

Plant Protection Measures of Crops: Prospects and Threats in Nepal

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Abstract

The study focuses on the possibilities and threats of using plant protection measures on crop production particularly in the eastern hills of Nepal. Relevant data were collected from the interview, key informant survey and field observation. For this, 30 percent (180hhs) sample households were selected from three altitude belts such as upper, middle and lower, ranging from 300 to 2,250 masl along the Koshi-highway. It has a wide range of climates, ranging from sub-tropical to alpine with monsoon precipitation in the summer three and half months and therefore diversity in flora and fauna, and people. Similarly, secondary data were gathered from previous research journals, dissertations and official records.

This paper showed that plant protection measures are known as important technology for protection and promotion of both cash and cereal crops in this area. More than 72 percent (130hhs) farmers have been using this technology as a new innovation. The attraction of farmers towards traditional maeasures seems to be gradually increasing however; the newly developed measures are accepted as a necessary evil. The maximum effort of farmers seems to reduce the use of newly developed measures as far as possible. Thus, the use of traditional measures is as the wishes of the farmers, while the adoption of newly developed protection measures is found to be unintentional. But there is no possibility of reducing the use of these measures even if farmers want to at present. Lacks of timely identification of crop disease, negative impact of chemical pesticides on human health, lack of proper knowledge to use such technologies and inadequate supply of such technologies on time are major identified problems associated with this topic at present situation.

Key words: *Adoption, plant protection measures, improved seeds, pesticides and insecticides etc*

Introduction

Wagle (2019) has defined that plant protection measure technology is security guard of crops. It is a curative and preventive method to protect and promote the health of crops. It is not possible to get better yield from the crops unless we protect them from

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different diseases, insects and epidemic hazards. In this context, Singh and Dhillon (1984) remarked:

Plant protection measures include pesticides, insecticides and herbicides etc. These are poisonous substances used for preventing, controlling, destroying, repelling or mitigating pests, insects, weeds etc. Pest, insects and weeds can seriously damage crops. If adequate preventive and curative measures are not taken on time, much of the crops will be destroyed by large varieties of insects. Pests and weeds can be reduced by adequate and timely use of pesticides (p. 34).

Karki (1981) argues that Nepal consumes only 142 grams of pesticides per hectare which is significantly lower in comparison to other countries. In Japan the use of pesticides is 10700 grams per hectare, 1870 grams in Europe and 1940 grams in United State of America (p. 40, as cited in Pathak 2010).

Wagle (2019) has also mentioned that natural measures and newly developed chemical pesticides, insecticides and vitamins are used as plant protection measures in Nepal. The history of natural measures is so long in the country. Farmers have been using local herbs and cattle production (Nim, Titepati, Timur and Urine of cattle etc) to protect their crops for a long time. However, the newly developed pesticides, insecticides and vitamins were used only after 1972. At first, such newly developed measures were used in maize. After that, they used those technologies in paddy and vegetables farming respectively. The present situation of using such technologies shows that eastern hills of Nepal are either suffers from diseases or lack of nutrients in soil. It is an outcome of unscientific use of newly developed agricultural technologies In this context this paper has tried to analyze the prospects and threats of using plant protection measure technology in cereal and cash crops by raising research question what are the major prospects and threats of using plant protection measures in agricultural works of the eastern hills.

