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Research Article

Factors Affecting Adoption of Good Agricultural Practice of Rubber (*Hevea brasiliensis*) Orchard in Jhapa, Nepal

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Abstract

The study was conducted to determine adoption of good agricultural practices of rubber (*Hevea brasiliensis*) orchard and factors affecting its adoption. Seventy rubber growing farmers were selected by using simple random sampling technique. Data were collected with pre tested semi structured interview schedule during month of April, 2020. Chi-square test, Pearson coefficient of correlation and Independent t-test were used to analyze the data. Findings of the study revealed that out of eight management practice; Basin size (87.1%) was highly adopted while Chemical fertilizer application (22.9%) was least adopted. About 60% of rubber farmers had high adoption level and remaining 40% had low adoption level for good agricultural practice. Among selected factors; farm size (at 1% level), training (at 1% level) and frequency of contact with extension worker (at 5% level) had significant association with adoption level of good agricultural practices of rubber. Similarly adoption level of good agricultural practices was found to be significant with income (at 1% level) and productivity (at 1% level). Farmers with high adoption level had yearly income of 5.59 lakhs/ha and latex productivity of 3.04 Mt/ha while farmers with lower adoption level had yearly income of 2.13 lakh/ ha and latex productivity of 1.23 Mt/ha. Poor technical knowledge, price fluctuation in combination with high cost of input is limiting adoption of good agricultural practices.

Keywords: Adoption Level; Significant Association; Rubber; Good Agricultural Practice

Introduction

Natural rubber is known as White Gold [1] which can be obtained from more than 2000 species of 300 genera [2]. Para rubber or *Hevea brasiliensis* is the most commercially developed species of natural rubber in the world, which accounts 99% of global natural rubber production. Natural rubber is raw material with greater industrial strategy value and among the most diverse agricultural products, which is found to be used in about 50 000 products [3] like tyre, tubes, automobile parts, battery boxes, footwear, wires, belts, cables etc.

Rubber was introduced in Nepal during 2046 B.S in collaboration of government of Nepal gorakhhali rubberudhyog, sudhafalrus Pvt. Ltd and some Indian experts on 5 ha land with the vision to perform plantation test, geographical, climatic and edaphic suitability [4]. According to report of PMAMAP, (2019) 15,000 to 20,000 ha land of eastern terai namely Jhapa, Morang, Sunsari and lower part of Illam were considered potential for rubber production. Despite of such climatic suitability only 555 ha of land is under rubber cultivation with production of 269 Mt and productivity of 1.1 Mt/ha. In Nepal there is a huge gap between rubber production and

consumption. Import of rubber and rubber related good in 2018 is of worth 8,307,815,000Nrs while export of worth 18,207,000Nrs with a trade deficit of -8,289,608,000Nrs [5]. Demand of rubber and rubber related goods are more than its supply which shows the scope of rubber cultivation in Nepalese context.

According to FAO, Good agriculture practices are set of principles that are applied during pre-production and post-production processes for safe and healthy agricultural products considering economic, environmental and social sustainability. Adoption of GAP will help to promote sustainable agriculture and to achieve national and international goals for environmental and social development [6].

Adoption of recommended package of practice plays vital role in production and productivity but various factor influences this aspects. Adoption is a dynamic decision process involving information acquisition and learning-by-doing by growers who vary in their managerial abilities, risk preferences, and their perceptions of the profitability and riskiness of the innovation [7]. Perception of farmers towards a new technology is a key precondition for adoption [8]. According to Roger [9] adoption of technologies depends on their characteristics: compatibility with the existing values and norms and relative advantage.

Materials and Methods

Study area

Study was conducted in Jhapa district of province no. 1. Jhapa district lies at 26.6398°N latitude and 87.8942°E longitude and around 500 meter above sea level. It is bordered by Ilam at North, Morang at West and by India on East and South.

Sample and sampling technique

Five municipalities (Kankai, Arjundhara, Mechi, Bhadrapur, Damak) and 3 rural municipalities (Buddhashanti, Barhadarshi, and Kachanakawal) of Jhapa district are used for the study. According to information provided by PMAMP office a total of 147 farmers were involved in rubber cultivation among which 70 farmers were selected by using simple random sampling technique.

