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FARMERS' AWARENESS ON PESTICIDE USAGE, CLIMATE CHANGE AND ADOPTION OF STRATEGIES: A CASE STUDY OF SHIMLA DISTRICT IN HIMACHAL PRADESH

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ABSTRACT

The study was conducted in Shimla district of Himachal Pradesh in India to assess farmers' awareness of pesticide usage, productivity, change in climate and adoption of strategies used by the farmers to minimize adverse impact of pesticide usage on biodiversity and soil. The primary data was collected from the farmers who were using the agro-chemicals for growing vegetable and apple crops. Awareness about the impact of pesticide use and immediate treatment practices for pesticide poisoning and precautionary measures against the exposure of pesticides were slightly more on large farms than small farms. The farmers' response on the perception of decrease in productivity was also more on large farms. For increase in cost of production, there was similar response on both farms. The climate was the main factor to decrease in productivity followed by disease and pest and lack of pollination in the study area. There was a variation in the perception of farmers of both farms for the change in temperature and rainfall. The humidity and snowfall were also decreasing. The temperature fluctuation and hailstones were the main prevailing problems of the study area which affecting the productivity of apple on both farms. A few farmers were using the anti hail net to protect their apple orchards from the hailstones on both farms. The study concluded that there is a need to create awareness in farmers by the extension workers for growing resistant varieties of crops and government should provide subsidy for anti hail net to protect their apple crop from hailstones. *Also, the use of agro-chemicals in a scientific way and organic agro-chemicals should be encouraged. This could be very useful to reduce the cost of production, minimize the adverse impact on biodiversity, soil and human health. It will play a vital role to save the livelihood of the farmers and our ecosystem.*

KEYWORDS: *Adverse Impact, Awareness, Biodiversity, Climate Change, Pesticide and Strategies*

INTRODUCTION

Pesticide use in most of the developing countries is reported to be unscientific and unregulated, causing serious damages to the ecosystem and human health. The trade-off between the health impacts and financial benefits of crop production has been reported by various researchers across the globe (Rola and Pingali, 1993; Pingali *et al*., 1994; Antle and Pingali, 1994; Crissman *et al*., 1994). Despite this, pesticide use policies and regulations are in their infancy in many developing countries and as a result, pesticide misuse is prevalent (Tjornhom *et al*., 1997). Pimental, (1995) estimated that only 0.1 per cent of applied pesticides reach the target pests, leaving the bulk of the pesticides (99.9 per cent) to impact the

environment. Hence, Integrated Pest Management is an ecosystem-based strategy that provides economical, long- term solutions to pest problems through a combination of biological, cultural, physical and chemical controls. The different studies exposed that excessive and indiscriminate use of pesticides led to adverse impact on biodiversity, soil and health and decline in the productivity of crops (Mclaughlin and Mineau, 1995; Partap 2003; Shetty, 2004; Dasgupta and Meisner *et al.*, 2005; Devi, 2007; Devi, 2009 and Kumari and Sharma, 2014). This paper has evaluated the awareness regarding pesticide use and handling, sources of information for pesticide application, changes in productivity and production, change in parameters of climate and strategies adopted by the farmers to minimize adverse impact on loss of natural resource base and climate change.

METHODOLOGY

In the first stage of sampling, Shimla district was purposively selected in Himachal Pradesh for the study. The selection of the district was done, because of cultivation of high value cash crops namely apple and vegetable is being practiced since the late sixties and early seventies. In second stage, Theog block in Shimla district was purposively selected for the same reason. Thereafter, a list of panchayats falling in the selected block was prepared. In the next stage of the sampling, one panchayat from the selected block was randomly selected. The selected panchayat was Matiyana from the Theog block. Later on the list of the villages falling in the selected panchayat was prepared. Thereafter, 50 per cent of the villages were selected randomly from the selected panchayat. In the selected panchayat, hundred households were allocated among the selected villages through a proportional allocation method. Thus, the total sample size consists of 100 households. The data was collected from the pesticide applicator of each household. The farmer who was doing the spray in high value cash crops (apple and vegetables) for most of the time and for the last many years considered pesticide applicator (Kumari & Sharma, 2014). The cumulative square root frequency method was used for the stratification of the data (Singh and Mangat, 1995). The data was divided into two strata, small farm (farmers who had land $\leq$ 2.08 ha) and large farm (farmers who had land more than 2.08 ha). Therefore, out of selected 100 farmers, 70 farmers are those who had small farms and 30 farmers are those who had large farms. The study is based on primary data which collected from the pesticide applicator of sample households by using a pre-structured questionnaire through a personal interview method for the agricultural year 2005-2006. The percentage and bar diagrams were used to present the results of the study.

