the purpose of study. The descriptive cum diagnostic research design was employed for conducting the study. The respondents were selected by proportionate random sampling with a sample size of 240 respondents. Data were collected from the selected respondents with the help of semi- structured interview schedule by using the personal interview method. The respondents were interviewed either at their home, at community places or at their farms and their responses were recorded on the spot. The collected data were analyzed by using both parametric and non- parametric statistical tests are used. Computer based SPSS programme was used for analyzing the data.

RESULTS AND DISCUSSION

Socio economic profile of silkworm rearers

The socio-economic profile of sericulture rearers is discussed below:

Age: The average age of silkworm rearers in Reasi district was 48.56 years followed by Poonch (47.76 years) and in Rajouri district (45.93 years) respectively. The overall age in all the three districts was 46.58 (±11.42). Majority of respondents 52.92 per cent belong to middle group (40-56 years) followed by 25.09 per cent (21-40 years) group. The range was between 21 and 80 years (Table 1).

Education: The majority of the respondents 41.18 per cent from Rajouri district were middle pass, followed by 24.12 per cent who were illiterate and 18.23 per cent were respondents primary pass, 10.59 per cent respondents were matric and only 5.88 per cent respondents were having 10+2 qualification. In case of Poonch district 41.67 per cent respondents were having middle, 20.44 per cent respondents were having primary, 11.11 per cent respondents were having matric and only 2.77 per cent respondents were having 10+2 qualification. However 25.00 per cent of respondent were illiterate. The data further reveals that 35.29 per cent respondents were having primary, 32.36 per cent middle and 2.94 per cent were having matric and 10+2 qualification in Reasi district. However one fourth of the respondents in Reasi district were illiterate (Table 1).

The overall percentage of the education of respondents in three districts was 40.00 per cent middle, 22.91 per cent primary, 9.58 per cent matric and only 3.33 per cent were 10+2. Whereas one fourth of the respondents were illiterate. The average formal education in years was highest in Rajouri 5.83 (±3.68) followed by 5.75(±3.74) in Reasi and lowest was in Poonch 5.03 (±3.43). The average overall formal education in years was 5.70 (±3.65).

Size of family

The average family size in Reasi was 6.12 members followed by Pooch 5.92 members and 4.94 members was in Rajouri . The overall average size of family was 5.28 (±1.52) members. In Pooch district 69.45 per cent respondents were having 5-7 members, followed by 64.71 percent in Reasi and 52.36 per cent in Rajouri . The overall average percentage was 56.67 having 5-7 family members followed by 30.00 percent respondents having 1-5 members and only 13.33 percent respondents had the family size of 7-13 members (Table 1).

Occupation

The main occupation of the respondents were identified into four groups namely farming and sericulture, farming sericulture and labour, farming sericulture and service, farming sericulture and business. It is clear from the table that 45.00 per cent respondents were solely depending on agriculture and sericulture for their livelihood. 37.08 per cent respondents were depend on labour followed by 11.67 per cent respondents who were having service as their main occupation and only meager percentage of 6.25 respondents were involved in agriculture, sericulture and business (Table 1).

Table 1: Socio-economic profile of silkworm rearers

Particulars	Districts			Overall
	Rajouri (n=170)	Poonch (n=36)	Reasi (n=34)	Percentage (n=240)
Age (% farmers)				
(21-40) years	31.76	16.67	23.53	25.09
(40-56) years	51.18	58.33	55.88	52.92
(56-81) years	17.06	25.00	20.59	18.75
Average age (years)	45.93±	47.76±	48.56±	46.58±
S.D	11.44	11.73	11.07	11.42
Std. Error	0.88	1.84	2.01	0.74
Education (% farmers)				
Illiterate	24.12	25.000	26.47	24.58
Primary	18.23	20.44	35.29	22.91
Middle	41.18	41.67	32.36	40.00
Matric	10.59	11.11	02.94	09.58
10+2	05.88	2.77	02.94	03.33

