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Determination on the level of adoption of IPM Technology in western Nepal

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Abstract— *Integrated Pest Management (IPM) is as a broad based approach for economic control of pests. A study on determination of level of adoption of IPM technology was conducted in the Banke and Surkhet districts of Nepal. For determining the spread of information and level of adoption, farmers were asked a series of questions during the survey to determine knowledge of IPM and level of IPM adoption. Using descriptive statistics and differences in means, analysis was done on relationships among access to information, IPM knowledge and adoption. This study revealed that 51.13% of the population were male with an average family size was 6.45. Almost half of the respondents had adopted IPM practices for vegetable production by receiving advice or getting training about IPM technology through agriculture officer, Market Planning Committee, I/NGOs, etc. Market Planning Committee has played a vital role in spreading IPM knowledge and information quickly, followed by mass media, as MPCs allow farmers to aggregate smallholder produce to meet market demand. Several farmer organizations join together and elect representatives to serve on the board of the MPC and have regular monthly meeting so that they could discuss on IPM technology and marketing strategy of the products. MPC group has been identified more effective in improving knowledge of IPM than other farmers' groups.*

Keywords— ***IPM Technology, Knowledge, level of adoption and dissemination.***

I. INTRODUCTION

Agriculture is the main source and backbone of Nepalese economy. It provides employment opportunities to around 65 percent of the total population and contributes about 31.23 percent in the GDP. Nepalese agriculture has stumpy productivity, depriving farmers of a sustainable livelihood. Especially in the mountain region, people who endure by cultivating cereals on mountain slopes, small valleys and river basins to meet their basic needs, often have low income and suffer from food deficits. Therefore to diminish farm-poverty, the country, through various plans and policies (NPC, 1995; NPC, 1998; NPC, 2003; NPC, 2007; MOAC, 2004; MOICS, 1992), identified vegetables to harness the advantages of agro ecological diversity in Nepal. For reducing the poverty a planned has been made in a vegetable promotion strategy for small holders to capture the comparative advantage of vegetable production and marketing in economic growth and development.

The most restricting factor to accelerated crop production is pests and diseases (Wilson, 2001). In annual, an average of 32.1 percent of the global crop production is lost because of pests (Dhawan *et al*., 2010). Pests are the major constraint to increased vegetable production. In developing countries, including in total agricultural production and post-harvest losses due to pests is 25-50% of total production (IPM-IL, 2013). The cost of pesticides can be as much as 35% of total agricultural production costs in developing countries (Karim, 2009). Various approaches had been practiced for the diffusion of IPM technologies in Nepal, including farmer field school (FFS), field day, group dissemination through market planning committee (MPC); demonstrations, training, field days, written media (pamphlets), etc. through FAO, Integrated Pest Management Innovation Lab (IPM IL), KISAN, and Caritas Nepal among others. Given only limited involvement of the public sector in technology transfer, decision makers/policy makers should need information about farmers on the depth of knowledge and level of adoption on IPM technology. This understanding can help promote better technology transfer and helps in sustainable vegetable production through IPM in Nepal.

II. METHODOLOGY

2.1 Selection of the study area

The study was conducted in Banke and Surkhet districts of Nepal. These districts were the major vegetable growing areas in Nepal and IPM IL program funded by USAID was promoted in that area for the vegetable production through IPM technology. Altogether, 500 households were randomly selected as the samples comprising of 42 farmers from each of six VDCs of each district, which included farmers and marginalized people.

2.2 Spread and source of information by IPM adoption level

To assess the spread of information, farmers were asked a series of questions during the survey to determine knowledge of IPM and degree of IPM adoption. Using descriptive statistics and differences in means, analysis was done on relationships among access to information, IPM knowledge and adoption, and word-of-mouth diffusion of IPM techniques to neighboring farmers. Estimating the speed at which each method delivers information to farmers is based on information obtained about the different methods but is not based on formal quantitative analysis. If farmers do not receive information in a timely manner, the technology may lose its usefulness by the time it reaches them. Based on expert opinion on the study area, it was assumed that marketing planning committee reaches farmers at the fastest rate of all formal methods. Other methods, such as mass media, collection centre, field day, farmer field school, neighboring farmer, agriculture officer, community business facilitators (CBFs), cooperatives and agro-vets may not transfer information as quickly as market planning committee, but may be more effective at spreading information faster than farmer field school (FFS).

