Analysis of Mechanized Agriculture In Southern Region Of Ethiopia, Particularly In Central Zones

Abstract

The central zone of southern Ethiopia is one of the well-known regions of Ethiopia for agricultural food production; the main crops found in the central zone are; fruits and vegetables, cereal crops like teff, maize, sorghum, bean, pea, haricot bean, wheat, rice, barley. Cash crop, Coffee, Ginger, Pepper, Sugarcane. Oil crops for oil manufacturing in the food industry, soybeans, peanuts, sunfowers, and groundnut are harvested for human consumption. Feed crops for cattle or livestock consumption barley, beets, grasses for domestic animals to graze and store as hay or silage. Currently, poverty is commonly observed in both urban and rural areas in this region, mostly familiar within the rural part of the whole country. One of the main causes of food insecurity is unplanned and traditional rain feed agricultural habits.Prsently the farmers of southern region of Ethiopia are following the traditional methods for the land preparation, sowing and other allied operations of their farms. However to reduce the povetry, economic growth and living style of this region community mechanized agriculture is only one of the the solution. To enhance productivity by using a mechanized agricultural system using advanced farm machineries, tools and optional water sources for small-scale households as well as bulky massive irrigation to feed the rapidly growing population is very essential. However, mechanization is one of the most important categories to improve overall agricultural production. The use of advanced agricultural machinery and irrigational supplemented mechanized farming has a direct impact on food security and rural development strategies. Therefore; the present study is conducted to assess data on mechanized agriculture including the use of improved machinery, water resource, and irrigated farming methods in southern Ethiopia, particularly in central zones.

Keywords: - Agricultural , Farm machinery , Irrigated agriculture , Mechanization, production

1. Introduction

1.1 Background of study

Ethiopia is mostly an agricultural country, reliant on draught animals for power. Hand tools are primarily employed in the country's south and south-western regions, where tsetse fly infestations make it difficult for cattle to survive. Hoe culture and shifting cultivation are dominant in some parts of these areas, such as Assosa and Gambella. This was the case until the settlement scheme was implemented. The settlers gradually introduced draught animal-based agriculture to these locations. Farming was introduced using mechanical power technology in the lowlands of Afar and Somalia, which are largely pastoral areas, especially with the creation of large cotton fields (Kelemu, 2015). Similarily Ethiopia has a low rate of agricultural mechanization, with less than 1% of agricultural fields plowed with a tractor. However, the adoption of agricultural mechanization has accelerated in recent years. We observe a significant increase in the importation of combine harvesters and tractors, which appears to be linked to the rising cost of agricultural labor and animal traction, both of which serve as replacements for agricultural mechanization(Berhane, Dereje et al. 2017).

We estimate that combine harvesters are currently used to harvest a few farm field of Oromiya region of Ethiopia planted to wheat the country's fourth most important cereal and that they are particularly prevalent in the country's major wheat-growing zones in the southeast. There has been a fast rise in the number of private mechanization service providers. For plowing, harrowing, and harvesting, smallholders in these wheat-growing zones rely largely on agricultural machinery rental services and using domestic animals(Berhane, Hirvonen et al. 2016).

1.2 Present practices of farming and poverty level in southern Ethiopia

The following sections address the farmers' farming practices, such as soil preparation, water sources, sowing methods, and harvesting, as well as the poverty level in southern Ethiopia. **Land preparation:** Ethiopia has great agricultural potential, because of its massive areas of fertile land, diverse climate, generally adequate rainfall, and large labor pool (OMO and ZONE , Debesa, Gebre et al. 2020). Despite this potential, however, agriculture has remained underdeveloped (Asmamaw 2017). Because drought has repeatedly affected the country, a poor economic base (low productivity, weak infrastructure, and low level of technology (Simane, Zaitchik et al. 2013). However, Agriculture in Ethiopia is believed to have started 7000 years ago drown to animals tillage (Gibling 2018). The paired use of animal drowns tillage implements for long pried still room for their improvement. In particularly southern Ethiopia pair oxen are primarily kept as a source of draft power for plowing with Marsha. The horses, donkeys, and mules are used as an alternative source of power for drafting and transportation. Tilling and herding are still the main activities and sources of livelihood for the people. Livelihood has been characterized and motivated by the subsistence and basic need of society.

Water resources: The data collected area has rain feed agricultural for along period. Data collected in the formal household questionnaire were on characteristics of husehold members, farmland, and non-farm activities and institutional factors hypothesized rain feed traditional farm is familiar withusing indigenous knowledge for crop production(Mojo, Todo, and Matous 2010). But very little supplementary irrigation for small household farmers' level of understanding on the impacts of climate change on water resources in their catchment level vegetation cultivation practice due to rain variability and shortage of water (Tesfahunegn and Gebru 2020), farmers constructed water harvesting ponds for livestock and garden plant watering(Jansen et al. 2007).

Sowing methods: Hand broadcasting, which has been practiced in the southern regional state as well as in other parts of the country for a long time, is the method of sowing cereal crops. To finish sowing activities within the range of sowing time and reduce overlaps between other farm activities and labour power, traditional sowing practice is common among Ethiopian farmers (Araya, Stroosnijder et al. 2012). After the introduction of the Agricultural Transformation Agency (Shrestha and Khanal) (2010/2011) in the research institute and farmer training center (FTC) as a sample, as well as agricultural practices like row-sowing teff and maize (Mekonnen, Gerber et al. 2018), banding fertilizer application, inter cropping could enhance farmers' productivity. However, hand broadcasting of the crop is familiar in the field of study (Vandercasteelen, Dereje et al. 2016). Farmers' strategies include cultivating different crops, planting different crop varieties using row planting manner, changing planting conservation agriculture and diversifying from farm to non-farm activities(Tesfaye and Seifu 2016). While introducing modern row planter technology, farmers' productivity and household food security are improved, as well as seed and fertilizer losses are reduced.

