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Relationship of Farmers Profile with Adoption of Climate Resilient Practices in Hilly Region of Uttarakhand, India

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A B S T R A C T

Analytical and Descriptive research design was used for study purposively selected districts of Uttarakhand. Total 200 farmers selected by using probability proportionate to size method. Age, sex, education, family composition, land holding, farming experience, occupation, social participation, socio economic status, extension agency contact, mass media utilization, information seeking behavior, personal localiteness, personal cosmopoliteness, scientific orientation, innovativeness and economic motivation were independent variable. Adoption of climate resilient practices was the dependent variable. The findings revealed that majority of the farmers were female, middle aged, educated up to middle level, small size family, marginal land holding, low farming experience, engaged in agriculture as a main occupation, with no official position in the society, belonged to middle class, low extension agency contact, medium extent of mass media utilization, low information seeking behavior, moderately localite, less cosmopoliteness, high level of scientific orientation, medium innovativeness and medium economic motivation respectively. The profile characteristics like education status, land holding, socio economic status, and extension agency contact, information seeking behavior, scientific orientation, innovativeness and economic motivation were positively and significantly correlated with the adoption of climate resilient practices. The R^2 value depicted that the gender, SES, land holding, farming experiences, personal localiteness, and information seeking behaviour, innovativeness and mass media exposure was the major contributory factors which explain 55.10 percent of variation in adoption level of farmers towards climate resilient practices.

Introduction

Agriculture and climate change are inextricably linked where agriculture is extremely vulnerable to climate change. India is a large developing country, where millions of rural populations directly depending on climate sensitive sectors such as agriculture, forestry and fisheries and natural resources for their survival and livelihood. Climate change impact is more prominent in ecologically fragile mountain areas such as Himalayas where rapid altitudinal change results in high degree of variation in relief, temperature, rainfall, natural vegetation, water regimes and other associated phenomena. The impact of climate change on the mountain system are evident in the rapid melting of

glaciers, changes in vegetation cover, biodiversity loss, erratic weather patterns and increasing frequency natural disasters (Shrestha, 2011).

According to Uttarakhand government report on climate change net increase in temperature in the Himalayan region in 2030s is forecasted to increase between 1.7ºC to 2.2ºC with respect to 1970s and seasonal air temperatures are also forecasted to rise in all seasons (GoU, 2012a). The state witnessed very heavy rainfall in 2013 which was in the range of 124.5 – 244.4mm.

There was a heavy rainstorm resulting in natural calamities in different part of the state and especially in the Kedarnath valley on 15-17 June, 2013. The severity of changing climate is more intense on agriculture sector mainly on rainfed agriculture. Venkateswarlu *et al.,* (2012) found that delayed onset of monsoon, mid-season and terminal drought, particularly in rainfed areas are causing huge losses to agriculture and livestock production affecting livelihood of the poor.

Efforts are required to reduce the vulnerability of agriculture to the adverse impacts of climate change and making it more resilient. Climate resilience stands as best adaptation options. Resilience define as the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity of self-organization, and the capacity to adapt to stress and change (Intergovernmental Panel on Climate Change IPCC 2007).

Climate resilient agriculture is defined as "an approach that guides actions in a changing climate to transform and reorient agricultural systems for effectively support development and ensure food security. India has recorded high priority on research and development to cope with climate change in agriculture sector.

To counter bad effects of climate change, many climate resilient technologies and practices are disseminated to educate the farmers through varies projects. NICRA is an ICAR initiative launched with a focus on making most vulnerable districts of the nation climate resilient. Two states which are most vulnerable were taken up from Uttarakhand under this project.

Uttarakhand is the mountainous state about 86 percent of its area is covered by mountains. Mountain regions are vulnerable to climate change and it will have direct impacts on livelihoods. So it is important to increase the resilience and adaptive capacity of the small land holders by incorporating varies adaptation and capacity building measures in the agriculture system that will help the farmers to cope up with adverse situation.

Although the project has been implemented with lots of expectation but to what extent people are adopting the technologies and impact of climate resilient technologies is to be analyzed to find out the extent to which these technologies could induce resilience.

With this background the present study was undertaken with the following specific objective;

To find out the relationship between adoptions of climate resilient practices with farmers' profile characteristics in order to find out which factors will influence a farmer adoption of varies climate resilient practices. The study is expected to serves as a helpful guide for scientist and policy makers to provide information which can be used in formulating new policies and supportive programmes towards adoption of climate resilient agriculture practices by farmers.

