Research Article

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Onion Production for Income Generation in Small Scale Irrigation Users Agro-pastoral Households of Ethiopia

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Abstract

Conceptually, the benefits of irrigation are realized through improvements in agricultural productivity. At household level, the agricultural production increases could be followed by improvements in income generation and food consumption patterns. The goal of this research was to examine the relationship between irrigation, income generation and household consumption patterns for the rural smallholders with pre-scaling up of onion variety (*Allium cepa*) of Bombie and Adama Red. A survey was undertaken in 500 households and information was collected on demographics, landholdings and family labor, irrigation, returns of cultivation, consumption behaviors, farmer perceptions and experiences, and other related variables. The results show that using irrigation the Bombie red yield on average was 193 quintal per ha with maturity date of 90-100 days. Though overall production increases the agricultural income of households because the amounts produced directly marketed which increases the household income generation and to spend on food crop purchases for consumption. However better dietary diversity was found on the consumption pattern of the irrigated households with higher income since part of the generated yield was supplied to the surrounding market and to other tertiary markets like Nazareth and Addis Ababa. The average total land holding was found 4.7 ha while the average land cultivated for onion production varies 2.2 to 1.1 ha in Amibara and Fentale districts of the Awash basin areas. Average years of experience of small holder households in using different improved verities were 7.3 in Fentale while 5.1 years in Amibara districts which had good contribution in production management. Producers indicated that every once days irrigated the crop on average in the district. Seedling rate used for onion bulb production was varying 3.8 kg/ha on average depending on the condition of the seed.

Keywords: Onion yield; Irrigation; Land size; Family labor; Dependency ratio; Adult equivalent

Introduction

Onion is considered as one of the most important vegetable crops produced on small scale in Ethiopia. It also occupies an economically important place among vegetables in the country. The area under onion is increasing from time to time mainly due to its high profitability per unit area and ease of production, and the increases in small scale irrigation areas. The crop is produced both under rain fed in the "Meher" season and under irrigation in the off season. In many areas of the country, the off season crop (under irrigation) constitutes much of the area under onion production. Despite areas increase, the productivity of onion is much lower than other African countries. The low productivity could be attributed to the limited availability of quality seeds and associated production technologies used, among the others.

For the supply of seeds, the informal sector is playing significant role in outreaching large number of farmers. Most of the demand for onion seed is either meets by local supplies unorganized market system and imported seeds informal trend. The formal sector, Ethiopian Seed Enterprise (ESE) is not generally supplying onion seed. Most amount is catered by public sector organizations like Ethiopian Institute of Agricultural Research (EIAR)-Werer Agricultural Research Center for small scale irrigation users as pre-scaling out activities.

Agro ecological requirements

Onion grows between 500-2400 m.a.s.l. The best growing altitude so far known in Ethiopia is between 700-1800 m.a.s.l. Besides altitude which has an indirect bearing on climate, onion production is affected by temp, rainfall and soil. It is grown under mild seasons without extremes of heat, cold or moderate rainfall. Optimum temperature of 18.3-23.90 day and 10-120°C of night temp are ideal for onion bulb production. But lower temperature is referred for seed stalk development. Onion requires deep alluvial and friable or sandy loam soil with a pH of 5-6.8. Onion does not tolerate badly drained soil and also it is moderately sensitive to soil salinity [1].

The genus *alliums* are large, consisting of more than 500 species grown in different parts of the world. The most important species, which are significantly important in the national economy, are onion (*Allium cepa*), shallot (*Allium ascolonicum*) and garlic (*Allium sativa*). The edible *Alliums* are of major economic and dietary importance in all parts of the world. Onion, shallot and garlic are grown, traded and consumed in most countries. They are used for spices and condiments for flavoring various dishes. They are also the main source of income for the local farmers since they are traditionally small farmer's crop. Onion, which was recently introduced different varieties for small scale irrigation users, is rapidly wide spreading for its high yield and contributing to the household income generation. Ethiopia has a great potential to produce the crop throughout the year. Unlike shallot and garlic, which are rain-fed, onions are produced under irrigation during the dry season of the year. In Ethiopia these crop is produced in home

gardens and commercially in different parts of the country at small scale commercial firms. From production point of view, onion is comparatively easy to produce, provided it is grown in the dry season when diseases are less prevalent [2].

