

# Impacts of Population Pressure on Agricultural Production and Farming Practices of Households: The Case of Essera Woreda in Dawro Zone, SNNPR, Ethiopia

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**Abstract:** Agriculture as a primary economic activity is the major economic base of the world's population. Agriculture as a primary economic activity is the major economic base of the world's population. More than 60 percent of the world population depends on agriculture for their livelihood. This study was conducted in Dawuro Zone Essera district achieve the general objective that assessed the impacts of population growth on agricultural production and farming practices. Essera district is 102,848, of whom 51.35% are male and 48.64% are female. This district falls into three agro-ecological regions, of which, kolla within (500-1500masl), weina-dega within (1501-2500 masl) and Dega above (> 2500 masl). To conduct this study, the cross-sectional survey design with the application of both qualitative and quantitative approaches were employed. The study involved a multistage sampling, i.e. a combination of purposive, stratified, and simple random sampling procedures to select the study area and sample households. To draw the samples, the households in the study area, Stratified random sampling technique was applied to collect information from respondents. Study area districts stratified into 3 stratum based on agro ecological zone, after this stratification in agro-ecological zone, kebeles that study has been undergone, selected purposively. That is kola whose elevation ranges from 1000m-1500m above sea level, woynadega whose elevation ranges from 1500m-2000m above sea level, and dega whose elevation ranges from 2000-3000m above sea level. Data that was made available through different instruments was analyzed using quantitative and qualitative techniques. Different tables, maps and figures were also used to illustrate the various aspects of the study. In the light of the theories considered and the finding of the study indicated, both the population pessimistic views of Malthusians and neo Malthusians and the optimistic views of Boserupian could not separately provides the complete explanations regarding the population and agricultural production relationship of this study. It was observed that, increase in population growth of the area associated with an increase in usage of modern inputs which increase in total crop outputs in general and yields for some crop types such as cereals in particular. Moreover, labor intensive land investment practices including tree planting; terracing, manuring croplands were increasingly under taking by peasants as result of rapid change in population size of the area. Farmers have to be advised to plant tree at area far away from land serving agricultural activities.

**Keywords:** Agriculture, Population, Farming Practices, Essera

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## 1. Introduction

### 1.1. Background of the Study

Agriculture as a primary economic activity is the major economic base of the world's population. More than 60 percent of the world population depends on agriculture for

their livelihood. It employs a high proportion of people especially in the developing world [11].

World Bank report of 2001 indicated that in many poor countries, agriculture accounts for 80% of employment and contributes 40% of GDP [19]. However, agricultural production is very poor in developing countries particularly in sub-Saharan African countries. According to [15],

although in global terms the world food situation has improved, in sub-Saharan Africa it has worsened for the last few decades [18]. The same source revealed that, after independence between 1961-2001, sub-Saharan Africa faced the highest rate of population growth at an annual rate of nearly 3%, whereas the crop output decreased by 13%. [11] FAO also noted in sub-Saharan countries, overall per capita yields declined from 1970 to 1980 and have stagnated ever since.

Ethiopia is an agrarian country and agriculture is the only source of livelihood for the majority of people. It accounts for about 50% of the GDP, provides employments for 85% of the country's total population and supplies about 90% of the total foreign exchange earnings [20]. Despite its dominant position both in the national economy and in the life of the majority of Ethiopian people, the stage of agricultural development is very stagnant with low productivity and unable to feed the rapidly growing human population sufficiently [30].

On the other hand, the global human population is growing at accelerating rate compared to agricultural land resource availability and its productivity to sustain people. World population passed 6 billion just before the end of 20<sup>th</sup> century. It is projected to grow from 6.83 billion in 2009 to 8.5 billion in 2025 and 10.5 billion in 2050 with most of the increase coming from developing countries [25].

In Ethiopia over the last 100 years, the population growth rate had shown dramatic changes. Its growth rate was very low at 0.2 percent in 1900. It increased to 1 percent in 1925 and to 2 percent in 1950. But after 1950 the population growth rate increased until it reached its peak of 3 percent in 1990. The population of Ethiopia has experienced steady growth over the years from 53.4 million in mid 1990s to 63.5 million in 2000 at an average annual increasing rate of 2.8 percent [14]. Total population projected to reach 71 million in 2004/05, 75.1 million in 2005/06 and 83.5 million by 2009/10 [20].

High growth rate of population has necessitated global increase in food production. More and more land has been taken over for food production to feed the growing population. World bank report of 2007 indicated worlds demand for food is expected to double within the next 50 years while the natural resource that sustain agriculture will become increasingly scarce and degraded [23]. This problem is serious particularly in the highland area of Ethiopia. The high growth and concentration of the population in the highland and hence ever decreasing per capita land has led to the expansion of agricultural activities into the marginal areas as the result the forest coverage depleted. Farming in the steep slopes would lead to accelerated soil erosion eventually decrease the productivity of the land [3].

Relation between population growth, agriculture and natural resource management is a controversial issues and it has been debated since the time of Malthus. Many studies have found population growth to be associated with various aspects of resource depletion, including deforestation, overgrazing, soil erosion, soil nutrient depletion, land

fragmentation and other problems [11]. On the other hand, many other studies disputed this idea and they found positive association between population growth, agricultural intensification and land conservation. However, it has been globally recognized that high population growth or density has negative impact on agricultural production and environmental security [4].

Southern Nations, Nationalities and Peoples Region is one of the regions characterized by dense population concentration. Average population density is 136.4 sq km, which is more than that of the national average population density that is 79 sq km [29]. In the SNNPR, 44% of the total land mass is highland, inhabited by more than 75% of the regional population [8]. Essera is one of the woredas in the SNNPR located in southwestern highlands of Ethiopia (the main part of kulo konta highlands) [22]. About 96% of the population of woreda is engaged in agricultural activities [24]. In the woreda, agricultural lands are found under heavy stress due to continuous cultivation imposed by population pressure over limited plot of land and increased land fragmentation especially at high and mid agro-climatic area. As result, the crop yield per unit area is declining from time to time. It is likely that without use of modern input land in the area may cease providing yields of crops [2].

Average land holding size per households in woreda is 1.18 ha [9] which is relatively low compared with the national average land holding size i.e. 1.25 ha per households [8]. The available farmland size of households is not enough to operate the basic economic activities in order to support family members [28].

The considerable part of woreda is covered by dense natural forest and high concentration of people observed over the remaining parts especially at dega and woina dega agro ecological zone. Chebera churchura national park covered about 1190 sq km of area with dense natural forest found in between Essera, Isera and Konta woreda. From the total 746.71 sq km area coverage of the woreda, more than 17% of land covered by natural forest. Agricultural land is highly shrinking in the area and the growing population pressure responded by expansion of farming in to the existing forestland.

To cope up scarcity and low productivity of land and subsequent decline in per capita food production, peasants and government bodies of the woreda had taken various measures. Peasants forced to change their cropping pattern to respond population pressure. Enset farming is more prevalent and dominating other farming systems of an area. Moreover, peasants more engaged on planting of eucalyptus and bamboo trees, which are highly expanding over crop and grazing lands particularly at mid and high agro ecological zone. Thus, there is land use competition between tree planting, crop farming and livestock grazing which further made unsustainability in agricultural production of the area.

In response to land shortage, resettlement has been taking place since 2003 by moving people from densely populated mid and high agro ecological zones to unoccupied forest

areas of lowlands. This measure is taken by government bodies and peasants of the area without considering the existing environmental condition and highly affecting the future carrying capacity of the environment.

Thus in line with this problems this study will assess agricultural production, farming practices, land holding and uses under situation of rapid population growth of the area. Investigating the impact of population pressure on agricultural land and coping strategies taken by households to decline of farmland size are also the focus of this study.

## 1.2. Statement of the Problem

Land is the basic resource in which our society depends for the production of food and other requirement. However, many parts of the country are facing agricultural land shortage due to rapid population growth [6]. For example according to [8], in an agrarian country like Ethiopia, where the vast majority of the people are engaged in agricultural land and the increasing farming population is not matched by adequate land, the structure of agriculture is typified by small and fragmented. In Ethiopia, population density is growing at faster rate. The simple man land ratio at national level increased from about 22 person /km<sup>2</sup> in 1975/ 76 to 40.7 in 1987 [5]. It also grew from 49.3 persons per sq.km in 1999 to 79 in 2007 [29]. This has led to reduced farm size, reduction of fallow intervals and soil fertility, which resulted in declining of yields per capita and per hectares. Average cropped land hold size is a key indicator of land use pressure. In Ethiopia, average cropped land holdings are low throughout the country. This is especially true throughout SNNPR and Southern Oromia [7].

