ADOPTION OF IMPROVED POTATO VARIETIES IN NEPAL: A CASE OF BARA DISTRICT

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ABSTRACT

The study examines the determinants of adoption of improved potato varieties in Bara district of Nepal. Data was obtained from 51 potato farmers through the use of structured questionnaires. The study employed descriptive statistics and regression analysis to assess adoption status and its determinants. The results of the regression analysis showed that household size has negative influence on adoption of improved potato varieties while land tenancy, cattle ownership, contact with extension agents, age and level of education have positive influences. It is recommended that adult education should be provided to the adult farmers and the number of extension agents should be increased who would help introduce new potato varieties and improve technical and managerial skills of farmers through improved extension services.

Key words: *adoption, logistic regression, factors, potato varieties*

INTRODUCTION

Agriculture is the mainstay of the Nepalese economy, providing a livelihood for three-fourths of the population and accounting 32.3% share to Gross Domestic Products (MoAC, 2011). Potato (*Solanum tuberosam* L.) is one of the most important crops in Nepal. It is utilized as a major vegetable in *Terai* (Plain region) and mid hills and used as a vegetable and staple food both in high hills. In the year of 2010, area under potato was 185342 ha and total production 2517696 tons with an average productivity of 13.5 t/ha. It occupies the fifth position in area coverage, second in total production and first in productivity among the food crops grown in Nepal (MoAC, 2011).

Since last two decades, Nepal Agricultural Research Council (NARC) has been engaged in generation of improved agricultural technologies for potatoes farming in Nepal. Till date, more than ten improved varieties of potato have been recommended by NARC along with improved production technologies. The varieties have large yield potential and the diffusion of these varieties can greatly enhance national potato production. However, farmers' choice on improved varieties is one of the most crucial factors affecting productivity of a crop which is affected by many factors (Neupane et al., 2002; Rogers, 2003). On the other hand, there is dearth of information on the adoption of the disseminated technologies and factors hindering or promoting their adoption.

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The present study was, therefore, undertaken to assess current adoption level of potato production technologies and identify major factors associated with the adoption of improved potato varieties in Bara district of Nepal, which is not yet well documented.

MATERIALS AND METHODS

The study was conducted in Bara district of Nepal. Bara is one of the Terai districts of the Narayani Zone in the central development region of Nepal. It is situated between North latitude of 26˚ 51″ to 27˚ 2″ and East longitude of 84˚ 15″ to 85˚ 16″ with altitude between 152 to 915 meter above sea level. The district covers an area of 1,190 km² and has a population of 559,135 (Population Census, 2001: cited in MoAC, 2011). Bihar of India lies at the south of Bara. The average maximum temperature ranges from 22.7°C to 34.52°C and minimum temperature ranges from 8.54°C to 25.9°C with an average annual rainfall of 1550 mm. The rainfall distribution is of unimodal type, 84% of the total rainfall is received from June to September (RARS, 2009). Main economic activities in the area include crop, livestock and fishery. The district has more than 100 village development committees (VDC). From these VDCs, three VDCs were randomly selected, namely Fattepur, Dumarwana and Banjaria, and 17 farmers who grew potato were randomly selected from each VDC making a total of 51 farmers. The survey was conducted between January and February 2011. Data was collected with the help of structured questionnaire and analysis was done using descriptive statistics and Logistic regression model. The logistic model is the standard method of analysis, when the outcome variable is dichotomous (Hosmer and Lemeshow, 2000; Cavane, 2011). In regression analysis, adoption of improved potato varieties was used as a dependent variable (Y) and independent variable included characteristics of the farmers. The functional form fitted is specified as follows:

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}, X_{11})$$

Where,

Y = Adoption of improved potato varieties (Yes =1, No = 0)
X_1 = Age of head of household (years)
X_2 = Level of formal education (years spent in school)
X_3 = Household size (number of household members)
X_4 = farm size (hectare)
X_5 = Access to off-farm income (Yes =1, no=0)
X_6 = Membership to farmers' group and cooperatives (Yes =1, No=0)
X_7 = Cattle ownership (number of cattle)
X_8 = Access to extension services (Yes =1, No=0)
X_9 = Availability of credit (Receipt of credit, Yes =1, No =0)
X_{10} = Forms of land tenancy (Own=0, Land rented =1)
X_{11} = Farming experience (years) on potato

RESULTS AND DISCUSSION

Socio-economic characteristics of respondents

The average age of sample potato growers was about 50 years with experience in potato production spanning over 16 years and about six years of formal education (Table 01). Family size was generally large with average figure of 7.9. The figure is larger than the average household size of 6.38 in Bara district as indicated by population census, 2001. A vast majority of the farmers (87%) had farm size less than 02 ha that means majority of them were small farmers. Regarding caste, Bramhan and Chhetri (so called upper caste in Nepal; 44%) were found slightly more than other castes, though representation from other castes was achieved.