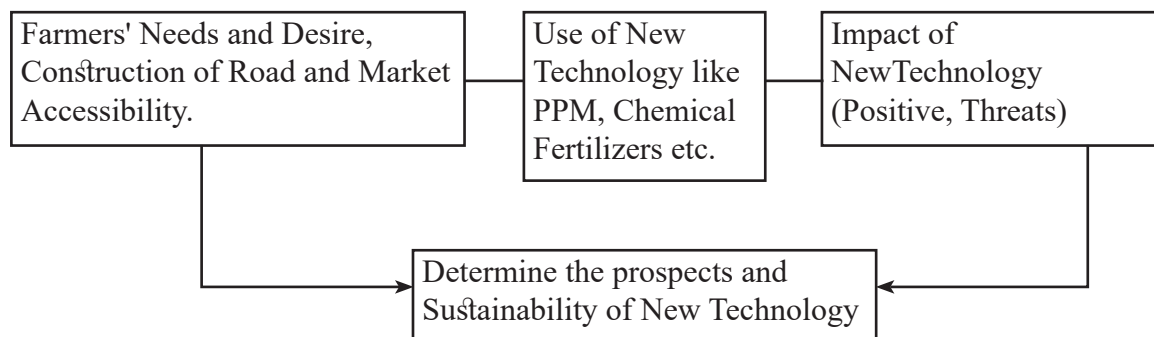
Methods and Material

This study is mainly based on field survey data through observation, focus group discussion, pre-structured (short) questionnaire and key informant survey focused on not only the protection of crops from disease but also the promotion of their health and quality with increasing production. For this purpose, the specific study area was determined along the buffer of 1.50 km of the Koshi Highway of Dhankuta district based on central place theory of Walter Christellar where rapid changes in agriculture sector have occurred over the past few decades. The study area was divided in three ecological belts on the basis of agro-climatic classification of the then District Agriculture Development Office Dhankuta, 2016 namely upper altitude (<.2000masl), middle altitude (1001 -2000masl) and Lower altitude (>1000masl) belts. Atleast 3 study centers were taken as representative form the each belts randomly. The study was based on stratified random sampling method. For this purpose, almost 30 percent (180hhs) farm households were selected out of total 601

households from three ecological belts having more than 0.50 hectare arable land. Among them, more than 72 percent (130hhs) farmers are using some forms of such measures now. Secondary data were gathered through various books, journals and official records. In addition, collected data were tabulated as required. Simple statistical tool percentage is used for the analysis of collected data. On the basis of analyzing these data, a descriptive paper is prepared. Both quantitative and qualitative techniques have been used in order to achieve the goal. The entire analysis of the study has guided through the concept illustrated in the figure 1 based on State- impact process.

Figure 1: A Conceptual Frame of Analysis

Exerts Pressure



Source: Pradhan & Pradhan (2006, p.28)