Average education (formal no. of schooling years completed)	5.83±	5.03±	5.75±	5.70±
S.D.	3.68	3.43	3.74	3.65
Std. Error	0.28	0.62	0.59	0.24
Size of family (% farmers)				
1-5 Members	38.82	08.33	08.82	30.00
5-7 Members	52.36	69.45	64.71	56.67
7-13 Members	08.82	22.22	26.47	13.33
Average family size (No.)	4.98	05.92	06.12	5.28
S.D	±1.23	±1.61	±2.16	±1.52
Std. Error	0.09	0.27	0.37	0.1
Occupation (% farmers)				
Agriculture+SericultureAgri	40.59	61.11	50.00	45.00
+Sericulture+labour	40.00	25.00	33.34	37.08
Agri+Sericulture+Service	13.53	08.33	05.89	11.67
Agri+Sericulture+Business	05.89	05.56	08.82	06.25
Average land holding (% farmers)		0.59	0.00	0.00
0.42				
Land less silkworm rearers	67.05	91.67	52.94	68.33
<1ha(marginal)	25.88	08.33	32.35	26.67
1-2ha(small)	06.47	00.00	14.71	4.58
2-4ha (semi-medium)				
Average operational land holding (ha)	0.84	0.50	1.10	0.83
S.D Std. Error	±67.05	±.77.03	±.20.13	±0.65.04
Net annual income (% farmers)				
Rs.15000-70233	52.35	86.11	73.53	60.41
Rs.70233-149615	37.65	08.33	26.47	31.67
Rs.149615-365000	10.00	05.56	00.00	07.92
Average annual income (Rs.)	83309	48748	51698	73647
S.D	±55591	±45428	±23868	±52862
Std. Error	8.33	4.87	6.17	7.36
Number of mulberry trees (% farmers)	82.35	91.67	82.36	83.33
0-162 trees	10.59	08.33	08.82	10.42
162-291 trees	07.06	00.00	08.82	06.25
291-750 trees				
Average trees owned (No.)	89	55	92	85
S.D	±122.70	±56.94	±96.08	±112.03
Std. Error	9.41	9.49	16.48	7.23
Experience in sericulture (% farmers)	40.59	55.55	41.18	42.92
1-17 Years	45.30	38.89	50.00	45.00
17-32 Years	14.11	5.55	8.82	12.08
32-65 Years				
Average experience (years)	20.72	20.80	17.11	20.19
S.D	±10.39	±10.65	±11.06	±10.56
Std. Error	0.80	1.84	1.83	0.68
Average distance from nearest sericulture market (km)	10.95	20.42	32.91	15.48
S.D	±4.03	±15.28	±6.78	±10.65
Std. Error	0.31	2.55	1.16	0.69
Average distance from home to sericulture office (kms)	4.13	4.36	2.06	3.87
S.D	±3.67	±4.46	±4.11	±3.92
Std. Error	0.28	0.74	0.70	0.25
Mass Media (% farmers)				
i. Low (2-6)	20.00	30.55	23.53	22.08
ii. Medium (6-8)	58.82	52.78	47.06	56.25
iii. High (8-12)	21.18	16.67	29.41	21.67
Mean	7.42	7.52	7.47	7.44
S.D	±1.47	±1.67	±1.66	±1.52
Std. Error	0.11	0.29	0.28	0.09
Extension Contact (% farmers)				
i. Low (2- 5)	19.41	27.78	11.76	19.58
Medium (5 to 7)	42.35	47.22	52.94	44.58
ii. High (7-10)	38.34	25.00	35.30	35.84
Mean	6.47	6.16	6.55	6.44
S.D	±1.93	±1.96	±1.82	±1.91
Std. Error	0.15	0.33	0.31	0.12
Training attended (% farmers)				
i. Yes	5.89	8.33	8.82	6.67
ii. No	94.11	91.67	91.18	93.33

Landholding: Out of 240 sampled silkworm rearers, 68.33 per cent respondents were having marginal land holding followed by 26.67 per cent respondents having small land holding and only 4.58 per cent respondents were having semi medium land holding. Further analysis of the data shows that the overall average operational land holding was 0.83 hectare. The district wise average land holding in Reasi was highest 1.10 hectare followed by Rajouri 0.84 hectare and lowest in Poonch 0.50 hectare which is less than the state average 0.67 hectare.However 0.42 per cent of the respondents were landless.

Annual Income: The majority of respondents 60.41 per cent were having annual income below Rs70233, followed by 31.67 percent respondents who were having their annual income ranges from Rs70233 to Rs 149615 and only 7.92 percent respondents were having their annual income ranges between Rs149615 to Rs365000. The average annual income was highest in Rajouri district (Rs.83309) followed by Reasi (Rs.51698) and lowest in Poonch was (Rs.48748). The average overall annual income of three districts was Rs73647 (Table 1).