Harvesting practice: Rain and storms frequently occur during harvesting season, causing significant crop damage.Extra days for land preparation and planting the following crop are made possible by a quick harvest.Machines can help harvest crops at the right stage of ripeness, eliminate drudgery, and speed up operations(Hassena, Ensermu et al. 2000). Crops are harvested when they reach full maturity, with the goal of removing grain, straw, tubers, and other valuable components with minimal waste(Berhane, Dereje et al. 2017). Harvesting and threshing for wheat, barly teff crops can be done in a number of ways, including manually and mechanically(Biweta, Agegnehu et al. 2006). But in my study area harvesting is usually done manually whereas threshing by domestic animals. Traditional harvesting, threshing, and handling of cereal crops lead to losses at farm field level and shelf-life issues at distribution were identified as vulnerable hot-spots of particularly haricot bean, wheat, barley, and teff crop. The interest to address supporting technological to harvesting, and thresh by domestic animals value chain constraints leading to food losses has increased significantly to provide adequate nutrition to the growing population(Brouwer and Bouma , Rosegrant and Riagler 1997, Myers 2000). One of the main goals of this study is to reduce crop loss due to domestic animal threshing by replacing hand harvesting with a low-cost harvesting and threshing machine and introducing farmers to mechanization(Annamalai 2004, Kumar, Kumar et al. 2017, Benaseer, Masilamani et al. 2018).

Poverty level in the southern Ethiopia: Ethiopia remains one of the world's least developed nations (Alemu, Bewket et al. 2011, Bogale 2012, Melese 2017, Mohammed 2020). More than 25 million Ethiopians live in abject poverty. In terms of the Human Development Index, the country is among the poorest in the world (HDI). According to (Eshetu and Mekonnen 2016, Mekore and Yaekob 2018) the scholer paper different disrtct of southeren Ethiopia findings reveals that 34% of households are living below the poverty line with a poverty gap index of 11% and severity index of 5.6%. The average income inequality with much much differe from household to housholde. This different shows that goverenmental body has no oppetional police to improve livelihood of rural peoples. Farmers can lead their life most theme are using indigenous knowledge(Alemaw and Hailu 2019).

To become food secured people in ethiopia the goverenemental and non governmental concerned bodys highly participating to adopet not optional, but it is mandatory to introducing climate smart agriculture to poverty minimizing(Belay and Mengiste 2021, Habtewold 2021). Poverty index of south Ethiopia is almost similar and has the same livelihood as other parts of Ethiopia.

Development planners to better understand welfare indicators and develop improved mechanized agricultural technologies to reduce poverty using one-dimensional income or extreme economic infilation of expenditure-based measures of poverty and related issues raised (HABTEWOLD 2020, Habtewold 2021). Similarly, based on expenditure-based metrics of poverty, which may exclude all commodities, including fertilizer and food crops, the purchasing power of regional people demonstrates multidimensional poverty reduction deprivation of the economy.

Ethiopia's current situation under the TPLF-conflict and other Shane Terrerst-led groups raised wippan indicates a rapid development of multidimensional poverty in all-round economic decrease(Bekalo 2022). This southern Ethiopia problem should be similar observed in Amhara and Oromiya regions of Ethiopia. Using the Ethiopian Socioeconomic Survey (ESS), collected in (Dasgupta and Robinson 2021) the results of the study show that the adoption of mechanized technologies reduces deprivation scores and one of its components, the standard of living part (Habtewold 2021, Lin and Gupta 2021). The multi-directional collaboration effect to enhance the productivity of both rural and urban economies must be mandatory to minimize the current poverty index. One of the existing poverty statuses shows the number of poor has increased significantly since the 1990s and about 88 % of the worlds poorest are expected to live in Africa by 2030 (Clemens and Kremer 2016, Langley 2021). In Ethiopia, a substantial number of the rural population lives below the national poverty line (33%), and an additional 14% of non-poor households are estimated to be vulnerable to falling into poverty (Biru, Zeller et al. 2020).

The country is among the poorest nations in the world, cause of highly drought- prone, suspected of enteral conflict and unstable polotics, and also has a traditional agricultural train that accounts for about 85 % of employment (Choufani, Davis et al. 2017). Ethiopia is one of the poorest countries in the world, where about 29.2% of its population is living below the poverty line (Damtew 2017). Rural development strategies and Food security becomes as a result of economic growth. The small scale irrigation in ensuring rural households food security based on existing natural resource(Muez 2014). But scarce and erratic rainfall and irrigation have achieved a positive impact better opportunities for production, income, reduction of risk, and enhancing generated benefits for poor rural communities (Philip , Eskeziaw 2020). Although, the majority of cropping in Ethiopia is 'rain-fed agriculture' there are four major categories of productive use of water in agriculture: 'rain-fed agriculture 85%, the rest 'supplementary irrigation', 'irrigated agriculture, and 'livestock' are 15%. It is also important to note the importance of coupling soil fertility management and the nexus of soil water in crop production and productivity improvement. Because agriculture is the major component of the Ethiopian economy, it is the primary determinant of economic growth and poverty reduction.

Irrigated mechanized farming has a direct and indirect impact on food security, and it is one of the most essential tools for rural development Economic growth leads to increased food security.

1.3 Objectives

Objectives of this study was investigate influencing elements for integrated intensive and sustainable mechanized agricultural implementation to improve agricultural productivity, provide crop output consistency throughout the year, reduce food imports, and promote local agricultural production.

The specific objective of study were:

1. To assess existing farm practice, technological integrity and level of crop production in the study area
2. To identify and analyze constraints for mechanized productive sustainable agriculture as experienced similar agro-ecological zone

2. Matrial and Methods of Data Collection

2.1 Description of the study area

Geographic location: The study area is found in the central zone of south Ethiopia, particularly the upper and lower rift valley water shad. This watershade includes, Halaba, Hadiya , Kambata tembaro, and Wolita zone. The elevation of the study area at the lowest place in the Wolita 1500 meters and Anbericho Kambata 3080 meter above sea level. According to the conventional Ethiopian agro-ecological zonation and information obtained the climate is characterized as temperate or locally called arid (*Kolla*), sub-humid (*woina dega*), and high land (*dega*). Southern Nation Nationality People Region(SNNPR) is one of the largest regions in Ethiopia, accounting for more than 10 percent of the country's land area and an estimated population of 20,768,000 up to May 2018 and almost a fifth the place of the overall country's population. The mid of 2008 population was estimated at 16 million; with less than one in the tenth of its population (8.9%) living in urban areas and the remaining population of the region overwhelmingly rural. The SNNPR capital city is Hawassa. The particular study area shown in Fig. 1