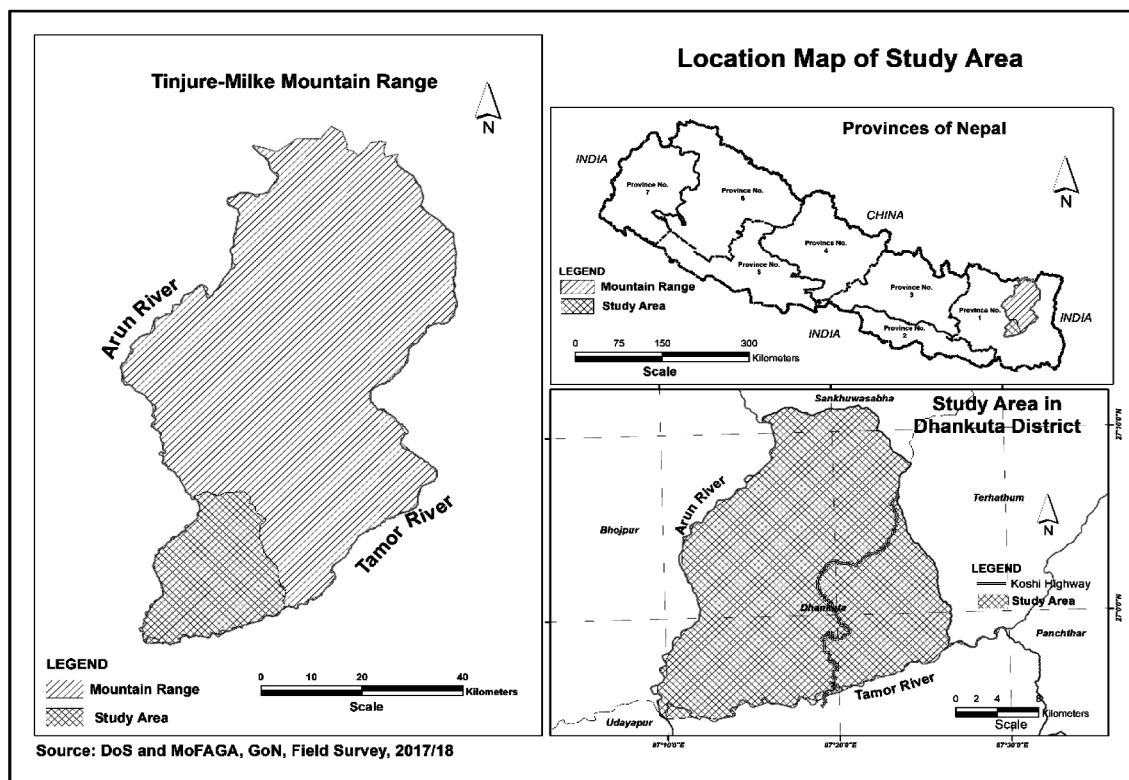
Study Area

The eastern hills of Nepal is full of specific characteristics in comparison with other parts of Nepal in various ways, such as geographical, ecological, historical, socio-cultural and economic perspectives (HMG/MoE, 1974). The farming population of this area is also living in subsistence agricultural system. It is an area of great natural and social diversity, resulting from the tremendous geographical and climatic extremes. In this area, altitudes (300-2250masl) and climates are ranging from sub-tropical to alpine and long periods of winter dryness altering with torrential downpours during the monsoon. This is a challenging for human survival. It is mainly due to poor resource base, especially, cultivated land; the extreme terrain and climate mean that communications are often poor and infrastructure minimal. The majority of the people who live in this region are subsistent farmers. Over the centuries, these people have developed strategies for survival that can be maintained independent of contact with the adjacent regions. Indeed, such conditions are found in the Hindu-Kush Himalayan Region (Ya & Tulachan, 2003, as cited in Wagle, 2019).

Moreover, majority of farmers living in this area seem to have gradually changed their socio-economic conditions after the use of new technologies in their agricultural

works. Koshi Hill Area Rural Development Project (KHARDEP) is one of the Integrated Rural Development Program (IRDP) approach launched in the eastern hills of Nepal. KHARDEP has made Koshi Highway. It has been able to transfer technology through, improved seeds, technical knowledge for the protection and promotion of crops, farmer training, exposure visits and field demonstration etc. In addition, the contribution of District Agriculture Development Office (DADO, Dhankuta), the then National Orange Research Center (NORC, Dhankuta) and other non-governmental organizations also seems very important. With all these efforts, the Koshi Highway seems to have brought major changes in the agricultural development of this area since the mid 1980s (Wagle, 2019). In the study area, Koshi highway provides access to the supply of new technologies like chemical fertilizer, improved seeds and plant protection measures at a significant rate. Indeed, it was comparatively low in the past (Pathak 2010). The use of new technologies in this area seems especially for high-value cash crops and off-season vegetable farming. But the amount of use of agricultural inputs is decreasing with the increasing distance from the road (Khatiwada, 2014). This situation is relevant to not only in the eastern hills, but also equal to other similar regions of Nepal and several developing countries (Wagle, 2019). Thus, it is relevant to the rigorous study about the result of using such technologies and changing attitudes of the farmers towards the selection of crops

Figure 2 : Location Map of the Study Area



Results and Discussion

Adoption Trend of Plant Protection Measures

The farmers have been using this technology as pesticides, insecticides and additional nutrients of crops in the agricultural works. Besides, all farmers are familiar with this technology and also have basic knowledge about it. The few farmers had started to use this innovation before 1980 through the inspiration of the then Pakharibas Agriculture Centre (PAC) in cereal crops. It was adopted in maize at first and then used in paddy production soon (Wagle, 2019). The field study reveals that it has been diffusing with various intensities after 1980 till now. However, the field study figures show that few farmers had already adopted this innovation before 1980. The key informant has reported that it had started in the study area through the inspiration of the then Pakharibas Agriculture Centre at that time. However, the acceptance of this remedy seems relatively higher after the extension of vegetable farming in the eastern hills (Table 1).

Table 1: Adoption Trend of Plant Protection (In hhs)

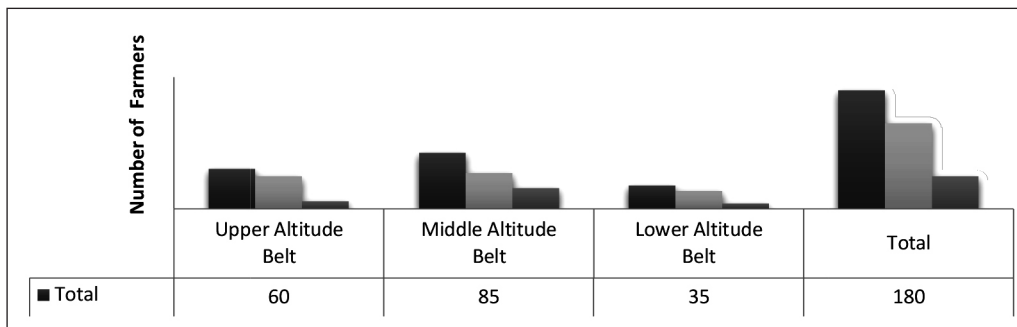
Years	Ecological Belts							
	Upper Altitude		Middle Altitude		Lower Altitude		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
<= 1980	0	0	7	5.39	0	0	7	5.39
1981 - 1990	4	3.08	15	11.54	1	0.78	20	15.39
1991 - 2000	33	25.40	21	16.15	11	8.46	65	50
2001 - 2010	10	7.69	11	8.46	10	7.69	31	23.84
2011 -2020	2	1.54	0	0	5	3.85	7	5.39
Total	49	37.70	54	41.54	27	20.77	130	100

