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Full Length Research

An assessment on adoption of Bordeaux paste and mixture by apple growers in Jumla district, Nepal

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ABSTRACT: Apple production largely depend upon the orchard management. High hill of Nepal has great potentiality for apple production. Quality products are pre-requisite of today's market. Quality product is only maintained through proper orchard management by adopting modern technology. This study focused on the determinants of adoption of Bordeaux paste and mixture by apple growers. A census survey was conducted to total 1500 apple growing farmers of Chandannath Municipality (1-10), Jumla in 2021 and interviewed individually with pre-tested structured interview schedules. Chandannath Municipality being the command area of Apple Super-Zone, Prime-minister Agriculture Modernization Project (PMAMP) having potential producing center was selected for study. The collected information was coded and analyzed by using STATA. The data were analyzed by using descriptive statistics and Probit Model of regression. Good explanatory power of probit model was revealed through likelihood ratio chi-square (LR chi^2) was statistically significance at 1% level and pseudo R^2 value was 0.6618. Variables such as gender, economic status of farmers, training received, experienced of farmers and availability of plant protection equipment were found statistically significant and are positively related to adoption. Others factors such as age of farmers and education status of farmers were positively correlated with adoption whereas factors such as active members of family, access to credit, farm size, family type and distance form extension services were found negatively related with the adoption of Bordeaux paste and mixture and statistically not significant. Providing subsidies to marginalized farmers, provision of training and extension service to rural farmers would increase adoption of Bordeaux paste and mixture for healthy apple production.

Keywords: Adoption, apple, apple growers, Bordeaux paste and mixture.

INTRODUCTION

Apple being the leading cash crop in Hindu Kush Himalayas Region provides employment opportunities to majority of the marginalized community (Devkota et al., 2017). Apple belongs to family Pomoidae (Korban and Skirvin, 1990) and major fruit of temperate region. Jumla is the leading among all the districts of Nepal in area coverage (700 ha), production (5500 Mt) and productivity (7.86 Mt/ha) of apple (DADO, 2021). It is known to be originated from Himalayan range of Middle East Asia probably Siberia. Fresh apple and its products such as jam, jelly, apple chips, cider and brandy build up the economic status of the rural community (Sharma et al., 2016). Phytochemicals present in the apple have numerous health benefits (Boyer and Liu, 2004).

Copper fungicide such as Bordeaux mixture and Bordeaux paste are most effective for controlling the pests of apple and help to enhance the quality (Martin, 1933). Diseases mostly declining the apple production are anthracnose, downy mildew, papery bark, apple scab and crown gall. These diseases can be controlled by the regular spraying of Bordeaux mixture (Garton et al., 2018). Many of the farmers apply the remedy for controlling but the majority of the farmers are not securing satisfactory results due to the imperfect knowledge and

recommendation (Scott and Quaintance, 1907). Bordeaux mixture is the only reliable preventive for many plants diseases (Taylor, 1920).

Level of education in less developed countries have positive relation with the adoption of different technologies (Chaves and Riley, 2001; Rao et al., 1997; Ridgley and Brush, 1992). But some researchers found that there is no relationship between education and adoption (Grieshop et al., 1988). The size of farm play vital role for the adoption of new technology as fixed transaction and information costs associated with innovations, there exist critical lower limit on farm size which prevent smaller farm from adoption of technology (Cornejo et al., 1994). Shennan et al. (2001) recorded the correlation between farm size and disease management technique. The similar result was recorded by Fernandez (1998). Age, training and experience have positive correlations with the technology adoption (Boland et al., 2006).

Since, the productivity and longevity of apple orchards greatly depend on orchard management viz: regular manuring, training and pruning, irrigation and most important one is plant protections measures. Regular application of Bordeaux paste and Bordeaux mixture reduces the pest infestation and improve fruits quality as well as productivity. The major objective of this study was to know the adoption rate of Bordeaux paste and Bordeaux mixture by the apple growers and factors responsible for adoption or rejection of Bordeaux paste and mixture.