Many writers report that the rapid population growth has resulted in land scarcity, expansion of cultivated land, change of cropping pattern, reduction of grazing land, increasing of landlessness [16]. As most of these writers noted declining land holding size because of population growth and deteriorating soil fertility are among the biggest challenges facing agriculture production system in Ethiopia [17]. On other hand, few peoples conducted research at certain parts of Ethiopia, link some positive association between population growth and agricultural intensification. For instance, Muluneh [9] reported that in Ezanawollene and Checha woredas of Sebatbet Gurage land population pressure is very high and arable land is scarce to allow any further expansion of cultivation. As result there has been the use of more labor input per unit area, multiple cropping, increased manure supply, increased cultivation of enset (which has high supporting capacity and less areal coverage) [26].

What was observed in the study woreda was as result of high growth rate of agricultural people, cropland expanding from time to time. The total cultivated land was 24,370 ha in the year 2004 but it increased in to 32,157 ha [10]. The expansion of the area under crop had affected the forest resources of the area. Moreover, in the region beside a heavy stress imposed by rapidly growing population on limited arable land, rugged terrain nature (53.6% are mountainous and plateau) of an area exposed existing land to continuous erosion

and productivity potential of land is highly degrading.

Aiming to improve agricultural performance, the government of Ethiopia emphasizes the use of modern inputs. Though, the application of fertilizers makes a good agricultural input, it has its own adverse effects. Firstly, the importation of fertilizers is expensive and secondly, their application is believed to deteriorate the soil in the long run. For example, the idea of [21] indicates that the progress in agricultural productivity has been achieved at the cost of long term biophysical environment degradation.

Regarding to the study area, peasants have much limited access and use of modern inputs. The poor transport infrastructure of the region together with long distance of the area from the supply center of modern inputs aggravated the price of inputs and created problem by peasants in its application [12].

Despite its expensiveness, the poor economic conditions of peasants partly share their role for the less application of modern inputs by peasants of the area. This clearly reflects the problem of agricultural production in the study area, apart from burden imposed by population growth on agriculture land, which needs an investigation [27].

There are some recent, studies on issue of population growth and agricultural production, which were conducted by different researchers at different parts of Ethiopia [13].

These studies mainly focused on the relationship between population pressure and agricultural development, land degradation, land use/cover change, sustainable land management, soil conservation practice and impact of population pressure on land [15]. However, the issue of agricultural production, farming system and their changes in relation to population growth has not been investigated before in this study area. Moreover, in the previous studies, changes observed over agricultural production and farmland across different agro ecological zones because of the population growth and the coping strategies of households to the problem of access to farmland was not well addressed. Thus, it is hoped that this study will fill this gap.

## 1.3. Objective of the Study

### 1.3.1. General Objective

The general objective of the study is to assess the impacts of population growth on agricultural production and farming practices in study area.

### 1.3.2. Specific Objectives

- 1) To examine the perceived impacts of population pressure on agricultural production;.
- 2) To assess the relationship between population pressure and farming system;
- 3) To assess household responses to land scarcity resulted due to high population pressure.

## 1.4. Research Questions

In accordance with the above objectives of the study, the following fundamental research questions will be attempted to be answered in this study:

- 1) How does farming system relate with population pressure?
- 2) Is there any change in agricultural production, in terms of population pressure?
- 3) To what extent have population growth affected agricultural practice in study area?
- 4) What are the strategies of study population in response to limited agricultural production due to population pressure?

## 2. Methodology of the Study

### 2.1. Description of Study Area

Based on the 2007 Census conducted by the Central Statistical Agency of Ethiopia (CSA), this zone has a total population of 489,577, of whom 249,263 are men and 240,314 women; with an area of 4,814.52 square kilometers, Dawuro has a population density of 101.69. While 35,044 or 7.16% are urban inhabitants, a further 14 individuals are pastoralists. A total of 89,915 households were counted in this Zone, which results in an average of 5.44 persons to a household, and 86,642 housing units. The two largest ethnic groups reported in this zone included the Dawro (97.32%), and the Hadiya (1.3%); all other ethnic groups made up 1.38% of the population. Dawurtsho is spoken as a first language by 97.44% of the inhabitants and 1.3% speak Hadiya; the remaining 1.26% spoke all other primary languages reported. 57.71% of the population said they were Protestants, 31.86% practiced Ethiopian Orthodox Christianity, 4.9% observed traditional religions, and 4.61% embraced Catholicism [15].

According to [7] total population of Essera district is 102,848, of whom 51.35% are male and 48.64% are female. This district falls into three agro-ecological regions, of which, kolla within (500-1500masl), weinadega within (1501-2500 masl) and Dega above (> 2500 masl).

### 2.2. Research Methodology

To conduct this study, the cross-sectional survey design with the application of mixed method. The study involved a multistage sampling, i.e. a combination of purposive, stratified, and simple random sampling procedures to select the study area and sample households.

To draw the samples, the households in the study area, Stratified random sampling technique was applied to collect information from respondents. Study area districts stratified into 3 stratum based on agro ecological zone, after this stratification in agro-ecological zone, kebeles that study has been undergone, selected purposively. That is kola whose elevation ranges from 1000m-1500m above sea level, woynadega whose elevation ranges from 1500m-2000m above sea level, and dega whose elevation ranges from 2000-3000m above sea level. From each stratum, based on the number of household, respondents were selected by proportionate stratified random sampling and sample was determined using Slovene's Formula. And again, from

sample frame or from total population of identified kebele, systematic random sampling was used to identify each respondent and list of total population was accessed from kebele administration office. People in kola, dega and woyna dega have different attitude about female in general and female headed household in particular.

The sample size was decided based on sample size determination formula, which is given a care to have the sample size of the study to be as representative as possible in accordance with the time and budget billed. Having this into consideration, out of total households in the selected the following or Slovene's formula was used.

$$n = N / 1 + N(e)^2$$

where; N= the total population that had been studied

n= the required sample size

e= the precision level which is = (±5%) Precision Levels

Where, Confidence Level is 95%. And total number of respondents was 81.

### 2.3. Data Sources

The data for this study was generated from both primary and secondary sources of data focusing on both qualitative and quantitative natures. The surveys was covered the population in Essera district, Dawuro zone.

#### 2.3.1. Primary Sources

The sources of the information were key informants, focus group discussants, field observation and photograph, household survey participants.

To collect the reliable data, the field study combined Key Informant Interviews (KIIs), Focus Group Discussions (FGDs), and household surveys, direct observations and transect walks.

#### 2.3.2. Secondary Sources

The secondary sources of information including, research journals and articles, internet sources, different agriculture and rural development office, Female and children affair office, Finance and economy development office reports and document was reviewed at different levels of government organizations.

### 2.4. Method of Data Collection

#### 2.4.1. Survey

The research based on a survey method using questionnaires. Questions applicable to this study was selected and arranged in a manner that could yield meaningful results in a cost effective manner. The household based questionnaires in surveys provided information regarding the basic population characteristics such as sex, age, household size, marital status, education and employment.

#### 2.4.2. Key Informant Interviews (KII)

Key informant interview was conducted with different individuals at different levels. At the kebele level, individual

interviews with Kebele chairperson, one kebele manager one kebele females' chairperson and development agents (Das). Further, at the Woreda level, mainly from Agricultural and Rural Development Office rural.

#### **2.4.3. Focus Group Discussions (FGDs)**

Two focus group discussions in each woreda was carried out within each district one at kebele level and other at woreda. Each group involved concerning individuals.

#### **2.4.4. Observation**

To support the above data sources observation was undergone. Researcher is also use observation as a method to get firsthand experience on the population settlement whether it is dense or sparse, land covered by different land use type and crop type they cultivate.

### **2.5. Data Analysis and Presentation**

Data that was made available through different instruments was analyzed using descriptive statistics quantitative and qualitative techniques. Different tables, maps and figures were also used to illustrate the various aspects of the study. Combinations of qualitative and quantitative methods were employed for data analysis. Quantitative analysis was carried out by Excel 2010 and SPSS software version 20. The data was edited and coded before entering into the cells of Excel. The qualitative data, which was generated from different sources, was analyzed qualitatively by sentences that explained what is true about the study on the ground, and the results of the key findings was displayed in the form of narrations, graphs, diagrams, tables, and pictures to provide evidence and to support the qualitative information.