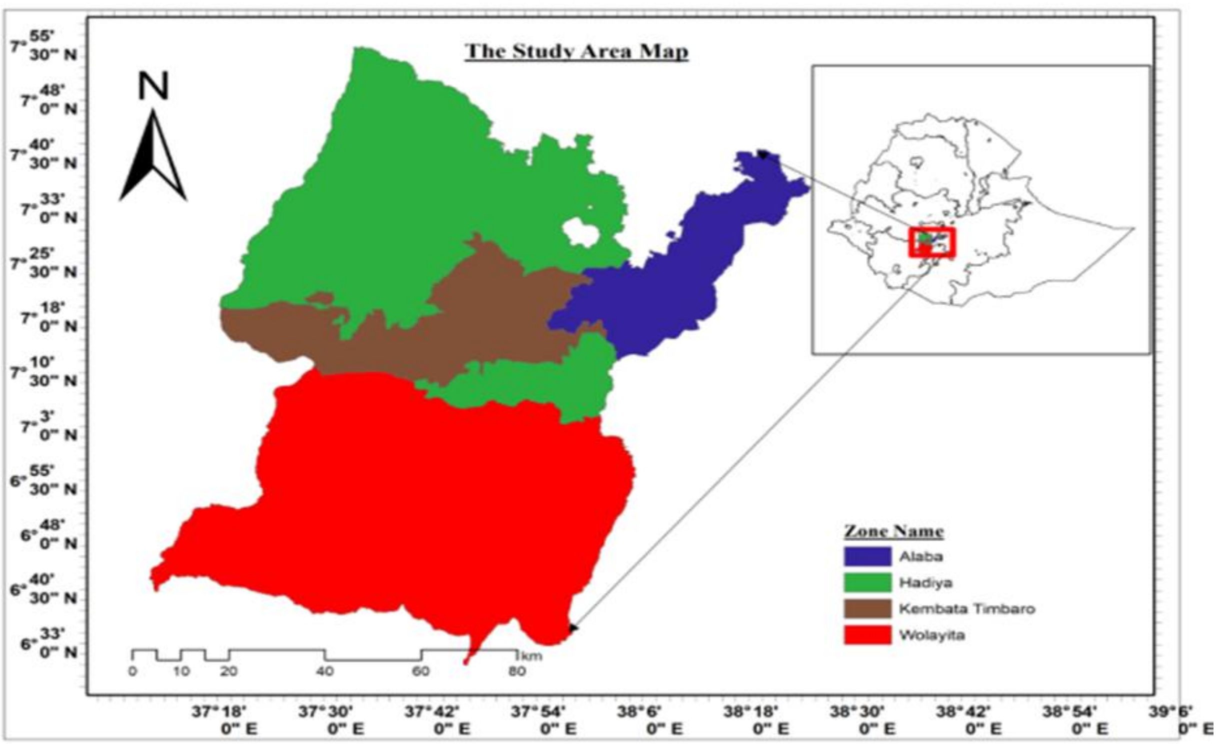

Figure 1: Study Map SNNPR includes the Hadiya, Kambata Tanebaro, Halaba, and Wolaita zone of Southern Ethiopia.

The mean annual temperature is about 20.05^{0C} and the mean annual rainfall falls between 601-1350 mm. The year is divided into two seasons: the wet season summer (*kiremt*) from June to October, and the dry season (Giziew and Mebrate) from October to June, broken in February/March or May by a short period of, so-called "little rains" (*Belg*) [Ethiopia meteorology southern station data, 2021]

2.2 Methods of Data Collection

Both primary and secondary data were collected as qualitative and quantitative approach to investigate influencing factors for integrated intensive and sustainable conservation mechanized agricultural implementation.

Primary data related to current agricultural practice, crop varieties, yield per hectare, mechanization status, and the present challenges for mechanization, were collected through each zonal agriculture and natural resource office. The current farm practices were identified from key informant interviews, group discussions, and field observations through random sampling techniques, in the selected study area of high potential crop production kebeles' of four representing sites. The viewpoints of stakeholders on mechanization, present technology use, extension services, and the available market for tractors, tools, harvesting, thrashers, and water pumps were recorded, and data were gathered to improve technology extension apperoch. A suitability examination of soil in the selected watershed was obtained from the southern region irrigation bureau as a qualitative and quantitative technique, and it was delivered to purposefully selecte dmodels kebele representative with the existing scenario of mechanized farming settings.

2.3 Among collected primary data

1) a home survey involving interviews with farmers or households who own a tractor, threshing machine, or other farm mechanical implements.

2) The percentage of the population in the central zone who has mechanized agriculture with rain feed, additional irrigation, or fully mechanized agriculture irrigation.

3) A source of water for agriculture, such as rainfall, surface water, rain harvested water, shallow wells, underground, or any other source, must be found.

4) Calculate the *per centile* (%) of kebeles in selected zonal administrations who have used mechanized farming, improved crop types, yield per hectare of existing farmers' practices, and

impediments to mechanization were collected at each zone. Other significant data was acquired from the southern Ethiopia irrigation beauro, including influencing factors for agricultural productivity and weather data. Fig. 2 presents the data **of** major soil types from the study area on water shadow (area delineation using QGIS 3.16.14) for limiting the covered area.