METHODOLOGY

Study area

The topographical feature of Jumla favors the production of apple all over the district. The annual mean minimum and maximum temperature of Jumla distict range from -5 c to 23°C respectively. Jumla received annually 150 to 246 mm rainfall with average relative humidity of 56 percentage. Jumla has subartic, dry winter and cool summer climatic condition (DHM, 2021). It ranked on the top in term of area and production of apple in the country. Apple provide employment to about 80% of the farmers so the area was purposively selected for the study.

Sampling design

The census survey was conducted among the apple growing farmers of Chandannath Municipality (1-10). Total 1500 apple growing farmers from the 227 farmers groups registered in Apple Superzone Jumla were interviewed individually by using pretested structured questionnaire in the month of March to April 2021. During the census survey, data related to socioeconomics and demographics information, insect and pest situation and its preventive measures, training received and extensive services from different institutions were collected as primary sources of data. Secondary data were collected from different articles, government reports, various books, annual reports, web sites, key informant information and group discussions.

Data summarization and analysis

The obtained data were categorized, tabulated and entered in Microsoft Excel. Adoption of Bordeaux paste and mixture by the apple growers was analyzed by using Probit Model in STATA. The Probit Model is operated when the dependent variable gives the two outcomes and it is based on the cumulative normal probability distribution (Liao, 1994). The probit regression uses an inverse normal link of function:

$$F(Y) = \Phi - 1(Y)$$

Where Φ= Cumulative normal distribution

The curve for probit model is not linear, it is sigmoid curve which satisfies the probability values of dependent variable.

RESULT AND DISCUSSION

Socioeconomics and demographics information of the study area

Total 1500 apple growing farmers of the Chandannath municipality, Jumla, Nepal (1-10) were interviewed individually with structured questionnaires. The average age of the farmers was found to be 42.68 years which showed involvement of youth in agriculture. Most of the farmers were marginalized and resource poor so the average farm size was only 0.26 ha and the average annual income was 80.15 thousand. The trend of commercial apple production is becoming popular among the farmer for the past few years. The average experience time of the farmers was found to be 9.6 years. The average distance of farmers from extension service was 4.95 Km and average economically active members were 2.64 which signified the labor crisis in the survey area (Table 1). Out of total 1500 farmers, 52.87% (793) were male and 47.13% (707) were female. Male and female were found to be equally encouraged in commercial apple production. The extension service like on-site field training was found to be poor i.e. only 34.13% (512) of farmers received extension services. Availability of plant protection and credit facilities were very poor. Only 7.89% (118) of the farmers had full access to credit and only 3.47% (52) of farmers had adequate plant protection equipment (Table 2).

Table 1. Distribution of respondents based on socio-demographics characteristics.

Independent variables	Mean ± Standard deviation
Age (years)	42.68 ± 10.7
Farm size (ha)	0.26 ± 0.28
Economic status (1000)	80.15 ± 97.43
Experience (Years)	9.6 ± 5.4
Distance from extension service (Km)	4.98 ± 3.2
Economically active members	2.64 ± 1.008

Source: Field survey 2021.

Table 2. Distribution of respondent based on sex, training received, access to credit, family type and farmers having plant protection equipment.

Parameter	Gender		Training received		Credit		Family type		Equipment	
	Male	Female	Yes	No	Yes	No	Joint	Nuclear	Yes	No
Frequency	793	707	512	988	118	1382	840	660	52	1448
Percentage	52.87	47.13	34.13	65.87	7.89	92.1	56.0	44.0	3.47	96.53

Source: Field survey 2021.

Determinants of adoption of Bordeaux paste and mixture by the apple growers

Probit model was used to assess the determinants of adoption of Bordeaux paste and mixture by apple growers in Jumla. The likelihood ratio chi-square (LR chi ^{2}) was found to be statistically significant at 1% level which provides better explanatory power of the probit model. The Pseudo R^2 value was 0.6618 and log likelihood was -328.43903.

Total eleven variable i.e. age, gender, training received and access to credit, family type, farm size, economic status, economically active family member, farmer experience, distances from extension service and facility of plant protection equipment were studied during survey. Among them, gender of household head, economic status of the farmer, training received by farmer and experience of the farmer were found statistically significant. The study showed that the farmers having male as household head were more likely to adopt Bordeaux paste and mixture as compared to other having female household head was found statistically significant at 1% level. The probability of adoption was found to be 46.9% higher for those having male household head as compared to those having female household head because decision making power was restricted mainly to male.