Source: Field Survey, 2020, Wagle, 2019.

Table 1 reveals about the historical development of diffusion of plant protection measures in the study area. The figure indicates that more than 5 percent (7hhs) farmers had already used this technology before 1980. Almost 15 percent (20hhs) farmers had adopted this innovation during the period of 1981 to 1990 in their agricultural works. The adoption is higher from 1991 to 2000. It was rapidly widespread and reached at the highest level at that duration. The figure shows that exactly 50 percent (65hhs) farmers have been added as the adopters at that time. After that, the adoption has been decreasing continuously till now. The field survey data indicates that nearly 24 percent (31hhs) farmers have involved in agricultural works by using such measures in the period of 2000 to 2010. And the adoption seems to have decreased rapidly after 2011 in comparison with previous period and currently limited to about 5 percent (7hhs). Now most of farmers

are using this technology especially for off-season vegetables. In this way, more than 72 percent (130hhs) farmers have used this measure in the present days. Due to the growth of these technologies' acceptableness in the study area, an existent traditional agriculture system gradually steps forward towards professional agricultural system. The current state of use of this technology is demonstrated in the figure (Figure 3).

Figure 3 :Current State of Using Plant Protection Measures



Source: Field Survey, 2016.

The regional variation in the adoption also seems in the study area. The figure concocts that around, 38 percent (49hhs) adopter farmers live in the upper altitude, almost 42 percent (54hhs) settle in the middle altitude and nearly 21 percent (27hhs) live in the lower altitude belts in the present days. Now they are using both curative and preventive measures to protect their crops (Table 2).

Table 2: Use of Plant Protection Measures According to Distance and Altitude Belts (In hhs)

Altitude Belts		Distance from Head Road Links (In meters)			Total	
		<= 500	500 - 1000	1000-1500		
Adopters	Lower	Number	10	10	7	27
		Percent	7.69	7.69	5.39	20.77
	Middle	Number	16	20	18	54
		Percent	12.31	15.37	13.85	41.54
	Upper	Number	17	17	15	49
		Percent	13.08	13.08	11.54	37.69
Total	Number	43	47	40	130	
	Percent	33.07	36.16	30.77	100	

Source: Field Survey, 2020.

The local agricultural technicians have reported that the adoption trend depends on nature of crops rather than the altitude. So, the adoption seems relatively high in the vegetable cropping area. However, Pathak (2010) had found higher adoption rate in cereal crops than vegetables in the similar study of Dhading district.

In addition, the table also shows the present situation of using this innovation in term of distance also. The degree of variation in adoption seems clearly. The table 2 indicates that more than 33 percent (43hhs) adopter farmers reside along the 500 meters distance from the headway links. Similarly, more than 36 percent such farmers (47hhs) reside from the distance of 500 to 1000m of the main road. Likewise, almost 31 percent (40hhs) adopters live from the distance of 1000 to 1500m of the headway.

The figure indicates that the users of this innovation are increasing according to the distance increasing from the headway links along the distance 1000m. The intellectuals have reported that the extension of cash crops farming due to the availability of sufficient of fertile land is major reason to develop this pattern. Besides, the extension of agricultural roads networking, increasing public awareness, and extension of service centers have also helped to extend adoption far away from the headway link. The study of Pathak (2010) in the case of Dhading district also supports this result.

Use of Plant Protection Measures in Selected Crops

The adoption of plant protection measures also varies from one crop to another. The variation seems so much significant. In general, the newly developed measures are used for both cereal and cash crops although the focus of the farmers seems in cash crops because of their weak immune capacity and needs of additional nutrient in the short period of time (Table 3).

