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Cost Benefit Analysis of OPV versus Hybrid Processing Tomato Varieties in East Shewa Zone, Ethiopia

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Abstract

Tomato (*Solanum lycopersicum Mill.*) is the major horticultural crop with an estimated global production of 164 million metric tons from 4.73 million hectare of land. In Ethiopia, it is an important food ingredient in daily diet of people in almost all regions. The crop is an important cash-generating crop to small-scale farmers and provides employment in the production and processing industries. Despite its importance the productivity of tomato is very low in Ethiopia as compared to other countries. This is due to lack of adaptability study, dissemination of improved varieties to all parts of the country and due to different biotic and abiotic factors. The objective of this study was to identify the Cost Benefit Analysis of OPV versus hybrid processing tomato varieties and to identify opportunity and constraints of tomato production in East Shewa Zone, Ethiopia. A multi-stage random sampling procedure was used to select 120 sample tomato producers from Dugda and ATJK districts. Both primary and secondary sources were used for data collection. The primary data was collected through interviewing from 120 sample households using semi-structured questionnaires. Qualitative data were also collected through focus group discussions, and key informant interviews using checklists. STATA version 15 Software was used for data analyzing. To conduct the cost-benefit analysis for this study the most common variety produced were selected (Gelila from hybrid and Gelilema from OPV). As the survey result and experiment conducted for two years indicate that, on average 533.10qt and 484.75qt/ha was produced from hybrid Gelila and OPV Gelilema respectively. As the study result indicate that, the Average gross return was 5,158,093.25birr per hectare for hybrid varieties whereas its 3,835,512.5 birr/ha for OPV tomato varieties suggesting hybrid tomato varieties was superior by **1,333,000** birr/ha than OPV tomato varieties. Even-though net return was higher for hybrid tomato variety, its benefit-cost ratio is lower than OPV tomato variety which is 29.83 for hybrid and 90.27 for OPV tomato variety suggesting better benefit gain from cost incurred for OPV tomato production. The major challenges identified in the study area were shortage of improved seed, high input costs, high production costs, disease and pests; perish ability nature of the products, broker's interferences, inadequate market information, price fluctuation, high competition from unlicensed traders, and shortage of capital and poor product quality. Therefore, any intervention that addresses the above-mentioned challenges are recommended to solve the problems in the study areas. The farmers get more benefit when they use hybrid variety but benefit-cost ration is high when they use OPV tomato variety suggesting better gain from cost incurred for production. Therefore, an intervention or any extension service through training and field visit should be given for farmers to increase their awareness on profitability of OPV tomato variety.

Keywords: Hybrid, OPV, Tomato, Cost-benefit, East Shewa Zone

1. Introduction

1.1 Background and Justification

Agricultural productivity and efficient use of scarce natural resources such as agricultural land and variable inputs remain an important focus of government policies in sub-Saharan Africa. This sustainability objective of governments is even more central in recent times where population pressure and increasing urbanization are continuously generating a decline in agricultural land (Kropff et al., 2013). In line with the government objective of sustainable land and environmental management, efficient resource (land) allocation is crucial. Efficiency increases productivity, which can be achieved by avoiding misallocation of scarce resources. The low productivity arising from misallocation of resources robs farmers from making meaningful livelihoods. Recognizing the prominence that the government of Ethiopia ascribes to staple crops, and the fact that OPV processing tomato versus hybrid processing tomato forms the primary recipients of many policy interventions in the cereal and processing tomato respectively, this study focusses on the two enterprises.

The processing tomato continues to be a significant contributor to the economic and social development of Ethiopia. As the vegetable with the largest smallholder coverage at 8 million holders (compared to 5.8 million for teff and 4.2 million for processing tomato), processing Tomato is critical to smallholder livelihoods in Ethiopia. In addition, processing tomato is the staple crop with the greatest production at 4.2 million tons in 2007/08, compared to teff at 3.0 million tons and sorghum at 2.7 million tons Moreover, processing tomato plays a central role in Ethiopia's food security. It is the lowest cost source of cereal calories, providing 1½ times and two times the calories per dollar compared to processing tomato and teff respectively. An effective processing tomato sector could propel Ethiopia's food production to quickly reduce the national food deficit and keep pace with a growing population.