RESULT

The six statements used to measure respondents' level of awareness about impact of pesticides on health and symptoms of poisoning (Table1). On all farms, all households reported that contact with pesticides cause eye injuries followed by 92 per cent who opined that pesticide cause blister or skin rash and 83 per cent who reported that pesticide exposure causes cancer and 80 per cent who reported that vomiting diarrhea, salivation and cramps are signs of pesticides poisoning. Three- fourths of the households reported that eating, drinking and smoking in the field increases the possibility of pesticides entering the body. The 83 per cent and 73 per cent reported that pesticides exposure causes cancer and increases health risk to pregnant women and children, respectively.

On large farms, more than four fifths of the farmers reported that vomiting, diarrhea, salivation and cramps are signs of pesticides poisoning, pesticides exposure can cause cancer and pesticides create many health risks to pregnant women and children. Whereas on small farm, 82.86 per cent of farmers responded that pesticides exposure can cause cancer and 68.57 per cent responded that pesticides create many health risks to pregnant women and children. The 78.57

per cent farmers reported that eating, drinking and smoking in the field increases the possibility of pesticides entering the body and Vomiting, diarrhea, salivation and cramps are signs of pesticides poisoning.

Table 1: Awareness about the Impact of Pesticides Use on Human Health

(Percent)

Particulars	Small	Large	All
Eating, drinking and smoking in the field increases the possibility of pesticides entering the body	78.57	66.67	75.00
Vomiting, diarrhea, salivation and cramps are signs of pesticides poisoning	78.57	83.33	80.00
Pesticide exposure can cause cancer	82.86	83.33	83.00
Pesticide may cause blister or skin rash	92.86	90.00	92.00
Contact with pesticides cause eye injuries	100.00	100.00	100.00
Pesticides create many health risks to pregnant women and children	68.57	83.33	73.00

From Table 2, it can be observed that farmers' knowledge about immediate treatment practices was high on both the farms. On all farm, all farmers reported that when pesticides come in contact with the eyes, eye flushing should be done. The response of households that the person who swallows pesticides should take water and medicine was also very high on both the farms. Victims who inhaled pesticides should be shifted from pesticides area to fresh air immediately was reported by 100 per cent of the households on large farms and 85.71 per cent on small farms.

Table 2: Awareness of Immediate Treatment Practices For Pesticide Poisoning

(Percent)

Particulars	Small	Large	All
Pesticides come in contact with the eyes, eye flushing should be done	100.00	100.00	100.00
A person who had swallowed pesticides it is important to take water	85.71	83.33	85.00
A person who had swallowed pesticides it is important to take Medicine	92.86	100.00	95.00
Victims who inhaled pesticides should be shifted from pesticide area to fresh air immediately	85.71	100.00	90.00

On all farms, table 3 shows that all farmers were of the view that pesticides should be stored out of reach of children and animals, should take bath and change clothes after handling pesticides, protective clothing should be worn while mixing or applying pesticides and it is not safe to store water in containers that had been used for storing pesticides. The more than four-fifths of the households reported that pesticides were dangerous for people and animals. On small and large farms, only less than one fifth of farmers were not having this knowledge. Whereas, on all farms, 75 per cent of the households responded that important instruction / warning labels on pesticide containers should be read and not safe to bring small children to the field after pesticide application.

On all farms, only two fourths of farmers responded that it is not good to apply pesticides on a windy day. On small farms, 42.86 per cent of farmers responded that is not good to apply pesticides on a windy day and on large farm, 33.33 per cent of farmers responded for the same. The remaining farmers were not aware about it. On all farms, 50 percent of the farmers responded that empty pesticide container should not be kept for reuse. Whereas, on small and large farms, 57.14 per cent and 33.33 per cent of farmers responded that they were using empty pesticide container, respectively. The 28.57 per cent on small farms and 16.67 per cent on large farms responded that eating fruits directly from the tree is not safe. This indicated that majority of the farmers are eating fruits without washing.

