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ASSESSMENT OF HAILSTORM IMPACT ON SELECTED REGIONS OF JALGAON DISTRICT

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Abstract
The vast literature shows the importance of climate on any country's agricultural progress and development. Agriculture can be impacted in various ways, through sudden changes in climatic conditions. This paper tries to analyze the impact on crop output due to recent hailstorm in Maharashtra. This paper visits other factors contributing to loss of revenue due to damage of crop through regression analysis. The primary sample data comprises of 172 household farmers from few talukas of Jalgaon district where a structured questionnaire was used. The linear regression method is followed for the analysis used by Basavaraja H. et al (2007) for estimating post harvest loss of food grains. The study indicated that in overall statistical analysis of data, non agriculture land and lack of availability of storage facility at household level, impact the household's revenue loss. None of the household farmers had availed the crop insurance to safeguard their interest from unexpected revenue loss, due to variations in climatic conditions. To reduce the impact on the revenue losses, there is need to increase warehousing/storage facility at village level, spread awareness on how and where to get the crop insurance, at the same time adopting new strategies to manage climate change to protect the long term interest of farmers.

Key Words: Climate Change, Crop Insurance, Loss of Revenue, Agriculture Land Ownership, Output.

1. Introduction

Agriculture occupies a pivotal role in a nation's development process. Agriculture contributes to around 14% of GDP of India, provides employment to 50 percent of the population (workforce) (Gulati Ashok et al, 2013) and provides food security to the masses.

Agriculture of any nation is often dependant on the vagaries of climatic conditions. Indian Agriculture faces various challenges of which some are controlled and some are uncontrolled. The controlled challenges include competing for resources by other sectors of the economy with respect to land, water, labour and capital. Any change in climatic conditions, directly impacts the price of agriculture commodities, which indirectly impacts the growth of economy. The uncontrolled factors like, change in climatic conditions directly impacts the agriculture productivity, resulting into a threat to the farmer's livelihood. The studies indicate that (Tol Richard; 2001, Kuramr Naresh et al, 2011; Khan Shakeel A. et al, 2009) agriculture is always vulnerable due to unexpected changes in climatic condition in terms of rising temperature, unseasonal rain fall, hail storms, hurricanes, river floods, rising sea level, etc. The effects of climate change will be greater on the people who are belonging to the socially and economically weaker sections of the society (Gupta Eshita et al, 2013) in general and farming community in particular.

The various studies have focused on how agriculture, especially farming is affected by climate change in various parts of world. Climate change impacts agriculture through, change in profitability in farming operations, prices of agriculture inputs and output, demand and supply of agriculture produce in domestic and international market. In agriculture, farming operations are always sensitive to changes in climatic condition over a very short period to long period. According to study conducted by Kang Yinhong et al (2009), the crop yield also gets affected due to change in climatic conditions and its effects are different for different regions. The global warming events impact temperature, atmospheric and soil moisture, ground water level and seasonal rainfall.

The study conducted by Khan Shakeel A et al, (2009) shows the climate conditions impact the growth and development of plant, so the farming operation involves "carbon dioxide concentration, temperature, radiation, precipitation and humidity". According to World Bank report (Dinar Ariel and Robert Mendelssohn, 1998), the Indian agriculture is sensitive to global warming,. The studies show that net revenues fall with warmer climatic condition. According to a study conducted by ICRISAT (Singh Naveen P et al 2012) the mean of yearly temperature has steadily raised by 0.02 degree Celsius from 1940 and expected to rise by 1.7 to 2 degree Celsius by 2030 and 3.4 to 4.4 degree Celsius by 2080 in Andhra Pradesh and Maharashtra. This increase could lead to 5 to 18% productivity loss from 2030 to 2080.

Guiteras Raymond (2009) district level study estimated crops yield reduces in between 4.5% to 9% (2010 - 2039) in medium term. The study also estimated the long run (2077- 2099) yield reduction more than 25%. These results indicate the climate change would impact 1% -1.8% of GDP on the Indian economy.

