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Review on Economic Efficiency of Vegetable Production in Ethiopia

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Abstract: Vegetables are important as a source of micronutrients for human nutrition, a means of income, food security, employment, and foreign exchange. In Ethiopia, most of the soil types suited for fruits and vegetables producing regions of the country range from light clay to loam and are well suited for horticultural production. However, the production in Ethiopia does not meet the need of the country's population for vegetable products, and/or the production levels of vegetables are still far below their potential, in general, there was inefficiency in the production of vegetables. The main objective of this paper was to review the determinant and level of vegetable efficiencies in Ethiopia. Based on the reviewing of the studies, basic determinants of vegetable efficiencies in Ethiopia were:- age, sex, education, family size, ownership of livestock, experience, frequency of extension contact, training, membership in a farmers' association, participation in off/non-farm income, credit access, land fragmentation, seed type, farm to home distance, distance to the nearest market and soil fertility, access to transportation, land slope and distance to extension service. The level of technical, allocative, and economic efficiencies was highly variable between vegetable farmers and the mean level of all efficiencies-all most below the required level (inefficient). Based on such findings we have been recommended:- enhance farmer education, offer training and extension service, provide access to credit, encourage the farmer to participated in off-farm income and farmer association members, built market, extension service, and farmer training center around.

Keywords: Vegetables, Technical Efficiency, Allocative Efficiency, Economic Efficiency, Ethiopia

1. Introduction

1.1. Background Review

Vegetables are a assembly of crops consists of more than 200 plant species all over the world [1, 2]. Horticulture is a branch of agricultural sciences that study scientific understanding to supply vegetables, fruits and flowers and enrich human diet [3]. It's consumed by each, individuals, industries to support the organic process and economic standards, to fulfill basic requirements of human health and wellbeing [4]. Farming crops are the first supply of poverty reduction by raising the incomes of rural cultivators and reducing food expenditure, and so reduces financial gain difference in most agriculture based economies [5]. Vegetable growing is one of the priority sectors in agriculture. Vegetables occupy an important place in the food, being an important component of the human diet.

Ethiopia has an area of 1.22 million square kilometers with great variety of climatic and soil types which can grow crops and vegetables for home consumption and foreign markets. Agriculture as the main branch of Ethiopian economy has 50% share in the GDP. Share of agriculture in employment is 85%. About 75% of Ethiopia's industry is engaged in processing of farm products. Vegetables took up about 1.18% of the area under all crops at national level. Vegetables contribute 2.0% of the total volume crop production [6]. According to the report of Ethiopia revenue and customs authority at 2013, Ethiopia shipped 220, 213 tons of vegetables and made USD 438 million. The total annual volume of fresh vegetable production of the state sector agriculture contribution is less than 20% [7].

In Ethiopia, most of the soil types in fruits and vegetables producing regions of the country range from light clay to loam and are well suited for horticultural production. Endowed with favorable weather, altitude, adequate water and availability of suitable soils, the potential to develop

horticultural crops, such as fruits, vegetables, root crops and cut flowers is great in Ethiopia [8]. Various types of vegetable crops are grown in Ethiopia under rain-fed and/or irrigation systems [1]. The major economically important vegetables include hot and sweet peppers (Capsicum spp.), Ethiopian mustard/kale (Brassica carinata), onion (Allium cepa), tomato (Solanum lycopersicum), chili (C. chinense), carrot (Daucus carota), garlic (A. sativum) and cabbage (B. oleracea var. capitata) (Alemayehu, *et al*., 2010).

Vegetable growing is one of the priority sectors in agriculture. Vegetables occupy an important place in the food by being an important component of the human diet through source of micronutrients for human nutrition, a source of livelihood to people along the value chain including farmers, traders, processors and transporters, it contributes in food security, employment, foreign exchange and it has been key in alleviation of poverty especially in rural areas where production is intensive [4]. According to [9] to improve income and provide gainful employment, diversification from grain crops to high value crops like vegetables have appeared to be an essential strategy for agricultural growth for any developing country. Moreover, vegetable value chains can offer new income and employment opportunities in trading and processing sectors [1, 10]. Fruit crops of significant importance and with a potential for domestic consumption, export markets, industrial processing and required labor force, demanding 32 to 34 laborers per hectare per day [11].