Table 3: Awareness of Precautionary Measures against Pesticides Exposure

(Percent)

Particulars	Small	Large	All
Pesticides should be stored out of reach of children and animals	100.00	100.00	100.00
Pesticides are dangerous for people and animals	85.71	83.33	85.00
It is important to read instructions/warning labels on pesticides containers	78.57	66.67	75.00
It is important to bath and change clothes after handling pesticides	100.00	100.00	100.00
Protective clothing should be worn when mixing or applying pesticides	100.00	100.00	100.00
It is not safe to store water in containers that have been used for storing pesticides	100.00	100.00	100.00
It is not good to apply pesticides on a windy day	42.86	33.33	40.00
It is not safe to bring small children to the field after pesticide application	71.43	83.33	75.00
Empty pesticide container should not be kept for reuse	57.14	33.33	50.00
Eating fruits directly from the tree is not safe	28.57	16.67	25.00

The sources of information (Figure.1) which influenced application of pesticides by the farmers were very diverse. On all farms, more than four-fifths received information from the pesticide sales agents. On small farms, 92.86 per cent of farmers and on large farms, 66.67 per cent of farmers responded that they were receiving the information from pesticides sales agent. On small and large farms, 85.71 per cent and 50 per cent of farmers responded that information regarding pesticide application was received from the extension workers, respectively. Co-farmers, own experience, radio, television and magazine and newspapers were other five important sources of awareness on both farms.

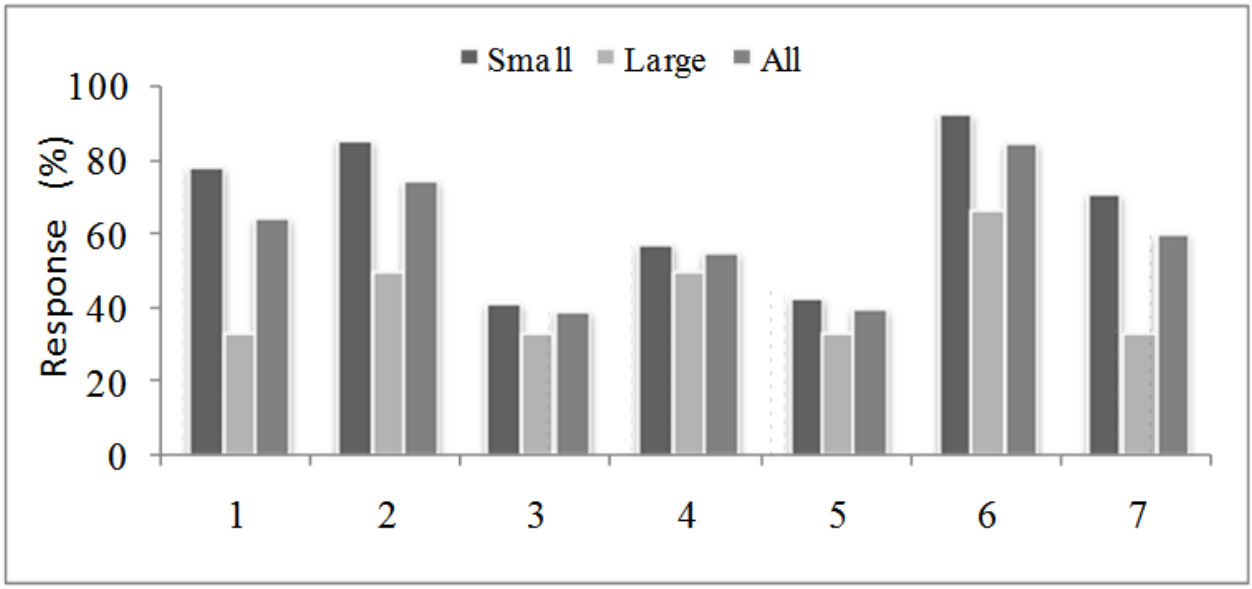

Figure 1: Sources of Information Regarding Pesticide Application

Note: 1-Co-farmers, 2-Extension Service, 3-Television, 4-Radio, 5- Magazine & Newspapers, 6-Pesticides

Sales Agent & 7-Own Experience

The response of farmers on problems in apple productivity has been given in figure. 2. On all farm, 35 per cent farmers felt that the productivity of apple was increasing and 65 per cent farmers responded by saying that it was decreasing. On small farms, 43 per cent and 17 per cent on large farm farmers felt that productivity was increasing. On the other hand, on large farms (83.33 per cent) and on small farms (57.14 per cent) farmers responded that productivity was decreasing.