Data source and data types

Primary data were collected from rubber growing farmer within study area by using research instruments like household survey, field visit, key informant interview and focus group discussion. Secondary data were collected from websites of various reputed national and international agencies, different rubber related books, reports and publication of various NGO and INGO**,** publications of MOAD, NARC, PMAMP, DADO and other government agencies.

Data analysis

Qualitative and quantitative analysis was done by using SPSS version 16, Ms-excel 2010.

Chi-square test

Chi-square test (χ^2) was used to study the association between two variables (dependent and independent). It is widely used method to judge the significance of association between attributes.

Chi-square is symbolically written as χ^2

Formula,

$$\chi^2 = \sum \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

Where, χ^2=Chi-square

O_{ij} = observed frequency of each ij^{th} term

E_{ij}= indicates expected frequency of ij^{th} term

i= 1, 2, 3…….. r

j= 1, 2, 3……k

df=(c-1) (r-1)

Where, c =means the number of columns and r means the number of rows

This was tested at 0.01, 0.05 and 0.10 level of probability for different degree of freedom.

Pearson correlation of coefficient

$$r = \frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{(n\sum x^2 - (\sum x)^2)(n\sum y^2 - (\sum y)^2}}$$

Where

r= Pearson coefficient of correlation

n= No. of observation being correlated

$\sum$ xy = Sum of product of x and yx and y = variable being correlated

$\sum$ x = Summation over all the cell entries of the first variable

$\sum$ y= Summation over all the cell entries of the second variable

$\sum x^2$= Sum of all the squared value of each cell of the first variable

$\sum y^2$= Sum of all the squared value of each cell of the second variable

This was tested at 0.01, 0.05 and 0.10 level of probability.

Independent t-test

The independent t-test was conducted to find out the association of variables singly i.e. keeping other variables constant. Here adoption level was considered as dependent variable whereas income and productivity as independent variables. The formula for independent t-test is as follow:

- Let us consider that A and B represent the two groups to compare.
- Similarly, let m_A and m_B represent the means of groups A and B, respectively.
- In the same way, let n_A and n_B represent the sizes of group A and B, respectively.

The t test statistic value to test whether the means are different can be calculated as follows:

$$t = \frac{mA - mB}{\sqrt{\frac{s^2}{nA} \frac{s^2}{nB}}}$$

S^2 is an estimator of the common variance of the two samples. It can be calculated as follows:

$$S^2 = \frac{\sum(x-mA)^2 + \sum(x-mB)^2}{nA+nB-2}$$

Management practice to determine adoption level

Eight agricultural practices were considered for the study as presented in table 1. These management was coded as 1 for the response "who uses recommended dose" and coded as 2 for the response "who does not use recommended dose". Some management practice like micronutrient use, irrigation, use of rubber coat and rubber processing were coded "1" for positive response and "0" for negative response.

From the response obtained from farmers, categorization of the farmers under low and high adopter categories was done. The adoption index was computed from the adoption score. The adoption score was computed by the sum of scores for adoption of eight different practices of orchard management. Adoption index developed by Karthikeyan (1994) was used.

$$AI = \frac{\text{Total adoption score obtained by an individual farmer}}{\text{Maximum score one can obtain}}$$

Management Practice	Recommended dose
Spacing	12*12, 14*14, 16*16 feet [4]
Basin size	1m3 [4]
FYM application	12 kg at the time of plantation [4]
Chemical Fertilizer application	For nursery= 10:10:4:1.5 (N:P:K:Mg) For 4-7 years of age= 10:10:4:2 (N:P:K:Mg) After starting of tapping=10:10:10:4 (N:P:K:Mg)
Micronutrient use	Yes = 1, No =0
Irrigation	Yes = 1, No =0
Use of rubber coat	Yes = 1, No =0
Rubber processing	Yes = 1, No =0

Table 1: Agricultural practiced used in study to determine adoption level.

