

An Economic Analysis of Potato Production in Achham District of Nepal

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Abstract

The objective of this study was to assess the production and economics of potato in Achham district, Nepal. Sampling was conducted among the total of 90 registered farmers by simple random sampling method. The respondents were categorized into small and large scale farm holders based on the mean of the land holding under potato cultivation. The data were analyzed using SPSS, Stata and Microsoft excel. Cobb Douglas production function was used to find out the technological relationship between inputs used and output produced and to estimate and analyze the return to scale. The result of sociodemographic characters showed that the average household size, dependency ratio and area under potato cultivation was 7.53, 1.05 and 0.081 ha respectively. About 58% of respondents were growing potato in summer season. Human labor was the major input followed by seed, manure and bullock labor in both large and small farms. The production per household (kg), productivity (mt/ha) and price of yield (NRs./kg) were 937.17, 12.287 and 30.33 respectively and there was significant difference in production (kg) per household between small scale farms (408.70) and large scale farms (1729.86). The total average cost, gross revenue and gross margin per hectare were estimated as NRs. 256,285.293, NRs. 373384.449 and NRs. 117099.156 respectively. The findings showed significant difference of variable cost between small and large scale farm which was due to the significant difference in use of inputs i.e. human and bullock labor mainly. Despite of adoption of improved potato production practices in most farms the average benefit cost ratio was 1.47. From the analysis of Cobb Douglas production function the inputs; human labor, seed and manure had positive relationship with income while bullock labor use had negative relation with the total income. The return to scale value was computed to be 1.033 indicating increasing return to scale in potato production in Achham district. Therefore, the findings suggest that, the production and income can be maximized if existing problems of irrigation, insect-pests, storage and marketing are solved and the inputs are made available in time and used properly.

Keywords: Potato, Production, Cost, Economics, Production function

Introduction

The potato (*Solanum tuberosum*) is a herbaceous annual that grows up to 100 cm tall and produces a tuber – also called potato – so rich in starch that it ranks as the world's fourth most important food crop, after maize, wheat and rice. The potato belongs to the Solanaceae family of flowering plants, and shares the genus *Solanum* with at least 1000 other species, including tomato and eggplant [6].

Potato is one of the major staple foods in Nepal and is grown in all agro-ecological zones extending from Southern plain of Terai to the Northern highlands. It can be grown from the altitude of 100 MASL to 4000 MASL. People residing above the altitude of about 2000 MASL use potato as the only staple food as the environment conditions do not favor the production of other crops like cereals, legumes, etc. Potato is the fifth-most important staple crop in Nepal after rice, wheat, maize and millet whereas it is the fourth major crop of the world [9]. Bhomi, 1997 (as cited in [7]) at elevations of 2000 m and above, farmers traditionally grow seed potato tubers that meet the requirements of farmers in the mid-hills and plains during the planting season. Still, most of the farmers in Achham follow their traditional way of potato cultivation. The potato cultivation season for Achham district was from middle of January to middle of March (summer season harvest) in upper hill belts and from October to November (winter season harvest) in the lower hill regions [1].

Potato favors cool environment and it can tolerate frost to some extent. For the germination of seed potato, the soil temperature should at least be 8°C. Similarly, the optimum day/night temperatures for the growth of potato are 25/12°C. The favorable night temperatures for tuber initiation and tuber growth are 15-20°C and 15°C respectively [8] [9]. Potato prefers a slight acidic sandy or silty soil with pH ranging from 5-6.5. At the same time, potato is a high manure/ fertilizer requiring crop [9].

In case of Achham, potato farming is one of the major agricultural crops which have directly assisted in the economy and livelihood of rural farmers. This place bears a huge potential for potato production and has an important role in the nutrition of Achhami people [1]. Nutritionally, aside from being high in water when fresh, potatoes are primarily composed of carbohydrates, and contain moderate amounts of protein and fiber, but virtually no fat [2].