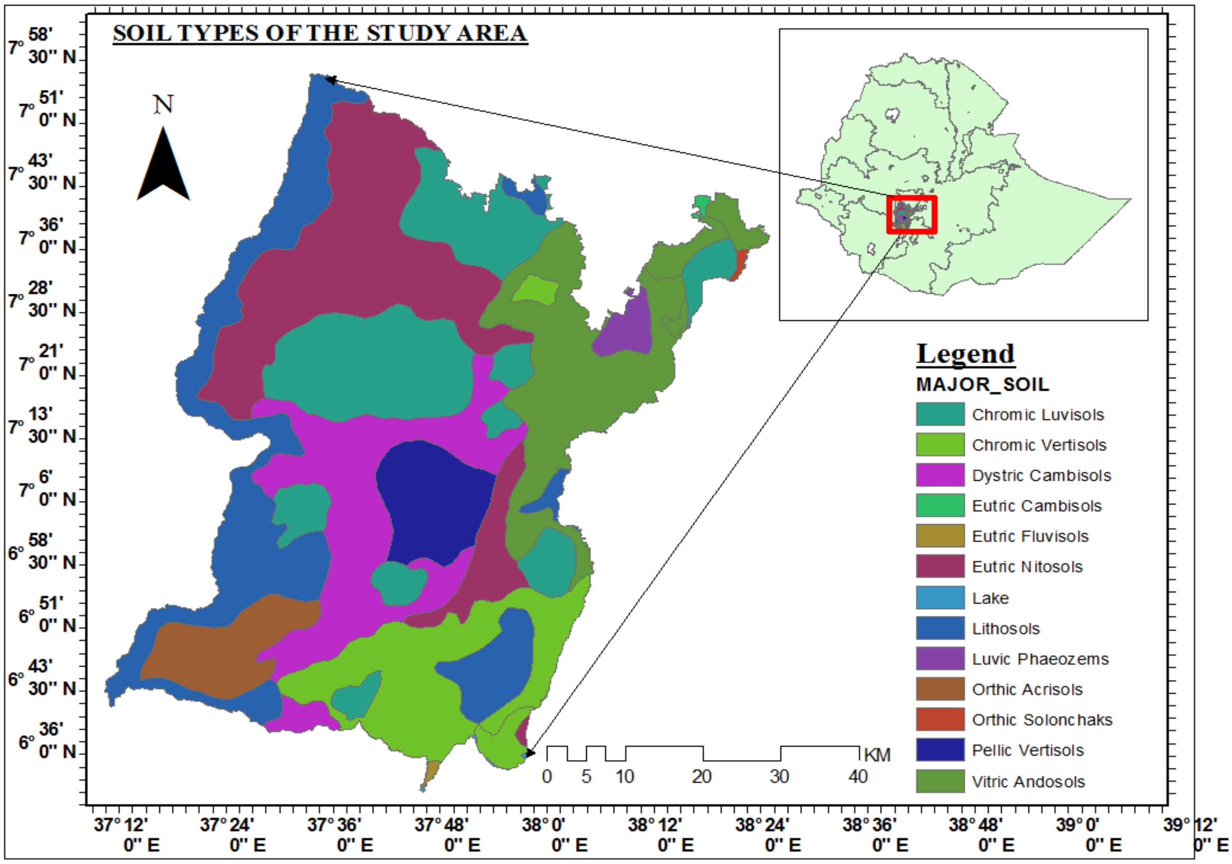

Figure 2: Major Soil types of the study area (source: FAO soil classification)

2.4 Gross and net profit margin of crop

Gross profit is the simplest profitability metric because it defines profit as all income that remains after accounting for the cost of produced crop sold (COPCS). COPCS includes only those expenses directly associated with the production or manufacture of items for sale, including raw materials and the wages for labor required to make or harvest crop product.

The gross profit margin compares gross profit to total revenue, = cost of total output
Formula for gross profit margin:

$$\text{Gross profit margin} = \frac{(\text{Net sales} - \text{cost of produced crop sold})}{\text{Net sales}} X100 \quad \ldots ..$$

(Nariswari and Nugraha 2020)

Net sale price = total output cost + expected net profit + tax,

About the benefit of farmer of crop productivity and yield profit margin:

$$\%Profit\ of\ crop\ = \frac{(\text{output cosss} + Profit + tax) - \text{cost of input}\,)}{\text{Net sale}} X100$$

(Moridipour and Mousavi 2014)

The benefit to the farmer, crop productivity, and yield profit margin .The percent benefits to the farmer are calculated by using the following relation :

% of benefits to the farmers = Net sale - the cost of input

Net sale = Cost of input + 20% (input cost) as profit + tax per quintal

Cost of input = variable costs

The Input costs to the farmers are rent of land, seed, tillage, fertilizer, weed killer/controlling, harvesting, and trashing costs. However; Input cost is variable costs such as Labor cost, machine of draft of animals cost, Fertilizer, Insecticide cost, Pesticide cost, Harvesting cost, Thrashing cost, and others related ,

Also, the output cost is calculated as:

Cost of output= Total crop yield/hectares x price = Gross income

Gross income=quantity produced x price (current price /quintal)

Gross margin=gross income-variable costs (source: https://agric.wa.gov.au/n/3483)

Variable costs vary from zone and differ from kebele to kebele. Example- farm daily lab our cost, pair oxen cost, harvesting cost, trashing cost etc. But I had taken current average costs of region. Similarly output cost had taken three year average annual yield of study area in table.1.

The following are some of the input expenses for calculating the productivity level for a one-hectare field: In southern Ethiopia, the annual average cost of several crops is:

Land tillage cost using animal draft $128, but using tractor $100, fertilizer quantity and cost of 300kg is $270, land rent per year $150, teff Seed cost is $9, Sorghum seed cost $11.1, Seed of wheat and barley have equal cost in the Ethiopia market $100, Seed of maize $26.25, Cost of manual weed controlling debarring for each sorghum and maize crop is $32, weed killer 1litter is $20, insecticide cost is $2, harvesting lab our cost is $40 , and trashing lab our cost is $40. Total output cost is Total crop yield/hectares x price is Gross income.

The costs benefit analysis of cereal crops on better preformed product results dependent.

Average productivity of teff of study area per hector per quntal is 15.51, 1quintal is 100kg and 1 quntal of teff is $84, expected profit is 40% of input cost and tax 1% of input cost.

Total Input of teff crop per hector is $777, Total output cost is $1304.52

$$\text{Profit} = \frac{(\textbf{out put} - \textbf{input})}{\textbf{output}} \mathbf{X100}$$ ……….(Heard, Jackson et al. 2013, Oke 2014)

$$\text{Profit of teff crop} = \frac{(\$1304.52, \quad -\$777)}{\$1304.52} \text{X100} = 40.44\%$$

Teff crops in the region is profitable and enhancing livelihood of farmers.

Average wheat production in the region is 41.5 quntal per hector (Table: 1)

Wheat output per hector $2075, input cost of wheat is $ 848

$$\text{Profit of wheat crop} = \frac{(\$2075 - 848)}{\$2075} \text{X100} = 59.1\%$$

From field observation and three year productivity reports of Southern Ethiopia agricultural office, it is better wheat production area and motivated farmers to word wheat production.

Averagely in the study area barely productivity is 19.75 and efficiency was :

Output of barley $987.5, input of barley is $ 848

$$\text{Profit of barely crop} = \frac{(\$987.5 - \$848)}{\$987.5} \text{X100} = 14.12\%$$

An efficiency or profitability margin is less and farmer is not interested to produce barley in their farm field. Similarly sorghum in the study area productivity is very less. Input cost of Sorghum $651 and output cost = $826.2.

$$\text{Profit of sorghum crop} = \frac{(\$826.2 - \$651)}{\$826.2} \text{X100} = 21.2\%$$

Relatively it has good result, but farmer's responds on the product, it is long term crop and highly exposed to climatically variability and plant disease.

Came to maize productivity input cost is $706.26, output cost is $1047.6.

And efficiency/ profitability of the productivity is 48.3%. Similar fashion all fruit and vegetable were done, but the cost of fruit and vegetable varies from day to day and difficult to decide in our context. It is perciable product and it is highly suspected to destroy in normal environment, it take care to keep as perciable.

