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SOCIO-ECONOMIC IMPACTS OF CLIMATE RESILIENT TECHNOLOGIES TO MARGINAL AND SMALL HOLDER OF RAIN-FED HAMIRPUR DISTRICT IN HIMACHAL PRADESH, INDIA

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Abstract

Marginal and Smallholder farming dominates the agricultural land-scape of India. More than 80 percent in India are marginal and smallholders having less than two ha farm size. Therefore, marginal and smallholder farmers constitute a key group requiring attention in agriculture to increase their productivity and income for reducing hunger and poverty in India. On the basis of socio-economic impact of climatic resilient Natural Resource Management (NRM) technologies, research is to be designed to achieve it by primary and secondary data. Here in the study primary data was collected from structural questionnaire which has been framed with the help of expert suggestions, existing literature and concerned thesis on this topic. Mostly, questionnaire was framed on Likert-Scale, which has 5-point satisfaction level. Potential for adoption of climate resilient agro-technologies have been assessed on point scales for variables. This data have been collected through interview, observation, pilot survey and questionnaire. The data was analyzed using descriptive statistics (Percentage, Correlation, Mean, Standard Deviation, Chi-square test and F-test). The major themes under Climatic resilient Natural Resource Management (NRM) identified were renovate defunct rain water harvesting structures (Jalkund or community based pond) as well as establishment of Poly-lined Tanks (10×6×1.5) m^3 and RCC tanks (3×3×3) m^3. However, after construction of rain water harvesting structures, the farmers use harvested rain water for irrigation by drip/sprinkles and ridges and furrows technologies in their vegetable crops. Hence, there is an increase in irrigated area as well as improving soil health and production of crops of two blocks in Hamirpur district. Thus, there is an uplift-ment of socio-economic status of smart farmers rather than non smart farmers of Nadaun and Bhoranj blocks of rain-fed Hamirpur district in Himachal Pradesh.

Key words: Climate Resilient technologies, Hamirpur, Natural Resource Management, Rain-fed, Smallholder, Socio-economic.

Introduction

Agriculture sector is considered as the most important in ancient history (Kavi-Kumar and Parikh, 1998). The basic function of agriculture hitherto remains to ensure access to adequate and quality food, apropos the cross-section of people on time scale, giving them an active and healthy life (Kavi-Kumar and Parikh, 2001). Food and nutritional security, on the other hand, is interwoven with numerous factors including increased production with sustained natural resources, protected and stable environment and even international table (Kilcher *et al*., 2004). The main reason for shifting the development paradigm since 1980s pivots to the enhanced concern for future generations to meet their basic needs. These concerns drew global attention and are termed as sustainable development, which intends to bring out planned changes to meet the needs of the present generation without compromising the future generation's requirements (Maria *et al*., 1986). With particular references to India and other developing countries, the revolution was instrumental in augmenting total as well as per unit production of field crops, insuring food security and raising rural farm incomes (Swaminathan, 2009). The country, however, still has a large population of poor and malnourished and the debate on poor continues even with consistently increasing price of commodity and its availability to common man (Lal, 2004). Marginal and Smallholder farming dominates the agricultural land-scape of India (World Bank, 2007). More than 80 percent in India are marginal and smallholders having less than two ha farm size (Maria *et al*., 1986). They contribute more than 50 percent of total agricultural output by cultivating 44 percent of agricultural land and support livelihood and food security of millions of people (Scialabba and Hattam,