Potato was ranked fifth in area (185,342 ha), second in production (25,17,696 tons) and first in productivity (13.58 MT/ha) among the major food crops grown in Nepal [11]. The national production and productivity of potato in the year 2017/18 was 2,881,829 tons and 14.769 MT/ha respectively

which was higher than the previous year's data [10]. In the year 2015/16, the area (ha), production (tons) and productivity (MT/ha) of Achham district was 411, 3705 and 9.013 respectively [11]. According to the record of DADO, Achham [1], the total area under potato cultivation was 424 hectares of which winter season potato covers area of 170 ha with production of 1584 metric tons and productivity of 9.32 MT/ha and the rainy season potato covers area of 254 ha with production of 2248 metric tons and productivity of 8.85 MT/ha.

Government of Nepal has demarcated area of two municipalities and three rural municipalities of Achham district as the 'potato zone' under Prime Minister Agriculture Modernization Project (PMAMP), for the promotion of potato production with commercialization and industrialization.

This study was conducted to assess the existing production practices, production, productivity, cost, income and benefit of potato production in Achham district.

Methodology

The study was carried out in the command area of PMAMP – PIU, potato zone, Achham. The potato zone command area covered all the wards of two municipalities (Sanphebagar municipality and Mangalsen municipality) and three rural municipalities (Bannigadhi-Jayagadh RM, Mellekh RM, Ramaroshan RM) which were purposively selected for the study.

A total of 90 potato farming households registered in PMAMP-PIU, potato zone, 18 from each municipality/RM were selected by simple random sampling method.

The pre-tested interview schedule was administered to the respondent to collect the primary data on socio-demographic information, prevailing production practices, cost and return of production and others by carrying out the household survey. Similarly, to get the better picture of information regarding the various aspects of potato production face to face interviews and Key Informant's Interviews (KII) with Potato zone staffs, AKC officers, local traders and progressive farmers were conducted.

Five comprehensive Focus Group Discussions (FGDs) were conducted at each municipality/RM of the study area after completing the field survey with help of the checklist to verify the results obtained from household surveys. In the FGD, participants were local farmers unbiased of gender and ethnicity along with other stakeholders.

The secondary data were collected from various books, national reports and publications, reports of different NGOs and INGOs, web, published articles, etc.

The statistical packages for social science (SPSS), Stata and Microsoft Excel were used for necessary qualitative and quantitative data analysis.

Benefit cost ratio, production, productivity, profitability, gross margin was calculated and analyzed. Similarly, Cobb-Douglas Production Function (CPDF) regression was carried out to find out the technological relationship between the factors used and gross revenue generated from potato production.

Gross margin of the producer for a particular enterprise is the difference between the gross revenue earned and the total variable cost incurred [6].

Gross margin is calculated as:

Gross margin = Gross revenue - Total variable cost

Where, Gross revenue = Price of potato × Total potato production

Total variable cost = Summation of all the variable costs

Variable costs = Cost of human labor, cost of seed, FYM, cost of bullock labor, fertilizer and pesticides cost and rental value of land.

Benefit-cost ratio was calculated using formula:

Benefit cost ratio (B:C) = Gross revenue / Total variable cost

[3] Also used this formula to determine the benefit cost ratio for assessing benefit cost analysis.

The Cobb Douglas production function was used to estimate and analyze the technological relationship among the different inputs of production and output produced i.e. total income. Cobb Douglas production function is one of the common and frequently used economic functions [4]. The regression coefficients represent the elasticity of respective inputs, and its sum gives the return to scale value.

The form of CPDF used in this study is as follows:

$$Y = aX_1^{b_1}X_2^{b_2}X_3^{b_3}X_4^{b_4}e^{\mu}$$

Where Y is the total income from potato production (NRs. /ha), X₁ cost of human labor (NRs. /ha), X₂ cost of seed (NRs. /ha), X₃ cost of FYM (NRs. /ha), X₄ cost of bullock labor (NRs. /ha), e base of natural logarithm and b₁, b₂, b₃ and b₄ are the regression coefficients to be determined.