Number of mulberry trees owned: The majority of respondents (83.33%) were owning trees between 0-162 trees owned followed by 10.42 per cent respondents who were having trees owned between 162 to 291 and 6.25 percent respondents were having tree range between 291 to 750. The average number of trees owned was highest in Reasi district with 92 followed by 89 trees in Rajouri district and 55 trees in Poonch district respectively. The average overall trees in three districts were 85 (Table 1).

Experience in sericulture: More than half (55.00 %) of respondents were having experience of 17-32 years, followed by 42.92 per cent respondents who were having experience between 1- 17 years and only 12.08 per cent respondents were having experience of 32- 65 years. The minimum experience was 1 year and maximum was 60 years. The average sericulture experience in Poonch was (20.80 years) followed by Rajouri (20.72 years) and 17.11 years was in Reasi. The overall mean experience of three districts was 20.19 years (Table 1).

Distance from home to sericulture market: The average distance from home to nearest sericulture market was highest in Reasi district 32.91 kilometers, followed by 20.42 kilometers in Poonch district and 10.95 kilometers in Rajouri district respectively. The overall mean distance of three districts was 15.48 kilometers (Table 1).

Distance from home to sericulture office: The average distance from home to nearest sericulture office was highest in Poonch district (4.36 kilometers) followed by 4.13kilometer was in Rajouri district and 2.06 kilometers in Reasi district. The overall mean distance of three districts was 3.87 kilometers (Table 1).

Mass media exposure: The data regarding mass media

exposure was measured on three point continuum and the findings revealed that 56.25 per cent respondents had medium level of mass media exposure followed by 22.08 percent who had low level of mass media exposure. Only 21.67 per cent respondents had high level of mass media exposure (Table 1).

Extension Contact: The Table 1 indicates that overall 44.58 per cent respondents had medium level of extension contact followed by 35.84 per cent respondents had high level of extension contact and 19.58 per cent respondents had low level of extension contact.

Type of rearing house: It is revealed from Table 2 that 33.12 per cent respondents had dwelling house for rearing the silkworms followed by 29.17 per cent respondents who were having separate rearing shed, 25.00 per cent respondents were having separate room in the dwelling house and 12.50 per cent respondents were using cattle shed as rearing house with highest in Poonch district (22.22%).

Table 2: Type of rearing house possessed by the silkworm rearers

Type of Rearing House	District wise percentage of respondents			Overall Percentage (n=240)
	Rajouri (n=170)	Poonch (n=36)	Reasi (n=34)	
Dwelling house	34.41	25.00	35.29	33.12
Separate room in the dwelling house	22.94	33.33	26.47	25.00
Separate rearing shed	30.00	19.44	35.30	29.17
Cattle shed	12.35	22.22	2.94	12.50

The data in the Table 3 reveals that 88.89 per cent respondents were having rearing trays in Poonch district followed by 73.53 per cent in Reasi and Rajouri (57.06 %). The overall percentage of the respondents who had possessed rearing trays were 64.17% per cent. The data further revealed that overall 60.00 per cent respondents had rearing stands, chopping board and chopping knives. The data further indicates that 58.82 per cent respondents were having dry and wet thermometer followed by (35.88%) followed by Rajouri and Poonch (33.33%). The overall 38.74 per cent respondents had dry and wet thermometers. The overall average 43.33 per cent respondents had mount ages, 46.66 per cent respondents had bed cleaning nets, 45.00 per cent respondents had crates and 50.83 per cent respondents had sighries.

CONCLUSION

It can be concluded that majority of respondents belong to middle age, were low educated and even illiterate and were having 5-7 members in family, about half of the respondents mainly dependent on sericulture and agriculture. The average land holding was 0.83 ha and majority of them were marginal farmers. The average annual income was Rs.73647 and the average experience in sericulture was 20.19 years and having 85 average trees owned by silkworm rearers. The average distance from home to sericulture office and

Table 3. Rearing equipments possessed by silkworm rearers

Rearing Equipment	District wise percentage of respondents			Overall Percentage
	Rajouri (n=170)	Poonch (n=36)	Reasi (n=34)	(n=240)
Rearing Stands	52.30	88.89	73.53	60.80
Rearing Trays	57.06	88.89	73.53	64.17
Chopping Board	53.52	86.11	67.65	60.41
Chopping Knives	54.12	83.33	64.70	60.00
Bed Cleaning nets	38.24	69.44	64.70	46.66
Dry &Wet Thermometer	35.88	33.33	58.82	38.74
Mount ages	40.00	41.67	61.76	43.33
Crates	36.47	66.67	64.70	45.00
Sighries	42.94	72.22	67.65	50.83

cocoon auction market was 3.87 km and 15.48 km, respectively. Majority of farmers were exposed to television and radio and were having good extension contact with only the watcher of sericulture department. hadmedium extension contact and mass media exposure. Majority of respondents were not trained and seek information from family and friends. Separate rearing houses play an important role to maintain the hygiene, but, only one third of respondents were having it. More than half of the respondents had rearing trays, stands, chopping board and sighries

