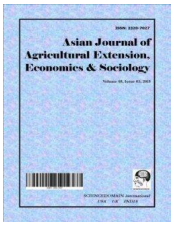

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Adoption and Economics of Improved Wheat Varieties in Eastern Nepal

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

A study was conducted to identify the productivity, profitability and adoption status of improved wheat varieties in Eastern Terai. A household survey was carried out in two districts of Eastern Terai viz. Morang and Saptari to collect information on the adoption of modern wheat varieties and economics of on-farm wheat production. In each district, two village development committees (VDCs) were selected to carry out the household survey. Structured questionnaire was administered to 20 randomly selected households in each VDC making altogether 80 samples in two districts. Descriptive and statistical tools including tobit model were used to analyze data. The tobit analysis showed that household with larger farm size was more likely to adopt improved wheat technology. About 60% of the total wheat area was covered by NL 297 followed by Gautam (15%) in Morang district, whereas in Saptari, 77% wheat area was covered by NL 297 followed by Vijay (15%) with average yield of 2.29 MT per hectare, the benefit cost ratio (1.25) indicated that wheat farming was profitable in the Eastern Terai.

Keywords: Household; improve; survey; variety.

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1. INTRODUCTION

Wheat is one of the major cereal crops after rice and maize. It has been growing since time immemorial in Nepal. It is grown in Terai, river basins, mid-hills, and high-hills of Nepal during winter season that lasts from October to April. Among the cereal grain crops, wheat ranks third in hills and mountains and ranks second in Terai region in terms of production and human consumption. The present average wheat yield in Terai is 2768 kg/ha compared to 2208 kg/ha in hill and 1892 kg/ha in mountain with national average 2496 kg/ha [1]. With proper management, wheat production can be easily obtained from 3.5 t/ha to 5 t/ha in Terai region with the present wheat production technology. There are several factors responsible for low wheat productivity in Nepal like poor irrigation facilities, less availability of fertilizer, pesticides and insecticides [2,3]. Wheat yields suffer from some factors such as lack of reliable irrigation, inclement weather, incidence of diseases and lack of improved technology [4,5]. Some of the popular wheat varieties of wheat in Nepal are getting susceptible to different diseases for instance, NL 297 has become susceptible to new biotypes of leaf rust [5].

Until 2016, NARC had released and recommended 39 wheat varieties for different agro-ecological domains. After 2000 A.D., modern varieties such as Gautam, NL 971, Aditya, Gaura, Dhaulagiri, Danphe having high yield potential and disease resistance characteristics were released by NARC [6]. Despite having various improved wheat varieties developed and recommended by NARC, farmers were adopting old and disease susceptible varieties. The decision of whether or not to adopt a new technology hinges upon a careful evaluation of a large number of technical, institutional and socio-economic factors [7] A study in Tanzania found that the importance of extension visits and the frequency of these visits in the adoption of improved wheat [8]. A study on wheat farmers in Afghanistan, found that education was the most important variable in the decision to adopt new seed technology [9]. Many Adoption of a new technology at farmers' level is determined by various factors like socio-economic characteristics of the farmers, agro-ecological condition, source of seed, role of government etc. This study analyzed adoption pattern and economics of wheat production in Eastern Terai region of Nepal.

2. MATERIALS AND METHODOLOGY

Morang and Saptari district were purposively selected based on the wheat growing potentiality. Four VDCs (Banigama and Motipur of Morang, Kanchanpur and Bhardaha of Saptari) were selected for this study. Twenty households from each VDCs were selected randomly. A total of 80 households (40 from Morang and 40 from Saptari) were selected. Collected data were analyzed with descriptive and quantitative methods. All variable inputs like human labor, tractor and animal expenses, seed, inorganic fertilizers, irrigation and FYM were considered and valued at current market price to calculate cost of production.

Total variable cost = C labor + C tractor and animal + C seed + C fertilizer + C FYM + C irri

Where, C labor = Cost on human labor used (NRs. /ha), C tractor and animal + tillage cost on tractor and animal used (NRs./ha), C seed = Cost on seed (NRs./ha), C fertilizer = Cost on chemical fertilizers (Nrs./ha), C FYM + Cost on organic fertilizers, C irri = Cost on irrigation (NRs./ha).

Gross return was calculated by multiplying the total volume of outputs from wheat by price of wheat grain at marketing period. Gross margin calculation was done by difference between gross return and variable costs.

Gross Margin (NRs./ha)= Gross return (NRs./ha) – Total variable cost (NRs./ha).

Benefit cost ratio is used to determine the economic performance of wheat farming. It is a relative measure, which is used to compare benefit per unit of cost.