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2002). Therefore, marginal and smallholder farmers constitute a key group requiring attention in agriculture to increase their productivity and income for reducing hunger and poverty in India (Mamu, 2009). Climate change is predicted to have severe implications on natural and social sectors and there are merits in both mitigation and adaptation strategies to address it (Liaw *et al*., 2004). The resilience approach has been proposed to prioritize the vulnerable areas for focused adaptation efforts around the world (Simpson and Burpee, 2014). However, resilience also proves difficult to measure, a characteristics which limits its utility in the implementation of adaptation programming (Tiessen and Cuevas, 1994). To address this challenge, the present article offers a novel framework for measuring the resilience of local livelihoods (IFAD, 2005). The use of resilience in the current context has gained momentum in the climate change debate although it has been in existence since 1973. Over-exploitation of fossil fuels, deforestation and less eco-friendly technologies have led to rapid accumulation of greenhouse gases (GHGs) in the atmosphere. CO_2 concentration has increased from a pre-industrial value of about 280-400 ppm in 2014 (Saikia, 2005). Similarly, the global atmospheric concentration of methane and nitrous oxides and other important GHGs has also increased considerably (Prinz and Singh, 2000). These are projected to cause an increase in temperature up to 4.8ºC by the end of the century. Further, the IPCC AR5 report on climate change has projected an increase in the frequency of droughts, floods and extreme events of temperature and rainfall (IPCC, 2007). Since climate is the most influencing factor for monsoon dependent Indian agriculture (Jamali, 2009), climate related aberrations have been significantly affecting the productivity in India (FAO, 2001). Abnormal monsoon have been affecting the productivity of *Kharif* season crops. Hamirpur district of Himachal Pradesh is a climate prone district making agriculture more vulnerable. The main cropping pattern of Hamirpur includes Maize/Paddy, Wheat/Gram and a few seasonal vegetables (Devendra and Chittedi, 2010). The region has a lot of livestock such as buffalo, cow and goat. Most families are dependent on agriculture for livelihood. In the current study, climate resilient natural resource management (NRM) practices include renovation of community ponds and damaged drinking water bodies, establishment of rainwater harvesting structures *viz*; Poly-lined tank and RCC tank technologies (IFAD, 2005). All these were target to enhance the crop and livelihood status of marginal and smallholders resilience to climate stresses (Scialabba and