Ethiopia is believed to have the largest vegetable population in Africa. Despite its huge population, the Vegetable sub sector in the country is less productive in general, and compared to its potential, the direct contribution to the national economy is limited (Kedija et al 2008).

Tomato is a widely grown vegetable crop in Ethiopia. Fruit and vegetables are a priority sector for the Government of Ethiopia (GoE), which aims to increase production by 47% between 2015 and 2020. Domestic and international investors are welcome and will be given prior attention to encourage them to invest. The Government is targeting to increase productivity of tomatoes from 87 quintal/hectare to 133.86 quintals/hectare with an average annual growth rate of 9% and total
production from 58.91 thousand tons in the base year to 90.64 thousand tons in the end line. Ethiopia is endowed with favorable weather, altitude, adequate water and availability of suitable soils for tomato production. Most of the soil types in potential tomato producing regions of the country range from light clay to loam and are well suited for horticultural production. As Ethiopia has no winter, it offers the perfect opportunity for all round tomato production (ATA, 2017).

Although agriculture still remains to be the back bone for Ethiopian economy, its performance has been unsatisfactory and unable to fulfill the growing food demand as result of high population growth. Now a day this decline in productivity has been given due attention in the national development efforts. However, because of the influential 'poor-but-efficient hypothesis' of Schultz (1964) resources have been concerned mainly with increasing the productivity of agriculture sector by the introducing and adopting new technologies.

Now a day in Ethiopia there has been increasing focus by policy-makers on investments on modern technologies rather than efforts targeted at improving the efficiency of inefficient farmers. Theoretically, introducing modern technologies can increase agricultural productivity and production. However, in areas where there is inefficiency in which the existing inputs and technologies are not efficiently utilized trying to introduce new technologies may not have the expected results. Obviously, the level of farmers' technical efficiency has paramount implications for country's choice of development strategy (Zenebe et.al, 2005).

Small scale farmers are facing high production costs and low prices due to limited access to processers (lead firms), that pays better prices and offers a guaranteed market. The farmers rely on selling their vegetable as live to buyers (middlemen) who offer lower prices and who in turn earn a lot of profits. The high production costs are also necessitated by longer time periods taken for the small-scale vegetable producers to be sold after they have reached their market since they have to be fed until they are all finished. Therefore, this study is proposed to analysis Cost Benefit Analysis of OPV versus hybrid processing tomato and design Strategies to link small scale vegetable producer farmers to lead firm processors for guaranteed market and improved Income which suggest possible solutions to different stakeholders. Moreover, there is no researches were done to identify the Cost Benefit Analysis of OPV versus hybrid processing tomato Production in East Shewa zones of Oromia region. Therefore, this study initiated to fill a gap in knowledge identifying cost benefit analysis of OPV versus hybrid processing tomato production and recommend the most economical vegetable for future intervention.

1.1 Objective of the Study

The general objective the study was to analyze Cost Benefit Analysis of OPV versus hybrid processing tomato varieties in East Shewa Zone, Ethiopia

The specific objectives of the study are:

1) To analyze the cost –benefit of processing OPV vs Hybrid tomato varieties

2) To study the existing marketing systems along with marketing cost, margins of processing tomato.

3) To identify the constraints in production and marketing of processing tomato vegetable.

2. Research Methodology

2.1 Description of the Study Areas

The study will be conducted in East Shewa Zone which found in central part of Oromia National Regional State, Ethiopia. East Shewa Zone lies between 60º 00' N to 70º 35'N and 380º 00'E to 40^0 00'E. East Shewa Zone has different agro-ecologies which categorized as highland, midland and lowland agro-ecologies. In the Zone, 18.70% of the agro-ecology is high land, 27.50% is midland and 53.80% is lowland. The Zone received 350mm-1150 mm annual rain fall and has uni-modal nature of rain fall pattern. This Zone was received 12ºC-39ºC annual temperature per year (Farming System Report, 2018). The study was undertaken in central rift valley of Ethiopia in two major OPV versus hybrid processing tomato producing districts namely Adami Tulu Jido Kombolcha and Dugda of Oromia Regional State of Ethiopia.