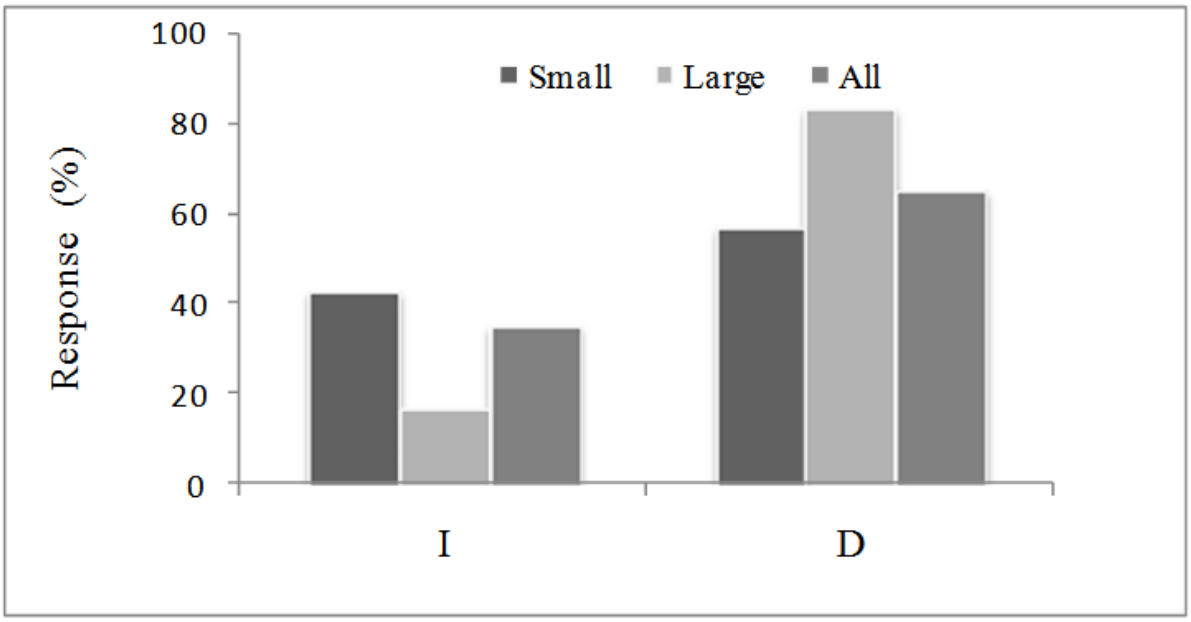

Figure 2: Farmers' Perception on Changes in Productivity

Note: I-Increased & D-Decreased

In figure 3, on all farms, 87 per cent of the households responded that cost of production had increased while the 13 per cent opined that it had not. On large farms, 90 percent of the farmers responded that cost production had increased while 10 percent felt that it had decreased. Whereas, on small farms, 85.71 percent felt that cost of production was increased while 14.29 per cent responded that it was decreased.

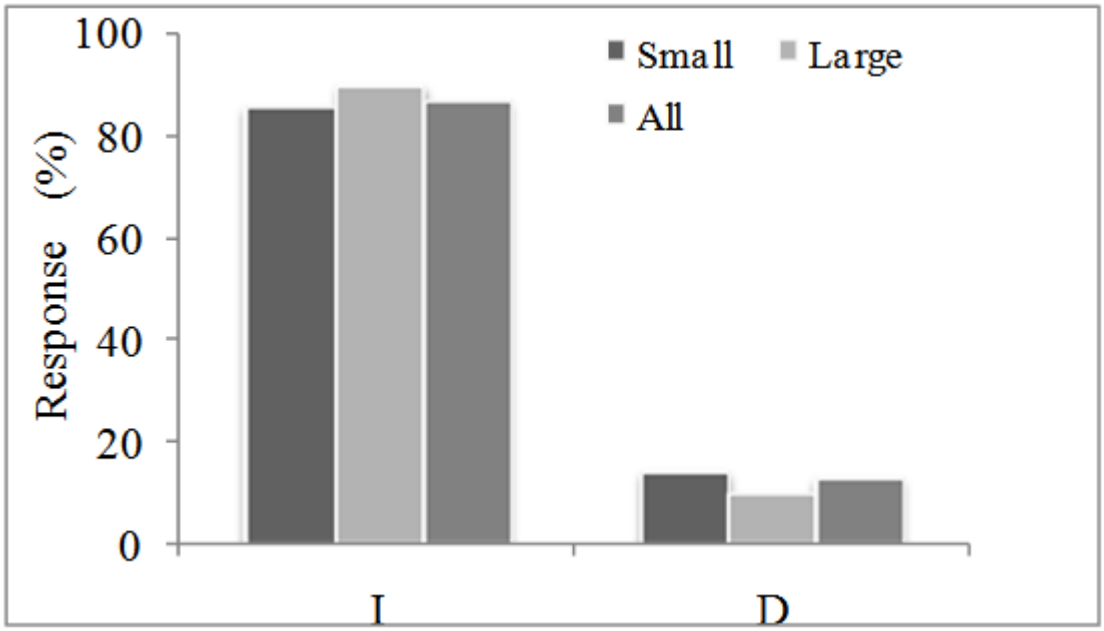

Figure 3: Farmers' Perception on Changes in Cost of Production

Note: I-Increased & D-Decreased

All sample households reported that climate was main responsible factor for the decrease in productivity of different crops (figure 4). On all farms, 30 per cent and 20 per cent farmers responded that disease and pest attack and lack of pollination were also responsible for the decrease in productivity, respectively.

