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Research Article

Economics of Potato Production in Rural Area of Ilam District, Nepal

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Abstract

Potato (*Solanum tuberosum*) is grown worldwide in more than 150 countries of the world as staple food including Nepal. It is important food crops for food security and fourth most important staple food in Nepal. It contributes 2.17 in Gross Domestic Products and 6.57 in Agriculture Gross Domestic Products. The NARC has established Agriculture Research Station in Jaubari Ilam in 2014 and conducting research mainly on potato. The main objective of this study was to identify the situation of potato cultivation in the vicinity of station and suggest future activities on potato research. The field study was conducted in surroundings of five locations of the station in the hills and mountain area. In each location 35 potato growing respondents were selected randomly for the semi-structured questionnaire survey. One focus group discussion was also made in each location for the triangulation of the household information. Data were analyzed using SPSS, Strata and excel software. The result shows that the average landholding of the respondents was 2.25 ha on which they used 0.218 ha for the potato and produce average of 1208 kg. The productivity in the area was 5.6 tons which is only about 40% of the national and district productivity. It was due to the use of local variety having low yielding and susceptible to disease like wart, late blight, and scab. The benefit cost of local cultivar found 0.68 whereas improved varieties 1.73. The regression model analysis shows that if improved variety planted by the farmers, there will be 21% increased production. Similarly, training also influence on increase the productivity by 33% whereas the membership of cooperative and group increases 34% of production.

Keywords: Benefit cost ratio; disease; food security; productivity; regression model.

Introduction

Potato (*Solanum tuberosum*) is grown worldwide in more than 150 countries of the world as staple food including Nepal (Sapkota and Bajracharya, 2018). The survival of hundreds of millions of people in the developing countries depends on the potato today (Timsina *et al.*, 2011). It is considered as one of the fourth most important crops in the world after wheat, rice and maize. It is important cash crops to address food insecurity and reduce poverty among small holders in the developing countries like Nepal (Sapkota and Bajracharya, 2017). It is important food crops for food security and fourth most important staple food after rice, maize, and wheat in Nepal (Gairhe *et al.*, 2017). In Nepal, it occupies first position in terms of productivity (14.03 t ha^{-1}), 2nd position in total production (2,805,582 ha), and 5th position in area of production (Pant et al., 2017). Potato is an important crop for both hills and terai of Nepal (Ghimire *et.al.* 2016). It is an important crop for food security in the high hills of Nepal contributing substantially to the

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livelihood of resource poor farmers in the mountains (Luitel, *et al.*, 2017).

Out of total agricultural land, potato cultivation is known to occupy about 6.47% which is about 199,971 hectares (ha) and the total production reached about of 2,805,582 tons (t) with average productivity of 14.03 t ha^{-1} in 2015/16 in Nepal (MoAD, 2016). Potato is grown from an altitude of about 70-meter mean above sea level (masl) to 4500 masl in Nepal where potato is planted in different seasons and harvested accordingly in different times, almost throughout the year (Sharma, 2014). Mostly, the farming is subsistence type with small landholding of only 0.68 ha (CBS, 2013). The cultivation of potato is popular among smallholder farmers due to its wider adaptability, high yield potential and demand. Thus, becomes major sources of food, income and employment to many Nepali rural farmers. The share of potato to Gross Domestic Product (GDP) and Agriculture Gross Domestic Product (AGDP) were 2.17 and 6.57%, respectively (MoAD, 2015). The per capita consumption of potato found 80.56 kg in 2013 which was 16.44 in 1961 (FAOSTAT).

The Agriculture Research Station (ARS) has been newly established in the Jaubari Ilam in 2014 which is located in an altitude between 2400-2900 masl. This station is mainly work on potato research for the development of suitable technology. Therefore, the main objective of this study was to identify the situation of potato cultivation in the vicinity of station and in the district so as to prepare the future plan for the potato research and development in the district as well as for the region and province. In addition to the above objectives we also attempts to analyze the economics of the potato production in the study area.