Despite the increasing importance of vegetables in Ethiopia, it does not meet the need of the country's population for vegetable products and/or the production levels of vegetables are still far below their potential [12]. This was because of, there was inadequate knowledge on improved production systems, marketing, small scale farming systems and poor pre and post-harvest handling techniques [13] and in general, there were inefficiency in production of vegetables. One of the main reasons for low productivity in agriculture all over the world, including Ethiopia is the inability of farmers to fully exploit the available technologies, resulting in lower efficiencies of production. This fact has been emphasized in many studies, particularly on cereals and pulses [14, 15].

With increasing population and declining land size, a better understanding of the production system, marketing channels and endowed opportunities for growth of- efficient production of vegetables. Therefore this review tries to reviewing the determinant factor of economic, technical as well as allocative efficiency of vegetables production plus the intensity of the level of economic, technical as well as allocative efficiency of vegetables production.

1.2. Objectives of the Review

This review basically looks over the efficiency of vegetable production in Ethiopia by addressing the specific issues on:

To review the level of technical, allocative and bot technical and allocative efficiency (economic efficiencies) of vegetable producers.

To review the determinants of economics, technical, and allocative inefficiencies in vegetable production.

2. Methodology

In order to review the efficiency of vegetable production in Ethiopia, we performed a systematic literature search with the academic search engine:-Web of knowledge (apps.webofknowledge.com), Scopus and Science Direct, Research Gate (https://www.researchgate.net), Google Scholar (scholar.google.com) by several keywords were chosen to obtain a wide number of search results. All keywords were searched in Ethiopia as well. The keywords selected were: “product efficiency”, “vegetable production”; “economic efficiency”, “vegetable(s)", “technical efficiency”, “inefficiency”, “vegetable(s)", “allocative efficiency”; “determinant of efficiency”, “horticulture”. The literature included mainly peer-reviewed articles, but sometimes also a few studies in technical journals, books, unpublished papers and conference proceedings.

3. Literature

3.1. Concepts and Definitions

Vegetables may be described as those plants, which are consumed in relatively small quantities as a side dish with the staple food. The term ‘vegetable’ can also be used to designate the tender edible shoots, leaves, fruits and roots of plants that are eaten whole or part raw or cooked as a supplement to starchy foods and meets [16]. Vegetables can be distinguished from field crops by the fact that, vegetables are harvested when the plant is fresh and high in moisture while the fields crops are harvested at the mature stage for their grains seeds, roots fibre etc. In human nutrition, vegetables are an essential protective food containing vitamins and minerals. Any balanced diet should include vegetables and fruits for this reason. The proportion of vegetables required in a balanced diet per capita per meal is of the order of 45% of the total volume of the food [17].

Efficiency in production refers to the farms’ ability to produce maximum output from the least input combination during the production process [1]. Efficiency in production means to maximum allocate of scarce resources [18]. In production economics, efficiency can be defined as a firm’s ability to convert inputs into outputs at the optimality to economic signals or prices [19]. It is the act of achieving good result with little waste of effort [20].

There were three types of efficiency, which were:- allocative (price) efficiency, technical (physical) efficiency and economic (overall) efficiencies. Allocative efficiency (AE), which refers to the capacity of the firm to use a set of inputs in optimal proportion with the given price and level of technology or a situation where a firm uses the least combination of inputs to produce a given quantity of outputs in the light of prevailing prices [21].