2.2 Sampling Procedure and Sample Size

Sample size and the sample selection process was assured the representativeness of the population. Sample size determination has its own scientific approach. In this study, to determine sample size, different factors such as research cost, time, human resource, accessibility and availability of transport facilities was taken into consideration. The study used a multi stage procedure employing both purposive and random sampling. The first stage was purposive selection of two districts in East Shewa zone of Oromia Regional State where OPV and hybrid processing tomato are majorly practiced. In the second stage, potential kebeles (the smallest administrative unit) was purposely selected based on the large number of farmers who produce both processing tomato of OPV and Hybrid varieties. In the third stage, from the list 120 sample respondents was selected by using simple random sampling method. The sample size determination formula given by Yamane (1967) was used to determine sample size as follows:

$$n = \frac{N}{1 + N(e)^2}$$

Where: n = is the sample households, N = is the total number of households that used produce both OPV and hybrid tomato varieties in the districts and e = 0.09 is the level of precision defined to determine the required sample size at 90% level of precision. The sample sizes selected from each PAs will be determined using probability proportional to size (PPS).

2.3 Type and Method of Data Collection

Both primary and secondary data sources were used in the study. The primary data sources were collected by using semi-structure questionnaires, interview, discussion, and observation. Secondary data was collected from related articles, books, publications and stakeholders records such as Ministry of Agriculture (MoA), Ethiopian Central Statistical Agency, Zonal Office of Agriculture and Natural Resource management, Woreda Office of Agriculture, Union and primary farmers' cooperatives, and Logistics providers (credit providers if any) by

using checklists. Furthermore, the survey collected cross sectional data and was made use of both primary and secondary data. Primary data was collected through personal interview applying face–to–face interview method through a structured questionnaire. The questionnaire was pretested to remove ambiguities. The structured questionnaires were administered to selected stallholder farmers producing mixed vegetable crop production. The information collected included quantities of variable inputs used and cost per each variable inputs, processing tomato production levels, herd size and socio-economic characteristics of respondent farmers. The collected information was first tabulated, coded and entered into computer for analysis. All the local measurements were converted into standard unit and final analysis was done using computer software packages: Statistical Package for Social Science

2.4 Methods of Data Analysis

Descriptive Statistics: The study was used descriptive statistics such as frequencies and means to analyze the socio-economic characteristics of processing tomato and processing tomato crop producing farmers. Cost benefit and gross margin analysis was used to assess economic analysis of smallholder of farmers in processing tomato and processing tomato crop production.

Benefit-Cost Analysis (BCA): Evaluation of economic returns plays crucial role in influencing farmers' choice to adopt improved agricultural technology and consequently influences farmers' resource allocation decisions. Understanding of costs and benefits is also an important pre-requisite for policy formulations aimed at improving productivity levels. Different scholars used cost benefit Analysis to measure smallholder farm profitability. Mburu *et al.* (2007) used cost-benefit analysis to compare the profitability of smallholder processing tomato production in different Agro-ecological zones in Kenya highlands.

Gross Margin Analysis: Johnson defines gross margin as the difference between the value of an enterprise's gross output and variable cost of production. Gross margins are used to evaluate economic viability of an enterprise. They are used in agriculture for farm planning and comparing different farms with similar characteristics or different enterprises on the same farm. The gross margin analysis was used to assess the profitability and viability of smallholder processing tomato production in study areas. In this study in order to determine the profitability of the processing tomato crop farming activities and as well the sideline processing tomato enterprises, gross margin and cost benefit analysis was used to estimate the average variable annual costs and returns of the enterprises and cost benefit ratio.