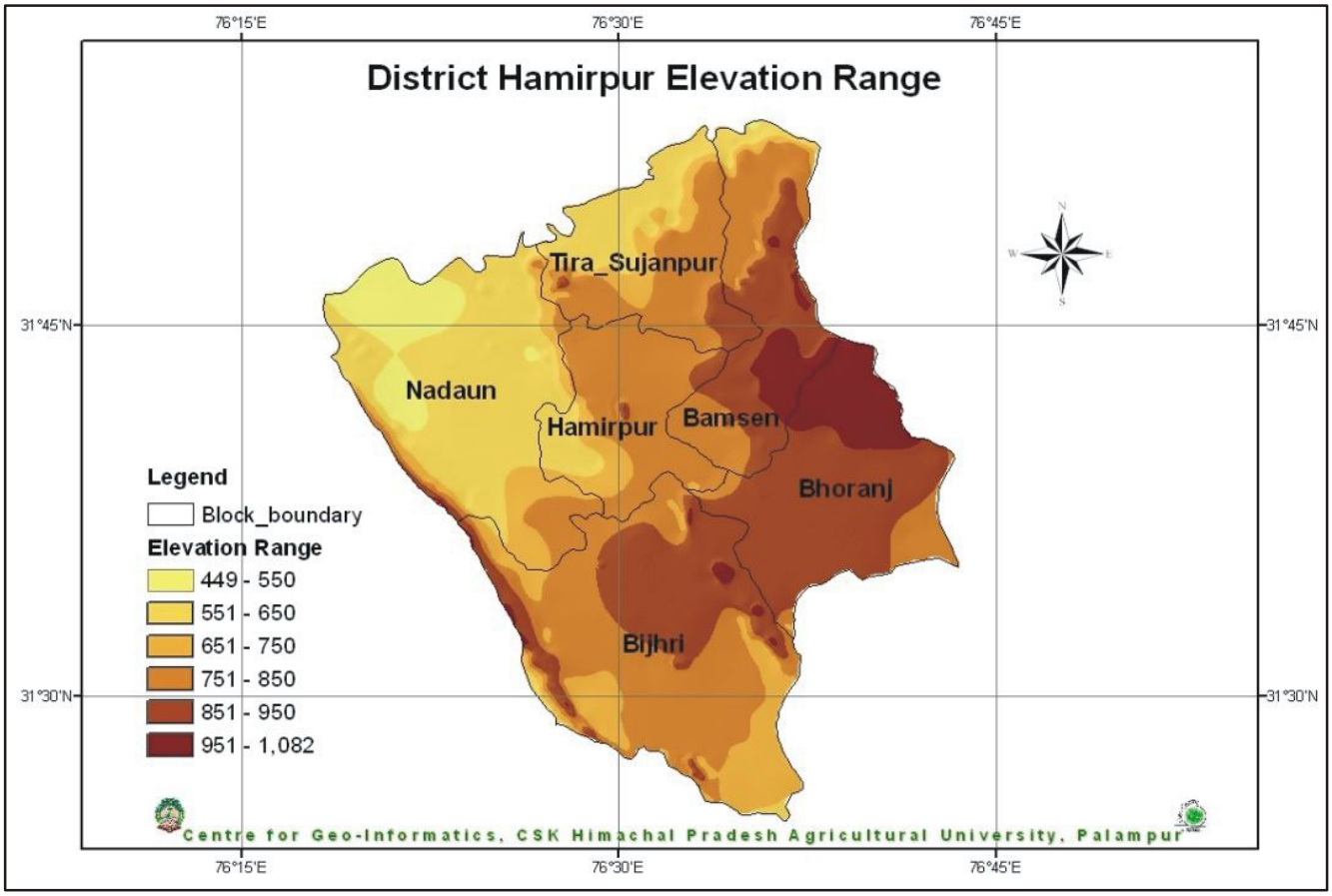

Fig. 1: Map of Study Area. (Source: *www. centreforgeoinformatics.cskhpkvpalampur.in.*)

Hattam, 2002).. In this study, we present the analysis based on questions.

Materials and methods

Study Area

The comprehensive study has been conducted in the Nadaun and Bhoranj blocks of rain-fed Hamirpur district, Himachal Pradesh and is based on the primary and secondary data. To select the sample households, random sampling procedure was followed. To begin with, 10 villages, namely Mann, Lag-Manwin, Ludder, Jahu, Badeher, Tareti, Jangloo, Ghumaharatsa Tal and kutheraha were selected to represent different micro agro-climatic niches (Fig. 1). A sample of households was selected randomly from these villages through proportional allocation method. On the basis of socio-economic impact of climatic resilient Natural Resource Management (NRM) technologies, research is to be designed to achieve it by primary and secondary data (Centre for Science and Environment, 2003).

Mostly, questionnaire was framed on Likert-Scale, which has 5-point satisfaction level. Potential for adoption of climate resilient technologies have been assessed on point scales for variables. This data have been collected through interview, observation, pilot survey and questionnaire. Earlier to construction of rain water harvesting structures, farmers were reluctant to opt for vegetable cultivation in rainfed situation (Janvry and Sadoulet, 2002). They also faced a big challenge to cope with vulnerability of natural resource management (NRM) especially irrigation and soil health problems during critical period of growth. The major themes under Climatic resilient Natural Resource Management (NRM) identified were renovate defunct rain water harvesting structures (Jalkund or community based pond) as well as establishment of Poly-lined Tanks (10×6×1.5) m^3 and RCC tanks (3×3×3) m^3. The whole questionnaire was divided into independent variables *viz*; block, sex, caste, level of education, family size, land holding particulars, source of irrigation, average annual income and livestock rearing. Secondary data has been collected by other agencies and further used for the research purpose. The data was analyzed using descriptive statistics (Percentage, Correlation, Mean, Standard Deviation, Chi-square test and F-test) (Prinz and Singh, 2000).