Above mentioned equation was linearized in a logarithmic function for convenience during computation, which was then expressed as,

$$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + \mu$$

Where, ln = natural logarithm, a = constant and μ = error term/ random disturbance term.

Human labor cost was calculated by quantifying the total requirement of human labor from pre-cultivation to post cultivation activities of potato production namely manuring, field preparation, planting, weeding, earthing up, irrigation, fertilizer application, harvesting, storage and marketing activities.

Return to scale indicates the response of output for the

proportional change in inputs of any production activity. It was obtained by summing up the regression coefficients of respective inputs from CPDF regression analysis.

Decision rule:

Return to scale >1: Increasing return to scale

Return to scale =1: Constant return to scale

Return to scale <1: Decreasing return to scale

Results and discussion

Socio-economic and demographic characteristics of the respondents

Various characteristics (continuous and categorical variables) of the respondents and their household are discussed here.

Socio-demographic characteristics (age, HH size, dependency ratio, landholding) of respondents

Table 1 presents the socio-economic and demographic characteristics of respondents by the two categories of potato farm size i.e. small scale (< 0.081 ha) and large scale farm (>0.081 ha).

The overall average age of respondents was found to be 37.79 years. The average age of respondents from small scale and large scale farm was found to be 37.61 years and 39.56 years respectively with not any statistically significant difference between the means.

The average household size of the sampled respondents was found to be 7.53 and there seem to be no any statistically

significant difference between the averages of household size.

The average number of male and female members in the sampled households was found to be 3.82 and 3.71 respectively with no any statistical significant difference of means between small scale and large scale farm for male and female household members. It means that the number of male and female members in both the small and large scale farm is almost equal.

The average of economically active members in the sampled respondents' households was found to be 3.93. There was no significant difference between the averages of economically active members from small and large scale farming households. Similarly, the data show no any statistical significance between the difference of means of economically active male and female members from small and large scale farming households.

The dependency ratio of the households under study was calculated to be 1.05 which means that the one economically active member has to support more than one economically inactive member. And no any statistically significant difference was found on dependency ratio of small scale farming household (1.11) and large scale farming household (0.95).

The average land holding of total surveyed household under potato cultivation was found to be 0.081 ha with average land holding of 0.04 ha and 0.14 ha by small and large farm household respectively. The size of land holding under potato cultivation of large farm households was found to be significantly higher than the size of land holding under potato cultivation of small farm households at 1% level of significance.

Table 1: Socio-demographic Characteristics of Respondents by Farm Category, Field Survey 2019, Achham

Variables	Mean (N=90)	Small Scale (n=54)	Large Scale (n=36)	Mean difference	t-value
Age of respondent (years)	37.79 (9.57)	37.61 (10.75)	39.56 (9.08)	-1.944	-0.893
Household size	7.53 (2.90)	7.57 (3.31)	7.64 (2.34)	-0.065	-0.109
Male members in HH	3.82 (1.85)	4 (2.10)	3.69 (1.53)	-0.305	0.75
Female members in HH	3.71 (1.49)	3.57 (1.65)	3.94 (1.22)	-0.37	-1.222
Economically active members	3.93 (1.65)	3.85 (1.80)	4.05 (1.39)	-0.204	-0.603
Economically active male members	1.89 (0.88)	1.83 (0.91)	1.97 (0.84)	-0.139	-0.732
Economically active female members	2.07 (0.95)	2.06 (1.07)	2.08 (0.73)	-0.028	-0.146
Dependency ratio	1.05 (0.62)	1.11 (0.71)	0.95 (0.43)	0.167	1.383
Area under potato cultivation (ha)	0.081 (0.058)	0.04 (0.02)	0.14 (0.04)	-0.103***	-14.152

Note: The figures in parenthesis resemble standard deviation

*** indicate significance at 1% level

Socio-demographic characteristics (gender, occupation and education status) of respondents

Among the total 90 respondents sampled 71.11% were male and 28.89% were female (Table 2). There was found to be significant association between gender of respondents and size of farm holding at 1% level of significance. Major source of income to sustain the family expenses was found to be agriculture only which accounts for 94.44% of all the respondent households' sources of income and from the table, the occupation of respondent was found to be independent of the farm size.