Table 3: The Use of Plant Protection Measures in Selected Crops (in hhs)

Crops	Altitude Belts			Total
	Upper	Middle	Lower	
Cereal Crops	0	5	0	5
Percent	0	3.85	0	3.85
Vegetables	42	30	21	93
Percent	32.31	23.08	16.15	71.54
Both	7	19	6	32
Percent	5.39	14.61	4.62	24.61
Total	49	54	27	130
Percent	37.69	41.54	20.77	100

Source: Field Survey, 2020.

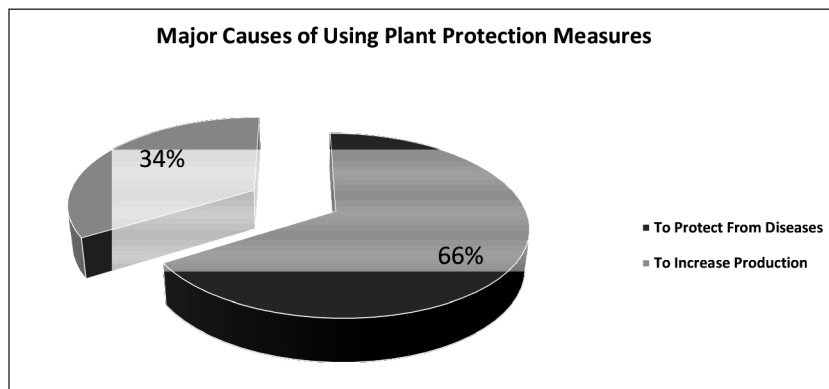
Table 3 depicts that more than 71percent (93hhs) farmers use this technology only for vegetable farming. The key informats remark that they are also known as quick adopters of innovations which do not match with the study of Pathak (2010) in the context of Dhading district. He has found paddy farmers are relatively quicker than other farmers. Similarly, nearly 25 percent (32hhs) farmers use it for the both crops and around 4 percent (5hhs) farmers have used only for cereal crops. However, both frequency and quantity of adoption seems higher in vegetables rather than crops. It means the major focus of the farmers seem to promote cash crops for their agricultural works.

Moreover, the use of traditional methods is also in the prevalence for the both crops and in limited area. The adoption rate of newly developed measures is decreased because of the various harmful effects in human health (Wagle, 2019). In addition, the key informants have stated that the intension of local farmers is gradually increasing towards organic and toxic free farming.

Major Casuseof Using Plant Protection Measures

The field survey data indicates that the protection of crops from diseases is major reason behind the use of plant protection measures. Moreover, to increase the productivity by supplying additional nutrients in the crops as vitamins is another key reason to adopt this technology in the study area (Figure 4).

Figure 4: Major Causes of Using Plant Protectio Measures



Source: Field Survey, 2020.

The field survey figures (2020) figures show that more than 66 percent (86hhs) adopter farmers use this technology to protect their crops from the different diseases. Besides, almost 34 percent (44hhs) adopter farmers have used it for the purpose of increasing productivity as instant source of nutrients in their crops.

Types of Plant Protection Measures Used in Agriculture

The farmers have been using two major types of protection measures for their agricultural works namely traditional and modern measures. However, the adoption of Traditional measures are comparatively lower than modern (Table 4).

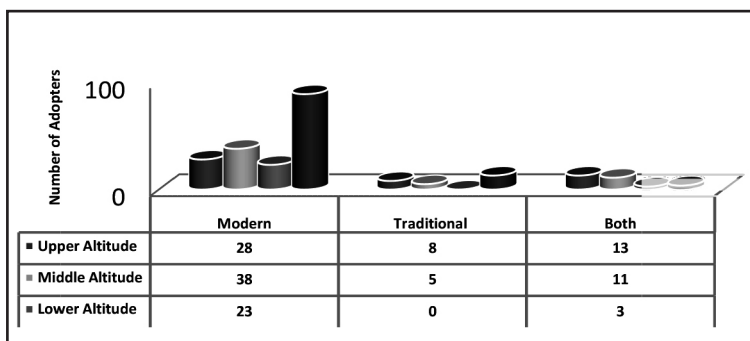
Table 4: Types of Plant Protection Measures used in Agriculture

Types	Altitude Belts			Total
	Upper	Middle	Lower	
Traditional	8	5	0	13
Percent	6.15	3.85	0	10
Modern	28	38	23	89
Percent	21.54	29.23	17.69	68.46
Both	13	11	4	28
Percent	10	8.46	3.08	21.54
Total	49	54	27	130
Percent	37.69	41.54	20.77	100

Source: Field Survey, 2020.