Perennial plants just needed to be planted once and did not require any extra inputs. Coffee, sugar cane, ginger, and avacado are examples of such planets. The cost of a coffee farm field per hector is $40 per year. One quintal of coffee is $460. The total input cost of ginger is $600, and one quintal of ginger is $46. Sugarcane for one quintal is $5.28. One kilogram of pepper is $3.8 , and the input cost is $210. One quintal of avocados is $60. For perennial plants, the land rental cost for one season is $150. Carrot input cost is $420, cabbage input cost is $580, one quntal pea is $110, bean input cost is $282, one quntal bean is $100, bean input cost is $359.4, and haricot bean quntal is $90, and input cost is $339.4. cost of a potato per hector is $1280, and one quintal potato is $36.

3. Results and Discussion

3.1 Results

Table: 1-5, below presents the crop wise production data and Percent benefits to the farmers get per ha for various zones of SNNPR.

Table 1: Data of three year average crop wise present 2021 production and % of benefits farmers get per ha by using traditional practices for kambata-Temgaro zone

S.No.	Crop type	Type of crop	Farm area in ha	Production per ha/Quntal	% of benefits to the farmers per hacrar
1.	Cereal crop	teff	15991.1	20.53	54.9%
		wheat	16748.59	40.98	58.6%
		Sorghum	1585.48	12.20	1.2%
		barley	958.345	23.	26.26%
		maize	6329.27	15.4	0.3%
2.	Cash crop	coffee	24704.04	3.06	64.47%
		Ginger,	9416	156	91.6%
		sugarcane	78	260	56.77%
		Pepper	704	9.59	42.37
3.	Fruit and vegetable	Avacado	977.815	239	89.53%
		mango	755.4	205	89.54
		carot	952.8	222	97%
		cabbage	2779.5	275.5	94.59%
4.	Oil crop	pea	1039.74	2.73	6.09%
		bean	5084.9	19.22	81.3%
		Haricot bean	1784	14.29	73.61

Source: Kambata Tambaro zone- Agriculture and Natural resource office January (2022)

Table 2:Data of three year average crop wise present 2021 production and % of benefits farmers get per ha by using traditional practices for Wolaita Zone.

S. No	Crop type	Type of crop	Farm area in ha	Production per ha	% of benefits to the farmers per hectar
1.	Cereal crop	teff	22867	12.5	33.42%
		wheat	3307	45	64.34%
		Sorghum	-	-	-
		barley	869	16	18.27%
		maize	8769	13	0.25%
2.	Cash crop	coffee	17623	3	63.2%
		Ginger,	5132	150	91.3%
		sugarcane	48	241	52.62%
		Pepper	-	-	-
3.	Fruit and vegetable	Avacado	1859.2	217	81.28%
		mango	-	-	-
		carot	167	212	92.63%
		cabbage	160	208	71.41%
4.	Oil crop	pea	1972	4	8.92%
		bean	2075	17	78.85
		Haricot bean	13923	12	68%

Source: Wolayita zone- Agriculture and Natural resource office January (2022)

Table 3: Data of three year average crop wise present 2021 production and % of benefits farmers get per hectare of traditional practices Hadiya Zone.

S.No.	Crop type	Type of crop	Farm area in ha	Production per ha	% of benefits to the farmers per hector
1.	Cereal crop	teff	40319	14	37.43%
		wheat	51487	40	57.19%
		Sorghum	7219	21	2.06%
		barley	6750.5	20	22.83%
		maize	22074	48	0.92%
2.	Cash crop	coffee	4530	2.5	52.67%
		Ginger,	278	130	90%
		sugarcane	-	-	-
		Pepper	298	8	93.26%
3.	Fruit and vegetable	Avacado	2200	100	37.46%
		mango	210	120	52.41%
		Carot	534	204	89.13%
		cabbage	9166.5	206	70.73%
4.	Oil crop	pea	6667	13	29%
		bean	16577.5	18	80%
		Haricot bean	3323	13	71%

Source : Hadiya zone- Agriculture and Natural resource office January (2022)

Table 4: Data of three year average crop wise present 2021 production and % of benefits farmers get per ha by using traditional practices for Halaba Zone

S.No	Crop category	Type of crop	Farm area in ha	Production per ha	% of benefits to the farmers per hactar
1.	Cereal crop	teff	9724	14	37.43%
		wheat	6111.5	40	51.2%
		Sorghum	1618	21	2.06%
		barley	441	20	22.83%
		maize	23223	40	0.77%
2.	Cash crop	coffee	692	5	64.47%
		Ginger,	-	-	-
		sugarcane	12.5	260	56.77%
		Pepper	6059	11	48.59%
3.	Fruit and vegetable	Avacado	112	200	74.92 %
		mango	86	206	89.97 %
		Carot	14.5	180	78.64 %
		cabbage	1097	220	75.53 %
		Potato	1509	240	85.18 %
4.	Oil crop	pea	-	-	-
		bean	132	17	78.85%
		Haricot bean	2612.5	19	81%

Source : Halaba zone agriculture and Natural resource office2022

Table 5: Data of summary of existing farm machinees in study area productivity and % of benefits of farmers per ha by using mechanization for Wolita, Kambata-tembero, Hadiya Halaba.

S.No.	zones	Type of far machinery	Number of farm machinery	Productivity per hr/ ha	% of benefits
1.	Wolita	tractor	-	0	no
		Harvesting	-	0	no
		Irrigation pump	-	0	no
2.	Kambata tembero	tractor	-	0	no
		Harvesting	-	0	no
		Irrigation pump	7	0	no
3.	Hadiya	tractor	2	0	no
		Harvesting	-	0	no
		Irrigation pump	-	0	no
4.	Halaba	tractor	6	0	no
		Harvesting	-	0	no
		Irrigation pump	-	0	no

Source: wolita, Kambata, Hadiya and Halaba zone agricultural and natural resource office 2020

3.2 Discussions

Mechanization practice: Only a few kebele in the Wolita and Halaba zones in southern Ethiopia's central zone have been mechanized utilizing rental tractors owned by the private sector. In the southern Ethiopian zones of Halaba and Hadiya, however, tractor tillage farm land improved maize yields. A few hectares of land in the center zone of south Ethiopia were irrigated to offer practice for fruit and vegetation. Water was obtained by rainwater gathering ponds, the Small River, and stream water diversion. As a result, small-scale irrigation has a positive impact on their life. Small-scale irrigated farmers' livelihoods are completely transforming their families' dietary habits and raising their earnings (Amare and Endalew 2016).