Most of the respondents were found to be literate (88.9%). Only 11.1% of the sampled respondents were illiterate and there is no such statistically significant association between the education status and size of farm holding of respondents.

Variables	Frequency(n=90)	Small scale (n=54)	Large scale (n=36)	Chi-square value
Gender of Respondents				
Male	64 (71.11)	33	31	6.572***
Female	26 (28.89)	21	5	
Major Occupation				
Agriculture Only	85 (94.44)	49	36	3.529
Business and Agriculture	2 (2.22)	2	0	
Teaching and Agriculture	3 (3.34)	3	0	
Education Status of Respondent				
Illiterate	10 (11.1)	3	5	5.6
Primary(Up to grade 5)	11 (12.2)	9	3	
Lower Secondary(6-8)	12 (13.3)	9	3	
Secondary(9-10)	29 (32.2)	15	15	
Higher Secondary(11-12)	21 (23.3)	13	8	
University(Bachelor)	7 (7.8)	5	2	

Note: The figures in parenthesis resemble percentage

*** indicates significance at 1% level

Input used and cost of production

Table 3 indicates the inputs used per ha for potato production by farm categories. The major inputs used for production of potato were human labor, seed, farmyard manure (FYM), and bullock labor. Human labor, both male and female, were used for the seed procurement, manuring, land preparation, planting, weeding, earthing up, fertilization, irrigation, harvesting and marketing. Bullock labors were mainly used in the primary land preparation. Both males and females were found to be involved almost equally in production and marketing activities.

The average number of human labor involved in production of potato was found more (516.80 mandays/ha) in small scale farm compared to large scale farm (328.46 mandays/ha) and the difference across the farms was statistically significant at 1% level. The reason behind such difference in the human labor requirement was that the small scale farm uses human labors in most activities of potato production from land preparation to marketing. The average seed requirement per hectare of small

scale farm (1183.28 Kg) was found lower than that of large scale farm (1404.82 Kg), and the difference was statistically significant at 5% level (Table 3). The average seed quantity required was found to be 1271.90 kg/ha which was lower than the recommended rate by government of Nepal, department of agriculture (1500-2000 kg/ha) and lower than the seed quantity used per ha in Baglung district [3]. The lower seed rate in small scale farm was due to the most of the small holder farmers' trend of planting the potatoes by cutting into pieces. Similarly, the bullock labor requirement of large scale farm (31.07 days/ha) was higher than the labor requirement of small scale farm (18.03 days/ha) and the difference was statistically significant at 1% level. At the same time, the average quantity of manure (bamboo basket/ha) applied was 685.79 bamboo basket. The quantity uses of manure in small scale farm (657.85 bamboo basket/ha) was significantly lower than the manure use in large scale farm (757.69 bamboo basket/ha) and this difference was statistically significant at 10% level which was found to be significant at 1% level in the study conducted by [3]. Amazingly, most the

respondents were not using chemical fertilizers and pesticides and only few of them were using occasionally in very low amount. Most of the small scale farmers were found to use fertilizers in higher quantity due to lower requirement and affordability for lower amount. The use of fertilizer was found to be significantly high in small scale farm (31.28 kg/ha) compared to large scale farm (10.96 kg/ha) and this difference was statistically significant at 10 % level of significance.