Materials and Methods

Selection of Study Area and Sample

Ilam district was selected purposively, where Agriculture Research Station, Jaubari Ilam under Nepal Agricultural Research Council has been newly established. One hundred sixty four potato growers were selected for the interview and collection of information. For the purpose of the study, five Village Development Committee (VDC), namely Jogmai, Nayabazar, Gorkhe, Pyang, and Jamuna were selected as a sample for the study which is the nearby VDC of the ARS, Jaubari, Ilam. In each VDC, 35 potato grower respondents were selected randomly for which name list was provided by the DADO, Ilam. One Focus Group Discussion was also made in each VDC for the triangulation of household information.

Interview and FGD

A semi-structure standard questionnaire was developed and used for face to face interview with sample farmers. In addition, checklists were also developed and used for producers, traders, and other stakeholders. An in-depth interview was held with potato grower. FGD was held with concern stakeholders specially the producers, traders, input suppliers.

Data Analysis

The primary information was collected from the field survey through semi structured questionnaire schedule. The secondary information related to the study was collected through different journal, proceeding, annual reports of Nepal Agricultural Research Council (NARC), District Agriculture Development Office (DADO), Department of Agriculture (DoA), Ministry of Agriculture and Livestock development (MoALD) and other developing agencies. The collected information were coded, tabulated and analyzed by using Statistical Package of Social Science (SPSS) and Micro-soft Excel for calculating cost of production, benefit cost ratio, and regression analysis. Moreover, SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis was also carried out.

Economic Analysis

Gross margin was calculated as:

Gross margin = Gross return – total variable cost

Where,

Gross return = Price of potato x Total potato production

Total variable cost = Summation of all variable costs

Variable cost = Cost of inputs (Seed, FYM/Compost, Human Labor cost, Bullock Labor Cost, Other Cost such as transportation cost, loading unloading cost)

Benefit-Cost analysis = Gross return/total cost (including only variable costs)

Multiple Regression Analysis

We use the multiple regression model to estimate the effect of socio-economic variables on potato production. Multiple regression analysis has been widely used statistical tools for analyzing functional relationship among variable, which is expressed in the form of equation connecting the dependent variable and independent variable. Multiple regression model can be expressed as:

Ln (yield) = ß0+ ß1 (Education)+ ß2 (Variety) + ß3 (Chemical fertilizer) + ß4 (Irrigation) + ß5 (Training) + ß6 (Membership) + Єi

Where, Ln is the natural logarithm, yield is the potato production per hectare (Kg ha^{-1}), $ß_0$ –$ß_6$ are the parameters to be estimated. We assumed that the potato production is affected by socioeconomic variables such as years of schooling of household head, use of variety i.e. whether it is improved or local, whether farmers use chemical fertilizer or not, whether farmers use irrigation or not in potato farming. We also use other dummy variables such as potato farming related training and membership i.e. whether the farmers involved in any agriculture related organization or not. Єi is the error term.

SWOT Analysis

SWOT (Strength, Weakness, Opportunity, Threats) analysis is a strategic planning technique used to help a person or organization identify strengths, weaknesses, opportunities, and threats related to business competition or project planning. It is intended to specify the objectives of the business venture or project and identify the internal and external factors that are favorable and unfavorable to achieving those objectives. Users of a SWOT analysis often ask and answer questions to generate meaningful information for each category to make the tool useful and identify their competitive advantage.

This tool provides a framework for understanding controllable internal and external factors that the interventions should address for the entire value chain (Fig.1).