Socio economic importance of onion

The demand for *Alliums* is worldwide and their use is not limited to any climate or associated to any nationality. They are consumed universally in small quantities and used in many homes almost daily, primary as a seasoning for flavoring varieties of dishes. Onion contains vitamin B and traces of vitamin C, carbohydrate and small percentage of proteins. In Ethiopia *Alliums* is for home use in flavoring of local dishes, like hot pepper; it is indispensable ingredient of the traditional sauce or "wot". Besides it's an important cash crop to the farmers. Generally onion consumption is much higher than most other vegetables. Onion has significant contribution to the national economy.

Objective

This research seek to evaluate the socioeconomic characteristics of the onion out growers in small scale irrigation in Ethiopia, determine the possibility of association among the variable costs in the production, evaluate profitability and identify constraints associated with production.

Methodology

The study area covers the upper and middle Awash River basin. Amibara woreda is one of the 30 woredas in the Afar region state. Based on figures published by the Central Statistical Agency (CSA) [3], this woreda has an estimated total population of 63,280, of whom 35,301 were males and while 27,979 women. The annual rainfall is between 579 mm to 674 mm with average monthly temperature ranges from 24°C and 37°C. Fentale woreda is one of the 180 woredas in the Oromia region state. Part of the Easter Shewa Zone located in the Great Rift Valley. The administrative town is Metehara. The woreda has an estimated total population of 82,225 of which 43,510 are male and 38,715 are women [3]. Primary data were collected from 500 respondents who were randomly selected from the list of participating farmers during farming season. The data were collected with the use of structured questionnaire designed in line with objectives of the study.

Cross sectional data on socioeconomic characteristic of producers, inputs and output were collected for the season of 2013/14. The weight of parameters on the yield studied through input-output relationship. A: Cobb-Douglas production function was employed using the following forms:

$$Y = \alpha X1^{b1} + X2^{b2} + > ... + \in^{nt}$$

Where:

Y=the dependent variable of onion yield per kg

α=the constant; scalar

X_i=the independent variable; explanatories

b_1 and b_2=regression coefficients estimated; elasticity of explanatory variables where $0 < b_i < 1$;

$b_1 + b_2 = 1$

∈nt= an error term assumed to be randomly distributed with zero mean and a unit of variance.

If $b_1 + b_2 = 1$, model shows constant returns to scale. If $b_1 + b_2 > 1$, increasing returns to scale and if $b_1 + b_2 < 1$, diminishing returns to scale.

The generalized transformation of the C-D production function can help to noise elimination, easy translation and can ease correlation problems. The logarithmic transformation of the production function provides a log-linear form which is convenient and commonly used in econometric analyses using linear regression techniques. Employing a more general form of the function can allow for estimation of the coefficients value and statistically testing hypotheses about return to scale:

$$\ln Y = \ln \alpha + b_1 \ln X_1 + b_2 \ln X_2 ... + \in nt$$

Taking the derivative of the logarithm form which can be interpreted as a percentage change of the parameters:

$$\frac{dY}{dY} = \frac{d\alpha}{d\alpha} + b1 \frac{dX1}{dX1} + b2 \frac{dX2}{dX2} + ...$$

%change in Y=% change α+b1*% changeX1+b2*% change X2+…

The model was specified as:

lnOy=lnα+b1 lnSd+b2 lnFa+b3 lnIr+b4 lnFs+b5 lnPs+b6 lnHs+b7 lnEd+b8 lnAg

Where:

α=the intercept

Oy=onion yield in kg per ha

Sd=seed applied per ha in kg

Fa=fertilizer applied per ha in kg

Ir=number of irrigation applied

Fs=family size

Ps=dummy variable of the use of pesticide

Hs=dummy variable of the use of herbicide

Ed=dummy variable of education (illiterate versus literate)

Ag=age of the household in years

Result and Discussions

Socioeconomic profile of the respondents

Socioeconomic factors are most important and always remain responsible for not only cropping patterns but for production technology and efficient trading system in a healthy and competitive important. The socioeconomic background has been defined and described in the following section in order to help in understanding the production environment of this vegetables.