Adoption intensity was defined according to the following five categories:

1 = 0% adoption

2 = 1% - 25% adoption

3 = 26% - 50% adoption

4 = 51% - 75% adoption

5 = 76% - 100% adoption

Adoption percentages was calculated by taking the total number of recommended IPM activities and determining the percentage of activities utilized by each farmer.

2.3 Knowledge on IPM technology

Knowledge of an innovation is usually preceded by awareness of a need, and it is need awareness that precipitates active knowledge seeking behavior in order to address the need. Since IPM is a multi-dimensional concept (Dent, 1995), a summated ratings scale consisting of six attributes, with a score range of 0-11, was devised to measure farmers' knowledge of IPM. Each of these knowledge attributes were considered fundamental to a strong working knowledge of IPM and have been validated in previous IPM studies in Uganda (Erbaugh, et al., 2001; Morse & Buhler, 1997). The coefficient of reliability for the knowledge of IPM scale was 84, indicating an acceptable level of reliability (Nunnally, 1978). The first item was asked whether they heard about IPM on 0-2 scale, where 0 indicated didn't heard about IPM; 1, indicated a partial heard about IPM; and 2, indicated a more complete known about IPM. Partial and more complete known were scored if farmers give description of IPM with examples. The second question was asked to the farmers if they can define the IPM on a 0-2 scale, where o indicated unable to describe IPM; 1, indicated a partial description of IPM; and 2, indicated a more definition of IPM. The third item was asked whether they were aware of merits of IPM on a 0-3 scale, and was coded 0 if they were unaware; and 1-3 if they were aware of one or more of the potential merits. A fourth item was asked to farmers whether they use pheromone traps on a 0-2 scale, and was coded o if they don't use and 1-2 on the basis of partial and complete use of pheromone traps. A fifth item asked was if they knew alternative pest management practices, with a no (0) response indicating that they were not aware of alternative pest management practices; and coded 1-3 on the basis of partial to complete use of alternative pest management practices, and the last item asked was whether they use mulching practices on a 0-2 scale, and was coded 0 if they don't use and 1-2 on the basis of partial and complete use of mulching practice.

2.4 Scaling technique

Scaling technique is the tool to study the degree and direction of attitude of the respondents towards any proposition. A respondent is asked to choose among various categories indicating his / her strength of agreement and disagreement. The categories are assigned scale values and the sum of the values of the categories is the measure of attitude of respondents (Miah, 1993).

The priority index for the problem was computed by using the following formula:

$$I = \sum f_i\, s_i / N$$

Where, I= priority index such that $0 \leq I \leq 1$

f_i= frequency of i^{th} priority (category)

s_i= scale value at i^{th} priority

N= Total number of participants $=\sum f_i$

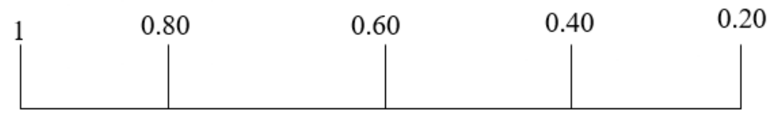

Fig.1: Scale value for intensity of situation.

III. RESULTS AND DISCUSSION

3.1 Area and production of vegetable crops in Nepal

In Nepal, vegetable production is the primary occupation for most of the people who are mostly smallholders and have low incomes. According to the Central Bureau of Statistics (2009-10) & Ministry of Agriculture and Cooperatives (MoAC), vegetable crops are cultivated in only 7.3 percent of the total cultivable land in Nepal. Total worth of vegetables (excluding potatoes) produced during 2009/10 was around Rs. 105 billion, which is 8.8 percent of the country's GDP. Per capita vegetable consumption has increased to 105 kg from 60 kg over last two decades due to massive rise in agriculture and production area.

