

Income determinants of Irish potato (*Solanum tuberosum* L.) growers: The case of west Arsi Zone of Oromia Regional State, Ethiopia

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ABSTRACT

Potato is playing a considerable role in enhancing the income of rural households in the study area. This study analyzed determinants of income from potato production and household decision making in potato production and marketing. The study used purposive sampling and simple random sampling to select the district and respondents respectively. Data was collected using semi structured interview and analyzed by STATA software. Multiple regression analysis was used to determine factors influencing income of potato production. Accordingly, seed cost, level of commercialization, number of oxen owned, frequency of extension contact and farming experience affected farmers' income positively and significantly. Total land owned, and ages of household head are negatively and significantly correlated to potato income. The study implies that to increase the income of potato growers, extension services should be consolidated, accessing quality seed availability through local level seed production system. Extension service should strengthen gender based economic empowerment of woman in potato marketing.

Keyword: Household, income, linear regression, potato, growers.

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INTRODUCTION

Potato (*Solanum tuberosum* L.) is an important food source globally (FAO and CFC, 2010). Ethiopia has good climatic and edaphic conditions for higher potato production and productivity (Endale et al., 2008a). It has the potential to grow in the 70% of the 10M ha of arable land in Ethiopia (FAO, 2008). Consequently, a considerable effort has been made to develop the commodity in Ethiopia. Accordingly, works have been done on varietal development in collaboration with some international organization (CIP) which resulted in the release of 29 improved varieties nationally. Potato is short duration crop of 3 to 4 months that can yield up to 50 t/ha worldwide and up to 30-35 t/ha in research station in Ethiopia (Endale et al., 2008b). However, the same scholar indicated that average tuber yield of potato was almost constant between 6 and 8 t/ha in the last 20 to 30 years under farmers condition in Ethiopia. Further, the crop under farmer's production level is suffering major challenges in retaining and accessing quality seed potato

due to the existence of long single rain fed growing season in most areas, virus and pathogen affected planting material, low productivity, poor storage condition and high levels of rural poverty.

Potato provides an opportunity for income generation. It is one of the most productive food crops in terms of yields of edible energy and good quality protein per unit area and per unit of time fitting into intensive cropping systems. Nutritionally, the crop is considered to be a well-balanced major plant food with a good ratio of protein and calories, and has substantial amounts of vitamins, especially vitamin C, minerals, and trace elements. Due to its correct balance between protein and calories, it is considered a good weaning food (Berga et al., 1993). Ethiopia has good climatic and edaphic conditions for higher potato production and productivity (Endale et al., 2008a). Despite the research and development efforts in improving the production and productivity of potato, little has been done to improve the performance of the entire

potato value chain. Some studies conducted on horticulture value chains considered potato as one of vegetable products and no study has been done on factors affecting farmers' income. Lack of information on socioeconomic factors influencing potato income is among the bottle neck in potato sector development. This study was conducted to assess household decision making in potato production and analyze the factors that affect income of potato growers, which include:

1. To understand farmers socioeconomic profile.
2. To analyze factors affecting potato income in the study area.
3. To assess house hold decision making in potato production.

METHODOLOGY

Location

The study was conducted in Kofele, Shashemene and Arsi Negele districts of west Arsi zone, Ethiopia. These three districts are the main potato production area located to the south Ethiopia. Shashemene and Arsi-negelle districts are found on the way to Hawwasa (the capital city of south nation nationality and peoples region). Kofele on the other way is located 25 km from Shashemene on the road of bale robe.

Sampling technique and sample size

The districts were selected purposively. They are potential potato producers and seller according to Eman and Nigussie (2011). Shashemene serves as hub or central for marketing of potato in Ethiopia. A combination of purposive and simple random sampling was used. From each district three kebeles based with higher production, both from nearest and farthest distance to market were selected and finally the study used a total of 95 respondents which include: 34 each from Shashemene and Kofele respectively while, 27 sample respondents from Arsi Negele were selected randomly. Field level data was collected with the aid of semi structured interview.

Data analysis

Data was undertaken using simple descriptive statistics and multiple linear regression analysis. The descriptive statistics include frequencies, mean, maximum and minimum values and chi square test. Further, multiple linear regression was also used to determine factors affecting potato income. STATA Version 13.1 was used for analysis.

RESULTS AND DISCUSSION

Household socio-economic characteristics

Household labor has an indication on the productivity of farmers. The higher the availability of productive labor in the family, the better productive the family. The average is higher for Shashemene followed by Arsi-negelle and Kofele. Although there is little difference, the average

family size in the household of each district is low and considered to be non-significant (Table 1).