Technical efficiency (TE), refers to the farms' ability to produce along the production frontier or alternatively it can be defined as the performance of the given firm to obtain maximum output from a given combination of input used with the given level of technology (Ibid). The given firm is technically efficient, when the combination of inputs or resources give rise to the utmost possible outcome and has no space for further enhancement of the output of the firm. Furthermore, it can be expressed as the physical relationship between inputs or resources and the final outcome or output. In a circumstance where the firm produced the same amount of output or larger than the previous production level while decreasing the use of at least one of the input in the production process, roughly indicates the existence of inefficiency in the production process [22].

Economic (production) efficiency, which is overall performance measure and is equal to the product of Technical Efficiency (TE) and Allocative Efficiency (AE). Therefore technical and allocative efficiency are components of economic efficiency [23-25]. An economically efficient input-output combination would be on both the frontier function and the expansion path. On the other hand, economic efficiency (EE) refers to the appropriate alternative of inputs and outputs combination according to their price relation or the ability of the firm to maximize profit by equating marginal revenue product of inputs to their respective marginal costs (Mideksa, 2020).

3.2. The Determinants of Efficiencies in Vegetable Production

In this section we are try to review the determinant factors of efficiencies of vegetable production in Ethiopia. There may have different factors that are responsible for efficiency variation and determine the level of efficiency among vegetable producers in Ethiopia. Even though, such factors have not equal influences and advantages among different place and households. Which means the importunacy of certain factor in one place at a certain time may not necessarily be a significant factor in other places even in the same place after some time.

One of the determinant factors for efficiency is age of household head, which has favorable and significant effect on efficiency. This is because, as farmers become aged, they are more experienced, learn from their experience about the allocation of inputs, more cost efficient than younger ones and the ability of decision making increases [19, 26]. However, according to [19] age contributes negatively to efficiencies, meaning that younger farmers were relatively more efficient than older farmers.

Farmers who had get reputed extension visits/teachings are likely to have a chance for gathering information and understanding new practices and the use of modern inputs which in turn will improve their economic efficiency through higher levels of technical efficiency and allocative efficiency respectively [25, 27, 28], but [29] was founded that extension contact had a undesirably and statistically related to efficiency indices.

For instance, Jema H. and Hanson A. [30] found age of household and efficiency was inversely relationship. This was indicated that when the farmer becomes more aged, he will be less efficient or otherwise. The probable reason for this could be that older farmers are less likely to have contact with extension agents and less willing to adopt new practices and modern inputs. However, [2, 25, 31], found a positive effect of age on farmer technical efficiency. This may be the case for, when the age of farmer increase there are a possibility to get more training, education and experience.

Efficiency also determined by household level of education. For example education built the capacity of household to do so rational decision on how much amount and price of inputs could be used in production to maintain the efficient level [32]. Educated farmers more likely to adopt agricultural information and proper utilization of improved inputs more optimally and efficiently [27, 31, 33]. This finding will be cup up with Ethiopian case, why because, in Ethiopia most farmers were less educated and it is witnessed by inefficient production of agricultural products and we are not food self-sufficient.

The analysis of the determinants of efficiency of vegetable-dominated mixed farming system in Ethiopia using a Tobit model by Haji [18] reveal that asset, off/non-farm income, farm size, extension visits, and family size are the statistically significant determinants of technical efficiency of the farmers. Asset, crop diversification, consumption expenditures, and farm size significantly determinants of allocative and economic efficiencies. However, crop diversification has negative and significant effect on allocative and economic efficiencies, this might be the reason that diversification required additional managerial complexity more than it facilitates risk management.

Study conducted by [28] on technical efficiency of smallholder farmers in red pepper production in North Gondar zone Amhara regional state, Ethiopia using SFM at Takusa and Dembia districts of 385 samples founded that age, education status, land fragmentation are statistically and negatively affect level of technical efficiency, whereas, land size, extension service, credit access and market information were found to be statistically and positively affect the level of technical efficiency of red pepper farmers. The negative effect of extension visits on technical efficiency may be due to limited and poor training extension officers receive, which is refute with the finding of [11, 34, 35].