Materials and Methods

The adoption of climate resilient practices by farmers was operationalised as the decision to make full use of an innovation as the best course of action available. The study was conducted in two purposively selected districts such as Uttarkashi and Tehri Garhwal of Uttarakhand. The study sample comprised of 200 farmers selected by using probability proportionate to size method from three purposively selected villages. The selection of districts and villages was based on the estimated vulnerability of these areas to climate change as declared under project National Initiative on Climate Resilient Agriculture (NICRA) of Indian Council of Agriculture Research (ICAR), Government of India in 2011. The data was collected using a pre-tested structured interview schedule and collected data was analyzed using SPSS 23.

Age, sex, education, family composition, land holding, farming experience, occupation, social participation, socio economic status, extension agency contact, mass media utilization, information seeking behavior, personal localiteness, personal cosmopoliteness, scientific orientation, innovativeness and economic motivation were the profile characteristics of the farmers studied under independent variables. Adoption of climate resilient practices was the dependent variable selected for the study. Regression analysis was used for the investigation of relationship between variables. The SPSS software version 23 was used to calculate the regression.

Results and Discussion

Socio economic communication and psychological characteristic of the farmers

A number of profile characteristics were selected as independent variables to find out profile of farmers of the study area. From the Table 1, it was found that most of the respondents (41%) belonged to the middle age group (44 - 55 years) while 32 per cent of them were in the young age group (up to 43 years) and rest of respondents (27 %) was belonging to the old age group (above 55 years).

Data also revealed that majority (54.5%) were female and 25% respondents were educated up to middle class. Family type and size composition of the study sample reveals that majority (50.50%) were nuclear and small (42%) size family, were having marginal (92%) land holding. Further, it could be seen that occupation of majority (35.5%) of respondent belonged to farming+ unpaid labour followed by 22.5 percent who belonged to farming + service group, 20 percent belonged to farming + private service group and 15.5 percent belonged to farming + business group.

Farming as their major occupation but only 27.50 percent were high farming experience whereas majority 37.50 percent reported having low farming experience. In case of socio economic status, majority of the respondents (47%) belonged to medium category. Data regarding extension agency contact, it is observed that majority 63.50 percent of the respondent had low extension contact, followed by 32.50 percent of had medium contact and only 4 percent had high extension agency contact.

As regards their mass media exposure data reveals that 57.50 percent respondents were having medium extent of mass media utilization followed by 29.00 percent were having high extent of mass media utilization. Only 13.50 percent respondents belonged to low extent of mass media utilization. The information seeking behavior of respondent were low (41%) in majority, followed by

39.50 percent medium and 19.50 percent were high level. Majority (45.50 %) of farmers were moderately localite and less (44.50) cosmopolite. Further, majority of the respondent (43%) displayed high scientific orientation. As regards innovativeness, majority of the respondent (41%) had medium level of innovativeness followed by 36.50 percent respondents had low level of innovativeness and 22.50 percent of respondents had high level of innovativeness.

Further, Data regarding economic motivation of the respondents found that 35 percent of the respondents had medium level of economic motivation. Only 32.50 percent each had high level and low level of economic motivation.

Overall level of adoption of climate resilient practices by farmers

The findings regarding adoption of climate resilient practices by farmers are given in Table 2 (Fig 1). It is evident from the findings presented in figure 1 that 37 percent respondents display low adoption of climate resilient practices followed by medium (35%) and high (27.50%).

The findings of the study are conformity with the result by Anseera T.P. (2019) that adoptions of climate resilient practices are not very encouraging. The findings of the study by Tiamiyu S. A. *et.al* (2018) indicated that a large proportion of respondents were not aware of most of the practices and so, adoption of most of the climate smart practices was very low.

Adoption of climate resilient practices by farmers

The finding regarding the adoption recommended climate resilient practices by farmers are given in Table 3. The finding shows that the 16.50 percent respondents displayed full adoption of low cost water harvesting structure followed with 39.50 percent of respondent were having partial adoption and 44 percent respondent comes under low adoption of low cost water harvesting structure. Second important recommended practice was poly house for vegetable cultivation, where 10.5 percent respondents have full adoption followed with 89.50 percent respondents were having low adoption of recommended practice.

Vermi composting was fully adopted by 9 percent respondent followed with 28 percent partial adoption and 63 percent low adoption. Another important practice was introduce to absorb the undesirable climate risk away from affecting crops were drought tolerant and high yielding varieties. The study imparted that 31 percent respondent was full adoption of drought tolerant varieties and 48 percent high yielding varieties.