Tol Richard S. J. (2001) analysis of monetary effects of the climate change indicates need of cost benefit analysis to improve green house emission policies. It also concluded that the impact of climate change is good or bad, depends on the location of a particular country/region. The findings of the study show that, the greenhouse gas emission of the rich countries hurt the poor may fight for emission drop.

Such sudden events may lead into uneven drought and rainfall variability. Such unanticipated changes in weather conditions could hinder the farmers' interest and result in an economic loss.

1.1 Unseasonal Rainfall and Hail Storm

The impact of climate has been seen in recent unseasonal rain and hail storm in Jammu & Kashmir, UP, Punjab, and Haryana in northern, Rajasthan and Maharashtra in western part, MP in central and AP in southern parts of India. It has heavily affected and damaged standing agriculture crops. In Maharashtra 28 districts were affected due to hail storms.

Various studies have been conducted on the impact of climate change on Indian agriculture and vulnerability. But, there is a need to conduct a study to ascertain the revenue loss incurred by farmer due to short term climatic changes in the form of unseasonal rain and hail storm. The objectives of study are:

1. To assess the revenue loss of household farmers, due to recent hail storm.
2. To study the other factors affecting the household farmer's revenue loss.

2. Methodology

The present study has been done on Jalgaon district of Maharashtra. The Jalgaon district has hot summer and general dryness throughout the year excluding south west monsoon period (June to September). The district has rich black soil (deep & medium) in most parts and in some parts sandy and forest soil. The area under cultivation has been increased from 75.20% to 75.41% of total land under cultivation during 2011-12. The main source of water is wells covering 2391 thousand hectares of land and 84 thousand hectares from canals.

The study has been based on primary sample data collected from the households (farmers) through structured questionnaire. The data collected from households includes-

1. General information about family size, any alternative occupation in addition to farming.
2. Education level among the family members,
3. Family land handholding, agriculture land (irrigated and non-irrigated).
4. Sources of water, area under irrigation,
5. Crops taken in kharif and rabbi season sowing season,
6. Crops affected by recent unseasonal rain and hail storm in term of output and quality.
7. Awareness about crop insurance and having storage facility to protect the crops from unforeseen seasonal changes etc.,

The data of 172 households is tabulated and analysis has been done on different factors affecting the outputs, resulting into loss of revenues. Firstly, the households are segmented into various categories i.e.-

1. Farmers holding less than one hectare land are classified as marginal farmer household.
2. Farmers holding less than two hectare land but more than one hectare are classified as small farmer household.
3. Farmers holding less than four hectare land but more than two hectare are classified as semi medium farmer household.
4. Farmers holding less than ten hectare land but more than four hectare are classified as medium farmer household.
5. Farmers holding more than ten hectare land are classified as large farmer household.

The analysis of data had been done on the educational background of male and female members of household, land holding/ownership of different households, household users of modern farming equipments, different sources of water for farming, area having throughout the year irrigation and water sources. Analysis has also been done to understand, the impact of recent hailstorm on agriculture output, and other factors other than hailstorm on their revenue.

The statistical method of regression analysis has been used to check the other factors and their impact on the loss of revenue.

2.1 Sampling

The data has been collected from households of Amalner, Parola, Chopda, Dharangaon and Bhadgaon by personally meeting the head of the households. The data has been collected by visiting selected villages of Amalner and Parola taluka and for other taluka places, data collected from taluka places. There are 172 households surveyed and collected information.

2.2 Analytical Techniques

The data collected from households is with respect to

- Crop harvested and sold in the open market before the hailstorm.
- Expected and actual output from crops standing in farms before and after the hailstorm.
- Market prices prevailing before and after the hailstorm

The difference between expected total output and actual output sold in open market after the hailstorm is considered as loss of output due to hailstorm for individual household farmer. The average prices of crops after hail storm were used to calculate total revenue loss incurred by households.