Generally, potato production in the area was male dominated (93%). Majority of the farmers (64%) lacked non-farm sources of income. About 40% of the farmers belonged to farmers' groups and cooperatives. Regarding land tenure status, 80% were owners and 20% had rented land. Farmers' access to extension agents (29%) and credits (18%) was low with while their access to irrigation facility (97%) and marketing (87%) was very high. About 77% of the farmers had kept cattle with average number of 2 cattle.

Current adoption level of potato production technologies

The finding showed 29% of agricultural land under potato (Table 02). Area under local varieties was found more than double of improved varieties. Respondent farmers used their irrigated land for rice in the rainy season and wheat, maize and vegetables production in the winter season and hence the area under potato was found less than one third. Exactly one third of the potato growers were found to use the improved varieties. Few farmers were also adopting both local and improved varieties that imply that they were observing the relative performance of these in their fields. The main improved variety of potato cultivated in the study area was Khumal Rato-2 (I-1039) followed by Kufri Sindhuri, Cardinal, Disire and Janakdev. Similarly, the main local varieties were of CIP number, locally called C40. As these varieties are not recommended by Nepal Agricultural Research Council for commercial cultivation, they are not considered as improved varieties.

Though a very high proportion (89%) of the farmers had used farmyard manure (FYM), the average rate was generally low (2.9 ton/ha) as against the recommended dose of 10 ton/ha (NPRP, 2006). The dose of chemical fertilizer used was moderate but did not follow the certified amount. The average use of chemical fertilizer was 341 kg/ha (DAP: 201; Urea: 68.5, and MOP: 71.5). The certified amount of chemical fertilizer was 310 kg/ ha

Table 01: Socio-economic characteristics of potato farmers

Variable	Value
Age (years)	
<30	0 (0)
30-50	28 (56)
>50	23 (44)
Mean ±SD	49.7± 10.6
Educational level	
None	6 (11)
Primary (up to 5 class)	26 (51)
Lower secondary and higher	19 (38)
Mean (years of schooling)	6.0±3.4
Family size (No.)	
<5	5 (9)
5-8	26 (51)
>8	20 (40)
Mean±SD	7.9±2.8
Cropping land in hectare	
<0.5 ha	20 (40)
0.5-2 ha	24 (47)
>2 ha	7 (13)
Mean	1.2±1.0
Caste	
Bramhan and Chhetri	22 (43)
Madhesi	11 (22)
Tharu	4 (7)
Muslims and lower caste	14 (27)
Sex (% Male)	93
Off-farm income (% Yes)	36
Membership to organizations i.e. farmers' group and cooperatives(% Yes)	40
Tenure status (% no tenancy)	80
Irrigation facility (% yes)	97
Extension contact (% Yes)	29
Access to credit (% Yes)	18
Years of farming experience in potato (Mean ± SD)	16.5±10.7
Marketing of potato (% Yes)	87
Livestock holding (Mean ± SD)	2±1.7

Note: Figure in the parenthesis indicates percentage.

(150:100:60 kg N, P, K) for potato production (NPRP, 2006). The average amount of MOP used was found higher than that of urea in the surveyed area. A quite high use of chemical fertilizers in the area is attributed to the availability of fertilizer in a market of India near to the surveyed area.

Table 02: Adoption status of potato production technologies

Technologies	Value
Area planted to potato (ha)	17.3 (29% of total agricultural land)
Area planted to improved varieties (ha)	5.4 (32% of total potato planted)
Area planted to local varieties (ha)	11.8 (68% of total potato planted)
Adopters of improved varieties	17 (33)
Adopters of local varieties	27 (54)
Adopters of both varieties	7 (13)
FYM adopters	45 (89%)
Rate of FYM use (ton/ha)	2.9
Rate of fertilizer use (kg/ha)	
DAP	201.0
Urea	68.5
MOP	71.5
Fungicides adopters	37 (73)
Insecticides adopters	21 (41)
Yield of improved potato (ton/ha)	15.4
Yield of local potato (ton/ha)	13.1
Yield of all potato (ton/ha)	14.3

Note: DAP = di-ammonium phosphate; FYM = farm yard manure; Ha = Hectare; MOP = muriate of potash

Farmers borrow fertilizers and pesticides, legally as well as illegally, from Raxual of India which is near about 10-15 kilometer from the area. A majority of the farmers (73%) used fungicides such as Krilaxyl, Diathane M-45 and Indofil-45 to control late blight of potato. It indicates that this disease was the major problem confronted by the farmers. Similarly, 41% used insecticides, namely Thimet and Rogor to control termite and leaf cutters. Obviously, the yield of improved varieties was found higher than of local ones. The average yield, 14.3 ton/ha found from the study is slightly higher than the national average of 13.5 ton/ha.

Factors associated with adoption of improved potato varieties

Table 02 presents the maximum likelihood estimates of the logistic model for factors associated with adoption of improved potato varieties. The fit of the models was satisfactory. The model correctly predicted 77.8 percent of variation in the adoption behaviour of farmers. The estimated coefficient for the likelihood ratio chi-square was significant (P<.001), with chi-square value of 34.75. The model accounted (Nagelkerke R^2) for 72 per cent of the variation between adopters and non-adopters of improved potato varieties. The results show that household size, land tenancy, cattle ownership, access to extension agents, age and level of education were the

significant factors that influenced the adoption of improved potato varieties.