The study revealed that both area and productivity of the vegetables in Nepal were in increasing trend over the time. The positive value of the slopes indicates the decreasing trend on area allocation over the time. The area and production for vegetables was increasing at 6,902 ha per year and 13,254 mt. ton/year, respectively, in Nepal over the last 10 years as shown in figure 2.

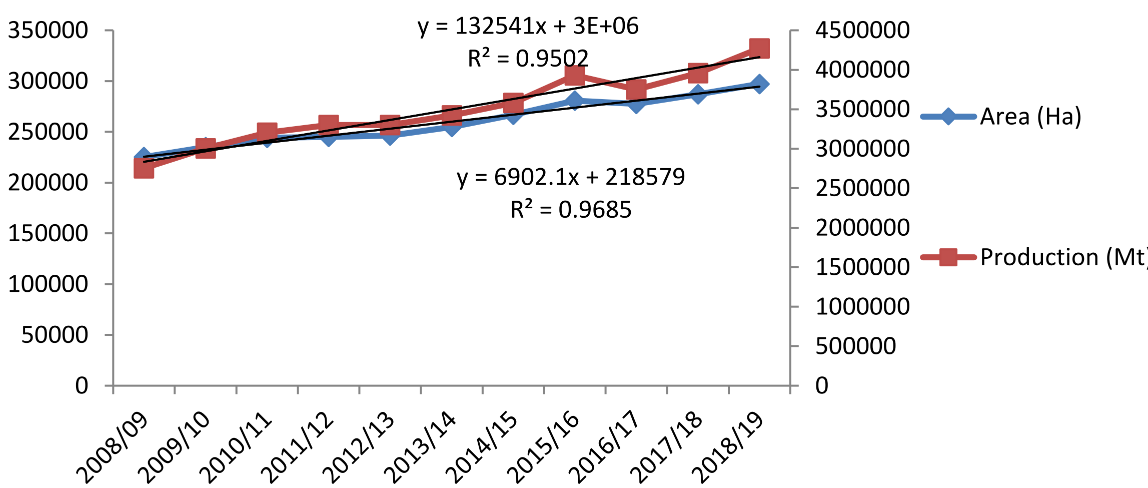

Fig.2: Area and productivity of vegetables over the time in Nepal (2075/76)
Source: Statistical Information on Nepalese Agriculture (2075/76)

3.2 Family size of the respondents

The population distribution showed that the population size was greater in Banke district than Surkhet because of low level of literacy in the Banke district. The average family size of the surveyed area was 6.45, particularly, 7.84, and 5.05 in Banke and Surkhet districts, respectively. The average family size in the study area was greater than 5.18 and 4.81 in Banke and Surkhet districts, respectively CBS, (2011). The higher family size may be due to the lower literacy rate in the study area. The detailed family size is described in table 1.

Table 1. Family size of the respondents in the study area

Average family size Banke(Mean ±SD)	Surkhet(Mean±SD)	Total Average(Mean±SD)	Minim-um	Maxi-mum	Modal size
7.84±2.07	5.05±1.78	6.45±1.92	1	12	5

Source: Field Survey (2019)
SD= Standard Deviation

3.3 Cultivation of vegetables

In the study area it has been found that 30% of the households have cultivated tomato, followed by cauliflower/cabbage (27%), bitter gourd (17%), cucumber (16%) and eggplant (10%). The study revealed that tomato is the major vegetable crops in the study area as given in figure 3.