#### **2.6. Ethical Consideration**

In order to protect respondents from risk and show them utmost respect, researcher wrote and verbal informed consent from each one of them. The objectives and purposes of the research clearly spelled out to them. Respondents were participated voluntarily and were free to withdraw from the study any time if they feel they did not want to be a part anymore. The study was registered with as culture of study area and the ethical principles of confidentiality and anonymity followed according to their culture throughout the research process. Written permission was then granted to carry out the research without any interference.

## **3. Data Presentation, Analysis and Interpretation**

As it has been stated earlier the study investigates sizes of agricultural land i.e. holding and uses, agricultural production, farming practice of households in relation to the growth of population size of the area. The study covers that production performance and land holding characteristics of peasants in the years found within the time ranges of 15 years back and comparing with the current condition. The

researcher selected these years only for this purpose so as to easily record the expected changes and the respondents can better remembers the changes. Therefore, in the study changes observed in the agricultural land holding sizes, uses and production, farming practices of household within the time range in aforementioned period investigated and the main features emerged presented in this chapter.

The first section of the chapter dedicated to explaining the socio-economic and demographic characteristics of sample households. The next sections, emphasize on the main finding of the study with particular focus to the inter relationship between changes in population size of the area and land holding characteristics. Later, the study conducted on farming practices and agricultural production of households and the implication of the finding would be described. Moreover, the various household responses to the changing condition of agricultural land and production and to increasing family size of household in relation to available resources also incorporated in the analysis section.

### **3.1. Demographic and Socio-Economic Back Ground of the Sample Respondents**

In the study the socio economic condition of surveyed households were assessed and the household characteristics of the respondents, which assumedly have a direct linkage with changing condition of agricultural land and production of the area, described in this section.

#### **3.1.1. Household Size of Surveyed Respondents**

Population growth results in changes of population structure such as arrangements of people into different households and increase in size of household members. Households are basic socio economic unit, may be either one person household or a multi person household and each household occupies a specific land area, consume natural resources [7].

Change in rural population i.e. pattern of household formation gradually imposes change in rural land holding and land use characteristics. Moreover, increase in size of household members result in higher demand for food and other needs, which eventually leads to intensification, as well as extensification decision in household land utilization. This pattern of a population change is one of the major demographic characteristics of rural Ethiopia and its effects on land holding sizes and land use pattern are significant features to the people of the study area.

The total household sizes of surveyed respondents to assess the production performance and land holding characteristics of peasants in the past 15 years and currently in the study area was 81. As indicated by survey result, there is a significant growth change in both the total household size and the average size of household members. The numbers of households of respondents in 1995 was 357 household members with the average household size of around 5 persons. The maximum household size was nine and minimum two persons with standard deviation of 1.54. However, in 2010 the total numbers of surveyed households were 581 members with an average household size of around 7 persons. The maximum and

minimum household sizes respectively were 12 and 3 persons with a standard deviation of 1.9. This difference indicates the newly added family members and households resulted by the increment of population as document in kebele administration office, kebele health extension workers and response of respondents indicated.

The observed household sizes of surveyed respondents in 2010 E.C or 2018 G.C were much larger compared to 1995 E.C or 2003 G.C. For example, as indicated in the Table 1 in 2010 E.C or 2018 G.C, the majority of the surveyed

respondents have household sizes of 6 to 8 members. However, in 1995 E.C or 2003 G.C larger proportion of households contain household sizes of 3 to 5 members. What can be inferred from this is that the surveyed households have large household sizes, which seem relatively beyond supporting capacity of existing resources of the area. With the traditional based agricultural production system of the area, the prevailing household size result in a heavier burden on the household and resource base of the area to meet the basic needs of the household members.

*Table 1. House holds size of the sample respondents.*

year	Household size	Surveyed households in agro ecological zone			Total	%
		Dega	Woina-dega	Kolla		
2019	3-5	4 (17.4%)	7 (25%)	8 (26.7%)	19	23.45
	6-8	12 (47.8%)	14 (46.4%)	17 (56.7%)	41	50.62
	9-11	9 (34.8%)	7 (25%)	5 (16.6%)	20	24.70
	12+	-	2 (3.6%)	-	1	1.23
	Total	25	30	26	81	100
2020	2	-	2 (8%)	1 (3.8%)	3	4.2
	3-5	15 (75%)	12 (48%)	16 (61.6%)	43	60.6
	6-8	4 (20%)	11 (44%)	8 (30.8%)	23	32.4
	9+	1 (5%)	-	1 (3.8%)	2	2.8
	Total	25	30	26	81	100

Source: House hold survey, 2021.

### **3.1.2. Age and Sex Composition of the Surveyed Households**

With regard to age structure of the sample households the total population of 581 persons embraced that, a young population (under 15 years of age) and an aging population (65 years and above) accounted for 56.6% and 0.9% respectively. Similarly, the proportion of economically active population (between 15 and 64 years of age) was 42.5%.

Age structure is an important factor when looking labor supply of households in the production process. It also indicates the dependency ratio of the population in a given area. The important characteristic of the surveyed households in the age composition is that in the region, not only the adult person and active population, but also children of less than 15 years participate in the labor force activities such as cattle keeping and joint cultivation of farmland of households. Thus, it would probably lower the direct dependency burden of the family members. However, this does not mean that the outputs of households increase with increase in the labor force participation. Here, it seems that with existence of more

young age structure in the area, the family has faced two big optimization problems. That is, the family must be able to provide the basic needs to its younger members currently, and at the same time it must be able to save part of its income for capital formation to supplement future needs. Concerning the age of the surveyed household heads, the maximum age was 70 and minimum was 28. The mean age of surveyed household was 41.83 with standard deviation of 8.75. Thus, potentially active age groups are involved in the study, which enabled to get more information and to see household production performance in detail.

Another important characteristic of the surveyed households is the sex composition. Out of 581 persons of the sample households 51.6% were males and the remaining 48.4% were females. The overall sex ratio of the investigated peasant households was about 107 males for every 100 females. The figure closely approximates the sex ratio of the woreda. The sex composition more or less balanced the surveyed households with slight differences.

*Table 2. Educational status of the surveyed household heads.*

Educational status	Surveyed household heads	%
Illiterate	62	76.54
Can read and write	3	3.71
Attend in first cycle primary school (1-4)	6	7.41
Attend in second cycle primary school (5-8)	9	11.11
Attend in high school (9-12)	1	1.23
Total	81	100

Source: House hold survey, 2021.

### 3.2. Population Growth, Agricultural Land Holding, Land Use Characteristics and Their Implication

Agricultural land is the most important natural capital, which is basic for livelihood, especially in rural Ethiopia. This is because agriculture dominates the Ethiopian economy and accounts for about 50% of the GDP and 85% of the labor force. Despite its importance, agricultural land becomes diminutive in rural areas from time to time and disabling households to produce enough crops in order to sustain their families. One of the notable factors of land holding change is the demographic condition. Rapid population growth and then population pressure plays an influential role for changes in land holding size [1].

Total population of the study woreda in general and the sample kebeles in particular were found in rapid rate of growth. Data obtained from secondary sources indicate that before 2007 population census and then after, population of area was growing by 2.9% per annum which is one of the highest compared to the country level. The number of households and total population engaged in agriculture (96% of the total population of the woreda) are also high and further increasing since the other means of occupation is much limited. Hence, the extensions of the area under cultivation were remarkably high in the region. Existing land of peasants is continuously cultivated without fallow and resulted in the decline of land fertility. Furthermore, land holding of peasants is shrinking under present condition. These are among serious environmental problems observed in the area which poses hindrances to improvement in agricultural production. In the following section of the thesis, details of study results are described. The topic presents under this section contains changes in total land holding, cultivated land, grazing land, fallow and land under forest and land fragmentation.

#### 3.2.1. Change in Nature and Size of Land Holding

Land is scarce in the study area, particularly in the mid and high agro climatic zones where there is high population concentration. Its shortage was aggravated from time to time. Many adult males who did not have their own land and farmers whose holding were considerably small joined

resettlement program in low land areas. As results of this, dense forest land in low land area found under severe threat of human settlement and agricultural expansion. Moreover, new land allocations have taken place at very marginal and communal grazing lands. As a result, the livestock feeding was also highly affected in the area in recent time.

