Original Research Article

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, sun+owers, 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. To enhance productivity by using a mechanized agricultural system using optional water sources for small-scale households as well as bulky massive irrigation to feed the rapidly growing population. In Ethiopia, agriculture is the primary determinant of economic growth and reduction level of poverty, because it has the largest component of the economy. 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

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 former SNNPR region is divided into 13 administrative zones, 133 Woredas, and 3512 Kebeles, and its capital is Awassa." The central zone of southern Ethiopia includes upper and lower parts of the rift valley watershed. The particular study area includes the Hadiya, Kambata Tanebaro, Halaba, and Wolaita zone of Southern Ethiopia as shown in Figure 1

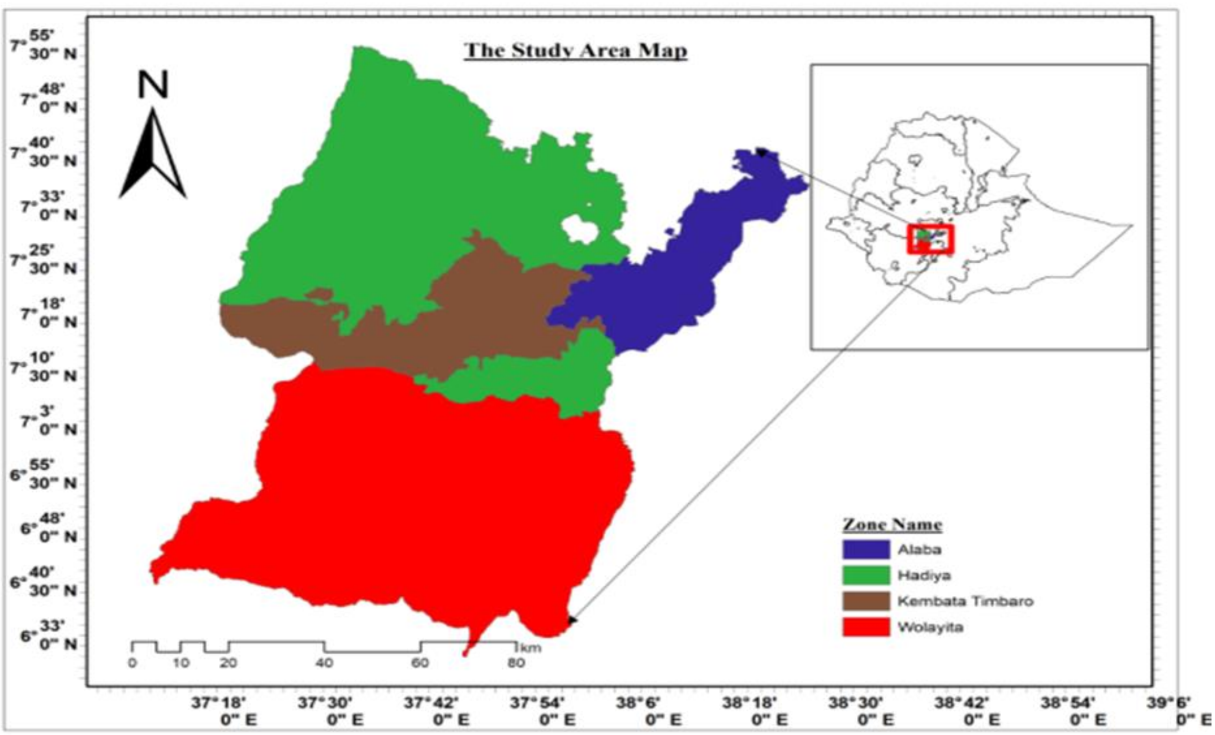

Figure 1: Study Map SNNPR includes the Hadiya, Kambata Tanebaro, Halaba, and Wolaita zone of Southern Ethiopia.

1.1 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 a partial Gurage zone, Silt's zone, Halaba zone, Hadiya zone, Kambata tembaro zone, and Wolita zone. The elevation of the study area at the lowest place in the Wolita is 1500 meters and Anbericho Kambata 3080meter 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*).

According to CSA 2007 total population of the study area is about 10,180,538. The mean annual temperature is about 20.050^{C} 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]

1.2 Present practices of farming and poverty level in southern Ethiopia

The farming practices, such as land preparation, water resources, sowing methods, harvesting, followed by the farmers and poverty level in southern Ethiopia are as discussed below;

1) Land preparation: Ethiopia has great agricultural potential, because of its massive areas of fertile land, diverse climate, generally adequate rainfall, and large labor pool. Despite this potential, however, agriculture has remained underdeveloped. Because drought has repeatedly affected the country, a poor economic base (low productivity, weak infrastructure, and low level of technology (Yihun 2015). 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.