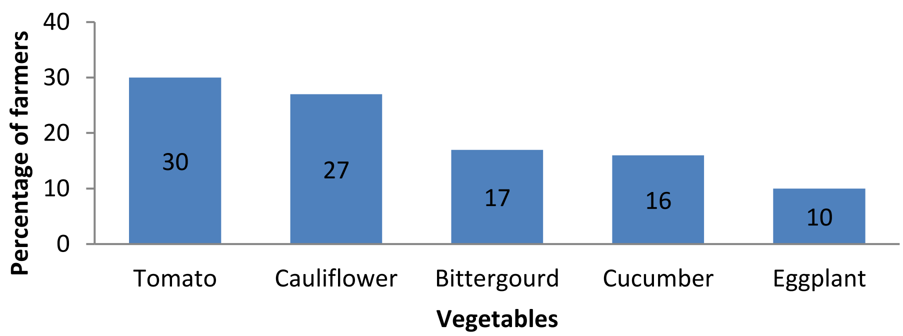

Fig.3: Cultivation of vegetables by the households in the study area.

3.4 Information on pesticide management

Majority of the population approximately 50% of population in the study area received information on pesticide management through agro-vets followed by CBFs/NGOs (27%), DADO (9%), neighbor (9%), family members (2%) and others (2%) respectively as shown in figure 4.

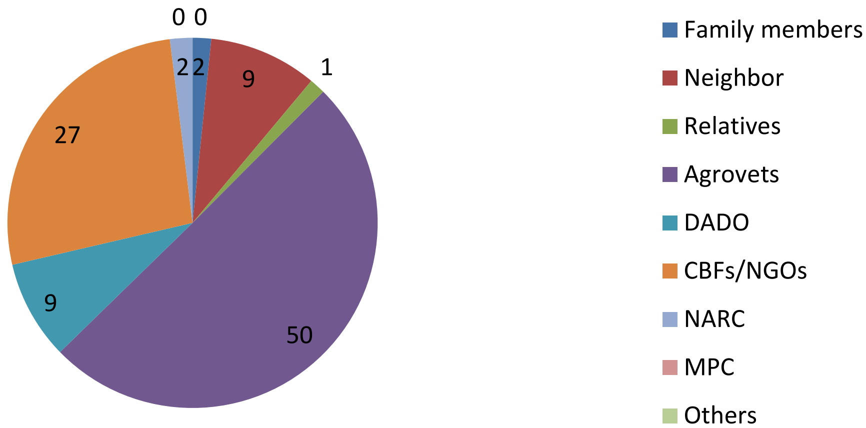

Fig.4: Information on pesticide management.

3.5 Distribution of sample household on IPM technology adoption

In the study area it has been found that 48% of the households have adopted IPM technology for the production of vegetable crops.

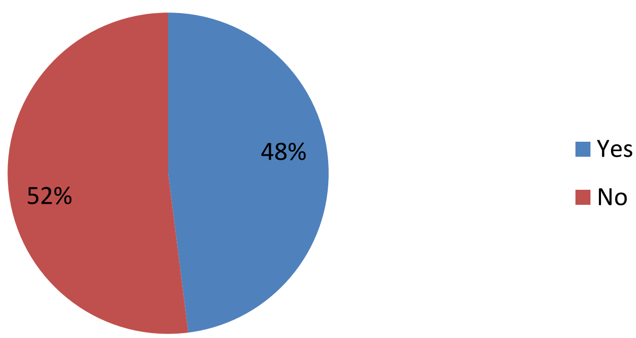

Fig.5: Distribution of sample household on IPM technology adoption.

3.6 Sources of IPM knowledge

The study revealed that most of the respondents (53%) in the study area received advice or learned about IPM technology through agriculture officer (DADO/NGOs), followed by MPC, CBFs, neighboring farmers, mass media, farmer field school, field day, collection centre, Agro-vets and others (cooperatives). In the study area, 35% of the respondents claimed that they had not received advice and/or learned about IPM. The sources or media from where the respondent received or learned about the IPM technology were ranked with index value in table 2.