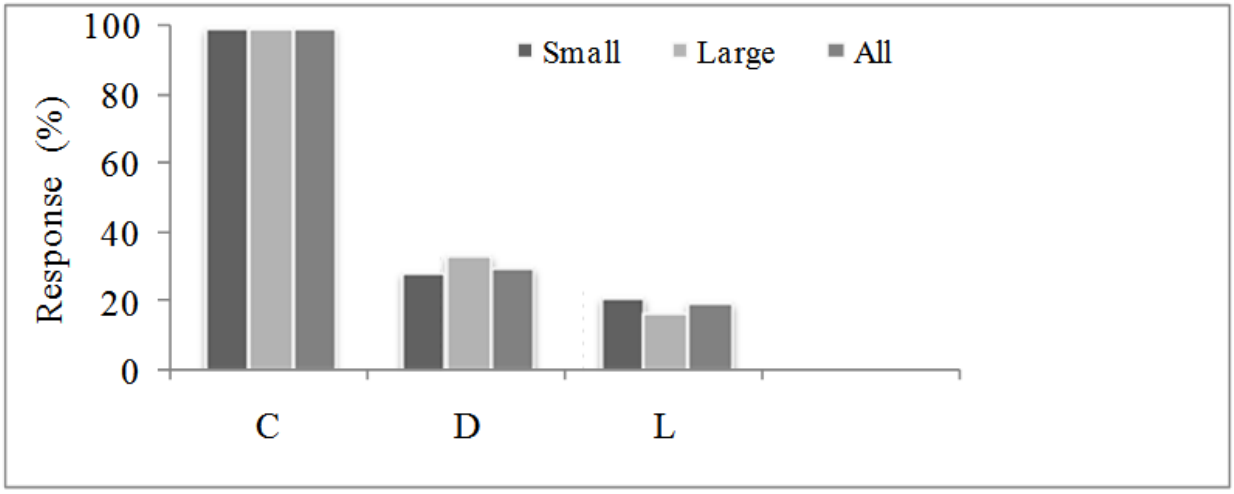

Figure 4: Farmers' Perception on Factors Affecting Productivity

Note: C-Climate, D-Disease & Pest & L-Lack of Pollination

Figure 5 indicates the response of farmers about the change in temperature which had contributed towards change in climate. Figure shows that on all farms, 50 per cent of the farmers responded that there was an increase and fluctuation in temperature. On large farms, 66.67 per cent of farmers felt that there was fluctuation in temperature and 33.33 per cent farmers responded that it was increasing. Whereas on small farms, less than three-fifths and 42.86 per cent of the farmers responded that there was an increase and fluctuation in temperature, respectively.