2) Water resources: The data collected area has rain feed agricultural for a long period. Rain feed traditional farm is familiar with using indigenous knowledge for crop production. But very little supplementary irrigation for vegetation cultivation practice due to rain variability and shortage of water, farmers constructed water harvesting ponds for livestock and garden plant watering.

3) Sowing methods: The method of sowing; which is practiced in the south regional state as well as in other parts of the country for a long time familiar is hand broadcasting usually the method of sowing cereal crops. After the introduction of the Agricultural transformation agency (ATA) (2010/2011) in the research institute and farmer training center (FTC) as a sample as well agricultural practices, like row-sowing teff and maize, banding fertilizer application, inter cropping could enhance farmer's productivity. However, still, hand broadcasting sowing of the crop is familiar in the field of study.

4) Harvesting practice: 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.

5) Poverty level in the southern region: Poverty is one of the hoariest socioeconomic problems in the world and a complex concept that attracted the involvement of several researchers and policymakers. About poverty index of south Ethiopia is almost similar and has the same livelihood as other parts of Ethiopia. According to (Nyasha, Gwenhure, et al. 2017 Habtewold 2020), Multidimensional Measured Poverty results will help policymakers and development planners to better understand welfare indicators and develop improved agricultural technologies to reduce poverty using one-dimensional income or extreme economic infilation of expenditure-based measures of poverty and related issues raised (Habtewold ,2021). Similarly, the purchasing power of regional people expenditure-based measures of poverty which may refilect all commodities including fertilize and food crop shows deprivations multidimensional poverty reduction. The current status due to Ethiopia under the TPLF confilct raised indicates the rampant expansion of multidimensional poverty in all-rounded economical reduction.

This southern regional problem should be similar observed in Amhara and Oromiya regions of Ethiopia. Using the Ethiopian Socioeconomic Survey (ESS), collected in 2019 Wave 3, 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 (Alemu and Singh 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, Bank 2020). 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 (World Bank 2015b).

The country is among the poorest nations in the world, cause of highly drought- prone, suspected of enteral conflict, and has a traditional agricultural train that accounts for about 85 % of employment (Thornton and Lipper 2014). Ethiopia is one of the poorest countries in the world, where about 29.2% of its population is living below the poverty line (Book 2013). Food security becomes a result of economic growth (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 (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: (1) 'rain-fed agriculture', (2) 'supplementary irrigation', (3) 'irrigated agriculture, and (4) 'livestock'. 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.

objectives of this study was Investigate influencing elements for integrated intensive and sustainable mechanized agricultural implementation ways 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. Assessing existing farm practice, technological integrity and level of crop production in the study area

2. Identify and analyze constraints for productive sustainable agriculture as experienced similar agro-ecological zone.

2. METHODS OF DATA COLLECTION

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 was 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 selected kebele representative models with the existing scenario of mechanized farming settings.

2.1 Quantitative data

Qualitative data includes 1) a Survey of household data by conducting an actual interview with the farmers or households who have a tractor, threshing machine, and other improved farm mechanized implements. 2) Number of the population from central zones who have mechanized agricultural with rain feed, mechanized with supplementary irrigated or complet mechanized irrigated. 3) Source of water for agriculture must be identified like; Rainfall, Surface water, Rain harvested water, Shallow wells, underground any other source. And 5) Number of *kebeles*, in selected zonal administration must be identified who have participated in the mechanized farming system must be represented in percentile (%). Primary data related to mechanized agricultural practices, improved crop varieties, yield per hectare of existing farmers' practice, and the challenges to their mechanization, were collected through each zonal agriculture and natural resource office. Similarly upper and lower rift valley water shade of the study area have some spatial data of soil suitability for mechanized agricultural [source south Ethiopia irrigation Bureau] these data includes like 1 Spatial data/ laboratory data of Soil category for suitability analysis of agricultural productivity (fig 2). Soil details OM, textures, structure, soil electrical conductivity, pH, Salinity, Soil depth, etc. Water shade data (area delineation using QGIS) for limiting the area of coverage.

By using the above two, soil suitability and meteorological data were collected from southern Ethiopia particularly in central zones by using calibrated instruments and are reported in the present research.