The economic status of the farmers was also found to be statistically significant at 1% level. It revealed that the better economic status was more likely to adopt Bordeaux paste and mixture as compare to the resource poor farmers. The probability of adoption was found to be higher for the economically sound farmers as compared to resource poor farmers. The economic sound farmers are less risk prone as compare to the resource poor (Cornejo et al., 1994). Similarly, the farmers receiving training adopted the technology at faster rate than who were deprived from training. The probability of adoption was 35.3% higher for the farmers received training. Training helps to solve the problem themselves and provide technical guidance regarding time of application, dose of application, pest infestation and safe handling of protection measures. Training changed the attitude and behavior of the farmers. Similar results were found by Mariano et al. (2012) on the adoption of modern technology in rice.

Skill and experience of farming along with appropriate equipment is indispensable element of adoption. Farmers who had experience along with appropriate equipment were more likely to adopt Bordeaux paste and mixture as compared to farmers lacking both experience and adequate equipment. Experience of a person help to reduce risk and urge to adopt new technology earlier. Both experience of farmers and plant protection equipment were found to be statistically significant at 1% level. The probability of adoption was 0.8% higher for the farmers who had experience as compared to other lacking experience. Similar effect was recorded for the farmers having plant protection equipment earlier. The adoption rate was found to be 35.5% higher for those farmers who had plant protection equipment as compared to others. Boland et al. (2006) recorded similar result.

Other variables such as age of household head and level of education of household head were positively correlated with the adoption of Bordeaux paste and mixture and both variables were statistically significant. The result was in line with the findings of Chaves and Riley (2001) but differ from that of Grieshop et al. (1988) who find no relation with

Table 3. Determinant of adoption of Bordeaux paste and mixture using probit model.

Variables	Coefficients	Standard error	Z	P>|Z|	dy/dx
Gender of HHH (@)	**0.3991741*** **	0.1124969	3.55	0.000	0.469
Age of HHH (years)	0.0089842	0.0051781	1.74	0.083	0.0010
Schooling HHH (years)	0.1787129	0.1229166	1.45	0.146	0.020
Economic status (1000)	**0.0021395*** **	0.0005148	4.16	0.000	0.00025
Active member	-0.0124007	0.0861916	-0.14	0.886	-0.0015
Training (@)	**3.006373*** **	0.1234213	24.36	0.000	0.353
Experience (@)	**0.0704587*** **	0.0103505	6.81	0.000	0.0082
Credit (@)	-0.029757	0.22642	-0.13	0.895	-0.0034
Equipment (@)	**3.027613*** **	0.3219234	9.40	0.000	0.355
Farm size (ha)	-0.3103593	0.1900508	-1.63	0.102	-0.036
Family type (@)	-0.2876743	0.1775535	-1.62	0.105	-0.033
Distance from extension (Km)	-0.0130325	0.0183058	-0.71	0.477	-0.0015
Constant	**-2.970962*** **	.3450876	-8.61	0.000	

Notes: ** and *** indicates significant at 5% and 1% levels respectively. @ indicate the dummy variable; Number of obs = 1500 farmers, Log likelihood = -328.439; LR chi^2 (12) = 1285.46; Pseudo R2 = 0.6618, Prob > chi^2 = 0.0000 (Source: Field survey 2021).

adoption. Others variables such as active member and access to credit, farm size, family type and distance from the extension service has negative relation with the adoption (Table 3). This was contradict the finding of Shennan et al. (2001).

Conclusion and Recommendation

Apple is the major fruit of temperate region and commercialization would be promoted through proper technology adoption. Modern technology helps to improve the production and productivity. The result revealed that the socio-economic, demographic, geographical, technological and psychological factors play vital role in the adoption of Bordeaux paste and Bordeaux mixture by the apple growers. The adoption of Bordeaux paste and Bordeaux mixture was found to be higher with farmers who have male household head, economically sound, receiving training, educated, young and experienced. Higher number of active member in family, access to credit, large farm size, joint family type and long distance from the extension service were found to be responsible for rejecting the Bordeaux paste and Bordeaux mixture. It is therefore recommended that training and awareness program should be conducted to increase the adoption of Bordeaux paste and mixture which ultimately increased the yield and quality of apple.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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