The work [36] on analysis of technical efficiency of potato production in Ethiopia (chilga district), based on data collected from 150 randomly selected farmers pointed that seed elasticity of potato output was the most significant and negative implication the efficiency of potato production, for example 1% increase in seed will decrease potato output by 0.52%, on average. This may be the cause for applied more than the recommended quantity of seed per hectare [37]. Improve seed and age of household the same as [2, 38] is statistically positive implication on efficiency of potato production. The positive coefficient of household distance to the market also has positive effect on technical inefficiency,

implies that an in increase in this variable would lead to increase in the level of technical inefficiency [26].

Efficiencies in general can be affected by the sex of household head. For instance, Haregu et al [39] investigate efficiency in onion production for male and female farmers in Kilte-awlaelo district, Ethiopia on 160 onion producer. They reported that, lack of education, this was the same as [2], inadequate extension service (supported by [11]), and small areas of irrigated land were factors causing economic inefficiency in irrigated onion production.

According to the study of Tsion *et al* [36] on technical efficiency of agricultural production in Ethiopia shows that sex, livestock, household size, extension service and seed type were negatively related with technical inefficiency while only off-farm income participation was positively related with technical inefficiency. From those factors seed type and household size highly affected efficiency in positively and off-farm income negatively. These may be because of, a larger household size guarantees availability of family labor for farm operations to be accomplished in time (the same argument as [30] and different conclusion as [40]), participating in off-farm activities leads to share of factors of production with farm activities, this may be the cause inverse related between technical efficiency and participation in off-farm activities, this result the same as [32, 41, 42] contradict with [8].

Family size has adverse and significant effect on both allocative and technical efficiency this is because as a family size increase it will leads to unable to manage properly in production of onion (diminishing marginal return of labor) this is supported by the fining of [43] and contradicted with [32], whereas ownership of livestock and training of production also positive and significant influence on allocative and economic efficiency of onion producer due to reason that training is an important method to develop the managerial capacity and decision making of the household head based on a study conducted by [35] on analysis of economic efficiency of smallholder onion producers in North Gondar, Ethiopia., whereas, education and family size has a negative (as like as [2, 22, 43]), extension service (the same as [11]) and altering frequency has a positive significant determinant on allocative efficiency. Land slop and watering frequency affected economic efficiency negatively and positively, respectively [44].

Extension contact exerts positively encouraging allocative, technical as well as economic efficiencies; this implies that farmers who had more extension visits/teachings are likely to be more successful in gathering information and understanding new practices and the use of modern inputs based on the investigation of [41] on determinants of economic efficiencies among 200 onion producing farmers in irrigated agriculture in Kobo district, Ethiopia. Source of irrigation water has positive and statistically significant coefficients for allocative efficiency and economic efficiency. The variables fragment, ownership of livestock, experience, total farm income, training and participation in field day visit affect efficiency positively while responsibility and age of the household head (the same as [22]) influence technical efficiency undesirably.

level of education, experience in tomato production, and application of pesticides were variables affecting technical and economic efficiencies positively on resources use efficiency of irrigated tomato production of small-scale farmers according to the study of [45].

Another scholars [40] revealed that education, experience, off-farm income, household size, membership in a farmers' association, use of irrigation water, extension contact, use of improved seed, access to product market and weak coordination of stakeholders' were significant factors influencing technical efficiency of 368 randomly selected potato producers in Northern Ethiopia.

Gebregziabher, G. et al. [11] study on technical efficiency in smallholder agriculture in Tigray, Ethiopia, found that access to credit and number of literate household members reduce the technical inefficiency of irrigated agriculture. And also as walking distance to extension service, it is a proxy for access to extension, decreases inefficiency and this particularly so for rain-fed agriculture.