B : C ratio = Gross return (NRs./ha)/ Total variable cost (NRs./ha)

Tobit model was used to study the extent of adoption of improved wheat varieties. In continuous data, Tobit (Censored regression) model is commonly used [10-13]. Tobit model was used to assess the extent of adoption of improved wheat varieties. Share of improved wheat area to total landholdings was used as dependent variable which is continuous and censored at zero (lower limit).

The model is defined as;

$$Y_i = X_i ß + u$$

Where, Y_i is the vector of dependent variable which is expressed as the percentage of wheat area to total area of household; ß is the vector of unknown parameter; and X_i is the vector of independent variables. The independent variables are; X_1 = Education, X_2 =Gender, X_3= Household size, X_4 = Total land, X_5= Membership, X_6= Training received or not.

3. RESULTS AND DISCUSSION

3.1 Household Characteristics of Wheat Farmers

The average education grade of respondent was 5.29 and average household size comprised of 6.49 members. Average size of land holdings of two districts is 1.53 ha in which wheat occupied 0.67 ha with productivity of 2.29 t/ha. The seed replacement period of Saptari district (2.6 years) was higher as compared to that of Morang district (3.82 years).The average yield of wheat in both of these sample districts was lower than the national average yield of 2.59 t/ha in 2015 [14]. Farm and household characteristics of the sample farmers are shown in Table 1.

3.2 Sources of Seeds of Wheat Varieties

Farmers obtained wheat seeds from various sources such as cooperatives, agro-vets, Nepal Seed Company, other farmers, own saving, NARC stations and District Agriculture Development Office (DADO) offices. In Morang district, 55% of total farmers used their own seed whereas in Saptari district, 32.5% farmers used seed from Agro vets (Table 2).

3.3 Adoption of Wheat Varieties in Study District

The study revealed that about 60% areas of the total wheat was covered by NL297 followed by Gautam (15%), local (12.5%), Bijay (5%) and Aditya (5%) in Morang. In Saptari, 77% area was covered by NL297, 15% by Bijay, 2.5% by Aditya and 2.5% by Gautam. Although NL 297 was found susceptible to leaf rust it was preferred by the farmers because of its good bread quality and market demand. UP 262, an old variety released in 1978 was still growing in Morang in a few areas.

Table 1. Farm and household characteristics of sample farmers (n=80)

S.N.	Variables	Morang	Saptari	Average
1	Average education grade	4.73	5.85	5.29
2	Average household size	6.58	6.4	6.49
3	Average land holding (ha)	1.28	1.75	1.53
4	Average wheat area (ha)	0.42	0.92	0.67
5	Average wheat yield (kg/ha)	2254	2320	2287
6	Seed replacement (year)	3.82	2.6	3.21
7	Participation on training (%)	28	35	31
8	Membership of organization (%)	40	23	31

Source: Household survey (2015)

Table 2. Sources of wheat seed among farm households (hhs) in the study districts

S.N.	Sources of seeds	Morang hhs (%)	Saptari hhs (%)	Average hhs (%)
1	Cooperatives	7.5	5	6.3
2	NSC	10	12.5	11.3
3	Agrovets	2.5	32.5	17.5
4	Other farmers	20	5	12.5
5	Own	55	25	40
6	Regional Agricultural Research Station (RARS,Tarahara)	5	17.5	11.3
7	DADO	0	2.5	1.3

Source: Household survey (2015)

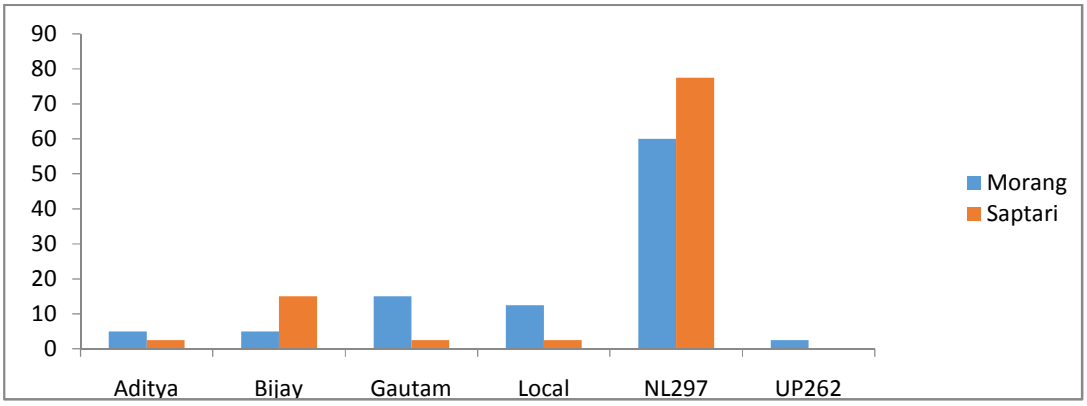

Fig. 1. Adoption of wheat varieties

3.4 Factors Influencing Adoption of Wheat Varieties

Tobit model was used to analyze the factors influencing adoption of improved wheat varieties. Total wheat area allocated for improved wheat cultivation was used as dependent variable and different explanatory variables such as education of the household head, gender, household size, land holdings, use of own seed, involvement in organization and participation on training. Out of six variables used in the model, only one variable i.e. farm size is found significant at 1% level. Household with larger farm size are more likely to adopt improved wheat technology.