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Impact assessment of training on farmer's perception, performance and entrepreneurship development

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ABSTRACT

This research paper investigates the impact of a sponsored training programme by Agriculture Skill Council of India (ASCI) on Small Poultry Farmer of Kathua district of Jammu region. A training programme of 200 hours was conducted at the KVK Kathua. The impact of the training programme on the livestock farmers' capabilities and performance level in their farm practice was evaluated. A total of 20livestock farmers' participated in this study as participants. A multi-stage approach was used where data were primarily collected using personal face-to-face feedback before and after the training programme.This was then supported by semi-structured interviews with selected identified individuals on the basis of purposive sampling. Analysis of findings suggested that on a general account a positive trend has emerged from this study indicating the effectiveness of the training programs although with range of variations of benefits gained by the farmers.A majority of the respondents agreed that the program have been useful and had made them become better farmers.

Keywords:*Farming practices, Performance level, Skill training, Livestock farmers.*

INTRODUCTION

This paper represents the findings of training impact on farmerspractices and livelihood resulting from training courses conducted through KVK. These training programmes are aimed at building the competencies, skills and capabilities of farmers in order to improve their farm practices and productivity. Skill development training programmes are aimed at imparting skills to the youth and providing them the opportunities of entrepreneurship development and be productive, while improving their economic status. This study depicts the primary objective of the training programme to explore the impact of the training in changing farmer's livelihood and economic status.

Background of rural youth

The training programme in focus in this particular paper has been sponsored by Agriculture Skill Council of India under the Sub-component "*Small Poultry Farmer"* under the "*Prandhan Mantri Kaushal Vikas Yojana"* of the Ministry of the Skill Development and Entrepreneurship. The target youth for the training programme belongs to the lower strata of the society in terms of economic conditions. Few of them had the previous experience of poultry farming but due to the lack of scientific training for the poultry farming they were not able to make headway. The youth were selected from the different blocks of the Kathua district.Majority of them are small farmers and landless labourers. Since almost half of the population of the country still live in rural areas and majority are farmers, government efforts are to double their income by 2022. The emphasis of the present skill development programme is on self-reliance. This may lead to improvement in socio-economic indicators and also arrest the outmigration of younger generation to towns and cities. Moreover, it also encourages the youth to participate in the agriculture and agro-based industries.

Training Evaluation

Evaluation of the training programme has the importance of measuring the impact of training in order to determine the effectiveness of the training programmes. Some rationale to this measurement as highlighted by Bernthal, (1998) includes:-

- To justify the financial investment in the training and development programmes;
- To gather feedback for ongoing improvement as a programme is being delivered;
- To compare the effectiveness of two or more training programmes; and
- To meet requirements set by professional organizations or government regulations.

Training of Farmers

Training for farmers has been proven to yield variety of results. Murshed-E-Jahan and Pemsl (2011) on their study on Bangladeshi small farmers concluded that building the capacity of farmers through training is more valuable than the provision of financial support in terms of raising production and income. Similarly, a study by Tripp and Hiroshimil (2005) confirms the importance of training can contribute to enhancement of farmer's skills in farming works. Studies on the effectiveness of training for farmers showed that not all programmers meet success as most failures of programmes in the developing countries were attributed to the tendency of excessively concentrating on a particular technology transfer rather than a broader

spectrum of farmer empowerment including knowledge disseminations (Oreszczyn, and Carr, 2010;Yang et al 2008). However, these gaps could be overcome by carefully revising and designing the training to address the needs. It was also reported that some success stories were related to using non-formal education and focusing on learning-discovery approach, and filling in the gaps in farmer's knowledge misconceptions.