The influence of household size

The negative relation between household size and adoption of family size plays a role on labour provision. Adoption of new technology requires more labour inputs (Feder et al., 1985). However, in the study area the farmers with larger families attached greater importance to nonfarm activities than smaller households to meet the increased needs of large family.

The influence of land tenancy

Positive relation between land rent and adoption of improved potato variety implies that farmers who rent their land are more likely to use improved variety to maximize profits. Ntege-Nanyeenya et al. (1997) mentioned that the odds of adopting the improved maize technology decrease by a factor of 0.24 if a farmer/family owns land compared to farmers who rent land. Similarly, Sserunkuuma (2005) reports that maize plots held under the freehold tenure system are more likely to be planted with improved seeds than plots held under leasehold, while plots rented for fixed payment are more likely to be planted with improved seeds than purchased plots, likely because those who rent land tend to be more commercial oriented and are, thus, more likely to use improved seeds to increase yield.

The influence of cattle ownership

As expected, cattle holdings have positive influences on adoption of improved potato varieties. Similar to this finding was also reported by improved variety was also reported by Kudi et al. (2010). However, the present finding contradicts with the findings of Paudel and Matsuoka (2008), in which this factor was positively related. It is a fact that Salasya et al. (2007). The result implies that the farmers having more number of livestock are better adopters of improved varieties.

The influence of access to extension

As expected, access to extension was positively associated with adoption of improved potato varieties which is very consistent with several studies (Saka et al., 2005; Paudel and Matsuoka, 2008; Saka and Lawal, 2009; Kudi et al., 2010; Namwata et al., 2010). The results suggest that farmers who have access to extension services may more likely adopt improved maize varieties. Extension visits will help to reinforce the message and enhance the accuracy of implementation of the technology packages.

The influence of age

Age was found positive and significant which is consistent with the findings of Etoundi and Dia (2008) which reported positive and significant relation between age group and improved maize variety, *CMS 870* in Cameroon. In that study, highest adoption rate was that of farmers aged between 46 and 60 years (58.18%). In the present study, 70% of adoption of improved potato varieties was observed among the farmers aged between 37 and 53 years which implies that the improved varieties were popular among the adult (36-55 years) farmers.

Table 03: Maximum likelihood estimates of logistic model for factors affecting adoption of improved potato varieties

Variables	β	S.E.	Wald	Sig.	Exp (β)
Age	.134	.079	2.885	.089*	1.143
Education	.312	.189	2.724	.099*	1.366
Family size	-1.224	.587	4.352	.037**	.294
Farm size	.032	.027	1.360	.244	1.032
Off-farm income	-2.293	1.729	1.759	.185	.101
Membership	-1.098	1.489	.543	.461	.334
Cattle ownership	1.566	.850	3.397	.065*	4.788
Extension contact	2.479	1.420	3.047	.081*	11.930
Credit availability	-2.721	2.075	1.720	.190	.066
Land tenancy	4.068	2.004	4.121	.042**	58.456
Farming experience	.134	.096	1.977	.160	1.144
Constant	-5.764	3.842	2.251	.134	.003
Likelihood ratio chi-square df(11)	34.75	-	-	.000***	

Note: *** = Significant at 1% level, ** = Significant at 5% level, and * = Significant at 10% level

The influence of education

The results suggest that a farmer who has more years of education is more likely to adopt improved maize varieties than those who have never been to school. The more educated household head is expected to be more efficient to understand and obtain new technologies in a shorter period of time than uneducated people. This is shown by the positive coefficient of the years of schooling of the respondent farmers. This finding is in harmony with the report of Asfaw and Admassie (2004), Salasya et al. (2007) and Paudel and Matsuoka (2008). This implies that education increases the probability for the adoption of improved maize varieties.

Effect of farm size, membership to organization, access to off-farm income, Farming experience, and availability of credit were not significant, indicating that they were not important predictors of adoption of improved technologies in the study area. These observations contradict with some findings (Salasya et al., 2007; Odoemenem and Obinne, 2010 and Namwata et al., 2010), in which these factors were found to be important. This reflects the importance of contextual specific (i.e. type of technology and location) factors for adoption. Therefore, factors for adoption for improved agricultural technologies should not be generalized, which was also reported by Namwata et al. (2010).

CONCLUSIONS

The study reveals that improved potato varieties are relatively less common in the surveyed area. A large potential for increasing potato production exists in the area through adoption of improved varieties, balance use of fertilizer and organic manures, and avoiding unnecessary use of pesticides. Interventions should focus on adult farmers with provision of adult education.

There should be increased in number of extension agents who would help introduce new potato varieties and improve technical and managerial skills of farmers through improved extension services. Strengthen farmers' groups and cooperatives to enhance their access to extension agents, credits and trainings on improved agricultural technologies.

Since the study covered Terai zone (plain area) only, in depth investigation into the factors constraining adoption and diffusion of these varieties in hilly areas is also suggested.

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