Only 3 percent respondent partially adopts high yielding varieties. Low adoption of drought tolerant and high yielding varieties was followed by 69 percent and 49 percent respectively. Further the data revealed that only 7 percent respondent partially adopted intercropping and rest 93 percent low adoption. Soil conservation practice was found to be low adopted (100%) practice among farmers. Soil health card were also issued to the farmers.

Vegetable Nursery raising practices were adopted by 31.50 percent respondent. 16.50 percent adopted partially and rest 52 percent was found low adoption of recommended practice. On the basis of observations from the field as well from the data analysis of adoption of traps to control white grubs indicate that the 5 percent respondents were having full adoption of these traps. 20 percent were having partially adopted and rest 75

percent respondent low use of traps to control the white grubs. About 5 percent respondents were partially adopted the nutritional gardens and rest 95 percent farmers were low or no adoption of nutritional gardens. Green manuring was also found to be low adopted (100%) practice.

Further, about 17 percent respondents were fully adopting soil test based nutrient application followed by 14 percent partial and 69 percent low adoption. Fodder grass on farm bunds was full adopted by only 3.50 percent respondents. 21 percent were partially adopting this practice and rest 75.50 percent respondent less use of farm bunds for growing fodder grass.

Further data also revealed that only 7 percent farmer's use improved varieties of fodder rest 43 percent were partially and 50 percent low or no adoption of the fodder varieties. Poultry farming was recommended as important off farm and income generating activities, only 0.50 percent farmers were fully adopt this practice. 55 percent partially adopt poultry farming and 44.50 percent have low adoption. On the basis of observation related to adoption of climate resilient agriculture practices it can be concluded that farmers are partially adopt most of the practices.

The possible reason for the above findings could be that those practices which were easy to adopt and required less skill were fully adopted by the respondents. Those practices which required more knowledge and skills were less adopted or not adopted by respondents.

Relationship between independent variables and level of adoption of climate resilient practices

Correlation coefficient was calculated to find out the relationship between selected independent variables with dependent variable. Further, t-test was used to check the significance of the relationship between the two variables. Results obtained are given in Table 4.

Findings presented in Table 4 reveals that out of seventeen independent variables which are selected to study the relationship with adoption of climate resilient practices education status, extension agency contact and information seeking behaviour were found to be significant positive relationship with the adoption of climate resilient practices at 5 percent level of significance.

It may be due to the fact that educated farmers had greater concerns towards contacting extension agencies for more information, better understanding and more adoption of new technologies.

It was also found that land holding, socio economic status, scientific orientation, innovativeness and economic motivation had a significant positive relationship with the adoption of climate resilient practices at 1 percent level of significance.

The findings of present study are in line with finding of study by Parwada *et al.,* (2010), which indicated that large scale farmers were always on the fore front in adoption of new technologies.

On the other hand age, gender, family type, family size, farming experience mass media exposure, personal localiteness and personal cosmo politeness had non-significant relationship with the adoption of climate resilient practices.

Stepwise regression analysis

Stepwise regression analysis was carried out by using SPSS-23 to single out best predictor combination of influencing independent variable on adoption level of farmers.

Table.1 Distribution of respondents according to their socio-demographic profile (N=200)

Sl No	Category	Frequency	Percentage
1.	**Age**		
	Young	64	32
	Middle	82	41
	Old	54	27
2.	**Sex**		
	Male	91	45.5
	Female	109	54.5
3	**Education**		
	Illiterate	12	6.00
	Primary	15	7.50
	Middle	50	25.00
	High school	39	19.50
	Intermediate	49	24.50
	Graduate	31	15.50
	Post Graduate	4	2.00
4	**Family type**		
	Nuclear	101	50.50
	Joint	87	43.50
5	**Family Size**		
	Small	84	42.00
	Medium	62	31.00
	Large	54	27.00
6	**Land holding**		
	Marginal	184	92.00
	Small	13	6.50
	Semi-Medium	3	1.500
	Medium	0	0.00
	Large	0	0.00
7	**Occupation**		
	Farming and unpaid Labor work	71	35.5
	Farming and Service	45	22.5
	Farming and Private Service	40	20
	Farming and Business	31	15.5
	Semiprofessional	4	2
	Professional	9	4.5
8	**Farming experience**		
	Low	75	37.50
	Medium	70	35.00
	High	55	27.50
9	**Socio Economic Status**		