Among the surveyed peasant households about 52% reported that their land size is declining from time to time. 14.7% and 33.3% reported that their holding size increased and no changes respectively. The majority of the households reported that the declining of land holding caused by share of parent (92.86%), sold (4.76%) and shared to government institution like school (2.38%). Those who reported their plot sizes increased was due to expansion in to unoccupied area, purchase and inheritance from parents.

The average land holding size of the surveyed households decreased for the study period. Households in the low land have relatively large size of land holding than in the high land parts. Concentration of people increases with elevation as one move from kolla to dega agro ecology due to its suitability to agriculture and livestock rearing. However, land holding size decreases with elevation following increasing population concentration. This may be attached with previous settlements of people and due to variation in family size at agro ecological zone. Furthermore, some of the surveyed households in kolla contain more land sizes compared to previous period. As noted by surveyed respondents the increment of households land holding size is due to expansion in to unoccupied area because of reallocation of land.

A total land holding of sample households in 1995 was 118.25 hectare of land and the average was 1.66 ha per hhs with standard deviation of 0.68. In 2010 the total land holding size now is 113.25 hectare of land and the average is 1.39 ha per hh with standard deviation of 0.65. The average land holding of the surveyed households varies in agro ecology. In 1995 average land holdings were 1.71, 1.33 and 1.95 hectare per hh for dega, woinadega and kolla agro ecology, respectively. In 2010, it declined to 1.34, 0.98 and 1.82 hectares per hh for respective agro ecological zones. Almost all of the surveyed households indicated that the land they hold is insufficient to support their households.

Table 3. Landholding size of respondents.

Years	Agro-ecological zone	Land holding size in hectare			Total	Average holding size
		1 and below 1	1.1-2	>2		
1995	Bale (Dega)	3	2	9	14	1.71
	Guza (Woinadega)	6	7	23	36	1.33
	Hageli 01 (Kolla)	3	8	20	31	1.95
	Total	12	17	52	81	1.66
2010	Bale (Dega)	9	14	9	32	1.34
	Guza (Woinadega)	11	10	4	25	0.98
	Hageli 01 (Kolla)	10	11	3	24	1.82
	Total	30	35	16	81	1.39

Source:-House hold survey, 2021.

When observed the proportion of respondents with landholding size, about 28.17% of the households were hold

land size of one and below one hectare in 1995. While the size of land holding of greater than two hectare owned by

16.90% of the surveyed household in the same year. In 2010, the percentage of households which hold a land size of one and below one hectare increased to 45.68% and the household with land holding size greater than two hectare decreased to 4.94%.

In the study, an emphasis was also given to see different land use system of the area. The amount of land holding of households for different uses was assessed. The reason why the focus was given is that, land surfaces (particularly the mid and high agro ecological zones) of the study woreda which mainly covered by man grown trees and their expansion increased from time to time. In contrary, to this natural forest of the area was highly declining as indicated in different sources. Moreover, land served for grazing highly threatened by expansion of cultivation particularly enset farm and man grown trees which are mainly associated with change of the demographic condition of the area. The overall survey result discussed in the following section.

### 3.2.2. Cultivated Land

The survey result shows that regardless of variation in amount, all of the surveyed respondents have owned cultivated land. The total and average amount of cultivated land holding size of the respondents showed considerable changes in the study period. The total size of cultivated land was 88.50 hectare and the average cultivated land holding sizes was 1.25 hectare for the surveyed households with standard deviation of 0.53 in 1995. However, in 2010, total cultivated land holding size of the surveyed households increased to 94.02 hectare, but the average holding size declined to 1.16 per households with standard deviation of 0.62. The percentage share of cultivated land had grown from 71.98% in 1995 to 79.44% in 2010 compared with other types of land use holding. This indicates that the total land area used for cultivation increased. In contrast to this condition, the average land holding size of a sample holder of this land use types had declined. These changes can be, therefore associated with growing changes of rural population.

With regard to cropland expansion, the researcher identified that in some area, particularly in dega agro ecological zone, crop cultivation expanded into steep slope and mountainous area where the area is highly exposed to erosion. Whereas, in kola zone crop cultivation expanded in to forestland. As result, burning and cutting of forest to expand crop land is serious environmental problem observed in the area. This condition revealed that in the region, in the past 15 years, cultivated land increased at the expense of natural forest area and other land use types, which is the effect of the changing condition of the area population.

The total and average amount of cultivated land holding for the surveyed sample household varies in relation to agro ecological zones for the surveyed period. The average amount of cultivated land size of the surveyed population in the past 15 years was 1.14, 0.94 and 1.62 ha for dega, woinadega and kolla zone, respectively. Its average size for the respective agro ecological zone was 0.97, 0.75 and 1.68

hectares in 2010. In the study period, the increment of cultivated land for the surveyed household was more pronounced in kolla zone. This is due to new land allocation, which brought more unoccupied land into cultivation of crops.

To sum up, as result of the growing changes of rural population, the total land area for cultivation increased to meet the growing needs for food. This in turn affected the total amount of land for other uses.

### 3.2.3. Grazing Land

Population growth in the area caused the expansion of cultivated land mainly for enset and man grown trees, human settlements etc. Large part of grazing areas were converted to tree farm i.e. eucalyptus plant as result, grazing area declined. This condition highly affected the livestock grounds and number of livestock owned by households. Almost all the surveyed households responded that grazing land holding decreased in the past 15 years. As indicated by them, the main reason for the decline of grazing land was the decrease of land holding size from time to time. They also noted other factors such as expansion of cultivation, planting of trees on the land serving for grazing, expansion of human settlement on communal grazing land etc.

The survey result showed that, in the area particularly in dega and woina-dega zone, grazing land holding of peasants decreased considerably. As result, peasant affected by severe shortage of animal feeding. They use leaves of enset and bamboo tree to feed their livestock.

The total amount of grazing land holding of the surveyed holder households in 2003 was 23.85 ha and its average size was 0.37 ha per hh. Compared with the total areas of all other land use holding size, share of grazing land was 19.4%. In 2018, its total sizes decreased to 15.23 ha for the surveyed holder households and its average amount was 0.23 ha. The total percentage share accounted to 12.87% compared to all other land use holding types. This indicates that grazing land significantly decreased in the study period. Information obtained through interview and discussion indicated that at kolla zone controlled grazing system is not familiar in the past 10 years. As they revealed at present time most of the farmers use controlled grazing system to graze their livestock.

### 3.2.4. Fallow Land

The result of the study shows that at kola agro ecological zone some surveyed households practice fallowing. However, almost all respondents from dega and woina dega area reported they do not have any pieces of land left for fallow at present time. The study also showed that though, fallowing practiced by some surveyed households of kola agro ecological zone, the number of households practicing fallow and the total amount of fallow land showed a declining trend in the past 15 years.

In 2003 from the total surveyed respondents of each agro ecological zone, 16 (61.5%) households from kola area and 18 (40%) from dega and woinadega area reported that they use land fallow for one or more years. The total land owned



by these households was respectively 3 and 3.5 hectare. In 2018 from the total surveyed agro ecology, only 10 (12.3%) households reported that they practice fallow. The total amount of land owned by these households was 1.5 hectare.

To sum up, with exception of some hh in kolla agro ecological zone, almost none of the surveyed peasants used fallow as a means of maintaining soil fertility. This indicates that increasing population of the area was associated with shortening of fallow period and land is cultivated continuously.

### **3.2.5. Forest Land**

Man grown forest such as eucalyptus and bamboo tree deliberately planted for economic benefit such as to raise financial gain, for constructional purpose, to keep safe the environment from erosion and landslide and as source of fuel wood. Moreover, trees planted in the area along roadsides and on plots between two holdings used for boundary demarcation.

In the study, an attempt was made to identify the total amount of land occupied by trees for surveyed households. The concerned persons also interviewed regarding the trend of forest cover of the area. Secondary sources of data were also reviewed to see the prevailing condition.