On the basis of value of adoption index, the respondents were grouped into two categories i.e. low adopters (less than average) and high adopters (more than average).

Results and Discussion

Socio-demographic characteristics of farmers

Socio-demographic characters like age, gender, educational level, farm size, family size and farming experience influence adoption decisions [10]. Study revealed that mean age of rubber farmers was 45.8 years, mean years of schooling was 8.13 years, mean family size was 4.41, similarly average farm size was 1.15 ha and average farm experience was 13.9 years. Similar result was found by Poudel., *et al*. [11] on their study.

Variables	Mean	SD	Minimum	Maximum
Age	45.8	7.942	33	66
Year of schooling	8.13	3.27	3	16
Farm size (ha)	1.15	0.827	0.30	4.05
Family size	4.51	1.031	3	8
Farming experience(years)	13.9	4.721	25	8

Table 2: Socio-demographic characteristics of rubber growing farmers.

Extension related information

Participation on training and contact with extension workers were considered in the study to collect information related to extension service. Extension service plays a crucial role to acquire information about modern technology which affects its adoption [12]. Study revealed that 78.6% of farmers have participated on training related to rubber cultivation. Generally PMAMP and Agri-

culture Knowledge Center (AKC) provide training related to rubber. Adoption decisions were mainly affected by participation on training programs, farmers participated on training has higher adoption level [13]. Study found that 72.9% of respondents have seldom contact, 11.40% have frequent contact and remaining 15.70% have never contact with extension worker.

Participation on training		Contact with extension workers		
Yes	No	Never	Seldom	Frequent
78.60 %	21.40%	15.70%	72.90%	11.40%

Table 3: Extension related information of rubber growing farmers.

Adoption of good agricultural practices of rubber

Correct orchard management practice is necessary condition for high production, better quality, to increase input efficiency and to lower the environmental impact [14]. Establishment of an orchard are a long term investment and require critical planning, selection of proper location and site, planting system and planting distance, varieties providing all the necessary inputs to ensure maximum production. Study revealed that basin size (87.1%) was most adopted management practice whereas chemical fertilizer application (22.90%) was least adopted management practice. The adoption of chemical fertilizer application, micronutrient use and irrigation is due to high cost and unavailability of inputs in time [15]. Similarly, higher adoption of spacing, basin size, and FYM application is higher due to participation on training program.

Management Practice	Adopter		Non-adopter	
	Number	Percentage	Number	Percentage
Spacing	59	84.3%	11	15.7%
Basin size	61	87.1%	9	12.9%
FYM application	58	82.9%	12	17.1%
Chemical fertilizer application	16	22.90%	54	77.1%
Micronutrient use	17	24.3%	53	75.7%
Irrigation	18	26.0%	52	74.0%
Use of rubber coat	55	78.6%	15	21.4 %
Rubber processing	39	55.7%	31	44.3%

Table 4: Distribution of extent of adoption of good agricultural practice by farmers.

Level of adoption of good agricultural practices

Adoption level was computed from adoption index sore obtained by individual farmers. Study revealed that about 60% of farmers were high adopter and remaining 40% were low adopter. Prodhan and Khan [16] also found similar result i.e. most of farmers were medium and high adopter in adoption of scientific management practice of aquaculture.

Adoption level	Frequency
Low (< 0.5911)	28 (40)
High (>0.5911)	42 (60)
Mean	0.5911
Standard deviation	0.175

Table 5: Distribution of respondents according to level of adoption of good agricultural practice of rubber.

Figure in parenthesis indicate percent

Factors affecting adoption of good agricultural practices

Adoption of a new technology depends on a careful evaluation of many technical, economic and social factors. Adoption of the technology must be made by the individual, but it can be. Continue or stop adopting technology for a variety of personal, technical, economic, institutional and social factors focused on the availability of ideas or practices that better meet their needs [9].

S.N	Factors	Chi-square value	P- value
1	Age	1.172	0.774 NS
2	Family size	2.612	0.645 NS
3	Farm size	12.312***	0.01
4	Education level	7.590	0.22 NS
5	Farming experience	0.078	0.962 NS
6	Training	12.72***	0.01
7	Contact with extension workers	7.718**	0.021

Table 6: Chi-square test for factors affecting adoption of good agricultural practices.