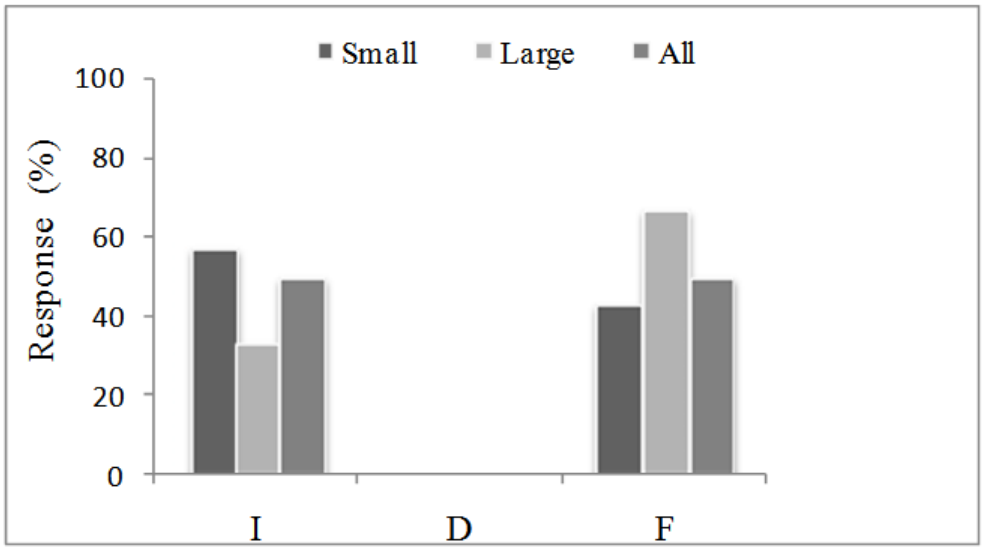

Figure 5: Farmers' Perception about Change in Temperature

Note: I- Increase, D-Decrease & F-Fluctuation

On all farms, the fluctuation in rainfall as a reason of climate change was reported by 48 per cent followed by decrease in rainfall by 40 per cent and 12 per cent responded for the increase in rainfall (figure 6). On large farms, the decrease, fluctuation, increase in rainfall were reported by more than 66.67 per cent, 26.67 per cent and 6.67 per cent of the households, respectively.

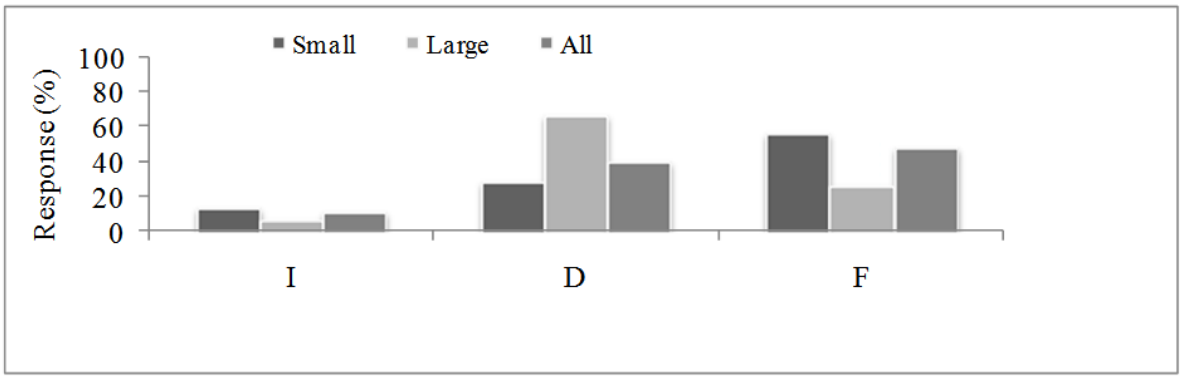

Figure 6: Farmers' Perception about Change in Rainfall

Note: I- Increase, D-Decrease & F-Fluctuation

Figure 7 shows that on all farms, the decrease in humidity as a reason of change in climate was reported by 64.66 per cent followed by fluctuations in humidity 28.28 per cent and increase in humidity by 7.07 per cent. On large farms, the decrease in humidity was responded by 66.67 per cent followed by fluctuations in humidity 26.67 per cent and increase in humidity by 6.67 per cent. Whereas on small farms, 64.29 per cent of the farmers reported that there was fluctuation in humidity followed by decrease (28.57 per cent) and increase (7.14 per cent).

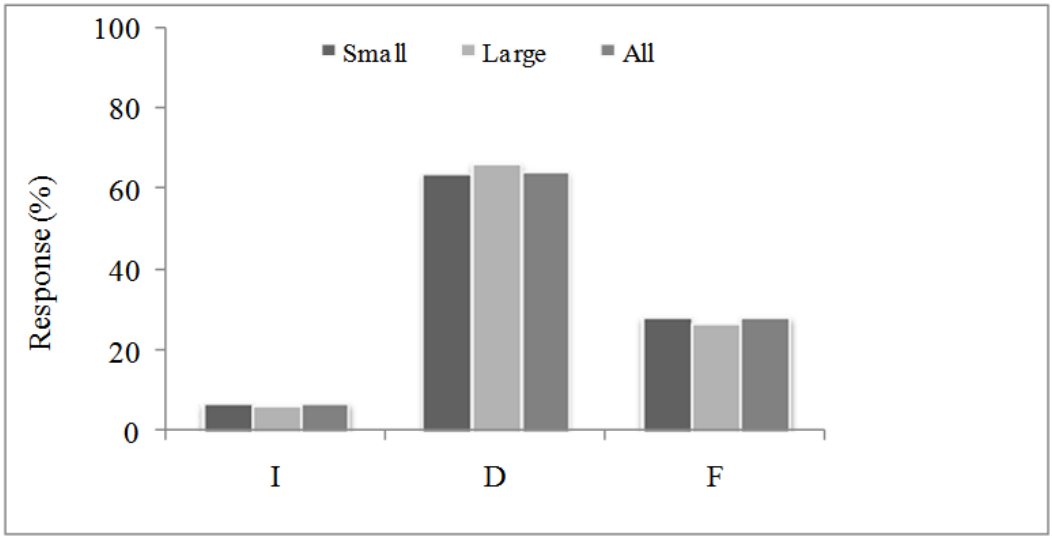

Figure 7: Farmers' Perception about Change in Humidity

Note: I- Increase, D-Decrease & F-Fluctuation

In figure 8, all the farmers on small and large farms in the study area reported that there was only decrease in Snowfall.