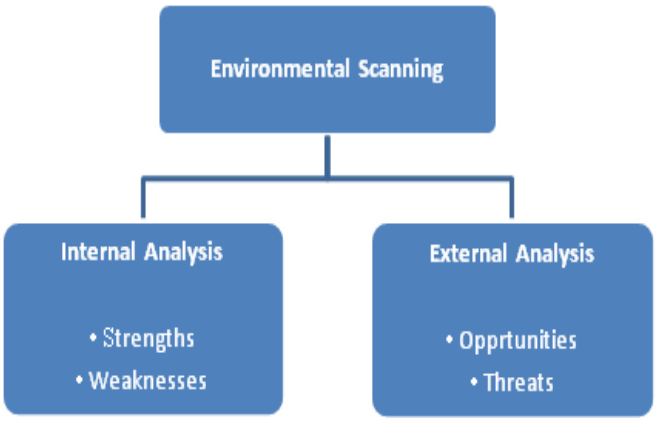

Fig. 1: Frame work of SWOT Analysis

Result and Discussions

Description of Study Area and Respondents

The study was conducted in five VDCs of Ilam district which are remote villages of the district and majority of the location was out of reach of public transportation. The altitude domains of study area comprises of hills and mountain which represents the 73 and 37 percent respectively. Among the survey household only 12 percent were represented by female headed. However, among the respondent about 25 percent were female. The majority of respondents (87.73%) were found at economically active age group (15-59 years) and rest was above 59 years of age. As far as education of the respondent is concerned, majority of the respondent (62.6%) were primary level and below, whereas 32.5 percent were secondary level and only 4.9 percent higher secondary and above education. Ninety eight percent of the respondent was involved in agriculture as a main occupation.

Landholding

The average total land holding size of the respondents in the study area was found 2.55 ha where about 40 percent land was *pakhobari*. Similarly, the average minimum and maximum landholdings were found 0.25 and 9.95 ha respectively (Table 1).

Manure and Fertilizer Use

Farmers were using both organic and inorganic manure for the cultivation of potato crop. The average application of FYM/compost was found 33 tons with minimum of 13 and maximum of 100 tons. Similarly, they were using 79, 101 and 40 kg of urea, DAP, and murate of potash in an average during the seeding the potato tubers (Table 2).

Table 1: Land holding (ha) of potato growing farmers in the study area

SN	Description	*Khet* land*	*Bari* Land**	*Pakhobari****	Total land
1	Average	0.81	0.71	1.03	2.55
2	Minimum	0.10	0.05	0.10	0.25
3	Maximum	3.00	3.45	3.50	9.95

Source: Field Survey 2016

* Khet land is irrigated and bunded land also called low land in Nepal

** Bari land is unirrigated and unbunded land also calle upland in Nepal

*** Pakhobari is marginal land and normally not used for cultivation of crops

Table 2: Application of FYM/Compost, Chemical fertilize (kg) in Potato cultivation in study area

SN	Description	FYM/Compost (ton)	Urea (kg)	DAP (kg)	MoP
1	Average	33	79	101	40
2	Minimum	13	20	20	10
3	Maximum	100	300	400	100

Source: Field Survey 2016

Table 3: Area (ha), Production (kg) and selling pattern of Potato per household in study area

SN	Description	Area ha	Production (kg)	Quantity of own consumption (kg)	Quantity sold (kg)
1	Average	0.218	1218.0	512	890
2	Minimum	0.025	80	80	80
3	Maximum	1.25	5600	2000	4800

Source: Field Survey 2016

Production and Consumption

The average production of potato in study area was found 1218 kg per household with minimum of 80 kg to maximum of 5600 kg. Out of produced potato, in an average 512 kg consumed by the household family. The result indicated that farmers sold up to 4800 per household (Table 3).

Productivity

Productivity of potato in the study area is only 5593 kg ha^{-1} which only about 40 percent of the national as well as district productivity (Table 4). The productivity of the study area is very low even compared to the district productivity. It is due to remoteness of study area where availability of improved variety of potato seed tuber is almost zero. Almost all respondents were found cultivating local cultivars which are very old and susceptible to various diseases like wart, late blight and others.

Table 4: Comparative analysis of potato production in study area, district and national level during 2016/17

SN	Production Area	Productivity kg/ha	Percent of National Productivity
1	Study area	5593	40.12
2	District Level	13993	100.36
3	National Level	13943	

Source: Field Survey 2016 and MoAD 2016/17

Disease/Pest Incidence and Control Measures

The major prevailing problems of disease and pest were reported by the farmers are: Wart, late blight, scab, potato tuber moth, white grub, and red ants. Farmers were not found aware of management practices and most of them are not using pesticides. Only about 2 percent farmers reported that they use chemicals to control the disease and pest but the initiative taken by the farmers is not sufficient.

Trend of Potato Production

The potato production trends in the study area are decreasing. During the study more than 70 percent respondents said that, there are decreasing trend in production of potato in the study area whereas 20 percent respond believed it is similar and 13 responds found it is increasing (Fig. 2).