The figure indicates that the demand of modern protection measures is higher than traditional measures. According to the local elite farmers, it is not the interest of the farmers but an obligation. They say that its use is compulsory for crop protection and growth and without its use the cultivation of improved seed would not be possible. According to the figure of the table, more than 68 percent (89hhs) adopter farmers are using this technology in current days. Then the number of farmers using both measures is around 22 percent (28hhs) and the number of traditional method users is only 10 percent (13hhs). Although the number of traditional technology users' seems to be low, the belief in it is still deeply ingrained in their minds (Wagle, 2019).

Figure 5 :Types of Plant Protection Measures Used in Agriculture



Source: Field Survey, 2020.

Frequency of Using Plant Protection Measurs

The frequency of using protection measures depends on the nature crops. Moreover, it also depends on the the frequency of diseases, the amount of nutrients in the soil and the quantity of compost manure used in the farm. The use of this technology seems to be more in cash crops and less in cereals. This technicque is usually used once in cereals and twice or more in vegetables (Table 5).

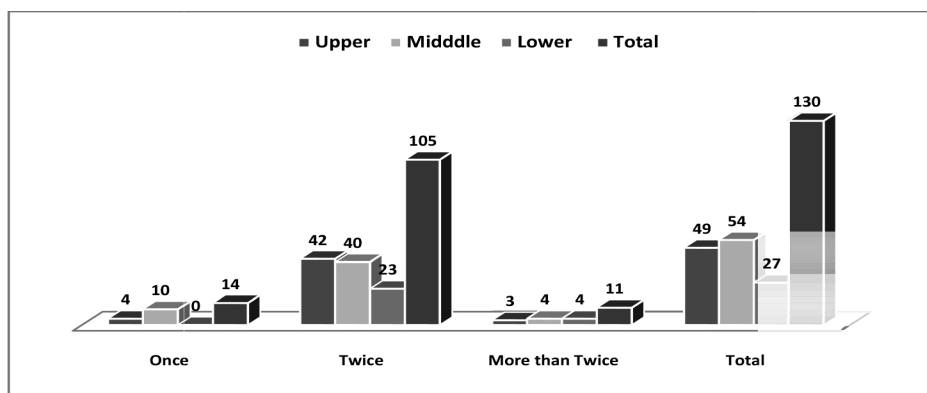
Table 5: Frequency of Using Plant Protection Measures

Frequency	Altitude Belts			Total
	Upper	Middle	Lower	
Once	4	10	0	14
Percent	3.08	7.69	0	10.77
Twice	42	40	23	105
Percent	32.31	30.77	17.69	80.77
More than Twice	3	4	4	11
Percent	2.31	3.08	3.08	8.46
Total	49	54	27	130
Percent	37.69	41.54	20.77	100

Source: Field Survey, 2020.

Most farmers seem to use this technology twice a year. The figure of table reveals that more than 80 percent (105hhs) adopters are using it twice a year. It is followed by nearly 11 percent (14hhs) farmers using once a year and around 8 percent (11hhs) farmers by using more than twice a year among the total adopters. Thus, from the current perspective, the use of plant protection measures has been widespread in eastern Nepal.

Figure 6: Frequency of Using Plant Protection Measures



Source: Field Survey, 2020.

Major sources of Inspiration to Use Plant Protection Measures

The acceptance of plant protection measures depends on various sources of inspiration. Wagle (2019) has remarked that the newly developed protection measures were used in the eastern hills before 1980 at first. Initially, it was introduced by local elite farmers through the technical and financial support of local research centers then rapidly diffused in the surrounding area with the help of various sources such as neighbors, friends and relatives, agricultural technicians, and television programs etc (Table 6).