Results

Socio-economic adaptation of Climate Resilient NRM Practices: Renovate defunct rain water harvesting structures (Jalkund or community based pond) as well as establishment of Poly-lined Tanks (10×6×1.5) m^3 and RCC tanks (3×3×3) m^3 which were beneficiaries to enhance crop yield and fish farming as well as traditional water bodies (Babri, Khatri) which provide hygienic water for drinking and domestic uses. Under rain-fed conditions of Hamirpur, small scale rain water harvesting structures were constructed at individual farmer level (Table 1). These structures enabled reuse of harvested rain water during critical period of vegetable crop growth stage by ridges and furrows method of irrigation or for providing pre-sowing and life saving irrigation to *Rabi* crops. These structures had an impact on increase in irrigated area resulting in crop diversification and increase in crop production (Fig. 2&3).

Data collection and analyses

Sampling: The present study was conducted in the agro-ecosystem of Hamirpur district of Himachal Pradesh. Two extreme block-Nadaun and Bhoranj were selected purposively from Hamirpur district. Twenty, twenty five and forty five farmers from different village in Nadaun and Bhoranj were selected randomly. Thus, total 300 farmers were interviewed in the present study.

Fig. 2: Polylined tank Rain Water Harvesting Technique.

Fig. 3: RCC Tank/Roof Rain Water Harvesting Technique.

Table 1: Details of the Polylined tank in rain fed area of Nadaun and Bhoranj blocks of district Hamirpur (Source: Prinz and Singh, 2000).

Size of each tank		Capacity (liters)		Number of bricks used in each tank	Cost (Rs)	Ownership
Top (mxm)	Bottom (mxm)	Depth (mxm)				
13 × 9 approx.	10 × 6 approx.	1.5 approx.	70000 approx.	4800 approx.	48000 approx.	Managed by group of beneficiary farmers of adjoining farm lands.
3×3	3×3	3	9000	1800	18000	Individual

Beside farmers, experts from CSKHPKV, Palampur; Career Point University, Hamirpur (H.P.) and KVK Subject matter specialists Hamirpur (H.P.) were also interviewed to enrich our primary observations. Beside this, 60 farmers were interviewed for the pilot study. Further, out of 300 respondents 170 respondents are from Nadaun block and 130 respondents are from Bhoranj block to meet the requirement of present study.

Table 2 depicts that out of 168 farmers, 50.6 percent farmers have been strongly agree opinion followed by 48.8 percent farmers agreed opinion about renovation of defunct Jalkund (community based ponds) and polylined rain water harvesting structures to enhance crop yields and fish farming in Nadaun block.

Whereas out of 132 in Bhoranj block, 77.3 percent farmers have neutral opinion followed by 11.4 percent have disagreed opinion, 9.1 percent have strongly disagreed opinion, 8 percent have strongly agreed, 1.5 percent have agreed opinion about renovation of defunct Jalkund (community based ponds) and polylined rain water harvesting structures to enhance crop yields and fish farming.

The awareness level of farmers about renovation of defunct Jalkund (community based ponds) and polylined rain water harvesting structures to enhance crop yields and fish farming is less in Bhoranj block as compared to Nadaun block.

However, the calculated value of correlation is -0.830 which shows negative relationship between Nadaun block and Bhoranj block.

Table 2 depicts out of 86 General Category farmers, 37.2 percent have neutral opinion followed by 31.4 percent have agreed opinion, 24.4 percent have strongly agreed opinion, 4.7 percent have disagreed opinion, 2.3 percent have strongly agreed opinion respectively. Out of 86 OBC Category farmers, 33.7 percent have strongly agreed opinion followed by 31.4 percent have neutral opinion, 25.6 percent have agreed opinion, 5.8 percent have strongly disagreed opinion, 3.5 percent have disagreed opinion respectively. Out of 124 Schedule Caste farmers, 35.5 percent have neutral opinion followed by 27.4 percent have agreed opinion, 26.6 percent have strongly agreed opinion, 6.5 percent have disagreed opinion, 4.0 percent have strongly disagreed opinion and out of 4 Schedule Tribe farmers, 75.0 percent have strongly agree opinion followed by 25.0 percent have agreed opinion respectively.