According to agricultural machinery information of south Ethiopia, this tractor is rented from the private sector. They do, however, come from Oromia's neighboring zone and are hired on a daily basis for farm tillage. However, most of the high land in the southern region topography is not suitable for standard 4WD tractors for a variety of reasons. According to my observations in the field, the land surface is slopped and the farmer is cultivating on stipslop. This highland shows how difficult low-lying terrain and level topography are for existing tractors to comprehend. Despite the fact that the soil is hard and the stone is mixed, the tractor disc has not taken this into account(Animaw, Nkanya et al. 2016). I've also considered the agricultural area, which contains a large number of trees and their roots. The rainy season lasts the majority of the year. Due to soil features, it is impossible to enter farm property for the majority of the wet season(Berhane, Dereje et al. 2017). Tractors that are environmentally friendly and affordable do not appear in the research area from a farmer's perspective. According to (Kolhe and Datta 2008) environmental friendly technology for agricultural enhancement is mandatory like southern Ethiopia terrain landscape.

Similarly, farmers use traditional fruit collecting procedures during the harvesting season, and as a result, their products should lose their inherent suitability and freshness. According to Kolhe (2015), development and testing of tree climbing and harvesting devices for mango and coconut trees in tractors mounted hydrolic elevators by using a digital loading system for mango and coconut harvesting were designed in India and other nations utilizing various technologies. In the research area, there is no other harvesting machine.

Irrigation was provided by furrow, and the Kambata Tembaro zone, a tiny river pumping in the Sana river for ginger plantation, has just seven water pumps. Farmers' financial benefits as a result of conventional rain-fed farming practices in the research area are not dimensionally quantified. Those that have automated farming, on the other hand, have better economic and social prospects in their communities. Similarly, in the Halaba and Hadia zone administrations, those who had tracror rental for tillage operations had better maize producers for their family food security as well as the national market. Animal power is the dominant mode for plowing, threshing, and transportation in Ethiopia and yet, at the same time, little effort was employed to assess subsistence farmer's tractor demand in the study area. This study was conducted to understand the preferences of wheat producer subsistence farmers for agricultural tractors in Ethiopia in 2017(Workneh, Ujiie, et al. 2021). Agriculture is the major social and economic sector in Africa, providing about 66% of the employment on the continent (Affognon, Mutungi, et al. 2015).

In sub-Saharan Africa (SSA), the livelihood of about 85% of the inhabitants depends on agriculture (Kotir 2011). Most of the agricultural land in Africa is rain-fed and subject to erratic rainfall and recurrent droughts, often leading to low performance (Ogenga, Mugalavai, et al. 2018). As a result, food insecurity, poverty, and low resilience to climatic effects are quite immense, particularly in rural areas of SSA, including Ethiopia. Thus, increasing agricultural productivity is essential in Africa to address the challenges of food insecurity and climatic variability. Irrigation in this regard can be the most viable option for boosting agricultural productivity (Yohannes 2020).

Cereal crops are one of the most important for life long in the earth's crust for a human being. These crops are limited in their species and productivity. To enhance the productivity of this crop improve the traditional tillage mechanism in farm machine operation, using supplementary irrigated in addition to rain feed systems, and use better yield seedlings to get sustainable food security. One of the faimen reducing food crops within a few hectares high yield is maize and wheat. One poverty redaction for Ethiopia farmers and enhance the productivity of cereal crops using mechanized rain feed farming with supplementary irrigation by technological supportable is mandatory. It is one of the world's most widely grown and productive cereal crops (Haddadi and Mohseni 2016). Based on the total area and production, maize is the 3rd most important cereal crop after wheat and rice in the world. To maximize productivity giving max imam attention to improving soil fertility and using better climate resistance breeding. Maize is also an adaptable crop, allowing it to grow across a range of aggro-ecological zones. It is cultivated in a wider range of environments than wheat and rice because of its greater adaptability (Singh, Kumar et al. 2020)

One production improving mechanism is known that appropriate sowing time and sowing types are not only important for proper germination and emergence but also to have the crop in the field when environmental conditions are conducive for vigorous growth and development. Sowing time is one of the most important factors infuencing crop growth, development, and yield. The variation method of sowing dates plays an important role in the variation of crop yield per unit hectare. Southern Ethiopia's central zone is one of the highest cereal, cash crop, fruit, and vegetation producing areas of Ethiopia increasing productivity using the row sowing method is a good indicator of farmer's training centers. The area receives a bimodal rainfall type. The late beginning or early cessation of rain is a common phenomenon in the area. This erratic rainfall leads to crop water stress and finally plants died. Considerable attention has been given by developing countries, including Ethiopia, to the development of Small Scale Irrigation (SSI) for reducing crop filerity and achieving food security (Hanjra, Ferede, et al. 2009). In addition to that sawing technology minimize loss of seed and fertilizer and enhancing productivity and quality production(Kolhe and Datta 2008, Affognon, Mutungi et al. 2015)

In addition, it is expected that small-scale irrigation (SSI) provides sustained agricultural growth, and employment for the landless and contributes to overall economic growth by boosting the ago -industry. Data Analysis the present collected data shows that from similar agro-ecology but different farming practices and soil conservation for fertility increment teff crop yield from zone to zone significantly different. Teff productivity in the kambate tembaro zone average 20.53 per hector, in Hadiya and Halaba zone productivity is 14 quintal per hector but in similar aggro-ecology in wolita zone 12.5 quanta per hector. This difference comes from farm practice, land management, and using a different variety of teff crops with technological support in the Kambata tembaro zone. According to (Sime and Aune 2018) technological change has been the major driving force for increasing agricultural productivity and promoting agricultural development in developing countries.

To improve agricultural productivity and farmers' livelihoods, several agricultural technologies (improved crop varieties and related agricultural practices) were introduced by various agencies to the farmers in the Rift Valley of Ethiopia. This implies that to enhance the productivity of all perennial and annual plants using mechanized support with supplemental irrigation due to erratic rainfall of climate variability problems to multi-increasing productivity and sustain food security. Similarly, other factors related to poor agricultural performance are reduced soil fertility, unreliable climatic conditions, poor infrastructure, environmental degradation, and land scarcity have resulted in low crop yields and income variability for each farmer (Bekabil 2014).
% of benefits to the farmers depending on the variability of productivity in different crops due to multiple actors to promote the productivity of annual or perennial crops but the cost of input and output is speedily increasing from time to time throughout the year. Because demand and supply of crop productivity are not balanced due to the population growth rate. The rapid population growth, on the one hand, and the high gap between the demand and supply of food production, on the other, have brought an impetus for policymakers of agriculture to acquire intention.