Technical efficiency determinants of potato production of rain-fed and irrigated smallholder farmers in Welmera district, Ethiopia, was investigated by [39] based on 72 randomly selected households. Such study found that, age and education level of household are highly and positivliy significant determinant of potato production efficiency. This is because; as the farmer become elder they have the benefit to manage inputs properly in irrigated potato farmers and educated farmers often use better agricultural technologies and information, and utilization [24, 37]. This result is against the study by [43]. However, soil condition and family size have a negative influence on technical efficiency.

Degefa, K. et al. [2] found that, sex of household head was found to have positively and significant influence on technical, allocative and economic efficiency of maize producers. Experience, family size and extension contact have positive and significant effect on technical and allocative efficiency, whereas age and education level of household head have magnified effect on effect on technical and economic efficiency.

The Tobit regression result of vegetable production efficiency of smallholders' farmer in west shewa, Ethiopia by [28] revealed that age of household head affect negatively allocative and economic efficiency of vegetable production, This is because younger households were eager for adopting and dissemination of new technique of production and education than older people [2]. Irrigation affected positive influence on economic and allocative efficiency, extension contact influencing technical and allocative efficiency positively, education have negative and significant implication on technical and economic efficiency. Farm land and access to information have a higher and positive significant effect on all on technical, allocative and economic efficiency. This may be the case of, household who have a large farm size can able to diversified it production and a farmer also have information about techniques of production

will have better efficiency than the counterpart.

When we look different factors that determine technical efficiency of irrigated potato producer in Awi zone, Ethiopia by [43], irrigation experience, farm to home distance, extension contact have favorable implication on technical efficiency and education, commodity rate of production, livestock holding, family size also have adverse influence on technical efficiency, it is supported by Abebe *et al*, 2018.

A study by [32] about technical efficiency of red pepper production in Dalocha district, southern Ethiopia, about 170 red pepper producing households found a result that education in years of schooling and family size has positive influence on technical efficiency of red pepper producer. This is because, education improve the ability of farmers for efficient utilization inputs and better decision making, more family sizes is more active labor force to perform an activities in efficiently [2, 24]. Coefficient of off/non-farm occupation has positive and significant effect on efficiency. Off/non-farm incomes enable the producer to purchase or hire additional productive inputs, this result was confirmed by [1, 4] and it is in contrast with the study by [38]. In general, farming experience, extension contact, access to credit, size of landholding, sex, distance to nearest market were negatively related with technical inefficiency while age, tropical livestock unit and fragmentation were positively related with technical inefficiency.

On the other hand [34] assessing the efficiency of sweet potato producers in the southern region of Ethiopia based on 158 sweet potato producers reported that, livestock ownership, age and education positively influence technical efficiency, while formal extension does the opposite.

Analyzing the technical efficiency of farm production of smallholder farmers in Girawa district, Ethiopia, using cross sectional data collected from randomly selected 200 sample households [24], revealed that, education, land size, livestock holding, irrigation, training, extension, access to transportation and land fertilities were positively and significantly effect on technical efficiency of smallholder farmers. However, social status have adverse effect on smallholder farmers technical efficiency, this was because of, those farmers who have a big social obligation were have not a time to devoted for production outputs and management of inputs [12].

Aman et al [28] investigated vegetable production efficiency of smallholders' farmer in west Shewa, Ethiopia, suggested that, age of households, education level, land size, access to irrigation, extension contact access to information and pesticide use were significantly affect all technical, allocative and economic efficiency of smallholders' farmer in west Shewa, therefore we concluded that these determinant variables were the most crucial variables in that study area to determine the farm efficiency.

3.3. Level of Technical, Allocative and Economic Efficiencies of Vegetable Producers

Farrell (1951) greatly influenced by [46] formal definition and [47] measure of efficiency introduced a method to decompose the overall efficiency of a production unit into its technical and allocative components. Debrew and Farrell defined the following measure of efficiency known as the Debreu-Farrell measure, one minus the maximum equi-proportionate reduction in all inputs that still allows the production of given outputs, a value of one indicates efficiency and a score less than unity indicates the severity of inefficiency.