However, the calculated value of correlation is 0.006 which shows positive relationship between all types of caste and their perception about renovation of defunct Jalkund (community based ponds) and polylined rain water harvesting structures to enhance crop yields and fish farming respectively.

Table 2 depicts that out of 40 farmers (50,000-1,00,000 Rs), 82.5 percent have neutral opinion followed by 7.5 percent have strongly disagreed opinion, 5.0 percent have disagreed opinion, 2.5 percent have strongly agreed and agreed opinions each respectively. Out of 97 farmers (1,00,001-1,50,000 Rs), 56.7 percent have neutral opinion followed by 19.6 percent have agreed opinion, 9.3 percent have strongly agreed opinion, 8.2 percent have disagreed opinion, 6.2 percent have strongly disagreed opinion respectively. Out of 122 farmers (1,50,001-2,00,000 Rs), 42.6 percent have strongly agree opinion followed by 40.2 percent agreed opinion, 11.5 percent have neutral opinion, 4.1 percent have disagreed opinion, 1.6 percent have strongly disagreed opinion respectively. Out of 41 farmers (>2,00,000 Rs) respondents, 58.5 percent have strongly agree opinion followed by 36.6 percent have agreed opinion, 2.4 percent have neutral and strongly disagreed opinions each respectively.

However, the calculated value of correlation is 0.542 which shows positive relationship between annual income of progressive farmers and perception about renovation of defunct Jalkund (community based ponds) and polylined rain water harvesting structures to enhance crop yields and fish farming respectively.

It is found from the table 2 that out of 5 primary passed farmers, 80.0 percent have neutral opinion followed by 20.0 percent have disagreed opinion respectively. Out of 73 middle passed farmers, 56.2 percent have neutral opinion followed by 19.2 percent have strongly agreed opinion, 16.4 percent have agreed opinion, 6.8 percent have disagreed opinion, 1.4 percent have strongly

Table 2: Classification of respondents on the basis of different independent variables have their responses regarding renovation of defunct *Jalkund* (community based ponds) and polylined & RCC rain water harvesting structures to enhance crop yields and fish farming.