The collected data has been entered in excel and used SPSS software for data analysis purpose. The analysis was carried out to examine the factors affecting revenue loss in addition to hail storm effect. For the calculation of revenue loss it is assume that all the household farmers will sell their output at same price.

The Revenue Loss due to hail storm is calculated as follows:

$$\boldsymbol{AVG\ Price\ of\ Crop\ (a) = \frac{1}{N}\left(\sum_{i=1}^{n} MPa_i\right)} \quad \textbf{(1)}$$

MP (a_i) = Market Price of Crop a of household (i)

Where a→ (1-----m)

N= Number of Household

$$\boldsymbol{RL(a) = Avg\ Price\ of\ Crop\ (a)\ X\ Qpl\ (a)} \quad \textbf{(2)}$$

$\boldsymbol{RL\ (a)}$ = Revenue Loss of Crop $\boldsymbol{(a)}$

$\boldsymbol{Qpl\ (a)}$ = Loss in Quantity of crop $\boldsymbol{(a)}$

$$\boldsymbol{TRL\ (i) = \sum_{a=1}^{m} RL_a} \quad \textbf{(3)}$$

Where, $\boldsymbol{TRL\ (i)}$ = Total Revenue Loss of Household $\boldsymbol{(i)}$

$\boldsymbol{RL_a}$ = Revenue Loss of Crop $\boldsymbol{(1 - - - - m)}$

The multiple regression analysis is used to examine the factors affecting the revenue loss at farm household level, as used by Basavaraja H. et al (2007) in economic analysis of post harvest losses in food grains.

The following multiple linear regression function is used in the present study:

$Y= a_0 + a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4 + a_5X_5 + a_6X_6 + a_7X_7 + a_8X_8 + a_9X_9 + a_{10}X_{10} + a_{11}X_{11} + a_{12}X_{12} + a_{13}X_{13} + a_{14}X_{14} + \text{------} + a_nX_n + e$ (4)

Where,

Y = Total Actual Revenue Loss (in Rupees)

X_1 = Level of Education among male member of household

X_2 = Present Total Land owned by household

X_3 = Present Non Agriculture Land (hectare) owned by household

X_4 = Present Agriculture Land (hectare) owned by household

X_5 = Irrigated Area hectare

X_6 = Non Irrigated Area hectare

X_7 = Sources of Water for Farming

X_8 = Irrigated (thought) Area hectare

X_9 = Drip Irrigation used which takes value '1' if yes and '2' otherwise

X_{10} = Tube Well Irrigation Area hectare

X_{11} = Storage Facility Available, which takes value '1' if facility available and '2' otherwise

X_{12} = Level of Education of female member of household

X_{13} = Agriculture related occupation in addition to farming

X_{14} = Equipment used for Farming

e = error terms

To check the relationship between dependent variable (Total Revenue Loss of household) with other independent variables following hypothesis are formed:

1) H_0 = Household farm revenue loss negatively related to Level of Education among male member of household
   H_1 = Household farm revenue loss not negatively related to Level of Education among male member of household.