3. Result and Discussion

3.1 Demographic Characteristics of Sampled Households in East Shewa zone

Average age of the overall sampled respondent was found to be 41.82 years. The average age of the sample households during the survey period, was about 41.82 years having farming experience 23.15 years which was less than 65.97 year of average life expectancy for both sex in Ethiopia (WPP, 2017). Based on Strock et al., 1991 (as cited in Ermiyas ,2013) this average value of age included in the most economically active age group of 17-50 year. Independent sample t test result shows that no statistically significant mean difference between two group

farmers in terms of age indicating absence of association of membership decision of cluster farming and age of sampled respondent households.

The average education level of literate sample household heads during survey period was about 6.4 years with the minimum of zero years (illiterate) and maximum of 12 years. Family size plays an important role in crop production and most farmers depend mainly on family labor. The average family size of the sample households was 6 persons per household (Table 1) which is greater than 4.6 persons per household as Ethiopia, based on household size and composition around the world in 2017.

Cultivated farmland was calculated as a sum of owned land, rented-in and shared-in farm land less shared-out farm. It is an effective farm land amount used by sample households to undertake agricultural production. Sample households were found to hold a mean of 1.44 ha of cultivated land in the survey year from total land holding of 1.92ha.

On average, sample household owned livestock of 6.345 TLU. This indicates that the farming system in Ethiopia is mainly based on plough by animal draught power that has created complementarity between crop and livestock production (Table 1).

Table 1. Socio-demographic characteristics for East Shewa zone

Demographic Characteristics	**Total Sample (n=120)**	
	Mean	**Std. Dev**
Age of household heads	41.82	12.32
Farm Experience	23.15	12.27
Family size	6	2.99
TLU	6.35	3.37
Grade level	6.43	2.74
Land cultivated	1.44	0.96
Total land holding	1.92	1.26

Source: Survey result of 2022.

3.2. Production and Profitability of Tomato

Yield (Marketable): Open pollinated tomato varieties, Gelilema, and Melkasasa gave significantly higher marketable fruit yield. Hybrid tomato varieties, Galilea, recorded significantly higher marketable fruit yield than the rest of the hybrid varieties. Hybrid or Open Pollinated Varieties (OPV): Hybrid seeds give higher yields but are more expensive

Quality of Tomato (TSS, firmness): Total soluble solute (TSS %) is the one of the main characters to be considered for processing tomato variety selection. OPV showed comparable higher TSS % than the hybrids. Gelilema responded significantly higher TSS% value.

Accordingly, there was a significant difference in marketable yield and TSS% among tomato varieties evaluated. Due to the difference in yield potential and cost of seed between hybrids

and open-pollinated tomato varieties, there was partial budget analysis to select the most feasible tomatoes for production.

Even though hybrids and OPV are in different classes and not comparable in yield, in terms of TSS% response OPV is higher than the hybrids. From the partial budget analysis, the use of hybrids is more profitable than OPV in yield. Since other input are similar for both hybrid and OPV tomato, only seed amount used and their cost and product yield produced and their prices are considered.

Generally, the results of the partial budget analysis showed that the use of hybrid varieties was superior (**1,333,000** birr) than the use of OPV tomato varieties with current product and seed prices. From hybrids, tomato varieties; Galilea, is recommended for their yield and quality response for processing purposes. Gelilema, are recommended for their yield and quality from the open-pollinated tomato varieties for processing purposes.

Table 2. Production and Productivity of hybrid and OPV Tomato variety

		Quality Parameters				
No	Variety	**pH**	**TSS**	**Titrable acid**	**Yield (qtls/ha)**	**Over all Rank**
1	Melkasalsa	4.39	3.65	8.48	474.00	3rd
2	Gililema	4.33	3.28	5.46	484.75	2nd
3	Gelila	4.10	3.30	5.81	533.10	**1st**

Source: Own computation based on on-farm yield (2022)

Table 3. Partial economic analysis for hybrids and OPV tomato varieties

Treatments	Seed/seedling required (ha)	Seedling/seed (birr/kg)	Total/ETB	Average yeild (kg/ha)	Product price (birr/kg)	Gross Income/ETB	Net Income/ETB
Hybrids	25,000 seedlings	5	125,000	533,100	10	5,331,000	5,206,000
OPV	0.3kg	2000	5,000	484,750	8	3,878,000	3,873,000
						Difference	**1,333,000**

Source: Own computation based on survey data (2022).