	Low	54	27.00
	Medium	94	47.00
	High	52	26.00
10	**Extension Agency Contact**		
	Low	127	63.50
	Medium	65	32.50
	High	8	4.00
11	**Mass media Exposure**		
	Low	27	13.50
	Medium	115	57.50
	High	58	29.00
12	**Information Seeking Behaviour**		
	Low	82	41.00
	Medium	79	39.50
	High	39	19.50
13	**Personal Localiteness**		
	Less localite	53	26.50
	Moderately localite	91	45.50
	Highly localite	56	28.00
14	**Personal Cosmopoliteness**		
	Less cosmopolite	89	44.50
	Moderately cosmopolite	61	30.50
	Highly cosmopolite	50	25.00
15	**Scientific Orientation**		
	Low	73	36.50
	Medium	41	20.50
	High	86	43.00
16	**Innovativeness**		
	Low	73	36.50
	Medium	82	41.00
	High	45	22.50
17	**Economic Motivation**		
	Low	65	32.50
	Medium	70	35.00
	High	65	32.50

Table.2 Distribution of respondents according to their overall extent of level of adoption of climate resilient practices (n=200)

Sl. No.	Categories	Frequency	Percentage
1.	Low	74	37.00
2.	Medium	71	35.50
3.	High	55	27.50

Table.3 Distribution of respondents according to their Extent of adoption of various recommended climate resilient practices (n=200)

Sl. No.	**Recommended practices**	**Extent of adoption**		
		Full	**Partial**	**Low**
		Percentage	**Percentage**	**Percentage**
1.	Low cost water harvesting structure	16.50	39.50	44.00
2.	Poly house for vegetable cultivation	10.5	0.00	89.50
3.	Vermi Compositing	9.00	28.00	63.00m
4.	Drought tolerant varieties	31.00	0.00	69.00
5.	Use of High Yielding Varieties	48.00	3.00	49.00
6.	Intercropping	0.00	7.00	93.00
7.	Soil conservation	0.00	0.00	100
8.	VegeTable Nursery Raising	31.50	16.50	52.00
9.	Use of traps to control white grubs	5.00	20.00	75.00
10.	Nutritional Garden	0.00	5.00	95.00
11.	Green manuring	0.00	0.00	100
12.	Soil test based nutrient application	17.00	14.00	69.00
13.	Fodder grass on farm bunds	3.50	21.00	75.50
14.	Improved varieties of fodder	7.00	43.00	50.00
15.	Poultry Farming	0.50	55.00	44.50

Table.4 Relationship between independent variables and level of adoption of recommended climate resilient practices

Sl. No.	Variables	Correlation coefficient
1.	Age of respondent	-.168*
2.	Gender	-.222**
3.	Education	.152*
4.	Family type	-.068
5.	Family size	.012
6.	Land Holding	.386**
7.	Farming experience	-.421**
8.	Occupation	.082
9.	Socio-economic status	.498**
10.	Extension agency contact	.142*
11.	Mass Media Exposure	.029
12.	Information Seeking Behaviour	.065
13.	Personal localiteness	-.203**
14.	Personal cosmopoliteness	.065
15.	Scientific orientation	-.401**
16.	Innovativeness	.541**
17.	Economic Motivation	.155**

**Correlation significant at 0.01 level (2-tailed)
* Correlation significant at 0.05 level (2-tailed)

Table.5 Effect of independent variables on level of adoption of recommended climate resilient practices (n=200)

Sl No.	Variables	Multiple		Change in R2	F change	Durbin-Watson
		R	**R2**			
1.	Innovativeness	.541	.293	.293	82.117	1.531
2.	Socio-economic status	.643	.413	.120	40.250	
3.	Land holding	.683	.466	.053	19.431	
4.	Farming experiences	.703	.494	.028	10.591	
5.	Personal localiteness	.713	.509	.015	6.026	
6.	Information seeking behavior	.722	.521	.012	4.973	
7.	Mass media exposure	.734	.538	.017	7.060	
8.	Gender	.742	.551	.013	5.420	

Table.6 Direct and indirect effect of independent variables on level of adoption of recommended climate resilient practices

Sl. No.	Variables	Total effect	Direct effect	Indirect effect
1.	Land holding	.326	.326	.000
2.	Information seeking behaviour	.268	.268	.000
3.	Personal localiteness	-.247	-.247	.000
4.	Mass media exposure	.246	.210	.036
5.	Socio-economic status	.198	.149	.048
6.	Farming experience	-.150	-.102	-.049
7.	Innovativeness	.093	.093	.000
8.	Gender	-.086	-.086	.000
9.	Scientific orientation	.202	.000	.202
10.	Educational status	.077	.000	.077