Table 6: Major Sources of Inspiration to Use Plant Protection Measure (in hhs)

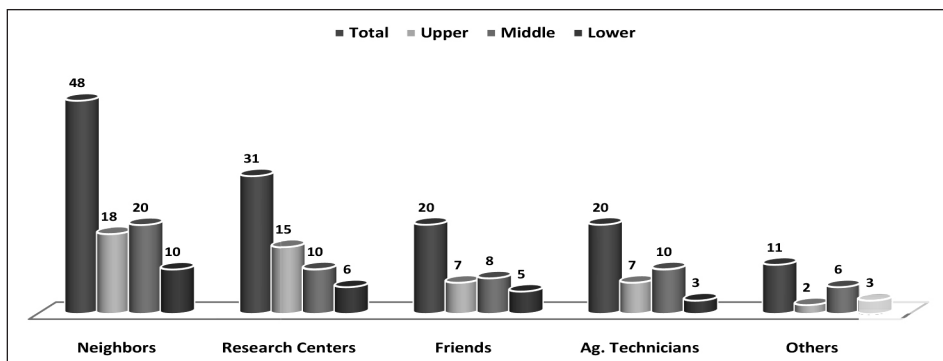
Altitude Belts	Number	Sources of Inspiration						Total
		Ag.Tec	Friends	Neighbors	Own	RC	Television	
Upper	Number	7	7	18	0	15	2	49
	Percent	5.39	5.39	13.85	0	11.54	1.54	37.69
Middle	Number	10	8	20	4	10	2	54
	Percent	7.69	6.15	15.38	3.08	7.69	1.54	41.54
Lower	Number	3	5	10	2	6	1	27
	Percent	2.30	3.85	7.69	1.54	4.62	0.77	20.77
Total	Number	20	20	48	6	31	5	130
	Percent	15.38	15.38	36.92	4.62	23.85	3.85	100

Source: Field Survey, 2020.

Table 6 shows that neighbors are pioneer for rapid diffusion of protection measures among the sources of inspiration. The figure reveals that nearly 37 percent (68hhs) of the adopter farmers are benefited from the communication of their neighbors. Likewise, the research centers itself seem as next important media to communicate this message. The figure indicates that around 24 percent (31hhs) of the adopter farmers move towards adoption through the inspiration of research centers

Moreover, the role of friends and agricultural technicians also seem remarkable towards the acceptance of this technology. The figures show that more than 15 percent (20hhs) adopter farmers have adopted this innovation with the contact of their friend and the same number the farmers have inspired through the inspiration of agricultural technicians. Besides, around 4 percent (5hhs) adopters move towards the use of this technology from the motivation of television programs and nearly 5 percent farmers have used it at their own discretion. The studies of Pathak (2010) and Wagle (2012) also support this result partially. They have found the decisive role of neighbors to diffuse protection measures in the study of Dhading and Dhankuta districts.

Figure 7: Major Sources Inspiration to Use Plant Protection Measures



Source: Field Survey, 2020.

Major Problems of Using Plant Protection Measures

Farmers in eastern hills of Nepal have to deal with various problems in their agricultural works. Difficult to identify diseases, unavailability of preventive measures in proper time, lack of knowledge for proper use and harmful effect on human health seem to be remarkable (Wagle, 2019). The detail information about these problems is listed in the table (Table 7).

Table 7 :Major Problems of Using Plant Protection Measures (in hhs)

Altitude Belts	Number	Major Problems				Total Users
		DID	LKPU	HH	UAT	
Upper	Number	24	10	10	5	49
	Percent	18.46	7.69	7.69	3.85	37.69
Middle	Number	20	20	10	4	54
	Percent	15.39	15.39	7.69	3.08	41.54
Lower	Number	12	8	4	3	27
	Percent	9.23	6.15	3.08	2.31	20.77
Total	Number	56	38	24	12	130
	Percent	43.08	29.23	18.46	9.24	100

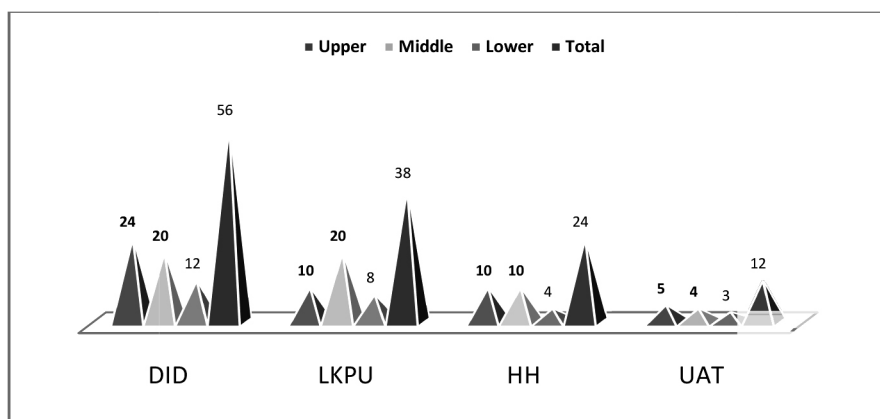
Source: Field survey, 2020.