This section presents the socioeconomic characteristics of the production process of onion in the sample province of Afar and Oromia regional states. The information regarding socioeconomic characteristics of the onion farmers is presented in Table 1. This table presents the averages and standard errors of the selected indicators, where standard errors indicate the robustness of the mean. The results show that average farm size 2.1 in Fentale district while 3.2 where in

Amibara hectares respectively, while the average family size small scale producers are 4.2. The farming experiences of the selected farmers were 7.1 years in Amibara and 10.7 in Fentale districts. Average distance of farm from road for producers was 1.3 km while 1.1 km from market point.

Characteristics	Amibara		Fentale		Total	
	Mean	St.Err.	Mean	St.Err.	Mean	St.Err.
Total land holding	3.2	7.7	2.1	4.7	4.7	3.7
Family size	4. 5	0.6	3.8	1.0	4.2	1.1
Age	30.1	1.6	34.5	1.6	33.2	1.7
Farming experience	7.1	1.2	10.7	1.9	8.5	1.9
Vegetable farming experience	5.1	0.7	7.3	0.5	6.3	1.2
Distance from road	1.3	0.5	1.1	0.1	1.5	0.3

Table 1: Descriptive analysis.

Household labor contribution

According to CSA [4], the average family size of Ethiopia is (5.4). The adult equivalent varies from (4.2) to (3.8) in Amibara and Fentale households respectively (Table 2). The adult equivalent shows that Amibara households have better labor input.

Household dependency ratio shows the economically inactive labor compared with the economically active one. It is measured by dividing the number of non-working members; children under the age of 15 and elders above the age of 64 who cannot work by the economically active family members. Dependency ratio is widely used to measure the economic labor of the household and the burden on household heads. Dependency ratio is negatively related with income and economic labor. Accordingly, in district shows that each 100 economically active person had 90 extra person to feed in the Amibara and Fentale respectively (Table 2). This shows that there is a relative dependency.

Characteristic	Amibara	Fentale	Total	χ2
Family size	4.5	3.8	4.2	9.5**
Adult equivalent	5.3	4.2	4.8	98.0
Dependency ratio	0.9	0.9	0.9	20.1

Table 2: Household labor contribution ***, ** and * indicate significance at 1%, 5% and 10% respectively.

Land allocated for onion production

Based on the analysis, the average land allocated for onion production was 1.7 hectare yet the allocation of land varies between the districts from 2.2 to 1.1 in Amibara and Fentale respectively. The average seed amount used per hectare was 3.8 kg and average price per kg 788.1 birr while the average yield found 16,650 kg per hectare which had a significant variation among the sample districts at 1% level (Table 3).

Characters	Amibara	Fentale	Total	χ2
Average land for onion	2.20	1.10	1.70	90.6***
Average seed used (kg/ha)	4.10	3.50	3.80	54.0**
Average seed cost (birr/kg)	800.7	775.5	788.1	95.9***
Average sales per kg	3.50	5.00	4.25	33.4**
Average yield per ha in kg	14,000	19,300	16,650	62.4***

Table 3: Average total land holding and average seed price ***, ** and * indicate significance at 1%, 5% and 10% respectively, χ2 the chi-square significance.

Production function analysis

Agricultural production is a complex process particularly vegetable production including onion. The onion production is function of number of variables used in production process. The production of these vegetables depends on natural environment, input use and combination of inputs and management practices. Knowledge of the importance in relative terms of the resource inputs influencing the production of these vegetables is very essential for the producers for introducing desirable changes in their operations at the micro level, and for policy makers for formulating plans for improvement in the productivity of theses vegetables based on sound economic principles at the national level.

For assessment of on-farm production efficiency and returns to scale, production function analysis has been carried out. The production function has been estimated through input and output relationship of these vegetables produced.

The intercept: This factor sum up the weight of different variables that are not easy to integrate in this investigation such as agronomical factors, weather condition, land and labor qualities, etc. In controlled environment research, no major significance is normally attached to this term because the exogenous factors to address are restricted [5]. Since this study use survey so there exists a factors that are not incorporated because of different reasons which such analogy the intercept has shown significance in affecting the yield at 10 percent of significant level (Table 4).