3.5 Cost of Production

Tillage and human labor were important and largely used inputs in the production of wheat. All the farmers used tractor or bullock for their land preparation. Farmers performed two to three tillage operations for wheat production. Per hectare cost of tractor and bullock was about NRs. 10,622 which accounted about 25% of total wheat production cost. Human labor was required for different operations such as land preparation, seed sowing, fertilizer application, weeding and harvesting. It was computed in terms of man day and converted to monetary term. The cost of human labor in production of wheat per hectare was estimated NRs. 9,484.5.

Table 3. Tobit analysis for adoption of wheat varieties

Variables	Coefficient	Standard Error	t	p-value
(Constant)	2.90	6.76	0.42	0.66
Education	0.04	0.34	0.14	0.89
Sex	-0.58	5.10	-0.11	0.91
Household size	-0.58	0.51	-1.14	0.26
Farm size	0.48***	0.03	15.80	0.00
Membership	1.39	3.28	0.42	0.63
Training	-1.53	3.55	-0.43	0.66

No of obs=80, LR chi2 (6)= 121.38, prob> chi2 = 0.000, pseudo R2= 0.163 Log likelihood= -311.59

Table 4. Average cost of production in wheat farming

Items of cost	Mean cost (NRs.)	Percent of total cost
Seed	7565.44	17.62
Chemical fertilizers	7071.56	16.47
FYM	1975.00	4.60
Human labor	9484.50	22.09
Threshing	4293.75	9.99
Tillage	10622.50	24.74
Irrigation	1927.63	4.49
Total cost	42940	100.00

Source: Household survey (2015)

Per hectare cost of seed was about NRs. 7565 which accounted about 18% of total cost. Seed rate in the study area was more than the recommended dose (120 kg/ha) which was 171 kg/ha. Almost all the farmers were largely dependent on chemical fertilizers like Urea, DAP and Potash instead of farm yard manure (FYM) for wheat production. Per hectare costs of inorganic fertilizer was estimated about NRs.7072 which constituted about 17% of total cost. In the study area almost all of the farmers used thresher machine for threshing wheat grain. It accounted about 10% of total cost of wheat production. Per hectare cost of FYM was NRs. 1975, which constituted about 4.6% of total cost. Per hectare cost of irrigation was accounted about 4.5%. Irrigation cost in the study area was higher among those farmers who didn't have canal irrigation facility. About 25% farmers used pumpset for irrigation in wheat production.

3.6 Returns from Wheat Production

Farmers in the study area were involved in wheat farming on an average 0.67 hectare of land with per hectare production as 2.29 MT. The average farm gate price of wheat was NRs.2226 per quintal. The average per hectare price of wheat straw in the study area was NRs.2762. Per hectare gross return and total variable cost were estimated about NRs.53764 and NRs.42940 respectively. Per hectare gross margin of wheat production was estimated about NRs.10824. Benefit Cost Ratio (BCR) is a relative measures, which is used to compare benefits per unit of cost. It helps analyze the financial efficiency of the farmers. It was observed that the overall undiscounted BCR considering total cost was 1.25.Thus it was found that wheat production was profitable in the study area.

Table 5. Economic statement of wheat production in the study area

Measuring criteria	Average value
Main product value (NRs.)	51002
By product value (NRs.)	2762
Gross return (NRs./ha)	53764
Total cost (NRs./ha)	42940
Gross Margin (NRs./ha)	10824
BCR	1.25

Source: Household survey (2015)

4. CONCLUSIONS

NL 297 in both the districts was the most popular and widely adopted variety, which is very old and susceptible to diseases. The adoption of newly released varieties such as Vijay, Aditya and Gautam were very minimal despite relatively higher yield of these varieties. Government and extension agent should focus on extension of newly released wheat varieties Agrovet shops were the major sources of improved varieties in Saptari district, whereas farmers' own seed was the major source of seeds in Morang district. Households with larger farm size were more likely to adopt improved wheat technology. The wheat farming in the study area was profitable with benefit cost ratio 1.25. Farmers expensed more than 22% in labor cost, to reduce the labor cost there should be focused on mechanization in wheat farming. Similarly, farmers invested about 25% in tillage operation, for the reduction in tillage cost there should be focused on conservation agriculture.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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