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Table 4. Tomato production costs and profitability analysis of Hybrid and OPV varieties

	Hybrid (Gelila) Variety			OPV (Gelilema) Variety		
Item	**Quantity**	**Unit price**	**Total (ETB)**	**Quantity**	**Unit price**	**Total (ETB)**
Marketable yield	533,100kg/ha	10birr/kg	5,331,000	484,750kg/ha	8	3,878,000
Variable cost						
Land preparation	4 days	600	2400	4 days	600 birr	2400
Seeds (seedlings)	25,000	5	125,000	0.3kg	2000	5000
Fertilizer/ha-hybrid,	DAP 229.6 kg	4970	11,411.12birr	20qt of	100/qt	2000
Compost-OPV	UREA 154 kg	3747	5,775.63 birr	compost		
Fungicides	4 bottles	350	1400	1 bottles	350	350
Insecticides	6 bottles	450	2,700	2 bottles	450	900
Labour						
Planting	20 person	200birr/person	4000	20 person	200birr/person	4000
Spraying/weeding/	24 person	180birr/person	4320	20person	180birr/person	3600
Harvesting/harvesting						
Fuel			10,000		By rain fall	
Transportation	3.93 track	1500birr	5,900	484.75qt	50	24,237.5
Average VC			**172,906.75**			**42,487.5**
Average revenue			**5,158,093.25**			**3,835,512.5**
Benefit-Cost Ratio			**29.83**			**90.27**

Source: Own computation based on survey data (2022).

Tomato Production in the study areas

Tomato (*Lycopersicon esculuntum Mill*) is one of the most important and widely grown vegetable in Ethiopia in general and the study area in particular. Tomato was produced more than two times in the study area due to the availability of irrigation. The average tomato productivity is 533.10qt/ha in the study area which is greater than national average yield which is 45.03 quintal per hectare (CSA, 2017).

In Table 4, production cost was calculated for seed, manure, fertilizer, human labor, hormone, pesticide, irrigation, etc. The average variable cost per hectare of hybrid tomato production was AVC 172,906.75 birr/ha. Average variable cost is equal to the sum of all variable cost in the production process. As indicated in Table 3, AVC 172,906.75 birr/ha for hybrid tomato variety whereas its 42,487.5 birr/ha for OPV. Among all the farmers the highest production cost is carried out by the hybrid varieties.

Average gross return 5,158,093.25birr per hectare for hybrid varieties whereas its 3,835,512.5 birr/ha for OPV tomato varieties. The average price is 10 birr per kilogram for hybrid whereas its 8 birr/kg for OPV. Even-though, net return was higher for hybrid tomato variety, its benefit-cost ratio is lower than OPV tomato variety which is 29.83 for hybrid and 90.27 for OPV tomato variety.

Fertilizers, Chemicals and Labor

In the study areas, the farmers applied fertilizers and chemicals for tomato production. The majority (85%) of the respondents applied inorganic fertilizers (DAP and UREA) and the remaining 15% applied composts for tomato production. The sampled households applied 229.60 kilogram of DAP per hectare and 154.14 kilogram of UREA per hectare for tomato production in the study areas. The respondents applied fertilizer (DAP is 200kg per hectare and UREA is 100 kg per hectare) above the recommendation rate for tomato production in the study areas. The farmers purchased fertilizers (DA and UREA) from Private retailers (73%), cooperative/union (71.2%), and WoA (51.4%) in the study areas.