Based on such evidence the level of all efficiencies are lies between zero to one, hereby, zero indicate that technical inefficient and one also postulate that there is 100% efficiencies in all aspect. Different scholars were conducted a study and estimate the level of efficiency of vegetable in Ethiopia.

Tadie et al. (2019) divulge that the mean technical efficiency was 78.80%. This technical efficiency was range from the minimum of 0.14% to the maximum of 0.95%, this indicated that there were higher variation in technical efficiency among farmers and Majority (83.33%) of the sample farmers have technical efficiency score greater than or equal to 50%. Moreover, 62.34% of sampled farmers have a technical efficiency score above 81%, implying that there is a room to enhance production by 19% by keeping the inputs usages constant.

Estimated value of mean technical, allocative, and economic efficiency emanated from m the DEA models are 0.91, 0.60, and 0.56 respectively indicating that farmers have attained a relatively high level of technical efficiency however the mean values of allocative and economic efficiencies were relatively lower. These results indicate there is a chance improves the production of agricultural output without using additional inputs, given the existing technology. The result also indicates that if these farmers operate at full efficiency levels, they could, on average, reduce their costs of production by 44% and still produce the same level of output (Haji, 2008).

Gebremariam, H. G. et al. [39] found that, the occurrences of the predicted technical efficiencies of the highest number of samples (48%) range from the lowest 0.2% to the highest 0.4% technical efficiency level. The mean value of technical inefficiency of potato for all sample respondents was 45% with the minimum value of 0.031% and the maximum value of 0.99%. This result witnessed that, there was significant inefficiency in potato production and high variability in technical inefficiency among sample farmers. However the study by [40] the average technical efficiency score of 368 randomly selected potato producers in Northern Ethiopia was estimated to be 75%.

When the sex of head households becomes male, the level of efficiency was relatively higher compare to female headed household according to the study of [39]. For male-headed farms, mean technical, allocative, and economic efficiency indices were 83%, 69%, and 58%, respectively; for female-headed farms they were 67%, 48%, and 34%, respectively. These result shows that there is a chance to increase output without increasing in inputs of production.

For instance, [35] work on analysis of economic efficiency

of smallholder onion producers in North Gondar, Ethiopia, based on multi-stage sampling technique and selects 205 onion producers. Stochastic production function coefficients revealed that the mean technical, allocative and economic efficiency of onion producer was 52.6%, 60% and 68%, respectively. In other words, on average smallholder onion sample households in the study area incur 47.5%, 40% and 32% of production and cost losses due to technical, allocative and economic inefficiency, respectively. This implies that on average output of onion can be increased by at least 47.5% without increments in inputs increments and technology, onion producer could be reduced the total cost of production up to 40% by keeping onion output fixed.

The mean levels of technical efficiency were 82.6% and 76.8%, under drip and furrow irrigated, respectively. This in turn implies that onion producing farmers in kobo district can increase farm production of onion on by 17.4% and 23.2% average, respectively when they were technically efficient. Similarly, their economic efficiency of drip and furrow were 51.49% and 44% respectively. This also means that, those farmers have a possibility to increase onion production by 49% and 46% without further increment in input of production [41].

Weldegiorgis, L. G. et al. [45] shows that the mean levels of tomato farmer's technical and allocative inefficiencies were 0.25 and 0.33, respectively. This mean level of technical and allocative inefficiencies implies that there is a chance to increase tomato production by 25% without using extra inputs and decrease the total input cost of tomato by 33% by keeping constant the output of tomato, The result showed that there is high inefficiency among tomato producers.

