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FACTORS AFFECTING ADOPTION OF BOTANICAL PESTICIDES IN THAHA MUNICIPALITY OF MAKAWANPUR, NEPAL

Ram Hari Timilsina — Assistant Professor and Head of the Department, Department of Agricultural Extension and Rural Sociology, Agriculture and Forestry University, Chitwan, Nepal

Sramika Rijal — Assistant Professor, Department of Agricultural Botany and Conservation Ecology, Agriculture and Forestry University, Chitwan, Nepal.

ABSTRACT This study was conducted in 2017 to analyze the factors affecting the adoption of botanical pesticides in Thaha Municipality, Makwanpur district of Nepal. Thaha Municipality, commercial vegetable production pocket area, was purposively selected for the study. The study area was divided in two clusters, Daman and Palung area. Simple random sampling technique was used to select the 200 samples from both clusters. This research revealed that about 40 percent of farmers were found applying botanical pesticides. Adoption of botanical pesticides was used as dependent variable. Age of the household head, gender, location, family size, education, occupation, farming experience, farm income, farm size, and membership in organization were used as independent variables to determine the adoption factors. Binary logistic regression model showed organizational membership of farmers' had significant positive effect on adoption of botanical pesticides whereas as primary occupation, and farm size were significantly negative at 5 percent level of significance. Age, gender, location, family size, education, and farming experience have no significant effect on adoption. The study revealed that knowledge gap on preparation and use, tradition of using chemical pesticides, easy availability of chemicals, slow effect of botanicals were the major problems of botanical pesticides adoption, respectively. Study suggests that government agencies, extension and research institution should play a role to strengthen the knowledge and networking of farmers' through organizational membership to increase adoption of botanical pesticides.

KEYWORDS : Botanical pesticides, adoption factors

INTRODUCTION

Agriculture is the major sector of Nepalese economy, provides employment opportunities to 60 percent of the total population and contributes about 35 percent in the Gross Domestic Product. Agriculture sector is a key for the development of national economy (MoAD, 2016). Among the several factors of low agricultural productivity, high incidence of pest and diseases was considered as one of the major factors (ADS, 2016). Commercialization and expansion of vegetables production area has increased pesticides use in Nepal. Although chemical pesticides is effective, it is expensive and has created threats on the sustainability of agricultural system due to destruction of the natural ecosystem, hazard on human health (Vaidya, 2017; Talukder, 2006; Isman, 2008).

Thus, there has been an attempt to replace the synthetic pesticides with less expensive, locally available, ecologically safe and socio-friendly options like botanicals (Banwo & Adamu, 2003; Ogendo et al., 2006). Botanical pesticides are the important alternatives to minimize or replace the use of synthetic pesticides and can play greater role in the production and post harvest protection of food in developing countries (El-Wakeil, 2013). Botanical pesticides being used in Nepalese agriculture for over a century, but importance, use, and import exhibit increasing trend in recent years (MOAD/PPD, 2014).

Several organizations in Nepal had conducted extension programs to reduce the heavy use of chemical pesticide in vegetable crops (DADO, Makwanpur, 2016). However, there was less progress on adoption of botanicals, as expected in Makawanpur district. In this context, a study was conducted in Thaha Municipality of Makwanpur, Nepal to know problems and factors affecting the adoption of botanical pesticides.

RESEARCH METHODOLOGY

Makwanpur district of Nepal was purposively selected for the study, as it is one of the commercial vegetable production pocket area. Two hundred vegetable farmers were randomly selected from Daman and Palung area of Thaha Municipality, using simple random sampling for household survey. To determine the factors of adoption, adoption of botanical pesticide was used as dependent variable. Socio-economic factors such as age of the household head, gender, location, family size, years of education, occupation, years of farming experience, farm income, farm size, membership in organizations were used as independent variables. Binary logit model was used to assess the factor affecting adoption. Focus group discussions were conducted to identify the problems in adoption, then problems were ranked during household survey.

Empirical model: The dependent variable is dichotomous, can take the value 1 with probability of success (π) or the value 0 with probability of failure ($1-\pi$). Logistic regression makes no assumption about the distribution of the independent variables. They do not have to be normally distributed, linearly related or of equal variance within each group. The probability of success (π) in logistic model is,

$$P(\pi) = \frac{e^{\beta_o+\beta_1 x_1+\beta_2 x_2+\cdots+\beta_n x_n}}{1+e^{\beta_o+\beta_1 x_1+\beta_2 x_2+\cdots+\beta_n x_n}} \quad \ldots\ldots\ldots\ldots(1)$$

P: probability of success
e: natural logarithm base
β_0: interception at y-axis
β_1: line gradient
β_n: regression coefficient of x_n