2) H_0 = Household farm revenue loss positively related to ownership of land
   H_1 = Household farm revenue loss negatively related to ownership of land.
3) H_0 = Non Agriculture Land (hectare) owned by households positively related to Household farm revenue.
4) H_1 = Non Agriculture Land (hectare) owned by household negatively related to Household farm revenue.H_0 = Household farm revenue loss negatively related to level of education.
5) H_0 = Household farm revenue loss positively related to Agriculture (hectare) Land owned by household
   H_1 = Household farm revenue loss negatively related to Agriculture (hectare) Land owned by household.
6) H_0 = Household farm revenue loss negatively related to Irrigated Area hectare
   H_1 = Household farm revenue loss not negatively related to Irrigated Area hectare.
7) H_0 = Household farm revenue loss positively related to Non Irrigated Area hectare
   H_1 = Household farm revenue loss negatively related to Irrigated Area hectare.
8) H_0 = Household farm revenue loss negatively related to Sources of Water for Farming
   H_1 = Household farm revenue loss positively related to level of education.
9) H_0 = Household farm revenue loss negatively related to Irrigated (thought) Area hectare
   H_1 = Household farm revenue loss positively related to level of education.
10) H_0 = Household farm revenue loss negatively related to Drip Irrigation used
   H_1 = Household farm revenue loss positively related to Drip Irrigation used
11) H_0 = Household farm revenue loss negatively related to Area hectare under Drip Irrigation.
   H_1 = Household farm revenue loss negatively related to Area hectare under Drip Irrigation.
12) H_0 = Household farm revenue loss negatively related to Storage Facility Available
   H_1 = Household farm revenue loss positively related to Storage Facility Available.
13) H_0 = Household farm revenue loss positively related to Level of Education among female member of household
14) H_1 = Household farm revenue loss negatively related to Level of Education among female member of household
15) H_0 = Household farm revenue loss negatively related to Agriculture related occupation in addition to farming.
   H_1 = Household farm revenue loss positively related to Agriculture related occupation in addition to farming
16) H_0 = Household farm revenue loss negatively related to Equipment used for Farming
   H_1 = Household farm revenue loss positively related to Equipment used for Farming

3. Analysis & Interpretations

3.1 Estimation of Revenue Loss due to fall in production of various crops:

The recent hail storm and unseasonal rain fall hit the Indian agriculture throughout the country. The study found that (from table no- 1) out of the sample size of 172 households 12.79% are involved in farming related occupation in addition to farming. Majority of them are from Amalner, Chopda and Dharangaon taluka, 87.21% are directly involved in farming in the Jalgaon district.

Table No :1 Household Land Ownership

Taluka	<1 hectare	>= 1 & < 2 hectare	>= 2 & < 4 hectare	>= 4 & < 10 hectare	>=10 hectare	Grand Total
	Marginal Farmers	Small Farmers	Semi-Medium Farmers	Medium Farmers	Large Farmers	
Amalner	6.98%	13.95%	15.70%	15.70%	2.91%	55.23%
Bhadgaon	0.58%	2.33%	0.00%	1.16%	0.00%	4.07%
Chopda	0.00%	0.58%	1.74%	0.00%	0.00%	2.33%
Dharangaon	1.16%	3.49%	2.33%	1.74%	1.16%	9.88%
Erandol	1.74%	0.00%	0.58%	0.00%	0.00%	2.33%
Parola	5.81%	8.72%	5.81%	5.81%	0.00%	26.16%
Grand Total	16.28%	29.07%	26.16%	24.42%	4.07%	100.00%

From the study (table no- 4) found that out of the sample size of 172 household farmers, 16.28%, 29.07%, 26.17%, 24.42%, 4.07% household farmers are marginal farmers, small farmers, semi medium, medium and larger respectively. Majority of the household farmers are having land holding between 1-10 hectares.

3.2 Estimation of Loss

The estimation of revenue loss due to hailstorm and unseasonal rain fall across Jalgaon district of Maharashtra. The revenue loss is being estimated as per the equation given in equation----- (3). For the calculation of revenue loss, the market price (Vishandass Ashok et al, 2013) of crops is being used, as market price is a better indicator of the profitability in agriculture. The market prices (domestic and international) are the important input to estimate the MSPs (Gulati Ashok, et al 2013).

TABLE NO: 2 Category wise Revenue Loss (in Rs.)

Particular	Marginal Farmers	Small Farmer	Semi-Medium Farmer	Medium Farmer	Large Farmer	Gr. Total
No. of Farmers	28	50	45	42	7	172
Cotton	24077	51628	68286	122599	174477	441067
Sugarcane	0	0	2857	27	55836	58720
Wheat	6088	10583	16578	19483	33511	86243
Jawar	2173	0	2516	4953	0	9642
Maize	5590	7697	9834	18495	20177	61793
Oilseeds	0	404	0	8379	11558	20341
Onion	0	4842	0	5223	0	10065
Vegetable	3942	40269	3796	22217	0	70224
Pulses (Grams)	2646	1767	9056	4342	4478	22289
Banana	0	1464	0	5809	13942	21215
Lemon	0	0	0	1904	0	1904
Other Fruits	0	61600	0	0	160000	221600
Other Crops	0	0	93	0	0	93
Average Loss (Rs.)	44520	180257	113019	213134	473982	1024912
Average Loss/hectare (Rs.)	60293	117254	38316	41937	29511	287311

From the above (table no 2) indicates small farmers has incurred heavy losses on both, an average in revenue loss and revenue loss per hectare whereas least average loss is incurred by large farmers on both, average loss and per hectare revenue loss.