Irrigation practice: Very little mechanization practice in southern Ethiopia central zone within a few kebele from rental tractors owned by the private sector in Wolita and Halaba zone have been practiced. But few hectares of land were irrigated to practice for fruit and vegetation in all of south Ethiopia's central zone of the study area with a source of water are rainwater harvesting pond, Small River, and stream water diversion.

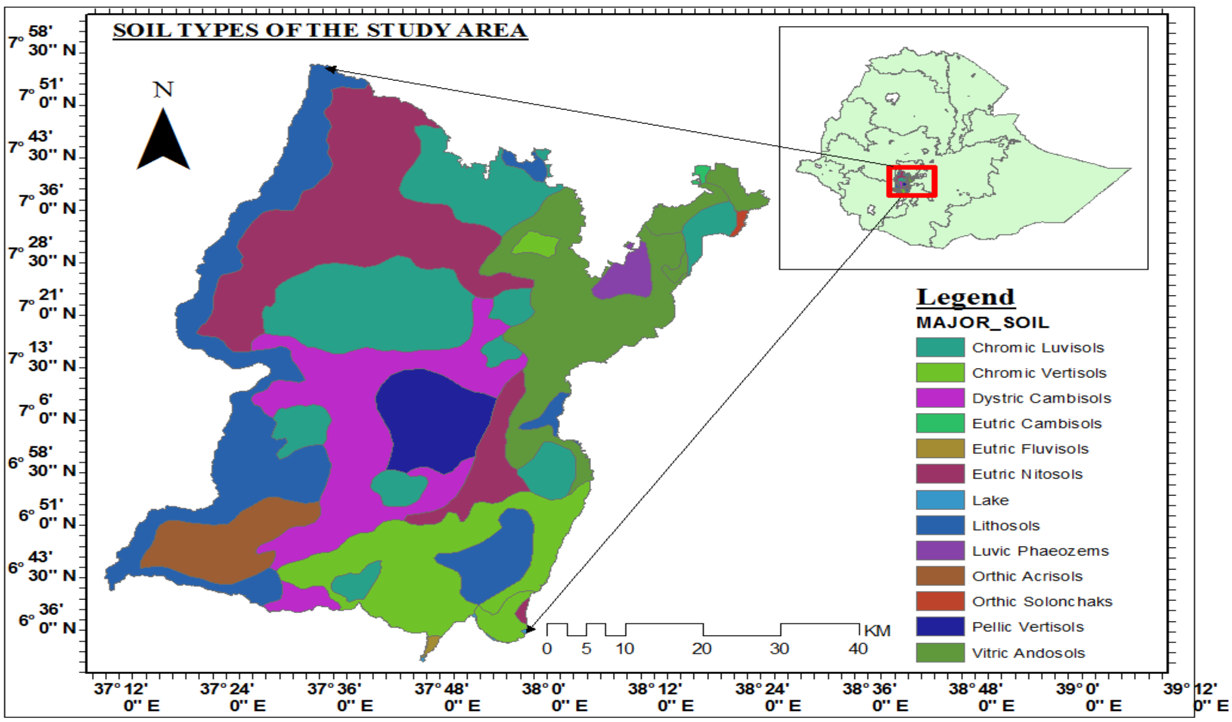

Figure 2: Major Soil types of the study area (source: FAO soil classification)

2.2 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.

Some of input cost field-for one hectare field of: annual average cost of study area of southern Ethiopia

1. land tillage cost using animal draft \$32X4
2. Fertilizer quantity and cost of 300kg= \$90X3 = \$270
3. Land rent per year = \$150
4. Teff Seed cost =10kg X\$0.9 = \$9
5. Sorghum seed cost =15kgX\$0.74 = \$11.1
6. Seed of wheat and barley have equal cost in the Ethiopia market =200kgX\$0.5 = = \$100
7. Seed of maize = 75kgX\$0.35 = \$26.25
8. Cost of Manual weed controlling debarring = 8X2X\$2 (for each sorghum and maize crop) = \$32
9. Weed killer 1litter = \$20
10. Insecticide cost = \$2
11. Harvesting lab our cost = \$40
12. Trashing lab our cost = \$40

Total output cost= Cost of output= Total crop yield/hectares x price= 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 =15.51 ()

1quintal = 100kg and 1 quntal of teff = \$84, expected profit = 40%of input cost and tax 1% of input cost.