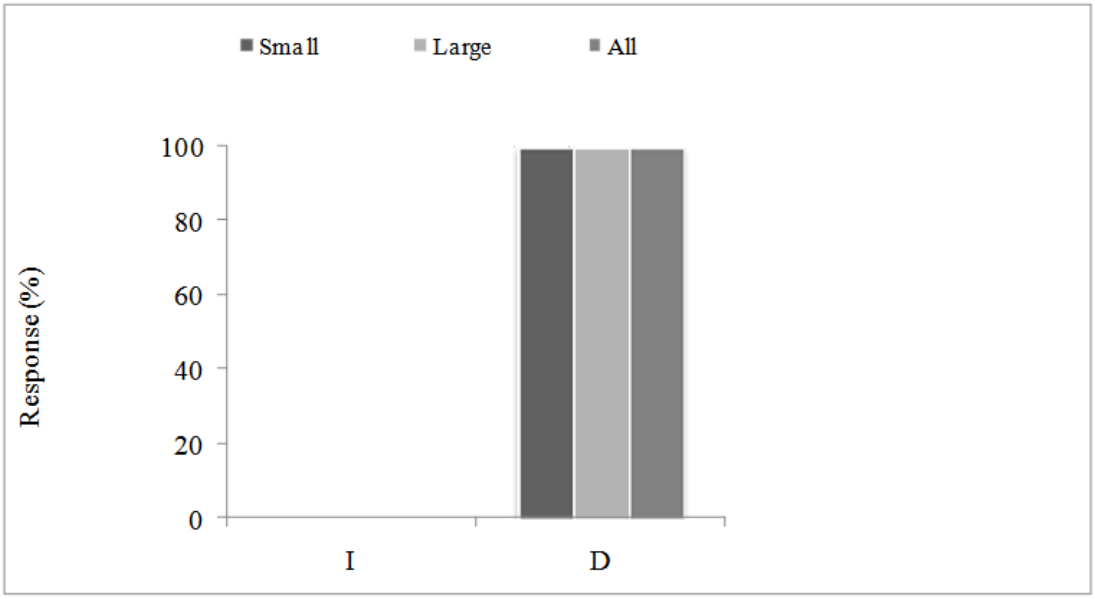

Figure 8: Farmers' Perception about Change in Snowfall

Note: I-Increase & D-Decrease

Table 4 shows that the farmers of the study areas have adopted different strategies like soil management, pollination management, pollinator management and orchard management to cope up with the adverse impact of excessive use of agrochemicals and climate change on soils and problems of decreasing productivity. In soil management practices, farmers of both farms had resorted to manuring. On all farms, the strategies of multiple cropping (52 per cent) followed by sloping agricultural land technology (50 per cent), use of crop residue (43 per cent) and droppings of sheep and goat (35 per cent) were used by the farmers for the soil management. On large farms, strategy of Sloping agricultural land technology (66.67 per cent) followed by use of crop residue (63.33 per cent), multiple cropping (40 per cent) and dropping of sheep and goats (36.67 per cent). Whereas on small farms, multiple cropping was used by 57.14 per cent followed by sloping agricultural land technology (42.86 per cent), use of crop residue and droppings of sheep and goat (34.29 per cent) were used by the farmers for the soil management.

In pollination management, on all farms, branch grafting was used by 80 per cent of the farmers. On large farms, branch grafting was used by all the farmers and on small farms, 71.43 per cent farmers were using it. In pollinator management, very less farmers were using the strategy of rearing honey bees in the study area. It has been observed from the table that only 12 per cent farmers were engaged in the honey bees rearing on all farms. Whereas on small farms, 14.29 per cent and on large farms 7 per cent were using it. Table also revealed that all the farmers were not using the practice of rented honey bees for the pollinator management in the study area.