The study estimated revenue loss in cotton, sugarcane, wheat, jawar, maize, groundnuts, gram, vegetables and other horticulture products. The losses are also estimated as the quantity of produce and quality of crops were affected. Majority of the farmers have lost more than 50% crop output. Whatever they could retrieve from the fields has been sold at cheaper rate due to fall in prices of crops in the market or due to down gradation of crop quality. As a result, household farmers were not able to avail good prices for their produce.

3. 3 Other Factors Affecting Revenue Loss at Farm/Household Level

The Multiple regression analysis (SPSS software) is being carried out to check the influence of different socio-economic factors on post hail storm/unseasonal rainfall on farm/household revenue loss. The farmers are highly sensitive towards reducing yield rate and net income (Latha Asha K. et al, 2012). The variations in 14 independent variables are included in

the regression analysis (**Table No-3)** explaining 19% variations in the total revenue loss. The p-value was significant, showing good fit of the regression model.

The study found that the regression coefficients of education level of male members of household, non irrigated land owned by households, irrigation available throughout the year, drip irrigation and use of modern equipments are negatively correlated with the revenue loss of household, whereas other factors are found positively correlated, as shown in the model.

Table No- 3

Multiple Regression Significance Level Test Result									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
	Q. no > 1 (Selected)				R Square Change	F Change	df1	df2	Sig. F Change
1	.444[a]	0.197	0.125	270037.683	0.197	2.736			
Model		Sum of Squares	df	Mean Square	F	Sig.			
1	Regression	2.79E+12	14	2.00E+11					
	Residual	1.14E+13	156	7.29E+10					
	Total	1.42E+13	170						
Multiple Regression Results of Coefficients									
Independent Variables		Beta	Std. Error	Sig. (p value)					
a_0	(Constant)	-61351.5	225079	0.786					
X_1	Level of Education among male members	-1588.88	25347.8	0.95					
X_2	Total Land owned	6065.683	41663.5	0.884					
X_3	Non Agriculture Land	170414.7	70232.7	0.016					
X_4	Agriculture Land	7282.673	263681	0.978	2.736	.001[a]	14	156	0.001
X_5	Irrigated Area	4131.011	263707	0.988					
X_6	Non Irrigated Area	-5290.54	262337	0.984					
X_7	Sources of Water	27473.6	59506.5	0.645					
X_8	Irrigated (thought)	-3730.36	32075.4	0.908					
X_9	Drip Irrigation	-20370.2	85557.1	0.812					
X_{10}	Drip Irrigation Area	4826.308	38194.3	0.9					
X_{11}	Storage Facility Available	123965.1	53369.8	0.021					
X_{12}	Level of Education of female members	18481	17416.4	0.29					
X_{13}	Agriculture related occupation	24778.1	62814.2	0.694					
X_{14}	Equipment used for Farming	-20377.7	18744.8	0.279					

a. predictors: (constant), equipments, related occupation, non_irrig, education level_f, non_agri, stor_a_y/n, dip_irri, education level_m, ownership, water_source, irri_througout, dip_irri_area, agri, irrigated.

b. at level of significance p< 0.05

From the above table no-10, the model found hypothesis 3 & 11 significant, so H_0 of both hypothesis is accepted and H_1 of both the hypothesis is rejected. On the other hand, except these two hypothesis, other all hypothesis are insignificant so, H_0 are rejected and H_1 are accepted. 3) H_0 = Non Agriculture Land (hectare) owned by households positively related to household

farm revenue loss.