Table 3: Inputs used for potato production by farm category, Field Survey 2019, Achham

Inputs	Small scale farm	Large scale farm	Mean	Mean difference	t-value
Human labour (mandays/ha)	516.80 (307.77)	328.46 (126.45)	441.46 (266.84)	188.34***	4.023
Seed (Kg/ha)	1183.28 (456.04)	1404.82 (450.15)	1271.90 (464.17)	-221.53**	-2.269
Manure (bamboo basket/ha)	657.85 (170.06)	727.69 (206.70)	685.79 (187.64)	-69.84*	-1.683
Bullock labour (days/ha)	18.03 (2.36)	31.07 (18.50)	25.85 (15.73)	-13.04***	-5.116
Fertilizer (Kg/ha)	31.28 (78.13)	10.96 (26.91)	23.15 (63.41)	20.31*	1.76

Note: Values in parentheses indicate standard deviation

***, ** and * indicate significant at 1%, 5% and 10% levels, respectively

Cost of production of potato

The average cost for the production of potato per hectare was NRs. 256,285.293 (Table 4). The total cost of production per hectare in small scale farm (NRs. 281,282.204) was significantly higher as compared total cost of production per hectare in large scale farm (NRs. 218,789.927), and the difference was statistically significant at 1% level (Table 4). The average cost of seed per hectare was NRs. 68198.659 and the data from Table 4 suggest that there was no any statistically significant difference between the average cost of small and large scale farm. Similarly, the difference of per hectare production cost of human labor and bullock labor was statistically significant across the small scale farm and large scale farm at 1% level (Table 4). The average cost of farmyard manure (FYM) per ha for production of potato was NRs. 17,144.817. The cost of FYM per hectare in small scale farm (NRs. 16,446.386) was lower than that of large scale farm (NRs. 18,192.465) and the difference was statistically significant at 10% level. Likewise, the difference of fertilizer and pesticide cost per hectare for small (NRs. 1,178.203) and large scale farm (NRs. 372.208) was statistically significant at 10% level of significance. The cost of land rent per ha was found to be NRs. 7,816.333, and the data suggest that the mean difference across small and large scale farm was not statistically significant.

The average cost of production per hectare for improved potato seed was NRs. 252,213 in Ilam [12] and was NRs. 197,186 in Baglung [3]. The cost of FYM was found quite less in Achham (NRs. 17,144/ha) compared to the cost of FYM in Baglung (NRs. 89,372/ha) [3], which was due to lesser quantity use per household of FYM despite of lower cost in Achham and use of fallen dried leaves of trees instead of FYM.

Table 4: Cost of production by farm category, Field Survey 2019, Achham

Cost items	Small scale farm	Large scale farm	Mean	Mean difference	t-value
Human labour cost (NRs./ha)	180880.438 (107719.680)	114962.407 (43906.668)	154513.226 (93395.134)	65918.031***	4.023
Seed cost (NRs./ha)	65814.484 (27222.162)	71774.924 (23523.551)	68198.659 (25836.637)	-5960.439	-1.073
Manure cost (NRs./ha)	16446.386 (4251.593)	18192.465 (5167.536)	17144.817 (4691.020)	-1746.079*	-1.683
Bullock labour cost (NRs./ha)	5409.588 (710.550)	9321.026 (5550.876)	7756.4551 (4718.104)	-3911.438***	-5.116
Fertilizer and Pesticide cost (NRs./ha)	1178.203 (3052.905)	372.208 (910.515)	855.805 (2456.407)	805.994*	1.822
Land rent (NRs./ha)	7641.667 (2303.508)	8078.333 (1880.529)	7816.333 (22144.023)	-436.667	-0.946

Total variable cost (NRs./ha)	281282.204 (132629.628)	218789.927 (52106.925)	256285.293 (111762.515)	62492.277***	3.12
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Note: Values in parentheses indicate standard deviation