Average household size could not only be enough to indicate the economic productivity of HH. It is better represented by the number of dependency ratio (the ratio of people below 15 and above 65 to the age between 16 and 64). The mean distribution of dependents to independent is high for Kofele with approximately two followed by Shashemene and Arsi-Negelle districts, respectively.

Availability of livestock is the indication of resource which is necessary for endowment. The result of TLU of the study area indicates that the average TLU for the three districts is 8.2 (Table 2). The comparison of the TLU of the three districts reveals that Arsi-Negelle, Shashemene and Kofele respectively stand from first to third in TLU per district.

Land use pattern, Access to farm land and area allocated to potato

The land use pattern of the study area shows that land is majorly allocated to cultivation with mean. One third of the respondents responded that they have fallowed around 0.6 ha of land for the purpose of reclaiming the fertility of their plot (Table 3). The average land owned by each district is indicated in Table 4 showing that there is high average land holding in Kofele followed by Arsi Negelle and Shashemene at HH level.

Relative to the national condition the average distribution in the study area is better. In line with this the average area allocated for potato production in Shashemene, Kofele, and Arsi Negele district is 0.57, 0.49 and 0.37, respectively. This result is below the study result obtained by Endale et al. (2008b) which states that in India the average land allocated for potato production is 1 ha. Moreover, although household land distribution is low in Shashemene the area allocated to potato production is high. This generally reveals that production of potato is better in land allocation at Shashemene.

In the entire three districts, the average productivity per hectare is 8.4 ton per hectare (Table 5). This shows that although a considerable effort has been done nationally by research, productivity still exists below 10 tons. The research station based results show that there is an achievement of up to 30 tons per hectare nationally. This result reveals that the small farmers productivity and research station productivity is by far different with very little farmers productivity. It is probably related with a number of factors among some is lack of access to improved variety, disease and pest, and inadequate use of input as well as price fluctuation. This result is consistent with the study of Fuglie et al. (2005) and Eman and Nigussie (2011). The same way, Hoeffler (2005) indicated that biophysical and socioeconomic factors are the limiting factors of potato production in developing countries.

Table 1. Average household family size by district.

District	≤15 yrs	>15 yrs	Total family member	Dependency ratio
Shashemene	3.39	3.96	7.35	0.86
Arsi Negele	2.85	4.22	7.07	0.67
Kofele	4.35	2.62	6.97	1.67
Total Average	3.53	3.6	7.13	0.98

Table 2. Average TLU by district.

District	N	Min.	Max.	Mean	Std. Dev.
Shashemene	34	0.10	39.43	7.29	7.48
Kofele	34	0.75	24.26	9.40	6.32
Arsi Negele	27	0.27	57.82	7.82	11.50
total TLU	95	0.10	57.82	8.19	8.43

Table 3. Land holding/tenure pattern of the study area.

Statistics	Irrigable land	Fallowed	Cultivated	Home	Rented out	Rented in	Range land
Frequency	5	30	93	92	5	8	3
Mean and S.E	0.125 ± 0.055	0.59 ± 0.21	1.42 ± 0.19	0.27 ± 0.01	0.45 ± 0.16	0.62 ± 0.08	0.29 ± 0.11

Table 4. Land allocation to potato production.

District	Average total land owned	Area allocated to potato production
Shashemene	1.30	0.57
Kofele	2.03	0.49
Arsi Negele	1.67	0.37
Average	1.67	

Table 5. Land allocation and potato productivity by district.

District	Area allocated (ha)	Amount produced in kg	Productivity per ha in kg
Shashemene	0.57	5100	8,947.3
Kofele	0.49	4032.35	8,229.2
Arsi Negele	0.37	3000	8,108.1
Total	0.48	4121.053	8,428.2

The study result revealed that majority of the respondent used local variety for production. It was shown only 4% use improved variety, while 16% used both local and improved variety of potato for their production. Table 6 shows that the result is statistically significant at probability less than 1%; despite the considerable efforts made to develop the crop in Ethiopia which resulted in the release of 28 varieties of improved potato (Endale et al., 2008a). There exist a gap in the better utilization through extension and research so that the number is reversed to benefit the majority. Further

Table 6. Types of seed used by farmer in the study area.

Type	Frequency	Percent	χ^2	P-value
Local	73	79.3	89.63	0.00
Improved	4	4.3		
Both	15	16.3		
Total	92	100		

study needs to be undertaken to identify and enhance the

Table 7. Description of production cost for potato.