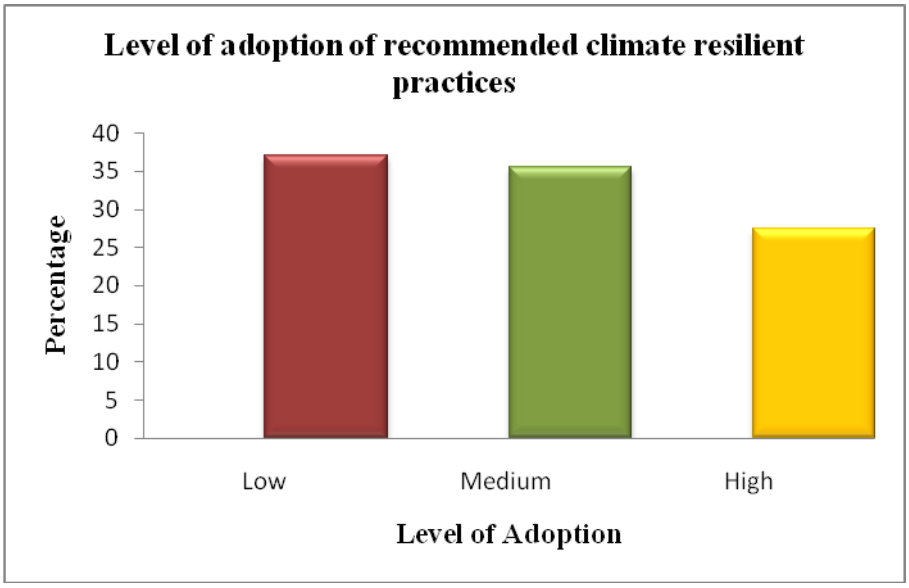

Fig.1 Distribution of farmers on the basis their adoption of recommended climate resilient practices (n=200)

Data regarding the effects of independent variables on level of adoption of climate resilient technologies and practices presented in Table 5. It was found that innovativeness, SES, land holding, farming experiences, personal localiteness, information seeking behaviour, mass media exposure and gender was the major contributory factors which explain the variation in adoption level of the farmers with a contribution of 55.10 percent of variances (R2 = 0.551).

The non-existence of auto correlation was confirmed by Durbin Watson test with a test score within the range of 1.5 to 2.5.

To get clear picture of direct and indirect effect of independent variable on the dependent variable (adoption) path analysis was carried out using SPSS. In Table 6 the variable has been arranged from high to low direct effect. The maximum direct effect on adoption of climate resilient practices was

exhibited by land holding (0.326) variable which were followed by information seeking behavior (0.268), Mass media exposure (0.210) and Socio economic status (0.149).

Further data also revealed that remaining variable innovativeness (0.093) had registered comparatively smaller direct effect on the adoption of climate resilient practices. The maximum indirect effect on adoption of climate resilient practices was exhibited by independent variable scientific orientation (0.202). The remaining other variables such as Socio economic status (0.048), mass media exposure(0.036) and education status (0.077) had registered smaller indirect effect on the adoption of climate resilient practices.

The highest total effect on the adoption of climate resilient practices was exhibited by land holding (0.326) followed by information seeking behavior (0.268), mass media exposure (0.246), scientific orientation(0.202) and socio economic status (0.198). The variable land holding shows the highest levels of effect because of fact that farmers who have bigger farm size will adopting more practices and trying new intervention in their farms.

The result of the study finding the conforms to the finding of Aryal J P *et.al* (2018) such as farm plot characteristics such as size of land, irrigation facilities, soil fertility, soil depth and plot distance from the house may influence farmers' decision to adopt CSA technologies. Larger farm sizes are more likely to adopt most CSA practices.

The information seeking behavior and mass media exposure also shows higher level of effect which might be because of the fact that more contact with information sources and gaining information and exploring come up with new ideas and can better manage the problems and hence get more profit resulting in higher adoption of climate resilient practices. These findings are in conformity with the finding of Singh A.K *et al.,* (2019).

Climate resilient technologies and new agriculture practices will require countering the increase climate risk in India as well as climate prone state such as Uttarakhand. At present, as presented in the paper, adoption level of hill farmers are not very high. It was also found that despite of many technological advancement are available but still farmers are not adopting it due to no or lack of information, lack of interest or traditional knowledge etc.

So it is concluded that still many organizations are working to create awareness towards adoption of climate resilient technologies but still majority of the farmers are not aware about them. So to face these challenges extension can make a significant contribution through enhanced farmer decision making in the light of changing climate. The most important purpose for extension today is to bring about the empowerment of farmers, so that their voices can be heard and they can play a major role in deciding how they will mitigate and adapt to changing climate.

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