*** And * Significant at 1% and 10% levels respectively

Production, productivity and benefit cost ratio analysis of potato

The average production of potato per household was found to be 937.17 kg in the study area. The total production per household was lower in the small scale farms (408.70 kg) in comparison with large scale farms (1729.86 kg), and the difference was statistically significant at 10% level (Table 5). The total average productivity of potato was found to be 12.287 MT/ha in the study site which was lower than the national average productivity of 14.765 MT/ha [10]. The difference of productivities between small and large scale farms was found statistically non-significant. The per unit total average price of potato was NRs. 30.33 per kg and the data from Table 5 shows no statistically significant difference between the means of small and large scale farms. The average gross revenue was found to be NRs. 373384.449 per hectare. The gross revenue of small scale farm (NRs. 382483.601/ha) was higher than the revenue of large scale farm (NRs. 359735.723/ha); though the difference was found to be statistically non-significant. The gross revenue from potato production with improved seed in Ilam was NRs. 435,193/ha [12] which was higher than the gross revenue of potato production in Achham (NRs. 373,784.449/ha) which was due to lack of improved management and inadequate use of input materials like seeds, fertilizer, irrigation, etc. The average total variable cost per hectare was found NRs. 256,285.293 and the variable cost per ha of small scale farm (NRs. 281,282.204) was found significantly higher than the variable cost of large scale farm (NRs. 218,789.927), and the difference was statistically significant at 1% level of significance. In the study area, the per hectare profit/ gross margin was found to be NRs. 117,099.156 with no any statistically significant difference between the profits from small and large scale farms.

The average benefit cost ratio of potato production was 1.47 in the study area (Table 5). This implies that the production of potato was profitable and one rupee spent for the production could yield 47 paisa of benefit. From the Table 5 it is inferred that the benefit cost ratio of small scale farms was lower (1.35) than that of large scale farms (1.64) and the difference is statistically significant at 1% level of significance. The calculated benefit cost ratio of study area of Achham was slightly higher than the B:C ratio of potato production in Baglung which was 1.44 [3] and was lower compared with the B:C ratio computed in the study of [13] in Taplejung (2.9).

Table 5: Production, productivity, profit and benefit cost ratio analysis of potato by farm category, Field Survey 2019, Achham

Items	Small scale farm	Large scale farm	Total	Mean difference	t-value
Production (kg/HH)	408.70 (254.566)	1729.86 (960.0)	937.17 (908.094)	-1321.157***	-8.07
Yield (mt/ha)	12.551 (8.184)	11.891 (5.191)	12.287 (7.113)	0.66	0.468
Price of yield (NRs./kg)	30.37 (3.34)	30.28 (3.95)	30.33 (3.579)	0.093	0.12
Gross revenue (NRs./ha)	382483.601 (253132.193)	359735.723 (155284.008)	373384.449 (218553.973)	22747.878	0.528
Total variable cost (NRs./ha)	281282.204 (132629.628)	218789.927 (52106.925)	256285.293 (111762.515)	62492.277***	3.12
Profit/Gross margin (NRs./ha) (NRs./ha)	101201.397 (182864.979)	140945.796 (136912.742)	117099.156 (166338.528)	-39744.399	-1.112
Benefit cost ratio	1.352 (0.475)	1.644 (0.569)	1.469 (0.531)	-0.291***	-2.632

Note: Values in parentheses indicate standard deviation

*** indicates significant at 1%, level

Production function analysis

Table 6 presents the results of Cobb Douglas Production Function (CDPF) analysis of potato production in the study area. The result showed that the F value (24.51) was statistically significant at 1% level of significance and has good explanatory power for the model function applied. Similarly, the R² value (0.5356) pointed that about 52 % variations in the dependent variable were easily explained by explanatory variables included in the model (Table 6). It was found that increase in human labor by 100% would result increase in total income (dependent variable) from potato production in the study area by 16.3%, and the increment was statistically significant at 10% level. The coefficient of seed cost (0.759) indicated that 100% increase in the seed cost would increase the total income by 75.9% and this was significant at 1% level. Similarly, the regression coefficient of farmyard manure (FYM) (0.311) pointed that increasing the manure cost by 100% would increase the total income by 31.1% which is significant at 10% level. Lastly, increase in the cost of bullock labor by 100% would reduce the total income by 20% (Table 6), and the reduction is statistically significant at 5% level.