H_1 = Non Agriculture Land (hectare) owned by household negatively related to household farm revenue loss.

11)H_0 = Household farm revenue loss negatively related to Storage Facility Available

H_1 = Household farm revenue loss positively related to Storage Facility Available.

As expected higher the non agriculture land owned by household farmer, lower will be the loss of revenue whereas the availability of storage facility with the households will minimize the loss of crop and will help them to reduce the revenue loss.

To check more reliable result, we have done both variables with one way Anova analysis. The results are same as expected as both the variables were found statistically significant. The results are given below:

Table No: 4

One Way Anova Test Revenue Loss & Non Agriculture Land (A)					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	2.38E+12	11	2.17E+11	2.937	0.001
Within Groups	1.18E+13	160	7.37E+10		
Total	1.42E+13	171			
One Way Anova Test Revenue Loss & Availability of Storage Facility (B)					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	3.81E+11	1	3.81E+11	4.699	0.032
Within Groups	1.38E+13	170	8.11E+10		
Total	1.42E+13	171			

3.4 Taluk wise Analysis

The Both Multiple regression test has been done on individual taluka to check the impacts of independent factor on revenue loss in detail. The results show that (table no-5) both the talukas are statistically significant in regression.

Table No: 5

Multiple Regression Test Summary_Amalner

Model	R Q. no > 1 (Selected)	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics R Square Change	F Change	df1	df2	Sig. F Change
1	.812[a]	0.66	0.6	122818.817	0.66	11.09	14	80	0

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	2.34E+12	14	1.67E+11	11.09	.000[a]
	Residual	1.21E+12	80	1.51E+10		
	Total	3.55E+12	94			

Coefficients[a,b]

Independent Coefficients[a,b]	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	95.0% Confidence Interval for B	
	Beta	Std. Error	Beta			Lower Bound	Upper Bound

a_0	(Constant)	26022.777	166971.867		0.156	0.877	-306261.829	358307.4
X_1	Occupation	-9119.068	21936.285	-0.034	-0.416	0.679	-52773.666	34535.53
X_2	Agriculture related occupation	-13491.284	35671.533	-0.027	-0.378	0.706	-84479.897	57497.33
X_3	Level of Education among male members	11627.596	17647.764	0.048	0.659	0.512	-23492.574	46747.77
X_4	Level of Education of female members	15754.635	10004.212	0.109	1.575	0.119	-4154.382	35663.65
X_5	Total Land owned	16036.452	27733.113	0.092	0.578	0.565	-39154.201	71227.11
X_6	**Non Agriculture Land**	**175976.225**	**37264.551**	**0.533**	**4.722**	**0**	101817.406	250135
X_7	Agriculture Land	15981.57	10608.863	0.294	1.506	0.136	-5130.741	37093.88
X_8	Non Irrigated Area	-16381.912	13876.821	-0.104	-1.181	0.241	-43997.665	11233.84
X_9	Sources of Water	49960.909	32400.818	0.148	1.542	0.127	-14518.774	114440.6
X_{10}	Irrigated (thought)	-19844.504	17745.403	-0.134	-1.118	0.267	-55158.981	15469.97
X_{11}	Drip Irrigation	-30693.843	58953.336	-0.069	-0.521	0.604	-148014.721	86627.04
X_{12}	Drip Irrigation Area	-13940.034	27131.184	-0.1	-0.514	0.609	-67932.811	40052.74
X_{13}	Equipment used for Farming	732.941	12446.681	0.004	0.059	0.953	-24036.743	25502.63
X_{14}	Storage Facility Available	34324.644	31679.967	0.077	1.083	0.282	-28720.5	97369.79

At Level of significance P< 0.05
The statistical analysis shows that non agriculture factor is found significant, other 13 factors are found insignificant on the revenue loss of the household in Amalner taluka.