$x1, x2, \ldots, xn$: predictor variable which predicts the probability of success (π)

Logit transformation of probability of success can be represented by following equation, $\ln(\pi) = ln\ \frac{(\pi)}{(1-\pi)} = \beta 0+\beta 1\ X1+\beta 2\ X2+\cdots+\beta nXn$ ……..(2)

Here in this study the dependent variable is dichotomous, the adoption of botanical pesticides take the value 1 with probability of success π, whereas the non-adoption of botanical pesticides take the value 0 with probability of failure $1-\pi$. The empirical specification for this study is as follows:

$$\ln(Adoption) = \beta_o+\beta_1 age+\beta_2\ gender+\beta_3\ location+\beta_4\ familysize+\beta_5\ education+\beta_6\ occupation+\beta_7\ experience+\beta_8\ income+\beta_9\ farm\ size+\beta 10\ membership+\mu$$

Where, ln is natural log, μ is an error term and β represents the coefficient of regression of each independent variables (Hosmer & Lemeshow, 2000).

RESULT AND DISCUSSION

Table 1 and table 2 depicted the socio-economic characteristic of the respondents. Majority of the respondent were adult, male having medium sized family. About 76 percent of the respondent were found having agriculture as primary occupation. Majority of respondent were found 15 to 45 years of farming experience, and medium level farm income. About 72 percent of the farmers were found having membership in several organizations. Out of 40 percent farmers

applying botanical pesticides majority were male, adult and having agriculture as primary occupation and same was the case with not applying botanical pesticides.

The results from binary logistic model presented in the table 3 are the factors that influenced use of botanical pesticides. The model log likelihood ratio Chi-square was 35 and significant, supports the existence of relationship between the explanatory variables and dependent variables. Besides, Pseudo R^2 are also more than 20 percent, which was statistically minimum level, further conforming that a large portion of changes in the dependents were attributable to the exogenous factors considered.

Table 1. Explanatory socio-economic variables affecting the adoption of botanical pesticides

Variables	Adoption of botanical pesticides		Total
	Apply	Do not	
Age of respondents (years)			
Young	12 (6)	20(10)	32 (16)
Adult	49(24)	82(41)	131(65)
Old	19 (10)	18 (9)	37 (19)
Total	80(40)	120(60)	200(100)
Gender of respondents			
Male	71 (35.5)	96 (48)	167 (83.5)
Female	9 (4.5)	24 (12)	33 (16.5)
Total	80 (40)	120 (60)	200 (100)
Location of respondents			
Daman	46 (23)	73 (36.5)	119 (59.5)
Palung	34 (17)	47 (23.5)	81 (40.5)
Total	80 (40)	120 (60)	200 (100)
Family Size of respondents			
Small	17 (8.5)	36 (18)	53 (26.5)
Medium	54 (27)	77(38.5)	131 (65.5)
Large	9 (4.5)	7 (3.5)	16 (8)
Total	80 (40)	120 (60)	200 (100)
Education level of respondents			
Illiterate	18 (9)	27 (13.5)	45 (22.5)
Basics	28 (14)	44 (22)	72 (36)
Secondary and below	28 (14)	44 (22)	72 (36)
Higher Secondary	6 (3)	5 (4.5)	11 (5.5)
Total	80 (40)	120 (60)	200 (100)
Primary Occupation			
Agriculture	47 (23.5)	104 (52)	151 (75.5)
Agri. and Business	17 (8.5)	7 (3.5)	24 (12)
Agri. and Employment	16 (8)	9 (4.5)	25 (12.5)
Total	80 (40)	120 (60)	200 (100)
Farming Experience			
< 15 years	8 (4)	22 (11)	30 (15)
15 years to 45 years	56 (28)	83 (41.5)	139 (69.5)
> 45 years	16 (8)	15 (7.5)	31 (15.5)
Total	80 (40)	120 (60)	200 (100)
Annual farm income			
Low	5 (2.5)	16 (8)	21 (10.5)
Medium	50 (25)	90 (45)	140 (70)
High	25 (12.5)	14 (7)	39 (19.5)
Total	80 (40)	120 (60)	200 (100)
Farm Size			
Small	27 (13.5)	69 (34.5)	96 (48)
Medium	44 (22)	49 (24.5)	93 (46.5)
Large	9 (4.5)	2 (1)	11 (5.5)
Total	80 (40)	120 (60)	200 (100)
Organization Membership			
Yes	61 (30.5)	83 (41.5)	144 (72)
No	19 (9.5)	37 (13.5)	56 (28)
Total	80 (40)	120 (60)	200 (100)

Source: (Field Survey, 2017)