The result of seed cost coefficient i.e. increment in total income with increase in cost of seed was in line with [3] who found increment to be significant at 1% level. Similarly, the increment in manure cost was significant but at 10% level which was statistically significant at 1% in the study of [3]. Also, decrement in total income with increase in bullock labor was statistically significant at 5% level in the study area which was statistically non-significant in the study of [3] in Baglung district.

Table 6: Production function analysis of potato production, Field Survey 2019, Achham

Explanatory variables	Coefficient	Standard error	t-value	P > t
Human labour cost (NRs./ha)	0.163*	0.981	1.66	0.1
Seed cost (NRs./ha)	0.759***	0.135	5.64	0
Manure cost (NRs./ha)	0.311*	0.168	1.86	0.067
Bullock labour cost (NRs./ha)	-0.20**	0.095	-2.15	0.035
Constant	-1.864	1.698	-1.1	0.275
R ²	0.5356	-	-	-
Adjusted R ²	0.5138	-	-	-
F-value	24.51***	-	-	-
Return to scale	1.033	-	-	-

Note: *, ** and *** indicate significance at 10%, 5% and 1% level respectively

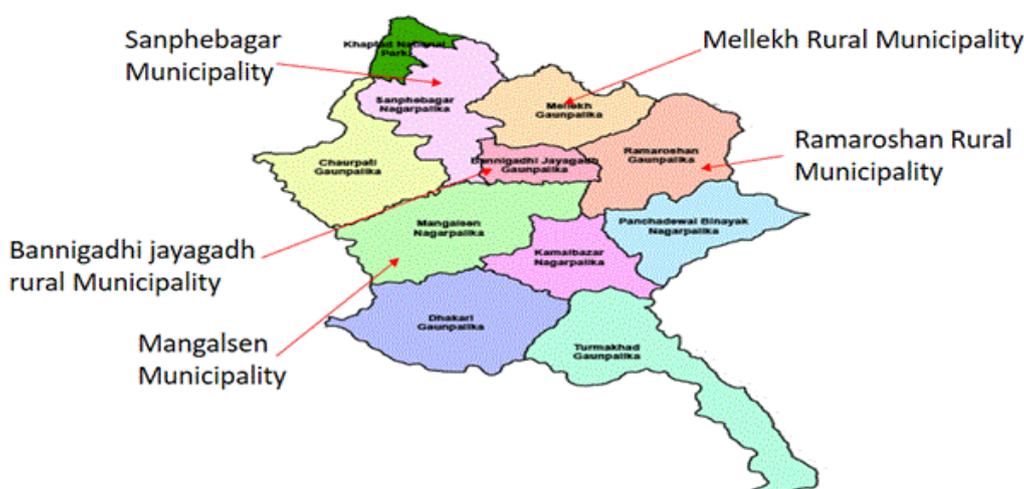


Figure 1: Map of Achham district showing the study areas

Return to scale analysis

From the regression analysis of Cobb Douglas Production Function (CDPF) the sum of coefficient was computed to be 1.033 which signifies the increasing return to scale in production of potato in the study area. This means that the increase in the cost of variable factors would give higher return of income. The obtained value of return to scale is higher than its value obtained by [3] in Baglung district.