According to Gebrehaweria *et al. [11]* average technical efficiencies of irrigated and rain-fed plots of agricultural output are 45% and 82%, respectively. These figures indicate that, there was a room to increase agricultural output under irrigated agriculture operation higher than rain-fed agriculture operation. in other word under irrigated agriculture operation actual output can be increased to 54% and rain-fed agriculture operation the existing output also increased by 18% without further usage of inputs. Technical efficiencies of irrigated and rain-fed plots of agricultural output ranged from the minimum of 0.25% to 1% and 0.4% to 1%, respectively. This also implies that there were farmers that had been produced on production frontier or 100% technical efficient.

Based on the finding of [48] the mean technical efficiency of rain-fed potato and irrigated potato were 81% and 68%, respectively. From the result all farmers' technical efficiency scores higher than or equal to 0.5 in both potato farming conditions. The majority (37.5%) of rain-fed potato growers score between 80% and 90% efficiency level, while 47% of irrigated potato farmers score between 60% and 70% around their mean. About 20% of the household score greater than 90% efficiency level in rain-fed potato production while only 3% of the household score greater than 90% efficiency level in irrigated potato production. Therefore, we have to conclude that rain-fed potato farmers are more efficient than their counter parts, irrigation farmers.

The mean technical, allocative and economic efficiency of tomato producers were found to be 72.88%, 67.17% and 50.13% respectively. The majority sample households were operating ranges 61% to 80%, 61% to 80%o, 50% to 60% level of technical, allocative and economic efficiency respectively, this stand for there were a probability to increase output without increase in the usage of inputs or lessening the usage of inputs keeping the amount of tomato output produced. That is increasing the production of tomato output by 27% within the existing resource or decreasing the cost of the production of tomato output by 33% by fixing the output production of tomato [22].

The mean level of technical efficiency was 0.59% with the maximum 0.97% and the minimum 0.18%, allocative efficiency average also 0.42% by the maximum and the minimum value of 0.59% and 0.23% respectively, finally the economic efficiency was 0.25% on average through ranging from the minimum values of 0.06% to the maximum value 0.58%. This indicated that vegetable production farmers in shewa zone were inefficiency in term of allocative, technical and economics and also there is higher variability of efficiencies among farmers [28].

The finding by Temesgen and Ayalneh [43], reveal that the mean technical efficiency of irrigated potato farms under modern irrigation schemes was to be 77% with the minimum value of 41% to the maximum value 98.5%. For farms under traditional irrigation schemes, the mean technical efficiency was 97% with a range of 95% to 99.4%. Such finding showed as technical efficiency under modern irrigation schemes relatively lower and higher variability among farmers compared to under traditional irrigation schemes.

A study by Dagineh *et al* [32] shows that the estimated mean technical efficiency of red pepper producing farmers at Dalocha district, southern Ethiopia was about 0.8 within the range of 0.35 and 0.965, this implies that there is room to boost famer's level of technical efficiency by using the existing input variables and currently available technology. This also again means that, the farmers can increase the level of red pepper production on average by about 20 percent without incurring additional production inputs.

The technical efficiency of sweet potato producers of southern region of Ethiopia ranged from 12.6 to 93.7%, with more than half (56%) of the producers having above the mean efficiency level in sweet potato production. In such a way, the average level of efficiency of sweet potato production was 66.1%, it implies that there was a fairly large room for improvement. If the average producers are to achieve the technical efficiency level of the most efficient producers in the sample (93.7%), they can realize a 29.4% output gain by keeping constant the input usages [34].

According to the study Godswill *et al* [37]. An analysis of the productivity and technical efficiency of smallholder irrigation in Ethiopia, the technical efficiency of the rain fed systems with no access to irrigation is estimated at 78% however, irrigated perennial system is estimated at 13%. Slightly more that 40% of the farmers in the communal

modern irrigation scheme are in the technical inefficiency range of 70 to 80%, whereas 53% of the farmers from the 'rain fed without access to irrigation' system are in the range of 80 to 90%. This result told us, there is higher volatility of technical efficiency among irrigated perennial system farmers and lower technical efficiency in this scheme.