Table No- 6

Multiple Regression Test Summary_Parola

Model	R Q. no > 1 (Selected)	R Square	Adjusted R Square	Std. Error of the Estimate		
1	.800[a]	0.64	0.484	83177.722		
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.69E+11	13	2.84E+10	4.098	.001[a]
	Residual	2.08E+11	30	6.92E+09		

	Total	5.76E+11	43					
Coefficients[a,b]								
Independent Coefficients[a,b]		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
a_0	(Constant)	54415.541	142806.246		0.381	0.706	-237233.721	346064.8
X_1	Occupation	36975.365	18371.459	0.313	2.013	0.053	-544.16	74494.89
X_2	Level of Education among male members	29023.598	18762.451	0.273	1.547	0.132	-9294.439	67341.64
X_3	Level of Education of female members	-4404.566	15104.309	-0.047	-0.292	0.773	-35251.68	26442.55
X_4	Total Land owned	48025.734	31398.955	0.451	1.53	0.137	-16099.487	112151
X_5	**Non Agriculture Land**	**-361575.5**	**175064.857**	**-0.293**	**-2.065**	**0.048**	**-719105.636**	**-4045.36**
X_6	Agriculture Land	76104.493	89712.597	1.274	0.848	0.403	-107113.073	259322.1
X_7	Irrigated Area	-50206.337	92839.19	-0.704	-0.541	0.593	-239809.257	139396.6
X_8	Non Irrigated Area	-49356.066	89409.606	-0.443	-0.552	0.585	-231954.84	133242.7
X_9	Sources of Water	-54939.016	60729.362	-0.165	-0.905	0.373	-178964.921	69086.89
X_{10}	Irrigated (thought)	37067.923	31850.991	0.354	1.164	0.254	-27980.478	102116.3
X_{11}	**Drip Irrigation**	**-138235.174**	**60471.592**	**-0.563**	**-2.286**	**0.029**	**-261734.64**	**-14735.7**
X_{12}	**Drip Irrigation Area**	**-53694.53**	**24786.008**	**-0.613**	**-2.166**	**0.038**	**-104314.311**	**-3074.75**
X_{13}	Equipment used for Farming	-793.362	13371.691	-0.007	-0.059	0.953	-28101.999	26515.28

At Level of significance P< 0.05

Table no 6 indicates that the regression model in case of Parola taluka found statically significant in three factors (non agriculture land, drip irrigation and area under drip irrigation). The detail analysis found that non agriculture land, drip irrigation and area under the drip irrigation are found statistically significant and others are insignificant.

4. Conclusion

In the present study, the impact of hail storm and unseasonal rainfall on the crops is significant. The study indicated that there is need to bring larger area under drip irrigation and improve the irrigation in Parola. Whereas in Amalner it is found that, there is need to improve non agriculture land productivity by increasing the area under crop cultivation. The uses and area under drip irrigation has to be improved to curtail the revenue loss of households.

The study has emphasized on the improvement in storage facility in rural area. The improvement in storage facilities would reduce the wastage of ready crop. It also safe guards the crops from natural calamities i.e. unseasonal rainfall, increase in temperature and hail storm. The revenue loss in agriculture is mostly dependent on the how farmers are adopting climate change mitigating strategies in future (Tol Richard 2001; Latha Asha K. et al, 2012). The strategies could be a change in

variety of seeds, use of high inputs (Kumar Naresh S et al, 2011), use water conservative equipments etc., could help the farmers to mitigate the adverse climate change effects on the revenue. In addition to on field measures, revenue from agriculture could be improved through use of storage facility. It could reduce the crop loss due to inadequate storage facility (Basavaraja H. et al, 2007). The penetration of crop insurance amongst the households is important to safeguard their interest from uneven fluctuations in climate. There is urgent need to increase the crop insurance awareness and penetration, so that more and more household farmers could avail of the same.

So its concludes that, the increase of warehousing/storage facility at village level and increase in the crop insurance coverage to hedge against unexpected weather events would reduce the short term revenue losses, at the same time adopt new strategies to manage the climate change so as to safe guard the long term interest of farming community.

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