To overcome this productivity need for technology adoption in agriculture, besides increasing factors and efficiency of crop yield. No significant difference in the cost variability of the crop in a rural or urban environment. But the variability of yield cause indicators is lack of adaptation of technological application of farm machinery and climactic variability resistive breeding variety brought high differ in the lively hood of farmers. Therefore to reap the benefits that agriculture can provide to the mass of the rural poor in particular and the national development at large, it is necessary to transform traditional agriculture into a productive sector (Enete and Amusa 2010) termed "getting agriculture moving." Agricultural transformation, therefore, requires appropriate public policy intervention (Yonas 2006) to generate surplus produce. Further, the formulation of agricultural policy in turn requires a consideration of various interacting factors that include, among others, organization of agriculture, natural factors, institutional arrangements, product characteristics, factors, and product markets (Erenstein 2003).

Conclusions

This regional state has one of the country's greatest food crop production zones, which was used to create the study area. Climate variability and traditional agricultural techniques, on the other hand, are two influential elements in improving crop productivity and livelihoods. Furthermore, field observations reveal a scarcity of environmental effect resistant seedlings. Due to a lack of superior seed varieties and the expensive expense of fertilizers, farmers are dependant on their fields. All of the existing outcomes are the product of the woreda center's agricultural extension officer's collaborative effect and the farmers' ongoing efforts.

Several vegetation irrigation systems have been constructed throughout around 57 hectares of land in the research region, mostly as supplemental irrigation for home food security. Those who had irrigated farm fields fared better in terms of livelihood and food security than those who relied on rainy-season families. Traditional tilling and herding are still the main activities and sources of revenue in the study region when it comes to agricultural machinery. Farmers' livelihoods have been shaped by life's most basic needs for nourishment. Crop yield varies throughout agro-ecological zones due to a variety of factors such as climatic fluctuation, land management, and technology adaptability.

Recommendation

Ethiopia's agricultural production is exceedingly low in compared to other African countries, and a farmer's livelihood is extremely fragile. And providing inexpensive, environmentally friendly tilling and traction tractors with a range of water sources for supplementary irrigation in the event of uncertain rains as a result of crop failure is one of the finest methods to address food security and mobilize farmers. Utilize agriculture to boost crop productivity and mechanized agricultural systems to enhance productivity in a long-term manner.

The authors of this paper declare that

1) Data and materials are readily available:

The study contains a lot of row data from field observations as well as official data from the relevant organization with proper procedures.

2) Conflicting interests.

We confirm that the entire work is unique, has never been published or presented before, and is not in the process of being published elsewhere. We also certify that both authors have conduct the research and approved the whole manuscript, and that no other individuals meet the authorship requirements.

3) Funding: The research was paid for out of pocket by the authors.The university's only use was for instructional purposes. however, the writers' own funds cover all expenses.

4) Authors' contributions:

We are entirely committed to this project and are tried to collect the data of overall SNNPR region, that may encourage the researchers for further research in Agricultural Mechanization specially in southern region of Ethiopia..

5) Acknowledgements:

Both the authors are very thankful to the agricultural and natural resource divisions of Kambata tembaro, Halaba, Hadiya, and Wolita Zones for providing accurate and reliable data for the present research.

References

Affognon, H., et al. (2015). "Unpacking postharvest losses in sub-Saharan Africa: a meta-analysis." World Development **66**: 49-68.

Alemaw, A. T. and A. M. Hailu (2019). "Institutional challenges of poverty reduction and household coping mechanisms in Eastern hararghe, Eastern Ethiopia." Економика пољопривреде **66**(2): 499-512.

Alemu, D., et al. (2011). "Extent and determinants of household poverty in rural Ethiopia: A study of six villages." Eastern Africa Social Science Research Review **27**(2): 21-49.

Amare, D. and W. Endalew (2016). "Agricultural mechanization: Assessment of mechanization impact experiences on the rural population and the implications for Ethiopian smallholders." Engineering and Applied Sciences **1**(2): 39-48.

Animaw, A. T., et al. (2016). AGRICULTURAL MECHANIZATION AND SOUTH-SOUTH KNOWLEDGE EXCHANGE: What can Ethiopian and Kenyan policymakers learn from Bangladesh's experience?, Intl Food Policy Res Inst.

Annamalai, S. (2004). "Mechanisation of Harvesting and threshing operations in rainfed crops–Issues and Strategies." Indian J. Dryland Agric. Res. & Dev **19**(1): 24-30.

Araya, A., et al. (2012). "Risk assessment by sowing date for barley (Hordeum vulgare) in northern Ethiopia." Agricultural and Forest meteorology **154**: 30-37.

Asmamaw, D. K. (2017). "A critical review of the water balance and agronomic effects of conservation tillage under rain-fed agriculture in Ethiopia." Land Degradation & Development **28**(3): 843-855.

Bekalo, S. A. (2022). "The Potential Impacts of the Stability/Instability of the Tigray Region and the Whole of Ethiopia on the Wider East and Horn of Africa." Global Responsibility to Protect **14**(1): 33-35.

Belay, M. and M. Mengiste (2021). "The ex-post impact of agricultural technology adoption on poverty: Evidence from north Shewa zone of Amhara region, Ethiopia." International Journal of Finance & Economics.

Benaseer, S., et al. (2018). "Impact of harvesting and threshing methods on seed quality-A review." Agricultural Reviews **39**(3): 183-192.

Berhane, G., et al. (2017). The rapid–but from a low base–uptake of agricultural mechanization in Ethiopia: Patterns, implications and challenges, Intl Food Policy Res Inst.

Berhane, G., et al. (2016). "Synopsis: Agricultural Mechanization in Ethiopia: Evidence from the 2015 Feed the Future Survey."

Biru, W. D., et al. (2020). "The impact of agricultural technologies on poverty and vulnerability of smallholders in Ethiopia: A panel data analysis." Social Indicators Research **147**(2): 517-544.

Biweta, W., et al. (2006). "Agricultural Mechanization." Amhara Regional Agricultural Regional Institute (ARARI): 97.

Bogale, A. (2012). "Vulnerability of smallholder rural households to food insecurity in Eastern Ethiopia." Food Security **4**(4): 581-591.