Seed amount applied: Measuring seed amount applied per hectare in kilogram has no worth difference in yield so that increasing seed used above the recommended volume which is 3.5 to 4.0 kg per hectare (Table 3) have no impact in growing the output. Table 4 states that applying quantity of seed from the optimal extent will not rise yield as p-value indicates that insignificance at all level (Table 4).

Fertilizers application: It was measured in kilogram per hectare. Hassan and Ayoub [6] stated that raising the level of nitrogen gave a high significant increment in total yield, average bulb size and reduces the percentage of bolting. Veck [7] find out that the fertilizer application in developing country very low as Ethiopia is one of them, the fertilizer application of onion in the districts are very low this needs further investigation but the perception is that apply fertilizer could not have implication in yield of onion for the irrigated areas as its assumed that the soil fertility is good yet the use have been found it had a contribution at significant level of 10% (Table 4).

Family size: Family members are the source labor for small scale irrigation users in the sample area, which the labor force affects the

farm management and in which different operations are conducted. The family of the farmers is an important source [8]. This variable was treated as continues variable as the matter of head count of the family and as stated in Table 4 the t-value show (2.22) which greater that the expected t-values to significance (1.9) and found that it has an implication on the houses holds production system in labor force and farm management with significance level of 5%, which is indicating that the labor availability to daily activities in the production process can maintain for incremental output.

Education: The level of education is assumed to have a high substantial importance and effect on the output. Which implies the better educated not only have the skill and knowledge but also the capacity for alternative methods and techniques than illiterate but also have more confidence in his own application technologies package which contributes to efficient production system. Education variable was a dummy variable literate or illiterate. Gladwin [9] finding stated that education level affected yield. Supporting literatures states that education variable are significant in agricultural production at the household livelihood change, finding of this research supports that education have significant impact in the household output with t-value of 9.33 at the significant p-value of 1% (Table 4) that conditions the more educated the household there is a probability to get highest yield than that of non-educated household in the sample area which engaged in onion production at small scale irrigation level.

Age of the household leader: The variable was used as continues. Age is expected to have influence on productivity and production as it affects mental and technologies handling ability. Furthermore; it has innovative impression with experience. Ali disclosed that there is a positive relationship between household age and productivities up to certain level beyond which the negative because of mental and physical abilities to carry out activities.

Variable	Coefficient	t-value	p-value
α	0.42	1.20	0.10*
Sd	0.51	0.12	0.50**
Fa	0.12	2.15	0.10*
Ir	0.32	3.83	0.00***
Fs	0.11	2.22	0.03**
Ps	0.03	2.44	0.02**
Hs	0.21	1.12	0.34
Ed	0.10	9.33	0.00***
Ag	0.11	7.08	0.00***
Ad.R2	0.72		

Table 4: Regression coefficient ***, ** and * indicate significance at 1%, 5% and 10% respectively.

This study revealed that age had a positive impact in the onion producer households in the sample district with t-value of (7.08) at the significant level of 1% (Table 4).

Table 5 indicates that the production function used as a mode provided good fit to the data collected in 2014 from the district of Amibar and Fentale small scale irrigation user households is

significant with F-value of 36.7 with significant level of probability at 1%. The coefficients of estimated parameters have the expected signs according to the economic theory.

Source of variation	Sum of square	Degree of freedom	Mean of square	F-value	Prob>F
Regression	0.68	10	0.068	36.72	0.01***
Residuals	0.13	69	0.002		
Total	0.81	79			

Table 5: Analysis of variance ***, ** and * indicate significance at 1 %, 5% and 10% respectively.

Data analyzed for the cost of production at small scale irrigation producers of onion in the sample district average cost of production with keeping constant other exogenous variables that can contribute to the cost of investment the total cost of production per hectare on average is 18,247.3 Ethiopian Birr (Which is at the time of US Dollar exchange rate was1USD=19.97 Eth. Birr) which is almost 913.74 USD (Table 6).

Seed cost and weeding practices for labor have the highest share the total production cost. The recommended seed weight per hectare is 3.5 to 4.0 kg (Table 3) yet the sales cost of seed at the market level varies from 800 to 775 Ethiopian birr which escalating in every season that indicates the supply side is not at equilibrium compare the demand, on the other side it is an opportunity for small holder commercial farmers to produce to supply the market at the local market. Though fertilizer application is not recommended in the sample districts because the return from application is insignificant yet there are households who apply at a minimal level, average share of the fertilizer is negligible which was (3.94%) from overall average allocated per hectare. Pesticide had an average cost of 1,891.10 Eth.