Table 2. Sources of knowledge for IPM

SN	Sources	Index value	Rank
1	Agriculture officer (DADO/NGOs)	0.97	I
2	MPC	0.95	II
3	CBFs	0.96	III
4	Neighboring farmer	0.93	IV
5	Mass media	0.92	V
6	Farmer field	0.87	VI

	school		
7	Field day	0.85	VII
8	Collection centre	0.81	VIII
9	Agro-vets	0.77	IX
10	Others (Cooperatives)	0.73	X

Source: Field Survey, 2019

3.7 IPM practices used in the study area

Just over 48% of the respondents indicated that they incorporated at least one IPM practice in their production of vegetables. Bio-fertilizers, jholmol and bio-pesticides were the most popular IPM practices, followed by the adoption of pheromone traps, soil amendments, mulching, soil solarization, bagging and grafting. Bio-fertilizers, jholmol and bio-pesticides were adopted most as these practices were easily available, cheap, increase the yield of vegetable and effective in controlling insects and diseases. Similarly, grafting technology was adopted the least, possibly due to the higher level of training and inputs required for successful adoption. In contrasting to the result, Kabir and Rainis, (2015) in their study in Bangladesh had identified among different IPM practices most farmers had adopted sex pheromone traps and soil amendment methods. The findings also indicate that farmers in the study areas hardly used any complex IPM practices, such as bagging, graftings, which is similar to the findings of other studies (Singh *et al*. 2014; Materu *et al*. 2016). Figure 6 depicts the percentage of total respondents adopting each of the nine different IPM practices.

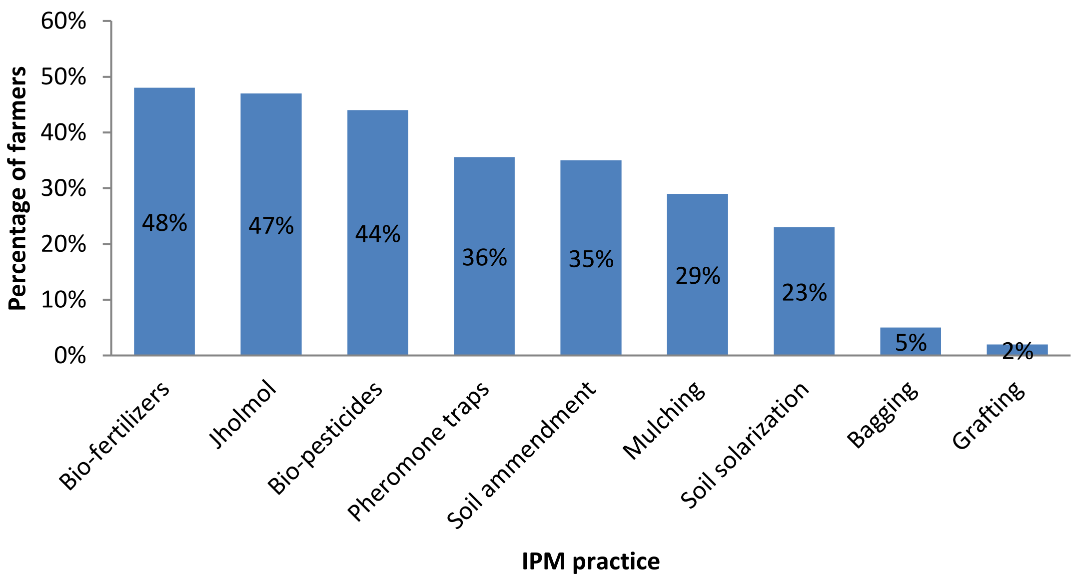

Fig.6: IPM practices used for crop production in the study area

3.8 Knowledge on IPM technology

A t-test was done for assessing differences on IPM knowledge between MPC and other farmers' groups using various scales. The results showed statistically significant difference in IPM knowledge between the two groups at 1% and 5% levels of significance. For all activities, mean scores were higher among farmers who were from MPC group, indicating that MPC group was more effective in improving knowledge of IPM than other farmers' groups (Table 3).