Predictor		SA	A	N	D	SD	Total	Correlations
Block	Nadaun	85(50.6%)	82(48.8%)	1(0.6%)	0(0.0%)	0 (0.0%)	168(100%)	-0.830
	Bhoranj	1(8%)	2(1.5%)	102(77.3%)	15(11.4%)	12(9.1%)	132(100%)	
	Total Respondents	86(50.6%)	84(28.0%)	103(34.3%)	15(5.0%)	12(9.1%)	300(100%)	
Caste	GC	21(24.4%)	27(31.4%)	32(37.2%)	4(4.7%)	2(2.3%)	86(100%)	0.006
	OBC	29(33.7%)	22(25.6%)	27(31.4%)	3(3.5%)	5(5.8%)	86(100%)	
	SC	33(26.6%)	34(27.4%)	44(35.5%)	8(6.5%)	5(4.0%)	124(100%)	
	ST	3(75.0%)	1(25.0%)	0(0.0%)	0(0.0%)	0(0.0%)	04(100%)	
	Total Respondents	86(28.7%)	84(28.0%)	103(34.3%)	15(5.0%)	12(4.0%)	300(100%)	
Average Annual Income (Rs)	50,000-1,00,000	1(2.5%)	1(2.5%)	33(82.5%)	2(5.0%)	3(7.5%)	40(100%)	0.542
	1,00,001-1,50,000	9(9.3%)	19(19.6%)	55(56.7%)	8(8.2%)	6(6.2%)	97(100%)	
	1,50,001-2,00,000	52(42.6%)	49(40.2%)	14(11.5%)	5(4.1%)	2(1.6%)	122(100%)	
	>2,00,000	24(58.5%)	15(36.6%)	1(2.4%)	0(0.0%)	1(2.4%)	41(100%)	
	Total Respondents	86(28.7%)	84(28.0%)	103(34.3%)	15(5.0%)	12(4.0%)	300(100%)	
Level of Education	Primary	0(0.0%)	0(0.0%)	4(80.0%)	1(20.0%)	0(0.0%)	5(100%)	0.176
	Middle	14(19.2%)	12(16.4%)	41(56.2%)	5(6.8%)	1(1.4%)	73(100%)	
	Matriculate	41(30.4%)	43(31.9%)	41(30.4%)	3(2.2%)	7(5.2%)	135(100%)	
	Graduate/Postgraduate	31(35.6%)	29(33.3%)	17(19.5%)	6(6.9%)	4(4.6%)	87(100%)	
	Total Respondents	86(28.7%)	84(28.0%)	103(34.3%)	15(5.0%)	12(4.0%)	300(100%)	
Source of Irrigation	Polylined Tank	12(48.0%)	13(52.0%)	0(0.0%)	0(0.0%)	0(0.0%)	25(100%)	-0.372
	RCC Tank	36(34.0%)	40(37.7%)	28(26.4%)	2(1.9%)	0(0.0%)	106(100%)	
	Bore well	5(55.6%)	3(33.3%)	1(11.1%)	0(0.0%)	0(0.0%)	9(100%)	
	None of these	33(20.6%)	28(17.5%)	74(46.3%)	13(8.1%)	12(7.5%)	160(100%)	
	Total Respondents	86(28.7%)	84(28.0%)	103(34.3%)	15(5.0%)	12(4.0%)	300(100%)	
Land holding Particulars (ha)	Marginal (0.1-1.0 ha)	65(30.5%)	57(26.8%)	73(34.0%)	8(3.8%)	10(4.7%)	213(100%)	-0.038
	Small (1.1-2.0 ha)	11(19.3%)	19(33.3%)	22(38.6%)	4(7.0%)	1(1.8%)	57(100%)	
	Medium (2.1-4.0 ha)	9(50.0%)	4(22.2%)	3(16.7%)	2(11.1%)	0(0.0%)	18(100%)	
	Large (>4.0 ha)	1(8.3%)	4(33.3%)	5(41.7%)	1(8.3%)	1(8.3%)	12(100%)	
	Total Respondents	86(28.7%)	84(28.0%)	103(34.3%)	15(5.0%)	12(4.0%)	300(100%)	

disagreed opinion respectively. Out of 135 matriculate passed farmers, 31.9 percent have agreed opinion followed by 30.4 percent have strongly agreed and neutral opinions each, 5.2 percent had strongly disagreed opinion, 2.2 percent have disagreed opinion also. Out of 87 Graduate/ Postgraduate passed farmers, 35.6 percent have strongly agreed opinion followed by 33.3 percent have agreed opinions, 19.5 percent have neutral opinion, 6.9 percent have disagreed opinion and 4.6 percent had strongly disagreed opinion respectively.

The percent of level of education revealed that the matriculate passed farmers have highly apprehension to renovation of defunct Jalkund (community based ponds) and polylined rain water harvesting structures to enhance crop yields and fish farming respectively.

However, the calculated value of correlation is 0.176 which shows positive relationship between level of education of farmers and their apprehension about renovation of defunct Jalkund (community based ponds) and polylined as well as RCC rain water harvesting structures to enhance crop yields and fish farming respectively.

It is found from the table 2 that regarding Source of Irrigation, out of 25 Polylined Tanks, 52.0 percent have agreed opinion followed by 48.0 percent have strongly agreed opinion respectively. Out of 106 RCC Tank, 37.7 percent have agreed opinion followed by 34.0 percent have strongly agreed opinion, 26.4 percent have neutral opinion, 1.9 percent have disagreed opinion respectively. Out of 9 Bore well, 55.6 percent have strongly agreed opinion followed by 33.3 percent have agreed, 11.1 percent had neutral opinion also. None of these source of irrigation (160 farmers), 46.3 percent have neutral opinion followed by 20.6 percent have strongly agreed opinions, 17.5 percent have agreed opinion, 8.1 percent have disagreed opinion and 7.5 percent had strongly disagreed opinion respectively.