#### **(i). Man Grown Forests**

Obtained data indicated that in dega and woina dega zone, the total amount of land occupied by man grown forest were respectively 2.3 and 1.8 hectares per hh in 2003. The percentage share was 6.7% for dega zone and 5.4% for woina dega compared with the total holding of other land use types. In 2018 the area covered by man grown forest for respective agro ecological zone was 3.9 hectares (12.58%) and 2 hectares (7.27%) per hh. There is also large amount of trees in the plots of some surveyed households, which is not possible to put it in hectare as it found in scattered manner. Its increasing importance for constructional purpose and declining trend of natural forest forced the peasants of kolla area to grow eucalyptus trees in their plots and it is also at increasing trend in the region.

Thus, the area covered by man grown forest is increased with population growth particularly, in dega and woina dega zone. Such condition could lead to the transformation of farming structure from cultivation of crops and livestock based agriculture to expansion of trees. Aforestation of trees did not remain along farm area. Their increasing importance in terms of generating money and declining household land holding size forced the peasants to plant tree in plot near to homestead which is the area serving for planting of vegetables. As a result new land use zonation introduced in to the household plot at the expense of the old one and permanent gardens with eucalyptus tree have gained prominence.

What important thing observed in the region as result of manmade tree expansion was that, though it expanded to crop land and grazing grounds in most area bamboo tree planted in the stony land around river banks which is not much attractive to the production of crops and grazing of livestock.

As result, it protects land from erosion. Moreover, leave of this tree serves as fodder of livestock at a time of feed shortage. It is also important to create controlled land management system. Here, the expansion of bambo tree associated with increasing population and its increment best serves in the area for land conservation practice. Similar condition observed in the area as result of eucalyptus tree expansion. On one hand, some area exposed to erosion protected and on the other, this tree has long root, which penetrates deep into soil and drying soil moisture content and fertility level. Its expansion highly threatens land used for cultivation and grazing, which adversely affects the productivity of both pasture and cultivated land.

#### **(ii). Natural Forests**

Regarding to the natural forest covers of the area at kola agro ecology few trees found in the plots of peasants isolated form and dense forest exist in unoccupied land surface of the area. As a result, it is not possible to obtain land holdings size of hhs covered by natural forest. However, secondary sources and personal observation of researchers showed that the area coverage of natural forest declined in the past 15 years. For example, information obtained from woreda agricultural office revealed that due to human intervention, land covered by natural forest decreased considerably in the region.

Personal observation of the researcher also identified that in the area particularly at low land zone as result of growing population pressure, cultivation, human settlement and grazing activities considerably expanded to forestland. To this end, there is contradiction between peasants of the area and governmental body in condition that the former to use forestland and the latter to protect it from destruction.

To conclude, because of the increasing population growth of the area and growing need to farmer for construction, financial gain resulted in the increment of manmade tree. On the other hand natural forest is highly threatened, by the growth of human need.

The emergence of new urban area like zonal center and establishments of road infrastructure are recent phenomena of the area, which opened new wood market for escalating prices of eucalyptus and created partly, conducive condition for its devastating expansion.

### **3.2.6. Land Fragmentation**

Farm fragmentation is also another change in land structure observed in the study area, as result of population growth. Due to the division of farmland and human expansion in to unoccupied area, farmland owned by peasants found fragmented and scattered. The survey result indicate that about 56.52%, 42.86% and 53.3% of the households from dega, woina-dega and kolla zone hold 2 or more than 2 plot of land. As reported by surveyed households and interviewed persons, the main factors of land fragmentation in the area was inheritance of land and expansion of peasant to unoccupied area.

To sum up, growth in the size of population and increased in the number of households in the area have resulted in, the diminution of farm size of households, decline in fallow time

and land fertility and land fragmentation. Moreover, increased population in the area also promoted growing demand of households for more food, and constructional material, the need for more cash money and shelter resulted in the expansion of land under cultivation and man grown trees. Thus area of total land use for cultivation particularly enset farm increased in the past 15 years. The implication of man grown tree expansion in the area is that, it promotes some environmental conservation (land slide, soil erosion and controlled land management) which has strong relation to Boserup's assertion that growth in population leads to environmental conservation. On other hand, its expansion highly threatened farmland, which is used for crop cultivation and grazing.

### **3.3. Population Growth and Farming Practices**

#### **3.3.1. Change in Farming Practices of Surveyed Households**

As indicated above, agricultural land is continuously cultivated in the area without fallow time, which resulted in reduced soil fertility and lower soil productivity. To replenish soil nutrients, fertilizers and selected seeds are widely used. New techniques of production such as cultivating land for 3 to 4 times before sowing and investing on land such as terracing also developed by some surveyed households. In contrary, a very low proportion of the vital inputs of agriculture such as farm oxen observed. Farm oxen are decreasing from time to time as surveyed household reported. The condition forced farmers to use hoe for farming particularly in the dega and woina dega zone. The use of manure and or compost at the plot of peasants has shown an increasing trend. The detail of survey results regarding to changes observed in farming practices of the surveyed households presented in the following section.

#### **3.3.2. Change in the Use of Modern Farm Inputs**

Peasants asked to indicate the total amount of modern inputs used and the total area occupied by them in the study period. Their interest to further application of modern farm inputs was also assessed. The study results showed that the use of modern inputs, such as fertilizer and improved seeds by surveyed households showed an increasing trend. In 2003, the sample households used modern inputs (fertilizer) accounted for about 30% of their total number. Accordingly, the total amount of fertilizer used and cropland area covered by sample user respectively were 9.5 qt and 8 hectares. However, the trend shows an increase and hence, in 2018 the sample households used fertilizer accounted for about 88% of the total surveyed households. The total volume of chemicals used grew to 34.12 quintals and the total areas of croplands occupied by modern input of the sample hhs were 28.85 hectares. Similar trend also observed regarding the use of selected seed. In addition to this, each peasant has a growing need for the use of modern inputs. However, access to modern farm inputs, partly limited by their high cost. For this reason, some of the surveyed peasants particularly from kola agro ecology revealed that application of modern inputs

increased the level of production. However, the cost is much greater when compared to the yield obtained using modern inputs. According to the respondents, they are unable to use with the present sky rocketed cost of modern inputs.

In general, at present time the majority of households apply modern inputs. As a result, the total amount of modern inputs used by peasants shows an increasing trend. The reason for increment trend is that since fertility of existing farmland is deteriorating, increase of crop output in the area achieved only by increasing uses of other inputs. However, the uses of inputs vary in agro ecological zone for surveyed households. Most surveyed households of dega and woinadega zone applied more modern inputs than households of kolla zone did in the surveyed period. Thus, application of modern inputs increased with increase in elevation. The usage of input is also more of related with selected crop type particularly applied to crops such as wheat, maize, barely and teff.

#### **3.3.3. Change in Soil Conservation Practice**

Land conservation practice such as terracing is the newly introduced farming practice adopted by some surveyed households, which has not been familiar to the area in the past 15 years back. Regarding to this, although it is found at the early stage of development in the area among the surveyed households from all agrological zones about 79% use terracing to conserve soil by protecting it from erosion.

The household survey result and information obtained from interviewed person also revealed that in order to raise productivity of land, peasants of the area cultivate or plough their farms repeatedly (3 to 4 times) until the farm is softened or ready for sowing. This method of cultivation applied more by peasants of dega and woinadega area at present time. The study result showed that about 76% of the total surveyed households used such method of cultivation in 2018. However, the percentage share of households using this method of cultivation before 15 years was only about 40%.

Other major techniques used by the surveyed peasants in order to maintain soil fertility is that, crop rotation and compost (prepared from cow dung and leaves of plant). To show the details, about 54.3% of the respondents used different soil conservation practice such as crop rotation, manuring land and application of modern inputs in 2018. Some of these methods applied in the past 15 years. However, their application becomes wide and the numbers of households practicing were larger in 2018.

To conclude, change in population size of the area resulted in various changes in farming practices of households, such as, increased use of modern farming inputs to replenish soil fertility, adopting new land escape investments such as terracing and tree planning, wide application of crop rotation etc. On the other hand, shortage of grazing land resulted in the decline of farm oxen in the area, which in turn forced the peasants to cultivate their plots by using hoe instead of farm oxen. This condition severely affected the efficient utilization of land resources in the area.

To this end, changes in population size of the area resulted

in changes in the farming practices of the households in which some positively, while others negatively affected the agricultural production and land resource as well. However, as most of respondents agreed application of fertilizer and improved seed are the only ways widely used by peasants and the most important practice to raise productive capacity of land in the area?