Type	N	Mean	Min.	Max.	Std. Dev.
Labour cost*	76	821.8	.00	3235	774.3
Seed cost	95	1100.3	.00	12900	2031.8
Input cost	94	1235.5	.00	12480	1521.1
Total sell	95	9074.1	.00	70000	11165.8
Profit	62	6324.7	-2776	55792.4	10664.4

*In ETB, 1USD equal 20 ETB.

Table 8. Distribution of potato farming information source.

Source of information	n	%	χ^2	p
Nearby farmers	29	30.5		
Trader	25	26.3		
Relative	2	2.1		
Broker	9	9.5		
Broker and farmers	18	18.9	70.13	0.00*
Other farmer and relatives	9	9.5		
Radio and other farmer	1	1.1		
Personal observation	2	2.1		
Total	95	100		

crop productivity in the area. This result reveals that the coverage of improved variety in the area is very little and little effort done on promoting improved variety in the area or probably farmers may prefer local to improved variety. This is because most of the time, technology development may not consider the need and interest of farmers. To effectively enhance and raise the awareness of farmers in the use of improved potato varieties, farmers participatory research should be used so that farmers preference would be considered and better result would be obtained.

Costs of production for potato in the study area

In potato production, a number of costs are related to the production. This study generalize those costs of production into major costs, that is, labour cost, seed cost, input cost. The labour used for production is covered from household and hired labour. However, Table 7 describes all the costs, their minimum and maximum average, and its deviation from average.

As can be seen from Table 7, the mean labor cost of production in the area is 821.84 Ethiopian birr, while seed cost is 1,100.3, and input cost is 1,235.4. Among all costs, cost related to input is high in the area because it involves the use of fertilizer and chemicals for production followed by seed cost. Meanwhile, there is relatively less cost involved in labor in the area for potato production. This result is similar to the study by Hoeffler (2005) in

which they indicated that among socioeconomic factors that affect potato production in Ethiopia is high cost of production and lack of access to credit service. The average revenue obtained in the study area is 9,074.1 while this differs over the districts; however, there is no statistically significant difference for revenue between districts. The average net profit obtained as calculated by revenue minus costs involved is 6,327.1.

Potato market information

Farmers need better information for a better price of their product. There are numerous source of market information in the study area. Consequently, the difference in sources of information is statistically significant that farmers most frequently use other nearby farmers, traders and brokers respectively (Table 8).

Farmers use neighbours as source of information (30.5%) (Table 8). Traders hold the second level by serving as source of farmers' information followed by combined use of broker and farmers as information source with percent distribution of 26.3 and 18.9, respectively. The distribution by district indicated that among the 29 respondents who use other farmers as a source of information, 48.2% of them were found in Arsi Negele district while 25.9% were found at Shashemene and Kofele. This result is different for traders as source of information which reveals that among 25 respondents who use trader as a source of information, 50% of them

were from Kofele while 32% were from Shashemene with the remaining from Arsi Negele. This reveals that by location the providers of market information are quite different between the study districts. This however, makes relative price different. Among the study site price of potato is higher at Shashemene with average price of 2.37 birr per kg while it is similar at Kofele and Arsi Negele with approximately average price per kg of 1.8 and 1.3 birr respectively.

Credit service

Access to credit is one of the factors that can facilitate and hinder good marketing and price in potato production. It was only less than twenty percent of respondent accessed credit service. While majority of respondents has no access to credit service (Table 9).

Among credit service providers micro finance, credit and saving organization and cooperative respectively received the larger share. It is recommended that they have to enhance their service. The response of credit non-users on factors affecting their participation in credit service reveals that high interest rate of the service, lack of credit information on how and where to get, inadequacy of credit supply followed by restrictive procedure is among the major limiting factors respectively. This result is in line with the study of Hoeffler (2005), who in their study of sustainable potato production in developing countries, stated that lack of credit due to different reasons is among the socioeconomic factors limiting the sector. It is true in this study that farmers will benefit more from access to credit. This could be enhanced on facilitating farmers saving behavior, creating credit awareness and adequately supplying credit information through mobile banking and community credit information providers.

Factors affecting potato income

As shown in Table 10, the regression analysis indicates that income from potato increases with increase of seed cost. The statistical result of 3.26 reveals that a unit increase in seed cost results in a 3.26 increase in income. This result is statistically significant at 1% probability level. The probable justifications is that the higher price of seed might be related with better quality seed and can enable farmers to harvest and sell at higher price and give serious attention to the crop. The level of commercialization also positively and significantly affects income from potato. A unit increase in the level of commercialization results in a 23543.2 increase in income. The probable justification is that it is those farmers who commercialize more that obtain better income from potato production.