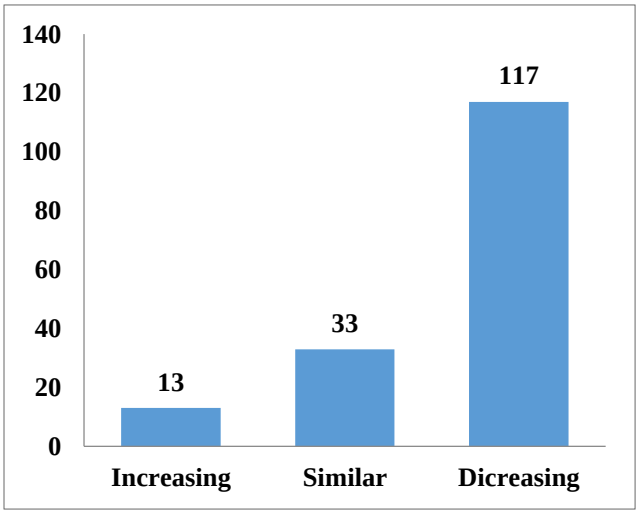

Fig. 2: Trend of potato production in study area (Source: Field survey 2016)

Cost of production and Benefit Cost Ratio

The cost of production of local and improved cultivar of potato in study area is greatly differs due to their yield/productivity. The cost of local and improved cultivar has calculated NPR 35 and 14 kg^{-1} respectively. The net income of local cultivar is in negative (NPR -93,428 ha^{-1}) with benefit cost (BC) ratio of 0.69 whereas improved cultivar gives better net income of NPR 182,979 ha^{-1} with BC ratio of 1.73 (Table 5). The local cultivar has negative net income as well as BC ratio even though farmers are cultivating it due to the opportunity cost as they work their self and do not hire the labor for work. The taste of local cultivar is also very good and like by the people. Similarly, its storage characteristic is also better than the improved one.

Table 5: Cost of production of local and improved Potato cultivation per ha and Benefit Cost Ratio

Particulars	Local	Improved
Human and bullock labor	131,750	124,350
Input cost	159,700	123,085
Land tax	645	645
Repair and maintenance	2,000	2,000
Depreciation	2,133	2,133
Total cost	296,228	252,213
Total Production (kg)	8,450	18,133
Cost of Production per kg	35	14
Sale Price per kg	24	24
Gross Return	202,800	435,192
Net Income	-93,428	182,979
Benefit Cost ratio	0.68	1.73

Source: Field Survey 2016

Regression Analysis

Summary statistics

Average production of the potato farmers is 6080 kg/ha. The average education of household head was 7 years. About 21 percent farmers used improved potato varieties and 34 percent farmers used irrigation in potato farming. Most of the farmers (80%) applied chemical fertilizers. In terms of training about 36 percent potato producer received potato related training whereas about 37 percent farmers were involved in agriculture related organization (Table 6).

Table 6: Descriptive statistics of potato farmers in Ilam district of Nepal (N=164)

Variable	Mean	Std. Dev.	Min	Max
Production (Kg/ha)	6080	3113.13	123	16000
Education of household head (Years)	7.42	5.74	0	16
Variety type (1= improved %)	21	0.41	0	1
Chemical fertilizer use (1= Yes %)	80	0.39	0	1
Irrigation use (1=Yes %)	34	0.47	0	1
Training received (1= Yes %)	36	0.48	0	1
Membership (1=Yes %)	37	0.48	0	1

Source: Field Survey 2016

Estimation Results

The results of the regression analysis are presented in table 7 as Cobb Douglas production function was used to estimate the coefficients of production elasticity. To achieve approximately normality and homogeneity of the error term, the variable production of potato was transformed to log form. The value of a coefficient of multiple determination (R^2) 0.35 shows that 35 percent of the variation in the potato production in the study area is explained by the independent variable included in the multiple regression model. The F- statistics (14.61) shows the stability of the overall regression equation and significant at 1% level. The Breush-Pagan test for heteroscedasticity showed a constant variance of error and model has no heteroscedasticity. The mean Variance Inflation Factor (VIF) was 1.14 and none of the variables had VIF higher than 2. It indicates that there was no multicollinearity between independent variables.