METHODOLOGY

This research aims to investigate the benefit gained and level of knowledge, skills and ability (KSA) gained by farmers through training. Three objectives of this research are: to identify the level of productivity improvement after training, KSA transfer from training to workplace, and benefits and improvement to farmers. To undertake this research study, the researcher subscribes to a multi-stage approach where data were collected via a variety of methods. The main approach to data collection was the used of questionnaires. Three sets of questionnaires were distributed to the respondents namely, the pre-test, reaction and the post-test. The pre-test were given prior to the trainees prior to attending the courses. The reaction level questionnaires were distributed to the trainees immediately after completing the courses during the training session. In addition, the post-test questionnaires sent to the participants 3 to 6 months after completing the course.The second method deployed in this study was the used of semi-structured interviews. Interviews were conducted with the trainees. The third method was the home visits or the use of WhatsApp group. The final approach was the farm visit and observation. Here the researchers visited several selected farmers who were respondents themselves. The purpose of this visit was to gain first hand information and to observe the extent of knowledge and skills applied to the farm practice. Farms were visited and interviews and farm activities were video recorded by the researchers.

RESULTS AND DISCUSSION

According to Kirkaptrick (2006:22) behavior can be defined as the extent to which change in behavior has occurred as a result of training. This level of evaluation actually determines whether training has been applied to workplace setting. In other words, the third level assess to what extent participants are able to practice what they have learned. Many organizations failed to implement this third level evaluation because the transfer of training is not immediate. Trainees should be given a certain duration of time and in reality the transfer of training could only be determined after a lapse of 3 to 6 months. In the case of this study, the trainees were assessed after a period of 6 months.

Table 1: Composition of respondent's gender

S.No.	Gender	Number	% ages
1.	Male	19	95.0
2.	Female	01	5.0
3.	Total	20	100

Table 2: Breakdown of respondent's age composition

Age group	Numbers	Percentage
Below 25 years old	08	40.0
26-30 years old	06	30.0
31-35 years old	06	30.0

Table 3: Farmer's perception on productivity as a consequence of training

Statements	1	2	3	4	5
I increase my networking	0.0	0.0	5.3	60.0	34.7
The knowledge and skills acquired enable me to perform my job better	0.0	0.0	4.7	74.3	21.0
My job performance level has increased after training	0.0	0.0	6.7	68.0	25.3
I am more motivated towards my job now	1.5	2.0	8.0	55.0	33.5
I can complete my work faster	0.0	2.0	13.0	63.0	22.0

1=Strongly Disagree, 2=Disagree, 3=Unable to Judge, 4=Agree, 5=Strongly Agree

Table 4: Ability of farmers to transfer SKAs from training to workplace

Statements	1	2	3	4	5
The course content is relevant to my job	0.0	0.0	8.0	59.0	33.0
Almost everything learnt can be applied at work	0.0	2.0	6.0	66.0	26.0
It is not difficult to practically apply what has been learnt	1.5	12.0	15.0	60.0	11.5
I found that the skills and knowledge that can be applied is high	2.0	22.0	15.0	55.0	6.0
I feel that I can coach other farmers	0.0	20.0	30.0	35.0	15.0

1=Strongly Disagree, 2=Disagree, 3=Unable to Judge, 4=Agree, 5=Strongly Agree

Table 5: Farmer's perception on the extent of benefits, knowledge and skill gained from training

No.	Items	%age										Total
1.	% Benefit gained	10	20	30	40	50	60	70	80	90	100	%
2.	% of new skills/knowledge gained	0	1.5	4.5	4.0	18.0	6.5	26.5	25.0	10	4.0	100%
3.	% of new skills/ knowledge practiced	1.5	2.5	7.0	7.0	20	6.0	16.0	26.5	10.0	3.5	100%
4.	% of time savings for work completed faster and easier	3.5	4.5	6	8.5	32.0	7.5	18.5	15.5	4.0	0	100%

CONCLUSION

In conclusion, what surfaced from this analysis of findings suggested that generally the training intervention provided was seen as imperative and timely in that this study found that it has brought about positive impact to the farmers. Although immediate impact cannot be measured and quantified, evidence gathered implied that majority of these farmers could now be considered themselves as better farm managers. Results from this research study also revealed that training has been effective in enabling the farmers to develop their SKAs and transfer them to their farm fields. Not only that, the impact of training has also enabled the farmers to do their jobs much faster and easier and that they were highly motivated as well as satisfied with the possession of new SKAs. Hence, what appeared from the research showed that the impact of training on majority of the farmers has been positive and effective. Such consequence implied that the government's effort

to improve the farmers‘ performance and capability through the training intervention had been meaningful as this initiative had not only brought positive impact to the farmers themselves but, to a larger extent, had indirectly contributed to the economic development of the country.

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