### 3.3.4. Change in Agricultural Production

#### (i). Trend of Livestock Production

As in all other parts of the Ethiopian highlands livestock are an integral part of the sedentary life of the people in the study woreda. Cattle, sheep, goats, horse and mules are main livestock species reared in Essera woreda. Cattle play a strategic role in farming system as they provide the traction power. Moreover, they are sources of additional incomes of peasants. In the woreda due to low access of people to modern transport facilities, animals such as horses, mules etc used for transportation purpose.

The study tries to look at livestock ownership characteristics of households, the productivity and feeding of livestock. The results of the study show that among the surveyed respondent, 66.6% of the households responded the number of their livestock trend declined. About 23.5% of the respondent told number of livestock increased and about 9.9% reported no change in past 10 years. With regard to reasons of decline of livestock number, about 55.6% of the respondents told shortage of animal feed and about 35.2% of them attributed to the prevalence of animal disease. Some others 9.2% reported other reasons like climate change and sold for different reasons. Thus, most of the households claimed that shortage of animal feeds among other things is

the most serious problem of livestock rearing in the area.

The overall survey result shows that per capita livestock holding declined for the surveyed households in the past 10 years. The average farm animal of households and the total numbers of farm animals owned by surveyed households showed decline trend. Decreasing trend of household land holding for grazing are the main factor behind the decline of per capita livestock holding. This was caused by growing population size of the area. Total livestock number for the surveyed household before 5 years was 1007. However, in 2018 their number declined to 863. The decreasing change also observed in average livestock possessions of farm animal per surveyed.

Decreasing trend in the number of oxen was more pronounced in dega and woinadega zones. When compared with the respective animal types of all agro ecological zones, its total percentage share was 14.2% before 5 years. However, its share declined to 12.6% in 2010. A similar trend observed regarding the households which owned farm oxen. The declining trend of grazing land influenced tremendously the number of oxen owned by peasants particularly in dega and woina-dega areas.

There was also variation in over all livestock numbers among agro ecological zone and households with different farm size groups. The surveyed households in kolla zone have large number of livestock than in dega and woinadega area. Particularly cattle ownership status found better in kolla zone. The computed coefficient of correlation between land holding size and number of livestock for the year 2010 also indicated a positive correlation at the strength of 0.63. This indicates that a household of large farm sizes possesses more livestock asset in the region.

Table 4. Distribution of livestock production by agro-ecological zone.

Years	Zone	Cattle				Sheep and goats				Equines				Total livestock
		Oxen	cow	bulls	calves	All cattle	sheep	goats	total	mules	horses	donkeys	total	
Before 5 years	Dega	22	91	29	28	170	69	20	89	7	15	-	22	281
	Woina Dega	28	96	33	36	193	75	26	101	10	19	2	31	325
	Kola	43	156	43	49	291	37	56	93	12	3	2	17	401
	All AEZ	93	343	105	113	654	181	102	283	30	37	4	71	1007
	No.of raiser hh	54	80	57	63	254	50	42	92	28	30	4	62	408
	Av. Animal No/hh	1.72	4.28	1.84	1.79	2.57	3.62	2.43	3.07	1.07	1.23	1.00	1.14	2.47
2018	Dega	16	80	23	25	144	50	11	61	6	12	-	18	223
	W.Dega	14	92	25	33	164	55	9	64	5	14	2	21	249
	Kola	45	150	45	47	287	44	46	90	9	5	-	14	391
	All AEZ	75	322	93	105	595	149	66	215	20	31	2	53	863
	No.of raiser hh	46	80	55	69	250	54	30	84	19	25	2	46	380
	AV. Animal No/hh	1.63	4.02	1.69	1.52	2.38	2.75	2.20	2.56	1.05	1.24	1.00	1.15	2.27

Source: Households survey, 2021.

The result of study also showed that relatively better livestock feeding and some common grazing ground in kolla area. In contrast, in the dega and woinadega zones livestock feeding is very scarce, grazing takes place only in private and controlled land.

Shortages of animal feeding also limited the qualities of the animals and resulted in the decline of livestock product such as meat and milk. This was revealed by about 88% of

hhs. This in turn, negatively influenced the farm incomes of the peasants and limited the products obtained from these animals.

In the area, Peasants have attempted to adjust themselves to the changing environment condition (declining trend of grazing land and associated livestock feeding) by creating or adopting new agrarian system. For example, as suggested by farmers and personal observation of the researcher revealed,

as a solution to the problem of animal feed and scarcity of land, enclosed use of grazing ground highly expanding in the high land area. It is also introduced to low land peasants. There, grazing ground divided or shared in to different uses such as oxen ground, milk cattle ground, calves ground etc. Highland Peasants with their livestock moves towards unoccupied area of low land in search of grazing land. Supplementary feeding types were introduced in peasant plots. Moreover, share arrangements were made with those do not have livestock. They also use leaves of enset to feed their cattle.

### (ii). Change in Crop Production

Crop production integrated with livestock rising and the agricultural system is a mixed type in the study area. The diversity of agro ecological features contributed to the increased variability in distribution of agricultural crops in the woreda. Annual crops, such as, maize and teff are extensively grown in the kolla agro ecological zone. Whereas wheat, barley, haricot bean and field peas are mainly cultivated in dega and woinadega agro ecology. Cultivation of enset is dominant in the area and it is the main source of food for the majority of people.

All crops are produced only once a year because of the unimodal rainfall distribution. The Crops cultivated at the main rainy season (meher) starts in June and extends to September. However, to some amount maize is produced in the belg season where there is small amount of rainfall.

In the study, an attempt was made to investigate crop cultivation of the area with particular emphasis to cropping pattern and crop output, which are described in the following section.

#### 1) Cropping Pattern

The sample households' cultivate crops in different forms of cropping system such as single cropping and multiple cropping. They have their own reason for doing so. These include the scarcity of land, farmer's preference for some high yielding crop than others and market needs of the farmers. Land holding size is decreasing in the area and this condition lead farmers to grow mainly those crops, which have higher yield per unit area in their small plot of land.

Enset is the main crop produced at all agro climatic zone of the woreda. However, it is dominant at dega and woinadega agro ecological zone, which associated with increasing number of population and availability of limited pieces of land. Since enset has high capacity to support large family size compared to other crops. Households particularly in dega and woina-dega agro ecology with small land holding size have devoted greater proportion of their land to enset. Peasants having large land holding size involve on production of multiple crops. Therefore, the availability of household land holdings significantly influences the capacity of peasant to produce grain crops. Peasants who have small farm size plant enset in their plots and they use a system of share cropping with others who have relatively large land holding size and shortage of labor force to produce annual crops. This system made an opportunity in the area to practice agricultural system for the mutual benefit.

Thus, Enset is the most important in the cropping pattern and its dominance has increased from time to time as information obtained on survey revealed. However, its productivity (thickness, the number of matured enset and output such as kocho) is declining. The surveyed result showed that the total area occupied by enset before 10 years accounted for about 16.22 hectares of all cultivated land per surveyed household and its percentage share compared with other major annual crop types (cereal, pulse etc) was 18.33%. However, in 2018, its area coverage was 22.38 hectares in surveyed households. Hence, its percentage share increased to 23.80% of all cultivated land. With regards agro ecological zone in dega and woinadega zone where it is dominantly grown, its share respectively accounted for about 31.07% and 25.37% of all cultivated land of the surveyed household before 10 years. However, in 2018 its share for respective agro ecological category was 37.02% and 38.63%.

The study result showed that its high population supporting capacity, multitude economic and social values (variety of food made from kocho, etc), environmental conservation values and its drought tolerant nature are a few among many reasons or factors encouraged peasants of area to cultivate more enset.

**Table 5.** Principal crops by occupied area in hectare, producer hhs and average area per producer hhs by surveyed agro ecological zone.