Table 3. Knowledge on IPM of respondents involved in MPC and other farmers' groups

Activities	Range	MPC group (n 90)	Other group (n 90)	df	t-value
IPM knowledge scale	0-11	6.43 (1.45)	0.78 (0.89)	178	-11.12*
Heard about IPM	0-2	2.06 (0.92)	0.86 (0.36)	178	-17.36**
Define IPM	0-2	1.21 (0.58)	0.21 (0.43)	178	-19.32*
Merits of IPM	0-3	1.93 (0.83)	0.57 (0.51)	178	-6.21*
Use of pheromone traps	0-2	1.57 (0.75)	0.86 (0.36)	178	-5.27*
Aware of alternative pest management practices	0-3	1.35 (0.74)	0.64 (0.63)	178	-4.39**
Use of mulching	0-2	1.71 (0.61)	0.43 (0.51)	178	-7.23**

Source: Field Survey 2019

Values in parentheses ~~()~~ are standard deviations; * t-test significant at p<.05, ** t-test significant at p<.01.

3.9 Depth of knowledge about IPM technology by information sources

It has been affirmed that agriculture officer Group contributed the highest IPM knowledge scores but CBF, FFS and MPC also contributed to high scores. Neighboring farmer, field day, mass media, collection centers, agro-vets and cooperatives also have some impact on knowledge, but scores are not as high as agriculture officer group and CBFs. In the study of Maucery *et al.* in 2007 also had identified that FFS had contributed the highest IPM knowledge scores as compared to field day, mass media, pamphlets, etc.

Table 4. Depth of knowledge about IPM technology by information sources.

(Knowledge category was determined by the percentage of IPM question answered correctly by farmers)

IPM knowledge by category	Information Source									
	MPC	Mass media	CC	Field day	FFS	Neighbor	Officer	CBFs	Agrovets	Cops
Category I (0%)	0.0	4.4	0.0	3.5	0.0	16.7	0.0	1.2	11.5	13.5
Category II (1-25%)	15.5	32.3	32.3	27.5	14.5	43.3	0.0	6.5	48.4	39.4
Category III (26-50%)	27.3	42.4	44.6	38.5	16.3	31.4	11.2	17.4	31.6	36.5
Category IV (51-75%)	36.4	17.6	20.4	19.4	44.2	4.7	23.5	47.7	6.3	7.1
Category V (76-100%)	20.8	3.3	2.7	11.1	25.0	3.9	65.3	26.2	2.2	3.5

Source: Survey Data, 2019

Note: A pearson chi^2 test showed significant difference between information sources at 1% level.

3.10 Level of adoption of IPM Knowledge by information source

It has been revealed that out of 500 respondents, 41.5% of the respondents had moderately high to high level of adoption of IPM technology (Category IV and V), 38.2% of the respondents had low to moderate level of adoption (category II and III) and 20.4% of the respondents had not adopted IPM technology (category I) as shown in table 5. The majority of the high level adopters had received information of IPM technology from MPC (68.6%). Farmers who were the member of MPC adopted more IPM technology rather than random farmers. MPC were associated with highest level of adoption. Category V adoption was mainly observed in MPC followed by agriculture officer, farmer field school, field day. The highest adoption rate in category IV was also observed in MPC, farmer field school, agriculture officer and field day (partially attributed to correspondingly high knowledge scores). Diffusion from neighboring farmer-farmer seemed to be less effective as both knowledge scores and level of adoption rates were lower. The lowest rates of adoption were observed in the farmers who had heard of IPM from cooperatives and claimed they had not received information on IPM. Neighboring farmers and cooperatives may lack the expertise to transfer IPM knowledge effectively. In the study of Maucery *et al.* in 2007 also had identified that FFS, field day participants were associated with highest level of adoption. When learning IPM technology, farmers show a preference for more experienced individuals. (Owens and Simpson, 2002)

Table 5. Level of adoption of IPM knowledge by information source

IPM knowledge by category*	Information Source								
	MPC	Mass media	Field day	FFS	Neighbor	Officer	Agro-vets	Cops	Total
Category I (0%)	2.5	27.6	12.6	16.4	32.6	9.2	19.6	42.6	20.4
Category II (1-25%)	11.3	24.2	19.5	13.2	21.6	17.4	29.3	27.2	20.5
Category III (26-50%)	17.6	19.2	19.2	14.4	16.7	14.6	18.2	21.3	17.7
Category IV (51-75%)	35.2	26.7	29.4	31.2	27.1	31.2	24.4	8.9	26.8
Category V (76-100%)	33.4	2.3	19.3	24.8	2	27.6	8.5	0	14.7
Total	100	100	100	100	100	100	100	100	100

Source: Survey Data, 2019

Note: A pearson chi^2 test showed significant difference between information sources at 1% level.