Activities	Cost (in Eth.Birr)	Percentage share
Nursery bed preparation	2012.49	11.03
Seed (seed cost)	2800.00	15.35
Seeding	1000.72	5.50
Land preparation	1025.35	5.60
Irrigation (canal maintenance)	1757.02	9.63
Transplanting	2013.45	11.03
Fertilizer	719.37	3.94
Weeding	2917.09	15.99
Pesticide	1891.10	10.36
Harvesting	2110.71	11.57
Total	18,247.3	100.00

Table 6: Cost of production per ha.

Birr which has the portion of (10.36%) from the gross cost, the suggested pesticides where Dime-tot (applied with 200-250 liters of water with 1.5 liters of Dime-tot for a hectare) and Celecron (200-300 liters of water with 1.5 liters of Celecron for a hectare) applied was

used to protect tribes in the sample area which is also recommended by Werer Agricultural Research Center.

For calculating the break-even point and profitability of production these formula was used:

$$\text{Break-even point} = \frac{\text{total cost of production per ha}}{\text{Price per unit of yield in kg}}$$

$$\frac{18{,}247.3 \text{ birr}}{4.25 \text{ birr/kg}} = 4293.48 \text{ kg (which is at about 43 quintals per hectare)}$$

The percentage part of the break-even point of the average onion yield was found:

$$\frac{4293.48}{16650} \times 100 = 25.8\%$$ the equilibrium share to profit was 26% at this point of production the household average cost and yield are at optimal stage of production where it shows increasing at decreasing rate of returns from the break-even yield to the average yield the producer is at increasing rate of returns to production where profitability rate is generated to the household income.

Conclusion and Recommendation

The Cobb-Douglas production function adequately estimated the input-output relationship for onion production at the district for small-scale irrigation users. The findings were consistent with the expectations and the availed economic theories production. The variables taken for production analysis were significant for instance family size was found to have implication in onion production because it needs an intensive labor application for different activities like land preparation, planting, weeding, irrigating, chemical spray and harvesting. Educational levels have positive effect on yield, which has a positive correlation with outputs. The analysis of cost prediction indicates that land preparation, seed cost, weeding and harvesting existed as noteworthy in the total cost of production at small-scale irrigated household onion production. The break-even point analysis revealed onion production is profitable at small scale irrigation level in the study district and this was replicated by considerable variances among the average yield per hectare and break-even point or the total variable cost for operational the activities.

The recommendations in the process are:

Seed production should be encouraged at small-scale level to intervene in the market.

The extension system should have to be more innovative in the production system so that households can have access to information like market price, seed price, pesticide and other variable cost information.

Though there is a potential supply yet the price sale per kg is minimal that affect the producers to have high margin of profit as there is less competitive of between buyers and price were fixed in a type of oligopolies marketing system.

References

1.   Werer agricultural research center unpublished report 2012.

2.   FAO (2006) Agricultural Marketing in FAO Concepts, Policies and Services: Rome.

3.   CSA Ethiopia (2010) Summary and statistical Report of the 2009.

4.   CSA Ethiopia (2011) Summary and statistical Report of the 2010.

5.   Johnson AC Jr, Johnson MB, Buse RC (1987) Econometrics; basic and applied. McMillan Publishing Company, New York.

6.   Hassan MS, Ayoub AT (1978) Effect of N, P and K on onion in the Sudan, Gezira. Experimental Agriculture 14: 29-32.

7.   Velck PLG (1991) The role of fertilizer in sustaining agriculture in Sub-Saharan Africa. Journal of Fertilizer Research 26: 327-339.

8.   Adam AZ (2005) Economics of onion production in the northern region of Omdurman city, Khartoum State. M.Sc Thesis, Sudan University of Science and Technology, Sudan.

9.   Gladwin CH (1992) Impact of fertilizers subsidy removal programs in Malawi and Cameroon. Journal of Agricultural Economics 21: 15-19.