The percent of level of education revealed that the

Table 3: Calculated results of Chi-square, Mean and Standard Deviation for renovation of defunct *Jalkund* (community based ponds) and polylined & RCC rain water harvesting structures to enhance crop yields and fish farming.

Predictor	MEAN	S.D.	Chi-Square
Block	1.4400	0.49722	284.046d.f.4
Caste	2.1533	0.85572	9.499d.f.12
Average Annual Income (Rs)	2.5467	0.88908	143.096d.f.12
Level of education	3.0133	0.77578	38.625d.f.12
Source of Irrigation	3.0133	1.10630	61.229d.f.12
Land holding Particulars (ha)	1.4300	0.77578	14.740d.f.12

matriculate passed farmers have highly apprehension to renovation of defunct Jalkund (community based ponds) and polylined rain water harvesting structures to enhance crop yields and fish farming respectively.

However, the calculated value of correlation is -0.372 which shows negative relationship between level of education of farmers and their apprehension about renovation of defunct Jalkund (community based ponds) and polylined rain water harvesting structures to enhance crop yields and fish farming respectively.

It is found from the table 2 that out of 213 Marginal farmers (0.1-1.0 ha), 34.3 percent have neutral opinion followed by 30.5 percent have strongly agreed opinion, 26.8 percent have agreed opinion, 4.7 percent have strongly disagreed opinion, 3.8 percent have disagreed opinion respectively as well as out of Small 57 farmers (1.1-2.0 ha), 38.6 percent have neutral opinion followed by 33.3 percent have agreed opinion and 19.3 percent have strongly agreed opinion, 7.0 percent have disagreed opinion, 1.8 percent have strongly disagreed opinion as well as out of 18 Medium farmers (2.1-4.0 ha), 50.0 percent have strongly agreed opinion, 22.2 percent have agreed opinion, 16.7 percent have neutral opinion, 11.1 percent have disagreed opinion and out of 12 Large farmers (>4.0 ha), 41.7 percent have neutral opinion followed by 33.3 percent have agreed opinion, 8.3 percent have strongly agreed, disagreed and strongly disagreed opinions respectively.

Therefore, the calculated value of Correlation is -0.038. It shows negative relationship between land holding particulars (ha) and number of year engaged and renovation of defunct Jalkund (community based ponds) and polylined rain water harvesting structures to enhance crop yields and fish farming.

Table 4: ANOVA.

Model	Sum of Squares	df	Mean Square	F	Significant
Regression	232.121	7	33.160	95.008	.000
Residual	101.916	292	0.349		
Total	334.037	299			

Block: On the basis of table 3, it is observed that the mean value is 1.4400 which shows higher side of mean score 3 on a five point continuum. The standard deviation is 0.49722, it is scattered more toward higher side.

Therefore, the calculated value of chi-square is 284.046 at 5 percent significance level and table value is 9.488 then difference is significant. Therefore, Null hypothesis is rejected.

Caste: On the basis of table 3, it is observed that the mean value is 2.1533 which shows higher side of mean score 3 on a five point continuum. The standard deviation is 0.85572, it is scattered more toward higher side.

Therefore, the calculated value of chi-square is 9.499 at 5 percent significance level and table value is 21.026, then difference is not significant. Therefore, Null hypothesis is accepted.

Average Annual Income: On the basis of table 3, it is reported that the mean value is 2.5467 which shows higher side of mean score 3 on a five point continuum. The standard deviation is 0.88908, it is scattered more toward higher side.

Therefore, the calculated value of chi-square is 143.096 at 5 percent significance level and table value is 21.026, then difference is significant. Therefore, Null hypothesis is rejected.

Level of education: On the basis of table 3, it is observed that the mean value is 3.0133 which shows higher side of mean score 3 on a five point continuum. The standard deviation is 0.77578, it is scattered more toward higher side.

Therefore, the calculated value of chi-square is 38.625 at 5 percent significance level and table value is 21.026, then difference is significant. Therefore, Null hypothesis is rejected.