In orchard management, all the farmers on both farms were using pruning, basin preparation, basin mulching and mulching of nursery. On all farms, 57 per cent of farmers were using concrete ponds for water storage followed by replacement of delicious varieties (49 per cent), rainwater harvesting structure such as a mud pond (45 per cent) and protection from hailstorm (4 per cent). On small farm, 43 per cent farmers were using rainwater harvesting structure such

as a mud pond and replacement of delicious varieties, 50 per cent were using concrete ponds for water storage and only 3 per cent farmers were taking the protection from hailstorms. Whereas on large farms, concrete ponds for water storage (73.33 per cent) followed by replacement of delicious varieties (63.33 per cent), rainwater harvesting structure such as a mud pond (50 per cent) and protection from hailstorm (7 per cent).

Table 4: Strategies Adopted by the Farmers to Minimize Adverse Impact of Loss of Natural Resource Base and Climate Change

(Percent)

Particulars	Small	Large	All
1. Soil management			
Crop residue harvesting	34.29	63.33	43.00
Manuring	100.00	100.00	100.00
Dropping of sheep and goats	34.29	36.67	35.00
Vermi compost fertilizers	0.00	0.00	0.00
Sloping agricultural land technology	42.86	66.67	50.00
Multiple cropping	57.14	40.00	52.00
2. Pollination management			
Bouquets pollination	0.00	0.00	0.00
Branch grafting	71.43	100.00	80.00
3. Pollinator Management			
Rearing honey bees	14.29	7.00	12.00
Rented honey bees	0.00	0.00	0.00
4. Orchard Management			
Pruning	100.00	100.00	100.00
Basin preparation	100.00	100.00	100.00
Basin mulching	100.00	100.00	100.00
Rainwater harvesting structure such as a mud pond	43.00	50.00	45.00
Concrete ponds for water storage	50.00	73.33	57.00
Mulching of nursery	100.00	100.00	100.00
Protection from hailstorm	3.00	7.00	4.00
Replacement of delicious varieties	43.00	63.33	49.00
Switching over to new crops	0.00	0.00	0.00

DISCUSSION

Regarding the awareness about the impact of pesticides use and immediate treatment and precautionary measures against pesticides exposure large farms have shown more awareness than small farms. While doing spray in their orchards farmers were not careful for the drift. This point outs that pesticide spray applied on windy day is affecting non- specific area than specific one. Sooner or later it has negative impact on human health and environment. It has been also observed that after washing the containers of agro chemicals farmers were using to store household items like cereals and pulses. This practice was followed by, those farmers who don't have awareness for the reuse of pesticide containers. This is similar with the result of Dharamajal, 1997; Rengam, 1999; Ajayi, 2000 & Dharamraj and Jayapraksh, 2003. The small farms have received more information from all the given sources for the pesticide application than large farms. This indicated that small farms are involved in more intensification than the large farms due to their less land holdings.

The majority of the farmers reported that over the period there has been a decrease in the productivity of different crops primarily as a result of adverse impact of excessive use of agro-chemicals on natural resource base, changes in climate, emerging disease and pest and lack of pollination. The excessive and frequent use of pesticides has affected both the diversity and the abundance of pollinating insects. This is similar with the finding of Partap, 2003. Regarding change in different parameters of climate, the majority of the farmers reported that over the years, there has been an increase in temperature, fluctuations in rainfall and decrease in the amount of snowfall. All these factors have adversely affected the productivity of different crops, particularly that of apple. The farmers of the study areas have adopted different strategies such as soil management, pollination management and orchard management to mitigate the adverse effect on the natural resource base. For maintaining the soil fertility, manuring was being done by all the farmers. The use of crop residues and dropping of sheep and goat was being followed by more than one-third of the households on all farms. Among other strategies, sloping land agricultural technology was being followed by fifty percent of the households in study area especially to convert grasslands into cultivatable land. The farmers were not using vermi-compost fertilizer. The awareness about the problem of pollination was very low, because of very high frequency of crop failure due to fluctuations in temperature at the time of flowering and hailstones at the time of fruit setting in the area. All farmers have adopted strategies like pruning, basin preparation and basin mulching to maintain the productivity of their apple orchards. The hailstones were the one of the major prevailing problem in the study area. Even than few farmers were taking the precaution from hailstones by using anti hail net. Because majority of the farmers was not able to carry the cost of anti hail net.

CONCLUSION

There is a need of intensive awareness, education and IPM training programs for the farmer of both farms for the usage of pesticides. Awareness regarding the use of resistant varieties of crops should be created in farmers by the extension workers and government should provide subsidy for anti hail net to protect their apple crop. The use of agro-chemicals in a scientific way and organic agro-chemicals should be encouraged. This could be very useful to reduce the cost of production, minimize the adverse impact on biodiversity, soil, human health and also it will play vital role to save the livelihood of the farmers and our ecosystem.

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