Note: **, *** indicates significant at 5%, 1% level of significance and NS indicate non-significant.

Farm size was found to have significant association with adoption level i.e. farmers with large farm size were higher adopter compared to small and medium farm size. Bilaliib Udimal., *et al.* [17] also found similar results, reported that farm size has significant association with adoption of (Nerica) rice. Participation on training also have significant association with adoption level i.e. farmers participated on training related to rubber cultivation were high adopters than non-participants. Farmers can learn different management practice by participating on training. Prodhan and Khan [16], Ntshangase et al., [18] reported similar results. Contact with extension workers have significant association with adoption level i.e. farmers with frequent contact with extension workers were high adopter compared to farmers with never and seldom contact.

Relationship of adoption of good agricultural practices with Socio-demographic and extension related information

From the study it was found that farm size and training participation had highly significant relationship, while contact with extension worker had significant relationship with adoption of Good agricultural practices of rubber.

S.N	Factors	Correlation value	P- value
1	Age	0.035	0.774 NS
2	Family size	- 0.195	0.106 NS
3	Farm size	0.426***	0.01
4	Education level	0.155	0.199 NS
5	Farming experience	0.018	0.883 NS
6	Training	0.413***	0.01
7	Contact with extension workers	0.025*	0.062

Table 7: Pearson's correlation test for factors affecting adoption of good agricultural practices.

Note: *, *** indicates significant at 10%, 1 level of significance and NS indicate non-significant.

Independent t-test analysis of adoption level with income and productivity

Average income of farmers with high adoption level was greater i.e. 5.59 lakhs as compared to farmers with low adoption level which was 2.13 lakhs. Income was affected by adoption level of improve management practice. The difference was found to be statistically significant at 1% level of significance.

Rubber productivity was found to be higher for farmers with high adoption level of improve management practice i.e. 3.04 tons/ha as compared to farmers with low adoption level i.e. 1.23 Mt/ha. It was found that productivity was affected by adoption level of improve management practice. The difference was found to be statistically significant at 1% level of significance.

Variable	Adoption Level		Mean Difference	T-Value	P-Value
	High	Low			
Income(In lakh)	5.59 ± 0.63	2.13 ± 0.30	3.46	-4.926***	0.001
Productivity (Ton/ha)	3.04 ± 0.16	1.23 ± 0.11	1.81	-9.219***	0.001

Table 8: Independent t-test analysis of adoption level with income and productivity.

Note: *** Indicates significance at 1% level of significance.

Constraints encountered by rubber growing farmers in adoption of good agricultural practices

Problems listed on table 9 were identified by different formal and informal meeting with farmer, some Key Informant Interview and household interview. Poor technical knowledge rank first with 0.77 index score. Price variation rank second with 0.72 index score. Sriyalatha [19], also report fluctuating market price as a major issue among small farmers in Kalutara district of Sri Lanka lack of proper variety, high cost of input, lack of irrigation and labor unavailability rank 3rd 4th 5th and 6th with index score 0.72, 0.56, 0.52, 0.45 and 0.44 respectively.

Constraints	Index	Rank
labor unavailability	0.44	VI
Poor technical knowledge	0.77	I
Lack of Irrigation	0.45	V
High cost of input	0.52	IV
Lack of proper variety	0.56	III
Fluctuating market price	0.72	II

Table 9: Constraints encountered by rubber growing farmers in adoption of good agricultural practices.

Conclusion

Agricultural practices like spacing, basin preparation and FYM application are highly adopted whereas chemical fertilizer ap-

plication, use of micronutrient and irrigation were least adopted. Farmers with medium farm size, seldom contact with extension workers and participation on training were higher adopter of good agricultural practice. For selected agricultural practice, about 60% of farmers have high adoption. Poor technical knowledge, fluctuating market price in combination with high cost of input is limiting adoption of good agricultural practice**.**

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