Year	Agroecologicalzone	Cereal crops					Allcereal	Pulse			All pulse	Enset	Other	Area occupied by all crops (ha)
		Teff	Maize	Sorghum	Wheat	Barley		Horse bean	Fieldpeas	Lentil				
2019	Dega	-	-	-	4.02	3.03	7.05	3.25	2.90	0.45	6.60	8.28	0.44	22.37
	Woyyna-dega	1.45	2.50	0.35	3.30	1.95	9.55	1.50	1.60	0.3	3.40	8.15	-	21.10
	Kola	9.35	25.90	5.75	-	-	41.00	0.90	1.15	-	2.05	5.95	1.55	50.55
	All Ag.e.zo.	10.80	28.40	6.10	7.32	4.98	57.60	5.65	5.65	0.75	12.05	22.38	1.99	94.02
	Producer sample hhs	28	46	23	27	20	-	23	22	4	-	71	10	-
Before 10 year	Average area per hhs	0.38	0.62	0.26	0.27	0.25	-	0.24	0.25	0.18	-	0.31	0.20	-
	Dega	-	-	-	2.70	3.25	5.95	3.70	5.05	-	8.75	7.10	1.05	22.85
	W.Dega	2.15	1.75	0.70	2.10	3.05	9.75	3.40	3.75	0.60	7.75	5.95	-	23.45
	Kola	16.35	14.85	5.00	-	-	36.20	-	-	-	-	3.17	2.83	42.20
	AllAg.e.z.	18.50	16.60	5.70	4.80	6.30	51.90	7.10	8.80	0.60	16.50	16.22	3.88	88.50
	Producer sample hhs	36	31	21	19	24	-	26	29	3	-	62	12	-
	Average area per hhs	0.51	0.53	0.27	0.25	0.26	-	0.27	0.30	0.20	-	0.26	0.32	-

Source: -Households survey, 2021.

**Table 6.** Percentage share of major crop types based on cultivated area by agro ecological zone.

Croptypes	Before 10 years			2018		
	Dega	Woina-dega	Kolla	Dega	Woina-dega	Kolla
Teff	-	9.17	38.74	-	6.87	18.49
Maize	-	7.46	35.19	-	11.85	51.24
Sorghum	-	2.98	11.85	-	1.66	11.37
Wheat	11.82	8.96	-	17.97	15.64	-
Barley	14.22	13.01	-	13.54	9.24	-
All cereals	26.04	41.58	85.78	31.51	45.26	81.10
Bean	16.19	14.50	-	14.53	7.11	1.79
Peas	22.10	15.99	-	12.96	7.58	2.27
Lentils	-	2.56	-	2.01	1.42	-
All pulses	38.29	33.05	-	29.50	16.11	4.06
Enset	31.07	25.37	7.51	37.02	38.63	11.77
Others	4.60	-	6.71	1.97	-	3.07
Total	100%	100%	100%	100%	100%	100%

Source:-House hold survey, 2021.

As the majority of surveyed households (55.5%) and almost all of interviewed persons confirmed, the reason for the decline in the productivity of enset was the decreasing of soil fertility and the amount of manure supply and the prevalence of enset disease. They also argued that increasing of household consumption (harvesting before right time of its maturity) because of increasing family size are other factors behind the decline of its productivity.

Information also gathered regarding the pattern of annual crops. Survey results for the two study period shows that the largest proportion (59.9%) of the total cropland of the sample hhs was used for cultivation of cereal crops. In dega and woinadega zone, the trend of wheat coverage increased next to enset in terms of areal coverage. The numbers of peasants cultivating these crops are also in increasing trend. In contrary to this, production of pulses particularly peas declined and given the position they had in the past 10 years to wheat. This is because peasants do not want to cultivate pulses since its yield declined from time to time together with declining trend of fertility of soil.

In the kolla agro ecology maize occupies the largest share of all crops. Peasants are more interested to cultivate this crop, because its yield is more than other cereal crops. Thus, majority of surveyed households have given more emphasis to maize and wheat cultivation.

Wheat in dega and woinadega and maize in kolla covered more space in 2018 than before 10 years. Their share is respectively 11.82% and 8.96% for wheat in dega and woinadega zone and 35.19% for maize in kolla zone per hhs before 10 years. Nevertheless, in 2018, they dominated the cropping pattern in the category of annual crop types and their share for respective agro ecological category increased to 17.97% and 15.64% for wheat and 51.24% for maize. Other crops like sorghum and barely in the category of cereal and beans and lentils in the group of pulse in addition to peas showed declined change in the pattern of cropping.

At present time production of pulses introduced to kolla zone which was not familiar to the area before 10 years. Its expansion facilitated by expanding of people from high land area and the existence of relatively fertile soil in the area.

In the recent year, new trend has also appeared in the cropping pattern of the area. New cash crops or plants like garlic, apple, avocado, and potato introduced to the plots of some surveyed households particularly in dega and woinadega area. These were not as such important in the area before 10 years. Peasants encouraged producing these crops in need of cash.

To sum up, what observed from this is that some changes observed in the cropping pattern in the past 10 years. Some crops like wheat, maize and enset have showed an increasing trend of change with regard to agro ecological zone and dominated the cropping pattern of the area. Others particularly pulse crops showed decline trend. The cropping pattern mainly determined by the motives of peasants for high yield and valued crops at the expense of crops with comparatively lowers returns. Farmers targeted to attain food requirements at the household levels and to generate cash incomes as well. Thus, they mainly produce crops that have high market value and high yield per unit area of land.

## 2) Trends of Crop Output

Land is degraded and becomes less productive in the study area due to the impacts of different physical resource depleting factors. One of the most important factors associated with low crop output is rapidly growing population of the area. Deteriorating of soil fertility due to overutilization of land resources is the major problem threatening agricultural development and worsening the livelihood of the farming community in the region.

Regarding the trends of crop output, data obtained through survey revealed that about 26 (32.1%) of the surveyed household respondents noted crop output increased while about 39 (48.1%) indicated their crop outputs decreased and 16 (19.8%) reported as no change for the past 10 years. The reason for increasing or decreasing of crop output was also assessed. As majority of respondents noted reasons for declined change of crop output was decline in fertility of land i.e. agricultural land degradation, which is repeatedly mentioned. Farmers also reported other reasons like crop disease, soil erosion, anticrop animals, shortage of farm oxen etc.

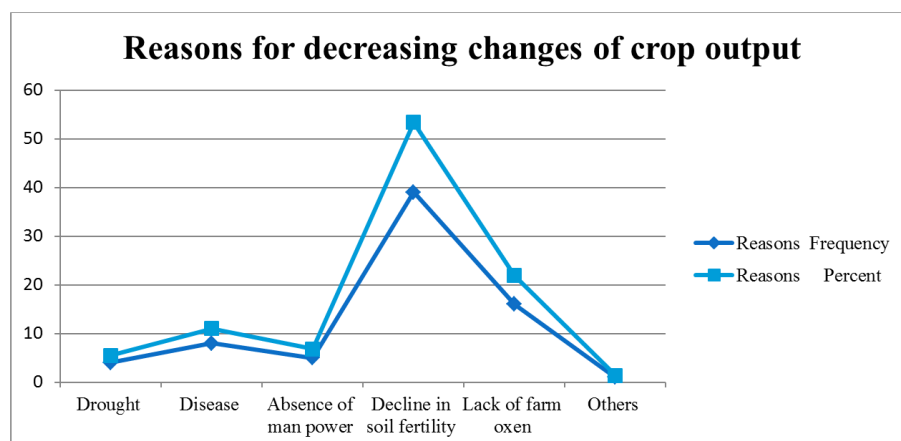


Figure 1. Reasons for decreasing changes of crop output.

The surveyed households responded their crop production improved in the past 10 years revealed that, the increments in crop yields were due to increased use of modern farm inputs, use of manure, repeatedly plough of farmland etc.

To analyze the production and productivity of crops, area cultivated for major annual crops and amount of crops harvested by households at normal harvesting season in 10 years back and currently taken. The reported total volume of crops produced by sample hhs before 10 years was 752.5 quintals per hhs. However, in 2018 its total amount for the surveyed households increased to 814 quintals. In the volume of crop production, cereal crops like maize, wheat and Barley showed increased change. This is due to increase of output per unit area for all listed crop types and increase of the total cultivated land (wheat and maize). The outputs of pulse crops decreased from 176.5 quintals 10 years back to 91.5 quintals per households in 2018 for all sample hhs.

Table 7. Total volumes of crops produced by sample HHs for surveyed period in (quintals).

Years	All crops	Cereal	%	Pulse	%
Before 10 years	752.5	576	76.5	176.5	23.5
2018	814	722.5	88.8	91.5	11.2

Source: Household survey, 2021.

The per capita amount of crops for the producer households in the surveyed period showed some increments. This is mainly associated with involvements of peasants in the production of crops, which has more yields per unit area of land in the later period. The average amount of cereal crops showed increased change whereas, pulse crops showed decreased change in the surveyed period. However, the average amount of crop output per rural population (the total household size) of surveyed households has much decreased in the study period.