Summary and Conclusion

This report entitled "An economic analysis of potato production in Achham district of Nepal" was conducted to assess the production practices and economics involved in the production of potato. The study was carried out in PMAMP, PIU, potato zone command area of Achham district taking the sample of 90 registered farmer respondents by simple random sampling technique. The methods of data collection were household survey with semi-structured questionnaire, FGDs and KII along with various other secondary information sources. The respondents were categorized into small scale farm holder and large scale farm holder based on the land holding under potato cultivation. The finding shows that 71.11% of respondents were male and 28.89% of respondents were female and there was significant difference between the number of male and female respondents in small scale and large scale farms. Agriculture was the major occupation of the respondents. The average age, household size, dependency ratio and area under potato cultivation of respondents were 37.79 years, 7.53 members, 1.05 and 0.081ha respectively. Most of the respondents were literate i.e. 88.9%. Bari land occupied most of the potato cultivation land i.e. 86.67%. About 47% of the respondents' land was irrigated, 41% had non irrigated land and remaining 12% had both irrigated and non-irrigated type of land. The majority of the respondents (44.45%) was following the flooding method of irrigation followed by rain fed based, sprinkler and both flooding and sprinkler. The frequency of respondents cultivating summer season potato was highest (57.78%) in the study area. Use of manual and bullock labor was common with furrow method of planting (81.11%). The major source of nutrient used was FYM and rarely chemical fertilizers. Lack of proper storage facility was the critical problem in Achham where most of the farmers were found to store potatoes in bamboo basket after removal of field heat (75.56%). The need of training on advanced farming techniques was observed with the result of only 24.44% of trained respondents. The major mode of transportation was manual because of irregular availability and higher cost of transportation.

The major inputs used to produce potato in study site were human labor, seed, manure and bullock labor. The total cost of production was NRs. 256,285.293 per hectare with average household production of 937.17 kg and average productivity of 12.287 MT/ha. The cost of production per hectare for small scale farm was found to be NRs. 281282.204 and for large scale farm was NRs. 218789.927 with highly significant difference of means.

The average price of per kg yield was NRs. 30.33. The average gross return from potato production was NRs. 382,483.601 in small farms and NRs. 359,735.732 per ha with total average gross return of NRs. 373,384.449 per hectare. The total average gross margin of NRs. 117099.156/ha was obtained in the production of potato with no significant difference of means between large scale and small scale farms. Similarly, total the average benefit cost ratio of 1.469 was found which shown the potato production a profitable agriculture venture carrying high possibility. The Cobb Douglas production function regression analysis result shown that, 52% of the variations in the total income could be explained by the explanatory variables included in the model. And the data showed positively significant relation of total income with human labor, seed cost and manure cost at 10%, 1% and 10% level respectively while there appeared significant negative relation of total income with bullock labor. The sum of the regression coefficients i.e. return to scale value was 1.033 which indicated the increasing return to scale in production of potato in study area.

Thus, it is concluded that, the potato bears a huge potentiality of production in Achham district. The agro-climatic suitability of the region was the major factor for the given production and productivity of potato despite of poor technical know-how and poor reach of extension activities from the authorities concerned. The higher cost and unavailability of improved seed and fertilizer in time along with the lack of irrigation in the potential areas were the important factors that had significantly affected the production of potato. Similarly, the insect-pests like red ant and white grub along with wild animals like wild boar, porcupine and monkey were prominent and had caused a huge loss in production. Lack of adoption of mechanization in the farming activities, due to insufficient information on advantages and difficult land topography along with small and fragmented land holding of farmers, has caused higher production cost. Seasonal roads with high cost of transportation and the dominance of potato imported from India were major marketing problems as per the information from FGDs, KII and household survey. As the major large producing area lies in the higher altitude regions of Achham district the store houses, rustic stores, are the imminent need of the farmers as many farmers were facing problem in storage of potato for seed purpose and also to supply during the high demand time in the market. The production and productivity along with profitability of potato production could be increased if the above mentioned problems are managed properly from the effort of all the responsible and concerned stakeholders. In a parallel manner, the income from the potato production could be increased considerably if the scale inputs of production increased in a good order.

Abbreviations:

AKC-Agriculture Knowledge Center

DADO-District Agriculture Development Office

FGD-Focus Group Discussion

FYM-Farm Yard Manure
GoN-Government of Nepal
ha - Hectare
HH- Household
INGO-International Non-Government Organization
Kg-kilogram
KII-Key Informants' Interview
MASL- Meter Above Sea Level
MT-Metric Ton
NGO- Non-Government Organization
NRs.-Nepalese Rupees
PMAMP-Prime Minister Agriculture Modernization Project
PIU-Project Implementation Unit

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