Source of Irrigation: On the basis of table 3, it is observed that the mean value is 3.0133 which shows higher side of mean score 3 on a five point continuum. The standard deviation is 0.77578, it is scattered more toward higher side.

Therefore, the calculated value of chi-square is 61.229 at 5 percent significance level and table value is 21.026, then difference is significant. Therefore, Null hypothesis is rejected.

Land holding Particulars (ha): On the basis of table 3, it is observed that the mean value is 1.4300 which shows

higher side of mean score 3 on a five point continuum. The standard deviation is 0.77918, it is scattered more toward higher side.

Therefore, the calculated value of chi-square is 14.740 at 5 percent significance level and table value is 12.592, then difference is significant. Therefore, Null hypothesis is rejected.

The calculated value of F is compared with the table value. The calculated value of F is 95.008 is greater than table value which is 3.97 at pre-assigned level of significance, the Null hypothesis is rejected (Table 4).

Discussion

Mountain eco-system are generally fragile (Atul and Pratap, 2003). Physiographic and biophysical characterstics of mountain areas lead to farming terraced; and sloppy land masses with in-appropriate land use pattern. Traditional farm practices with more impetus on human labour rather through mechanization (Baiyala *et al*., 2012). In terms of agricultural production, mountains have a low carrying capacity with emphasis; on household needs (Atul and Pratap, 2003). Small and marginal land holdings with scattered arable land in hilly terrains (Choudhary and Thakur, 2011). Exploitation of natural resource base is limited, Socio-agro-economic environment is highly vulnerable to external pressure. Steep slopes and harsh conditions challenge mobility; Transport costs to mountain areas are higher; Market access and agri-market infrastructure is poor; Inaccessibility is common in mountain areas leading to poor physical access to improved; agricultural inputs and farm technological advancement (Atul and Pratap, 2003). Flow of farm technology dissemination is poor; Establishment and maintenance of infrastructure is difficult and expensive; High fragility index; inaccessibility and marginally in remote and poor states are the main cause of food insecurity/malnutrition in Hamirpur region (Yadev *et al*., 2013). In present study, this observation has clearly shown that number of farmers who had adopted rain water harvesting technology, were more in Nadaun block than Bhoranj block. The negative value of Correlation revealed that there is difference between awareness level of farmers in both blocks (McConville, 2006). Awareness level about climate resilient technologies entirely depend upon education level of farmers (Pender, 2008). Most of marginal and small holders were matriculate and they had shown more adopting behaviour. Community caste had not significant effect on farmer's adoption behaviours about climate resilient technologies. Therefore, average annual income (1,50001-200000 Rs) had obtained by marginal and small land holders through establishing climate resilient technologies *viz*; Polylined and RCC tanks. The F-test also witnessed that population had not same variance to adopt these technologies in Hamirpur district. That is why, rain water harvesting offers a viable solution to the irrigation problems of the farmers of rain fed district Hamirpur. This can lead to sustainable management of agro-biodiversity of Hamirpur district and also lead to substantial improvement in the socio economic condition of the small and marginal farmers of Hamirpur district also.

Conclusion

Poverty and lack of employment is a serious problem in the study region, to overcome this situation it is a necessary to enhance agricultural production through promotion of irrigation through poly-lined tanks and RCC tank techniques as people gain more cash crops, development of agro-forestry system on wastelands and livestock development with a special focus on generation of productive self-employment for the farmers. These activities should enhance the economy of farmers by providing them gainful self employment opportunity in seasonal and off seasonal vegetables especially in protective cultivation year around. The remote areas are also deprived of basic infrastructural facilities so they should be the target areas of extension of current climate resilient NRM practices. There is also a need to develop low cost economically viable agriculture technologies as the target population is poor these technologies enhances the capacities of farmers and enable them to take active part in the process of strengthening the regional economy.

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Compliance with ethical standards

Conflict of interest: The authors declare that they have no conflict of interest.

Ethical approval: This article does not contain any studies against human ethical approach, performed by any of the authors.

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