*Adopted categories are defined by % of IPM practices adopted

3.11. Farmers' perception about IPM Practice

The study revealed that 28.2% of the respondent affirmed that IPM practice is good for health as compared to conventional practice which confirms with the finding of Roy *et al.*, (2009).This may be due to the fact that IPM may discourages excess use of harmful chemicals which can cause health problems. 25.8% of the respondent said that it is eco friendly method, 19.7% of the respondent thought that it yields more as compared to conventional practice, 16.5% of the respondent had opinion that it takes more time to implement and 9.2% of the respondent had opinion about that it is more costly practice as compared to traditional practice. 0.7% of the respondents said that they do not know about beneficial effects of the IPM, which indicates that the IPM concept is still not clearly understood by farmers although IPM IL program was running over there. More awareness should be done in the study areas to encourage farmers to reduce harmful pesticide applications. Previous studies done by Allahyari *et al*. in 2016 and 2017 have also identified that improving farmers' technical knowledge of IPM by extension services can minimize excessive spraying of insecticide. Figure 7 depicts the percentage farmers' perception about IPM practices.

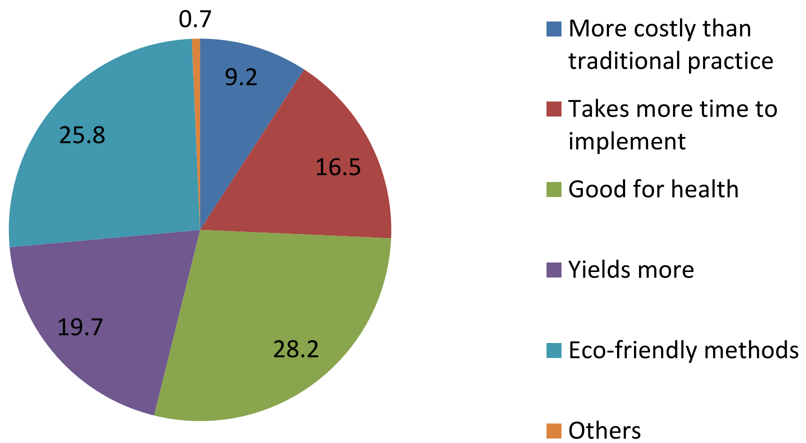

Fig.8: Farmers' opinion about IPM Practice

IV. CONCLUSION

Integrated Pest Management (IPM) is as a broad based approach for economic control of pests. A study on determination of level of adoption of IPM technology was conducted in the Banke and Surkhet districts of Nepal. For determining the spread of information and level of adoption, farmers were asked a series of questions during the survey to determine knowledge of IPM and degree of IPM adoption. Using descriptive statistics and differences in means, analysis was done on relationships among access to information, IPM knowledge and adoption. This study revealed that 51.13% of the population were male with an average family size was 6.45. Almost half of the respondents had adopted IPM practices for vegetable production by receiving advice or getting training about IPM technology through agriculture officer, Market Planning Committee, I/NGOs, etc. Market Planning Committee has played a vital role in spreading IPM knowledge and information quickly, followed by mass media, as MPCs allow farmers to aggregate smallholder produce to meet market demand. Several farmer organizations join together and elect representatives to serve on the board of the MPC and have regular monthly meeting so that they could discuss on IPM technology and marketing strategy of the products. MPC group has been identified more effective in improving knowledge of IPM than other farmers' groups. Farmers who were the member of MPC adopted more IPM technology rather than random farmers. MPC were associated with highest level of adoption.

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