Note: Figure in parenthesis indicate percentage, ***at 1 percent, **at 5 percent and * at 10 percent level of significance (N=200)

Table 2. Measurement and summary of explanatory variables and their hypothesized relation to adoption of botanical pesticides

Explanatory variables	Definition and measurement	Expected sign
Age	Years (discrete)	+/-
Gender	1= Male, 2= Female (dummy)	+/-
Location	Address of respondents; 1 = Palung 2 =Daman (dummy)	+/-
Family size	Number (continuous)	+/-
Education	Education of respondent; years (discrete)	+
Occupation	1= Agriculture, 2= Agriculture and Business, 3= Agriculture and Employment (nominal)	+
Farming experience	Farming Experience Years (discrete)	-
Income	Farm income of Respondent; Nepalese Rupees (continuous)	+/-
Farm_size	Operational farm size; Kattha (continuous)	-
Membership	Membership in Organization; 1= Yes, 2= No (dummy)	+

Source: (Field Survey, 2017)

Table 3. Result from Binary Logistic Regression Model

Variables	Adoption of botanical pesticides	
	Coefficient	P – value
Age	.040	.914
Gender	.723	.123
Address	.076	.404
Family size	-.179	.563
Education	-.059	.795
Primary occupation	-.265	.019**
Farming experience	-.387	.293
Annual income	-.252	.564
Farm size	-.655	.029**
Organizational membership	.756	.048**
Constant	1.672	.235

Source: (Field Survey, 2017)

Chi- square = 35.450 Prob.> chi2 = 0.000
-2 Log Likelihood = 233.754
Pseudo R^2 = 0.220

Empirical result showed that organizational membership has significant positive relation to the adoption of botanical pesticides whereas, primary occupation, and farm size showed negative relation with the adoption at 5 percent level of significance. This showed that farmers having large farm and agriculture as primary occupation were not interested on adoption of botanicals. This may be due to large farm sized farmers' having primary occupation agriculture were commercial and would not like to compromise on production by applying botanical pesticides. Farmers' membership in groups and cooperatives has shown significant positive relation with adoption of botanical pesticides. This revealed that farmers having high social cost have likelihood of adoption of botanical pesticides. Farmers participation has proven to be effective in increasing knowledge in adopting improve pest management practices (Damala, 2017). Agwu, Ekwueme, & Anyanwu (2008) also found that social participation and social capital significantly influenced adoption of improved agricultural technologies disseminated and this finding was also supported by Monge, (2008). Similarly, increased in associational memberships positively affect the probability of adoption of each

sustainable practice (Munasib & Jordan, 2011).

Problems of botanical pesticides adoption

The study revealed that knowledge gap on preparation and use of botanical pesticides, tradition of using chemical pesticides, easy availability of chemical pesticides, and botanicals considered not beneficial compared to chemical pesticides were the major problems of botanical pesticides adoption, respectively. This could be the reason that 60 percent of farmers in the study area were not using botanical pesticides.

This finding was also supported by Rijal et al., (2018) where 80 percent of growers choose chemical pesticides over others, even though the same percent were familiar with botanical pesticides, adoption rate was found very low (MOAD, 2014). A finding by Das (2014) showed similar results like botanical pesticides having low persistence in field condition, slow effective as compared to synthetic pesticides, and farmers' inclination to traditional pesticides due to perceived lack of efficacy were the reasons behind low adoption of botanical pesticides.

Table 4. Problems of botanical pesticides adoption in Makwanpur district

Problems of adoption	Frequency (N = 200)	Percent	Rank
Un availability of botanical pesticides	5	2.5	5
Knowledge gap on preparation and use of botanical pesticides	106	53.0	1
Not beneficial	8	4.0	4
Tradition of using chemical pesticides	50	25.0	2
Not effective	3	1.5	6
Easy availability of chemical pesticides	28	14.0	3
Total	200	100.0	

Source: (Field Survey, 2017)

Islam (2006) pointed out main barriers of botanical pesticides: sustainability of botanical resources, standardization of chemical extracts, and regulatory approval, and slow action of botanical which were in line with the findings of this study.

CONCLUSIONS

Expansion of vegetables production area and commercialization has increased pesticides use in Nepal, though it is harmful. The influence of extension programs on improving farmers' knowledge on botanical pesticides use appeared inadequate to change the traditional mind set of farmers. Result found that large sized commercial farmers, who have agriculture as primary occupation, seem reluctant to adopt botanicals. Thus, agricultural extension program should be focused on farmers' having large farm size. This study suggests that government agencies, extension and research institution should play role to strengthen the networking of farmers through organizational membership to increase botanical pesticides adoption.

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