Brouwer, J. and I. Bouma "1gg7. So'and crop growth variability in the saher: highlights of research (199G-95) at ICRISAT sahelia'. Center." lnformation Bulletin(49).

Choufani, J., et al. (2017). Climate change and variability: What are the risks for nutrition, diets, and food systems?, Intl Food Policy Res Inst.

Clemens, M. A. and M. Kremer (2016). "The new role for the World Bank." Journal of Economic Perspectives **30**(1): 53-76.

Damtew, T. (2017). The Effect of Small Scale Irrigation on Household Food Security in Bona Zuria Woreda, Sidama zone, Southern Ethiopia, Hawassa University.

Dasgupta, S. and E. J. Robinson (2021). "Improving food policies for a climate insecure world: Evidence from Ethiopia." National Institute Economic Review **258**: 66-82.

Debesa, G., et al. (2020). "GIS and remote sensing-based physical land suitability analysis for major cereal crops in Dabo Hana district, South-West Ethiopia." Cogent food & agriculture **6**(1): 1780100.

Eshetu, F. and E. Mekonnen (2016). "Determinants of off farm income diversification and its effect on rural household poverty in Gamo Gofa Zone, Southern Ethiopia." Journal of Development and Agricultural Economics **8**(10): 215-227.

Eskeziaw, M. (2020). "Land Grabbing and Smallholders in Ethiopia."

Gibling, M. R. (2018). "River systems and the anthropocene: A late pleistocene and Holocene timeline for human influence." Quaternary **1**(3): 21.

Giziew, A. and B. Mebrate (2019). "Determinants of the role of gender on adoption of row planting of tef [Eragrostis tef (Zucc.) Trotter] in central Ethiopia." Ethiopian journal of science and technology **12**(1): 19-43.

HABTEWOLD, T. M. (2020). Impacts of Improved Agricultural Technologies Adoption on Multidimensional Welfare Indicators in Rural Ethiopia, Addis Ababa University.

Habtewold, T. M. (2021). "Impact of climate-smart agricultural technology on multidimensional poverty in rural Ethiopia." Journal of Integrative Agriculture **20**(4): 1021-1041.

Hassena, M., et al. (2000). A comparative assessment of combine harvesting vis-a-vis conventional harvesting and threshing in Arsi Region, Ethiopia, CIMMYT.

Heard, J., et al. (2013). "Whole farm analysis versus activity gross margin analysis: a sheep farm example." Australian Farm Business Management Journal **10**: 16-29.

Kolhe, K. P. and C. Datta (2008). "Prediction of microstructure and mechanical properties of multipass SAW." Journal of materials processing technology **197**(1-3): 241-249.

Kumar, A., et al. (2017). "Performance evaluation of harvesting and threshing methods for wheat crop." International Journal of Pure and Applied Bioscience **5**(2): 604-611.

Langley, A. (2021). "Status, Drivers, and Trends of Food Security in Sub-Saharan Africa."

Lin, J. and A. Gupta (2021). "Implications of farm size and staple production on rural and urban dietary diversity."

Mekonnen, D. A., et al. (2018). "Gendered social networks, agricultural innovations, and farm productivity in Ethiopia." World Development **105**: 321-335.

Mekore, G. and T. Yaekob (2018). "Determinants and its extent of rural poverty in Ethiopia: Evidence from Doyogena District, Southern part of Ethiopia." Journal of Economics and International Finance **10**(3): 22-29.

Melese, M. K. (2017). "Employment 10 and incidence of poverty in urban Ethiopia." Economic Transformation for Poverty Reduction in Africa: A Multidimensional Approach **134**: 187.

Mohammed, S. (2020). "Assessment of Poverty Situation in Ethiopia." International Journal **5**(2): 109-117.

Moridipour, H. and Z. Mousavi (2014). "Relationship between inventory turnover with gross profit margin and sales shocks." International Research Journal of Applied and Basic Sciences **8**(8): 1106-1109.

Muez, H. A. (2014). The Impact of Small-Scale Irrigation on Rural household Food Security: The case of Emba Alaje woreda, Mekelle University.

Myers, N. (2000). "The new millennium: An ecology and an economy of hope." Current Science **78**(6): 686-693.

Nariswari, T. N. and N. M. Nugraha (2020). "Profit growth: impact of net profit margin, gross profit margin and total assests turnover." International Journal of Finance & Banking Studies (2147-4486) **9**(4): 87-96.

Oke, J. (2014). "Gross margin analysis of backyard farming in Osun state, Nigeria." International Journal of Agricultural Economics and Rural Development **6**(1): 67–74-67–74.

OMO, S. A. D. O. S. and E. ZONE "RESEARCH–GRANTHAALAYAH."

Philip, D. "Bioenergy Utilization in Eastern Africa: Prospects and Challenges for Ensuring Food and Energy Security." Bioenergies in East Africa between challenges and opportunities: 117.

Rosegrant, M. W. and C. Riagler (1997). Environmental and resource policies: implications for global food markets.

Shrestha, M. and S. Khanal (2020). "Future prospects of precision agriculture in Nepal." Archives of Agriculture and Environmental Science **5**(3): 397-405.

Simane, B., et al. (2013). "Agroecosystem analysis of the Choke Mountain watersheds, Ethiopia." Sustainability **5**(2): 592-616.

Tesfaye, W. and L. Seifu (2016). "Climate change perception and choice of adaptation strategies: Empirical evidence from smallholder farmers in east Ethiopia." International Journal of Climate Change Strategies and Management.

Vandercasteelen, J., et al. (2016). Row planting teff in Ethiopia: Impact on farm-level profitability and labor allocation, Intl Food Policy Res Inst.

Jansen, HC, Huib Hengsdijk, Dagnachew Legesse, Tenalem Ayenew, Petra Hellegers, and PC Spliethoff. 2007. "Land and water resources assessment in the Ethiopian Central Rift Valley: Project: Ecosystems for water, food and economic development in the Ethiopian Central Rift Valley." In.: Alterra.

Mojo, D, Y Todo, and P Matous. 2010. 'Perception of farmers and agricultural professionals on changes in productivity and water resources in Ethiopia', *World academy of science, engineering and technology*, 1: 860-68.

Tesfahunegn, Gebreyesus Brhane, and Teklebirhan Arefaine Gebru. 2020. 'Smallholder farmers' level of understanding on the impacts of climate change on water resources in northern Ethiopia catchment', *GeoJournal*: 1-19.