The other variable that affects income from potato production is total land owned. It affects income from

Table 9. Access to credit, source and related problem.

Parameter	Frequency	Percentage
Access to credit		
Yes	17	19.5
No	70	80.5
Total	87	100
Source of credit		
MOA	1	5.8
Cooperative	2	11.7
NGO	1	5.8
Micro finance	10	58.8
Credit and saving	3	17.6
Problem		
Inadequacy of supply	3	17.6
Interest rate	7	41.17
Restrictive procedure	2	11.76
Lack of information	5	29.41
Total	17	100

potato negatively and significantly. Keeping other factors constant, a unit increase in total land owned results in 2970.03 decrease in income; this result is statistically significant at 1% probability level with p value of 0.01.

It is probably because farmers of more holders do not allocate more of their land to potato production because on a large scale production system there might be another crop that gives relatively better income and shifts attention of farmers from potato to others. This result is consistent with the study of Hirpa et al. (2010) and Litaladio et al. (2009) which states that adoption and commercialization of potato is more related with those who rent land because those who hold land with lease are less likely to adopt and commercialize, and because of availability farmers tend to focus more on diversification.

Farm experience is among the variables that affect income significantly. *Ceteris paribus*, income increases by a factor of 469 with a one year increase in farming experience of potato producers. This is probably because more experienced farmers obtain better yield and quality product since they are expected to know well about market preference over time. Moreover, more experienced farmers are better resource endowed and store their product during low price; it is also related with establishment of secured customers that relatively secure their income of potato production. This result is also consistent with the study of Assa et al. (2012) and Litaladio et al. (2009) stating that more experienced farmers tend to sell more and profit more. Number of ox owned in Ethiopia is an indicator of traction force. The higher the number of oxen owned the better an individual has the capacity to plough more land and solvent to

Table 10. Model output of income as affected by various explanatory variables.

Variables	Coeff.	Std. Er.	t	P
Production cost	0.087	2.02	0.04	0.96
Seed cost	3.26	0.77	4.23	0.00*
Commercialization level	23543.2	5985.0	3.93	0.00*
Total land	-2970.03	1147.3	-2.59	0.01*
Farm experience	468.8	245.3	1.91	0.05**
Ox number	2917.9	1463.0	1.99	0.04**
Age	-410.8	237.6	-1.73	0.08***
Extension	8915.4	4806.2	1.85	0.067***
Total members	616.27	677.03	0.91	0.36
Constant	-4741.2	7506.7	-0.63	0.52

Number of observation = 95; F (9, 85) = 6.83; Prob. >f = 0.000; R² = 0.41; Adjusted R² = 0.358; Root MSE = 13348. *, **, and *** is significant at 1, 5 and 10% probability.

Table 11. Market information source by district.

Information source	District		
	Shashemene	Kofele	Arsi Negele
Broker	7	0	2
Broker and other farmers	4	7	7
Other farmer and relatives	8	3	0
Nearby farmers	6	8	13
Observation	0	2	0
Radio and farmers	0	0	1
Relative	1	1	0
Trader	8	13	4
Price per kg	2.37 (0.62)	1.8 (1.2)	1.32 (0.89)

input. *Ceteris paribus*, number of ox owned affect income positively and significantly. A unit increase in number of ox owned results in 2918 increase in income. The result is significant at $p < 0.05$ and is probably justified that those farmers who has better number of ox has a chance of ploughing more land for potato sowing. Moreover, higher number of ox would make farmers to use more input by selling extra ox without fear of lacking tract power.

Age has affected income from potato production in a negative and significant way. Other factors constant, a one year increase in age results in 411 units decrease in income. It is true that older farmers are more risk averse than taker. The result is statistically significant at $p < 0.08$ probability level. The probable justification is that older farmers had less labour access than the younger. On the other way, shortage in investment cost at old age made farmers to have less income from potato production. It is similar with the study result of Assa et al. (2012) who stated that an aging farmer is less energetic to participate in the farm. It is also against with the study of Hirpa et al. (2010) which reveals that an increase in age would increase adoption and income. It is concluded that

younger farmers are more market oriented and be given attention in potato research and development to benefit more. Participation in extension enhances farmers' access to technology, as well as product and input market. Extension service participation in the study area affected income from potato in positive and significant way. *Ceteris paribus*, the beta value of 8915 reveals that as extension participants' increase by one person, the value of income generated from potato increase by a factor of 8915. The students t value indicate that the result is statistically significant with $p < 0.067$ probability level. It is consistent with the study of Kafle and Shah (2012) which indicates that the higher frequency of participation in extension maximized the potato farmers' productive efficiency.