Tomato producers used different types of chemicals for tomato protection. The types of chemicals that widely applied by farmers in tomato production were Mancoziem (33.03%), mancozied and selecron (17.43%), mancozed, redomile and agrolaxine (13.76%), mancozeb, selecron and redmole (13.76%), mancozeb, redmole, malatine and coside (9.18%). The farmers in the areas purchased chemicals from Private retailers (93.4%), and cooperative/union (4.7%).

As the study result report revealed that farmers use hired and family labor for tomato production. However, the major source of labor for tomato production is from market hire which accounts for 66.36% in addition to family labor indicating tomato production is labor intensive.

Access to irrigation

Tomato production is sensitive to water by its nature. This study result also confirmed all of sample respondents use irrigation for hybrid tomato production whereas they produce by rainfall for OPV tomato in the study areas. All of hybrid tomato producer farmers used irrigation for tomato production. The farmers irrigated tomato farm two and half mean hours per day by using furrow irrigation system.

Land preparation, planting and weed management

Land is one of the crucial input factors agricultural for production. Tomato seed bed preparation was done twice in year for raising tomato seedling. The first seed bed preparation was done at the end of August for first season production of tomato and the second seed bed preparation was done at early January for second season production. The tomato land was cultivated 3-4 times/season before transplanting seeds from seedbed in the study area in particular and in the *Woreda* in general (WoA, 2022). Tomato producers used row planting according to recommended agronomic practice (one meter between row and 30-40cm between plants) during transplanting tomato seedlings (WoA, 2022).

The first season tomato production was based on rain fall whereas the second production season was based on irrigation for producing tomatoes. Tomato weed control was undertaken in the areas by applying hand cultivation/earthing up and chemical application.

Tomato harvesting and post-harvest Management

Tomato harvesting is one of the activities which is done by tomato producers during the production of tomato. Tomato producer farmers use wooden and plastic boxes during harvesting tomatoes. These boxes are availed by renting from the traders in the study areas. As study result indicate that 33% of OPV tomato product was lost during harvesting and post-harvest time in the study area due to poor farm management, high perish ability nature of commodity and lack of modern storage.

In the study areas, the majority (75%) of sample households performed different post-harvest management activities for handling tomato products. These activities were cleaning, separating, and grading. Cleaning and separating were done to separate physically destroyed and perishable tomatoes from the healthy one. Grading was undertaken by separating green color and not matured tomatoes from matured one and prepares the green colored tomatoes for long distant market whereas the red color and matured tomatoes were sold at local market.

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3.3 Challenges and Potential of tomato production and marketing

Table 5. Challenges & potentials of tomato production and marketing

Value chain stages	Constraints	Potentials
Input supply	High cost of inputs	High demand for improved seed
	Unstainable and low-quality seed	Short distance travelled to get inputs
	Shortage and Unavailability of inputs on time	Existence of input suppliers
	Shortage certified chemicals	
Production	High production costs	Enabling policy environment
	Disease, pests (*Tuta Absoluta*) and fungal disease ((leaf blight and early leaf blight)	Support from government and non-government organizations
	Perish ability nature of the product	Access to irrigation water
	Over dosage of chemical application	
	High post harvest loss	
	Lack of storage	
Marketing	In adequate market information	Access to road and transport
	Brokers interference	Good market demand of the product
	Market price fluctuation	Establishments of credit providers
	Perish ability nature of product	
	Capital shortage	
	Weak linkage along value chain actors	
	Lack of storage	
Consumers	Poor quality of product	High consumption preference
	Shortage of capital	Availability of product on the market
	High price of the product	

Source: WoA, Key informant interview and survey data (2022)

4. Conclusion and Recommendations

4.1 Conclusion

This study was conducted in Dugda *Woreda,* East Shewa zone of Oromia region with objective of identifying cost-benefit of OPV and Hybrid tomato varieties. Both primary and secondary sources were used for data collection. The primary data was collected through interviewing 120 sample households using semi-structured questionnaires. Qualitative data was collected through focus group discussions, and key informant interviews using checklists. STATA version 15 Software was used for data analyzing.