Total Input of teff crop per hector = \$777, Total output cost = 15.53X\$84= \$1304.52

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

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

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 41.5X2500 birr = 103750 birr, input cost of wheat = 42,400

$$Profit\ \ of\ wheat\ crop\ = \frac{(\$207.5\ - 848)}{\$207.5} X100 = \ 59.1\%$$

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 19.75X$50= $987.5

Input of barley =$ 848

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

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

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

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 =$706.26, output cost = 29.1X $32 = $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.

$54/quintals of sorghum, $46/quintals of maize, cost of coffee farm field per hector/$40, 1quintal coffee =$460

Total input cost of ginger = $600 and 1quintal ginger = $46, sugarcane is prinial plant it is difficult to exact price in local market, 1quntal=$5.28, 1Kg pepper = $3.8, input cost = $210, 1quintal avocado = $60, once it was planted no exter input cost, it is prinial plant, land cost of one season =$1500, carrot input cost =$420, input cost of cabbage = $580, 1quntal pea = $110, input cost of bean =$282, 1quntal bean = $100, input cost of bean = $359.4, Haricot bean quntal = $90 and input cost $339.4 , input cost of potato per hector =$1280 and 1 quint al potato = $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%
2		wheat	16748.59	40.98	58.6%
3.		Sorghum	1585.48	12.20	1.2%
5.		barley	958.345	23.	26.26%
6.		maize	6329.27	15.4	0.3%
1.	Cash crop	coffee	24704.04	3.06	64.47%
2		Ginger,	9416	156	91.6%
3		sugarcane	78	260	56.77%
4		Pepper	704	9.59	42.37
1	Fruit and vegetable	Avacado	977.815	239	89.53%
2		mango	755.4	205	89.54
3		carot	952.8	222	97%
4		cabbage	2779.5	275.5	94.59%
1	Oil crop	pea	1039.74	2.73	6.09%
2		bean	5084.9	19.22	81.3%
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%
2		wheat	3307	45	64.34%
3.		Sorghum	-	-	-
5.		barley	869	16	18.27%
6.		maize	8769	13	0.25%
1.	Cash crop	coffee	17623	3	63.2%
2		Ginger,	5132	150	91.3%
3		sugarcane	48	241	52.62%
4		Pepper	-	-	-
1	Fruit and vegetable	Avacado	1859.2	217	81.28%
2		mango	-	-	-
3		carot	167	212	92.63%
4		cabbage	160	208	71.41%
1	Oil crop	pea	1972	4	8.92%
2		bean	2075	17	78.85
3		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%
2		wheat	51487	40	57.19%
3.		Sorghum	7219	21	2.06%
5.		barley	6750.5	20	22.83%
6.		maize	22074	48	0.92%
1.	Cash crop	coffee	4530	2.5	52.67%
2		Ginger,	278	130	90%
3		sugarcane	-	-	-
4		Pepper	298	8	93.26%
1	Fruit and vegetable	Avacado	2200	100	37.46%
2		mango	210	120	52.41%
3		Carot	534	204	89.13%
4		cabbage	9166.5	206	70.73%
1	Oil crop	pea	6667	13	29%
2		bean	16577.5	18	80%
3		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%
2		wheat	6111.5	40	51.2%
3.		Sorghum	1618	21	2.06%
5.		barley	441	20	22.83%
6.		maize	23223	40	0.77%
1.	Cash crop	coffee	692	5	64.47%
2		Ginger,	-	-	-
3		sugarcane	12.5	260	56.77%
4		Pepper	6059	11	48.59%
1	Fruit and vegetable	Avacado	112	200	74.92 %
2		mango	86	206	89.97 %
3		Carot	14.5	180	78.64 %
4		cabbage	1097	220	75.53 %
		Potato	1509	240	85.18 %
1	Oil crop	pea	-	-	-
2		bean	132	17	78.85%
3		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
32		Harvesting	-	0	no
3		Irrigation pump	-	0	no
1	Kambata tembero	tractor	-	0	no
2		Harvesting	-	0	no
3		Irrigation pump	7	0	no
1	Hadiya	tractor	2	0	no
2		Harvesting	-	0	no
3		Irrigation pump	-	0	no
1	Halaba	tractor	6	0	no
2		Harvesting	-	0	no
3		Irrigation pump	-	0	no

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

3.2 DISCUSSIONS:

According to agricultural machinery information, 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. 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. 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.

However, irrigation was provided by furrow and only seven water pump is found in Kambata Tembaro zone small river pumping in Sana river for Ginger plantation. No dimensional quantify of income of benefit of farmers due to traditional rain feed farm practice of study area. 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 installed throughout around 57 hectares of land in the research region, mostly as supplementary irrigation for home food security. 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.

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