Access to market information

Market information is a necessary tool for farmers' better life. Price obtained by producer depends on the quality, source and channels of market information. The study result on farmer's information source (Table 11) shows

that in Shashemene district, farmers used other nearby farmers and traders followed by brokers as sources of information. In Kofele as well, most farmers used traders as a source of their market information followed by nearby farmers only. Further, the issue is different in Arsi-Negele respondents who used nearby farmers as primary source of information followed by broker and other nearby farmers together as a source of information (FAO and CFC, 2010). Also, it was found that farmers in North Shewa and West Shewa zones of the central area and East Hararghe zone of the eastern area of Ethiopia obtain information on potato technology from farmers in their own community

Farmers' decision making in potato production and marketing

In potato production, decision is made at different stages from production to marketing. In this study, the relative decision making process in potato selling is presented in Table 12.

Among all combination of decision makers, it is husband and wife together who make decision on the issue of time of sell. The study result indicates that the role of husband and wife together on time of potato sale represents the major share with the percentage coverage of 67%. It is followed by all household members together with coverage of 16%. Husband only is third with the percentage value of 11.7%. With regard to the decision on how much to sell, the contribution of husband and wife is 72.3%, followed by husband only and all family members together with 10.6% contribution from each. The result is indicated in Table 13.

Market location has an impact on price and intra-household decision. Female farmers' participation in decision on the place of potato sale is affected by the triple gender role, distance of the market and other mobility related factors (Table 14). Accordingly, in west Arsi the decision regarding place of sale is majorly decided by husband and wife together followed by husband only and all family members together. The study result also indicated that husband and wife together, husband only and all together, has 52.1, 31.9 and 10.6%, respectively.

Among the respondents in the study area, it is husband only who is responsible for potato sale with response rate of 66% followed by husband and wife with percent response of 19.1% (Table 15). The role of wife only is 6.4% while the responsibility of children in potato sale is 4.3%. As a response to maintaining price fluctuation, farmers use storing and selling on different time. The study result indicates that farmer's sell more than once.

Furthermore, 38.5% of farmers sold their product only once, they justify their reason that although price is low due to lack of adequate storage, lack of capital and other related factor they prefer to sale only once; followed by

Table 12. Decision making pattern on time of potato sale.

Decision maker	Frequency	Percentage
Husband	11	11.7
Wife	3	3.2
Children	2	2.1
Husband and wife	63	67
All	15	16
Total	94	100

Table 13. Decision pattern on amount to be sold.

Decision maker	Frequency	Percentage
Husband	10	10.6
Wife	4	4.3
Children	2	2.1
Husband and wife	68	72.3
All	10	10.6
Total	94	100

Table 14. Decision on place of sale (market site).

Decision maker	Frequency	Percentage
Husband	30	31.9
Wife	3	3.2
Children	2	2.1
Husband and wife	49	52.1
All	10	10.6
Total	94	100

Table 15. Responsible person for potato sale.

Decision maker	Frequency	Percentage
Husband	62	66
Wife	6	6.4
Children	4	4.3
Husband and wife	18	19.1
All	4	4.3
Total	94	100

sale twice with the response frequency of 48.4% and three times with 48.4% because that they had produced twice a year and and/or wait for better price. It is only 11% of respondents that sold their products three times in a year (Table 16).

CONCLUSION

In the area average potato productivity per hectare was 8

Table 16. Response on frequency of major sale.

Freq. of sale	Frequency	Percentage
Once	35	38.5
Twice	44	48.4
Thrice	10	11
Four times	1	1.1
Five times	1	1.1
Total	91	100

to 9 tons. This low productivity is related to the use of local seed potato, fluctuation in market price, disease and pest and other production related factors by majority of the farmers. The potential of potato in the area was not well utilized; enhancement of the potato sector in the area with developing the production and intensification skill of farmers will result in better realization of the crop potential. Establishing a more secure information system enhance better utilization of information on potato production and marketing. A better facilitated credit system development and mobilization will capacitate the investment capacity of farmers to the crop. The incorporation of more experienced younger farmers and availing better quality seed potato in potato based project extension shall be rewarding to the maximization of profit. Meanwhile, gender based division of labor and economic empowerment of women farmers will result in enhanced participation of woman in potato production and marketing decision.

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