Average age of the overall sampled respondent was found to be 41.82 years. The average age of the sample households during the survey period, was about 41.82 years having farming experience 23.15 years which was less than 65.97 year of average life expectancy for both sex in Ethiopia (WPP, 2017). Based on Strock et al., 1991 (as cited in Ermiyas ,2013) this average value of age included in the most economically active age group of 17-50 year. Independent sample t test result shows that no statistically significant mean difference between two group farmers in terms of age indicating absence of association of membership decision of cluster farming and age of sampled respondent households.

The average education level of literate sample household heads during survey period was about 6.4 years with the minimum of zero years (illiterate) and maximum of 12 years. Family size plays an important role in crop production and most farmers depend mainly on family labor.

Cultivated farmland was calculated as a sum of owned land, rented-in and shared-in farm land less shared-out farm. It is an effective farm land amount used by sample households to undertake agricultural production. Sample households were found to hold a mean of 1.44 ha of cultivated land in the survey year from total land holding of 1.92ha. On average, sample household owned livestock of 6.35 TLU. This indicates that the farming system in Ethiopia is mainly based on plough by animal draught power that has created complementarity between crop and livestock production.

Tomato is widely produced in Adami Tulu Jidokomlcha *Woreda*. Tomato producer farmers are market oriented since tomato is a commercial crop. The average tomato productivity is 533.10qt/ha in the study area which is greater than national average yield which is 45.03 quintal per hectare (CSA, 2017). The average variable cost per hectare of hybrid tomato production was AVC 172,906.75 birr/ha. Average variable cost is equal to the sum of all variable cost in the production process. AVC 172,906.75 birr/ha for hybrid tomato variety whereas its 42,487.5 birr/ha for OPV. Among all the farmers the highest production cost is carried out by the hybrid varieties. Average gross return 5,158,093.25birr per hectare for hybrid varieties whereas its 3,835,512.5 birr/ha for OPV tomato varieties. The average price is 10 birr per kilogram for hybrid whereas its 8 birr/kg for OPV. Eventhough net return was higher for hybrid tomato variety, its benefit-cost ratio is lower than OPV tomato variety which is 29.83 for hybrid and 90.27 for OPV tomato variety.

4.2 Recommendation

The findings of this study enabled us to make the following recommendations for policy makers, developments actors and researchers who have an interest to work on cost-benefit analysis. The farmers get more benefit when they use hybrid variety but benefit-cost ration is high when they use OPV tomato variety suggesting better gain from cost incurred for production. Therefore, an intervention or any extension service through training and field visit should be given for farmers to increase their awareness on profitability of OPV tomato variety.

The study identified pests, diseases, input costs and inadequate input supply as the major tomato production constraints whereas perish ability of the product; poor market information, and capital shortage are also major challenges in tomato marketing. Therefore, any intervention aims at tomato pest management, diseases control, credit service, and post-harvest management through providing training, deliver disease and pest resistance tomato varieties, provide credit service, and timely supplying the required inputs recommended to solve the problems. The service provided by cooperatives for farmers is very limited. Thus, this study recommended that any intervention that strengthens the existing cooperatives and organizing new producers' cooperatives is required in the study areas to improve cooperative service as well as benefit the members.

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Acronyms and Abbreviations

ATARC	Adami Tulu Agricultural Research Center
CSA	Central Statistical Agency
DA	Development Agent
DOA	District Office of Agriculture
GoE	Government of Ethiopia
ETB	Ethiopian Birr
FAO	Food and Agricultural Organization
GTP	Growth and Transformation Plan
Ha	Hectare
Km	Kilometer

MOA	Ministry of Agriculture
MoFED	Ministry of Finance and Economic Development
UNDP	United Nations Development Program
NGO	Non-Governmental Organization
OARI	Oromia Agricultural Research Institute
OPV	Open Pollinated Varieties
BCA	Benefit-Cost Analysis
GMA	Gross Margin Analysis
ISVCD	Inclusive and Sustainable Value Chain Development

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