Note: - DID- Difficult to Identify Diseases HH- Harmful to Health
LKPU- Lack of Knowledge for Proper Use UPT- Unavailable at Appropriate Time

Table 7 exhibits four major problems intensively faced by the farmers at the period of adoption. The identification of diseases is most extreme among them. The figure exhibits that more than 43 percent (56hhs) adopter farmers have reported that more technical person needs to identify the crops diseases for diagnosis in appropriate time but the services of agricultural technicians do not seem to be remarkable in time in rural areas of eastern hills.

Similarly, the second extreme problem is the lack of knowledge for proper use of this technology. The figure indicates that around 29 percent (38hhs) adopter farmers have put this problem in top priority. Likewise, harmful to human health seems as third miserable problem in the eastern hills of Nepal. The figures concocts that nearly 18 percent (24hhs) farmers express their view towards the support of this problem. In addition, the untimely availability of protection measures is seen as next remarkable problem in the study area. The figure describes more than, 9 percent (12hhs) farmers have put this problem in the first priority among their major problems.

Figure 8: Major Problems of Using Plant Protection Measures



Source: Field survey, 2020.

Moreover, most of the farmers are suffering from the above mentioned problems in one way or another so they have prioritized those problems (Table 8).

Table 8: Problems of Using Plant Protection Measures in Priority of the Farmers

Problems	Priority Order			
	First	Second	Third	fourth
Difficult to Identify Diseases	56	30	21	23
Percent	43.08	23.08	16.15	17.69
Lack of Knowledge for Proper Use	38	50	25	17
	29.23	38.46	19.23	13.08
Harm to Human Health	24	25	51	30
Percent	18.46	19.23	39.23	23.08
Unavailable at Appropriate Time T	12	25	33	60
Percent	9.24	19.23	25.39	46.15
Total	130	130	130	130

Source: Field Survey, 2020.

Perception of the Farmerson Plant Protection Measures

The local elder agricultural scientists and elder farmers have reported that the attitude of the stakeholders does not seem so positive towards newly developed plant protection measures but they have positive attitude towards traditional measures (Wagle, 2019).

Table 9: Perception of the Farmers on Plant Protection Measures (in hhs)

Altitude Belts		Attitude towards Plant Protection Measures			Total
		Constant	Decreasing	Making Zero	
Lower	Number	2	13	12	27
		1.54	10	9.23	20.77
Middle	Number	9	20	25	54
	Percent	6.92	15.39	19.23	41.54
Upper	Number	1	16	32	49
	Percent	0.80	12.30	24.60	37.70
Total	Number	12	49	69	130
	Percent	9.23	37.70	53.08	100

Source: Field Survey, 2020.

The major perceptions identified by the household survey in 2020 are listed in table (Table 9). Table 3.9 concocts the experience based perceptions of the farmers about this technology. The figure indicates that more than 53 percent (69hhs) adopter farmers want to forsake newly developed measures completely by increasing the adoption of traditional measures due to the serious drawbacks. Similarly, around 38 percent (50hhs) farmers want to decrease its use in the large quantity from the same problems and almost 9 percent (12hhs) of adopter farmers want to give the continuity in same quantity and ratio. This situation also confirms the previous result but they compel to accept modern measures as a necessary evil.

Conclusions

Plant protection measures are known as important technology for protection and promotion of both cash and cereal crops in the eastern hills of Nepal. More than 72 percent (130hhs) farmers have used this as a new innovation. The attraction of farmers towards traditional measures seems to be gradually increasing however; the newly developed measures are accepted as a necessary evil. The maximum effort of the farmers seems to reduce the use of newly developed measures as far as possible. If possible, they want to complete forsake it. Moreover, it is well diffused in the study area due to the problems introduced from the unscientific use of new technologies in the agricultural sector. Thus,

the use of traditional measures is as the wishes of the farmers, while the adoption of newly developed protection measures is found to be unintentional. But in the present context, there is no possibility of reducing the newly developed measures even if farmers want to. In addition, lack of timely identification of crop diseases, negative impact of chemical pesticides on human health and inadequate availability of these technologies on time are major threats of using newly developed measures in present situation. Thus, it seems inevitable to emphasize on the development and expansion of traditional technologies by gradually reducing the use of newly developed technologies and it is also the burning issue of present society.

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