Aman et al [28] by using DEA found that, the average technical efficiency, allocative efficiency and economic efficiency of farm households in Shewa zone were accounted for 49.5%, 33.7% and 17.4% respectively. which implies that they are less economical efficient and technically they were also better performance.

4. Conclusion

Vegetables occupy an important place in the food by being an important component of the human diet through source of micronutrients for human nutrition, a source of livelihood to people along the value chain including farmers, traders, processors and transporters, it contributes in food security, employment, foreign exchange and it has been key in alleviation of poverty especially in rural areas where production is intensive. To improve income and provide gainful employment, diversification from grain crops to high value crops like vegetables have appeared to be an essential strategy for agricultural growth for any developing country.

In Ethiopia, most of the soil types in fruits and vegetables producing regions of the country range from light clay to loam and are well suited for horticultural production. Endowed with favorable weather, altitude, adequate water and availability of suitable soils, the potential to develop horticultural crops, such as fruits, vegetables, root crops and cut flowers is great in Ethiopia.

Despite the increasing importance of vegetables, the production in Ethiopia, does not meet the need of the country's population for vegetable products and/or the production levels of vegetables are still far below their potential. This was because of, there was inadequate knowledge on improved production systems, marketing, small scale farming systems and poor pre and post-harvest handling techniques and in general, there were inefficiency in production of vegetables.

Different scholars were conducted a studies about what were the major determinants and level of efficiencies/inefficiencies on different varieties of vegetable production in Ethiopia and by detail reviewing of such studies we had been pointed out the following basic and vital determinants of vegetable efficiencies. That are:- age, sex, education, family size, ownership of livestock, experience, frequency of extension contact, training, membership in a farmers' association, participation in off/non-farm income, credit access, land fragmentation, seed type, farm to home distance, distance to nearest market and soil fertility, access to transportation, land slope and distance to extension service were identified as the main determinants of efficiency of vegetable production in Ethiopia.

When we have seen the level of technical, allocative and economics efficiencies were highly variable between vegetable farmers and the mean level of all efficiencies all most below the required level, in other word most of them were technically, economically as well as in term of cost were not efficient. Therefore there was a room for increasing the production of vegetables output without further increment of input of production and technology and/or reducing the usage of inputs of production by keeping constant the level of vegetables output or both of it simultaneously.

5. Recommendations

Main intension of this paper were reviewing the determinant and level of efficiency of vegetable production in Ethiopia to give an clue and information for policy makers on how to improve the technical, allocative, and economic efficiency of vegetable farmers and optimal use of inputs in production of vegetable in Ethiopia. The following recommendations have been set out based on the our review.

To help farmers education through formal, informal and short term access, for fastest and optimist adoption of trainings, policies and dissemination technology.

Inspiring farmers to conserve their land soil fertility by teach them and giving recognition, incentives and prize.

Provided frequent extension service around and nearest to farmer farm land/home by well-trained agricultural extensions for improving the efficiency in vegetable production.

Aware the farmers to diversify their source of income like off-farm income, this would help sufficiently finance their expenditure during production.

Encourage and support gender affirmative agricultural intervention to improve the participation as well as farm efficiency of female headed households.

Provide short term or long term credit access to the farmer and delivering financial institution nears to the farmer destinations.

Offer different training to the farmers, which will concern about agricultural practices, adopted and disseminations agricultural base technology.

Sting the farmers become a member of nears farmer association to share information, trainings, market for their product…

Built market centers, extension service center and farmer training center nearest to the farmer home based.

Declarations

Availability of Data and Materials

The datasets and articles used to support this study are available from the corresponding author upon reasonable request.

Competing Interest

The authors declare that they have no competing interests.

Consent for Publication

Not Applicable.

Ethics Approval and Consent to Participate

Ethical clearance was obtained from the college of business and economics, Samara University.

Authors' Contributions

The corresponding author was done all aspect of the manuscript solely.

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