Table 7: Results of regression analysis

Variables	Coefficient	Standard error	P-value
Education of HH (Years)	0.01*	0.01	0.07
Variety type (1= improved)	0.21**	0.09	0.03
Chemical fertilizer use (1= Yes)	0.07	0.09	0.41
Irrigation use (1=Yes)	0.01	0.07	0.97
Training received (1= Yes)	0.33***	0.08	0.00
Membership (1=Yes)	0.34***	0.08	0.00
Constant	8.13***	0.09	0.00
Number of observation	164		
R-square	0.35		
Adjusted R- square	0.33		
F value (6,157)	14.61		
Heteroscedasticity	chi^2 (1) =1.22		
prob > chi^2 = 0.269 (constant variance)			
Variance Inflation factor (VIF)	1.14 (mean vif) : no muticollinearity		
Model has no omitted variable (ovtest): F (3, 154)= 0.84 prob >F = 0.47			

*Note: * significant at 10% level, ** significant at 5% and *** significant at 1%*

The coefficient of years of schooling is 0.012. This indicates that potato yield will be increased by 1.2% if the year of schooling increases by 1 unit. This is significant at 1% level. The regression model showed that use of improved potato varieties had a positive and significant at 5% level. Holding other factors constant, if the farmers adopted improved varieties, there will be increased potato production by 21 percent. Potato related training was also positive and significant on production. Household those who received training the production increased by 33 percent. Membership is positive and significant at 1% level. Results showed that farmers who were members of any organization like agriculture cooperatives and farmers group; the probability of potato production was increased by 34 percent.

SWOT Analysis

The SWOT analysis of the potato shows number of strengths and opportunities for boosting value adding interventions. The researcher and developing agencies must give emphasis while designing of interventions for addressing the weaknesses and threats for the growth of the potato sector. The following table 8 shows the strength, weakness, opportunity and threat of potato sector in study districts as well as in the Ilam district.

Table 8: Strength, weakness, opportunity and threat of Potato sector in Ilam district

	Helpful/Positive Factors	**Harmful/Negative Factors**
Internal Factors	Strengths 1. Research Station established in Jaubari 2. Developing road access to the rural area 3. Access to communication facilities 4. Suitable climatic condition for year round production 5. Potentials for growth for area and productivity 6. Traditional knowledge and skills among growers 7. Production system are organic in the high hills 8. Traditional and economic seed storage in the high hills 9. Many high yielding varieties are released 10. Functional traditional marketing linkage 11. Groups and cooperatives involved in market 12. Great potential of import substitution	Weakness 1. Weak adoption of improved cultivation practice 2. Worse seed quality 3. High incidence of diseases 4. Poor value addition activities 5. Farmers not fully aware of quality seed 6. Lack of availability of improved variety 7. Poor road accessibility from farm to road head 8. Lack availability of inputs 9. Weak backward and forward linkage 10. Lack of investment
External Factors	Opportunity 1. Potential for increase area and productivity 2. Scope of establish potato processing industry 3. Government policy support as a high value income generating crop 4. Potentials to provide assistance in food technology and quality management 5. Scope of value added products 6. Import substitution is great opportunity 7. High hills could be developed for the organic seed production hub	Threats 1. Serious threat of diseases like wart, late blight, and brown rot 2. Potato tuber moth is also emerging threat 3. High cost of production in hills 4. Decreasing labor availability

Source: Field survey 2016

Conclusion and Recommendations

The productivity of the potato in the study area is very low compared to district as well as national level. It is due to use of local cultivar of potato which are susceptible to diseases like wart, late blight and scab. Similarly, insects like potato tuber moth and red ants are also contributing in the lowering the production of potato. The productivity could be increased by introducing new improved varieties, providing training to the growers.

Based on the assessment and analysis of findings, especially the constraints faced by the farmers following major recommendations have been made:

- Support farmers in quality seed production in their locality so as improved variety should be available
- Verification and demonstration of suitable varieties of potato should be done so as farmers could select their appropriate cultivar
- Promote integrated disease and pest management practices
- Research should be done to reduce the cost of production
- Training program should be organized on improved cultivation practices
- Farmers should be encouraged to form a group and cooperative

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