To conclude, trends in population change in the region resulted in variations in crop outputs or yields over time. There had been significant variations of yields from crops to crop. Cereal crops like maize, wheat and barley showed some increments whereas, pulse crops and other cereal crops (teff,

sorghum) showed decline for the surveyed households. Declined fertility of soil because of over land utilization is the main factors behind the declined crop yields. On other the hand, increased uses of modern inputs were resulted from increased population pressure and facilitated the increments of yields for some crops for which it mostly applied.

Table 8. Average amount of crops produced per surveyed producer households.

Crop types	Crop produced in quintals	
	Before 10 years	2018
Cereal crops	576	722.5
Pulses crops	176.5	91.5
Total amount	752.5	814
Total producer HHs (Cer.+pul.=total)	131+58=189	146+49=195
Average amount per SHHs	3.98	4.17

Source: House hold survey, 2021.

The average yield per hectare area of cultivated lands for individual crop types was also analyzed in the study. The reported average yield per hectares for crops such as bean, peas, lentils, teff, maize, wheat, barley and sorghum was respectively, 11.9, 10.1, 5, 7.9, 13.8, 12.9, 11.3 and 11.9, quintals before 10 years. The corresponding average yield per hectare for the same crop type in 2010 is 8.1, 7.6, 3.3, 7.2, 15.02, 14.3, 12.04 and 8.7 quintals. The reported result shows that mean yield per hectare for cereal crops like maize, wheat and barley showed some increments whereas, other cereal crop like teff, sorghum and pulses showed decline change. Maize and wheat account largest production volume of crops and yield highest amount in 2019 than 10 years back.

Information obtained during the survey showed that land productivity in the area attached with crop choice like wheat, maize and barley. The use of fertilizer and selected seed are also mostly associated with these crops in the area as noted by the interviewed persons. From this, it is safe to conclude that unlike other factors, the increments in outputs of wheat, barley and maize is associated with increased use of modern inputs by peasants.

Regarding the average amount of crops harvested per

sample HHs, its total amount for all crop types per surveyed producer household for the past 10 years was 3.98 quintals. Whereas, in 2019 the average amount of crops produced per producer households is 4.17 quintals per SHHs.

Agricultural land is most important household capital, especially in rural Ethiopia; this is because the entire life of rural population dominated on agriculture. Despite its importance agricultural land becomes smaller and smaller in rural area and unable to produce enough crops to sustain the growing population. This resulted from rising of population density.

The highland part of Ethiopia is heavily populated than other parts of the country as it accommodate more than 2/3 of population of the country. The increasing population results in growing demand for food, which has considerable impact on agricultural land resource of the regions.

Essera Woreda, part of the south western highland of Ethiopia is characterized by a rapid growth of its rural population. It is found that population of the area has been growing at a fast annual growth rate of 2.9% for the past two or more decades. Large family sizes of household are the main population feature of the area, which depend mainly, on agriculture as a means of livelihood.

In this paper, an attempt was made to investigate the agricultural land resource and production of Essera woreda in relation to population growth of the area. The study has documented that landholding size of peasants declined for the past 15 years, as 51.9% of the surveyed households reported. Farm land holding of peasants especially in dega and woinadega areas have more declined and intensively cultivated. Besides, farm lands were highly fragmented. Moreover, the nature and size of landholding of peasants for different uses have been also changed in the woreda for the past 15 years. Household survey results indicated cultivated area extended in to grazing land, steep slopes and natural forest lands, whereas, fallow and grazing land have declined.

The total cultivated area of the surveyed households has increased from 88.5 hectares in 2003 to 94.02 hectares in 2018. However, average cultivated land holding declined from 1.25 hectares to 1.16 hectares per surveyed holder household for the respective period. Land serving for grazing use is highly affected by expansion of eucalyptus tree and enset farm particularly indega and woinadega parts of the woreda. Consequently, the livestock production and productivity of peasants is being affected due to scarcity of grazing land. The average amount of grazing land holding for the surveyed holder households decreased from 0.37 ha in 2003 to 0.23 ha in 2018.

To mitigate the declining change of grazing land, supplementary cattle feedings are introduced to plots of peasants, grazing land intensively utilized with adoption or expansion of enclosed land use system, leaves of enset and bambo trees used for cattle feeding. Forest lands are also used for grazing use. In the study Woreda in contrast to shrinking of area with natural forest, manmade trees such as eucalypts and bambo highly expanding in the plot of peasants which used for cash earning, fuel wood and other uses. This

was the most popular response of demographic changes of area.

Declining per capita land holding of peasants and productivity of land due to continuous cultivation also resulted in changes in farming practices of households for the past 15 years such as increased use of modern farm input, repeatedly plowing of farm land, introduction of land terracing, uses of composts and crop rotation. These positively contributed to agricultural production and land resource conservations of the area. In contrary, decline of farm oxen of households especially at highland part of the woreda forced peasants to use hoe for land plow, which negatively influenced the production systems of peasants.

Changes were also observed in cropping pattern of peasants as result of population growth of area. In order to meet the consumption need of the family and cash incomes, production of high yielding and valued crops are more preferred by peasants of the area at present time. Enset has significant contribution to the food requirements of the area for increasing household members in which it is dominantly grown by peasants. The household survey results showed that the area covered by enset for all agro ecological zone of the woreda was increased from 16.22 ha before 10 years to 22.38 ha per surveyed households and its percentage share also increased from 18.33% to 23.8% compared with other crop types cultivated by peasants. In the mid and high agro ecological zones it respectively encompasses 38.63% and 37.02% of cultivated land at present time.

Regarding annual crop production the cropping pattern is dominated by the area of maize and wheat. Maize in Kolla and wheat in Dega and Woinadega zone cultivated by majority of peasants and covered more space in 2018 than before 10 years. In contrary, the area proportions of teff and pulse crops showed more decline change for the surveyed period. Currently, peasants of area do not want to produce particularly pulse crops because its output per unit area of cultivated land is low and further declining with the declining fertility of soil.

Declining agricultural land productivity is another thing observed in the study woreda which mainly resulted by increasing change in population size of area. Land is continuously cultivated which resulted in declines of soil nutrients and it becomes less productive as 53.4% of the surveyed households reported. In order to raise productivity of land, modern inputs are the only means mainly used by peasants. Household surveyed result indicated that yield per hectare land of some crops (maize, barley and wheat) had showed some increments, whereas, land productivity of other crop types decreased in the study year. The increments of yields of maize, barley and wheat can be associated to the positive contribution of increased use of modern inputs. The average amount of crops produced per households for surveyed period had increased from 3.98 to 4.17 quintals per surveyed households. The increments associated with more involvements of peasants in production of high yielding crops. However, the average amount of crop output per surveyed rural population has decreased in study period.

## 4. Conclusion

In the light of the theories considered and the finding of the study indicated, both the population pessimistic views of Malthusians and neo Malthusians and the optimistic views of Boserupian could not separately provides the complete explanations regarding the population and agricultural production relationship of this study.

It was observed that, increase in population growth of the area associated with an increase in usage of modern inputs which increase in total crop outputs in general and yields for some crop types such as cereals in particular. Moreover, labor intensive land investment practices including tree planting; terracing, manuring croplands were increasingly under taking by peasants as result of rapid change in population size of the area. Thus, the trend is towards agricultural intensification and to some aspects environmental recovery. These can be in line with the thinking of Boserup.

On other hand, high population growth of area was significantly associated with agricultural extensification in to forest area and land fragmentation, which has been seriously degraded the environmental condition and affected agricultural production as well. These can be supports the arguments of Malthusians and neo Malthusians. In contrary to land recovery because of tree planting, the increased expansion of man grown tree highly threatens land used for crop production and grazing, which negatively influenced agricultural production system of the area. Furthermore, in contrary to increase in volume of production for cereal crops, the output and yields have decreased for pulse and enset. The adoption of capital-intensive practices still remained low and not fully exploited in the area due to economic constraints and low access of peasants to market.

Therefore, all in all, neither Malthusian nor neo Malthusian or Boserupians propositions (theories) can completely explains the situation.

## 5. Recommendation

The following suggestions are recommended by the researchers for action to be taken by the concerned authority, the local people and others with the hope that they may help as preventive remedy to the existing interrelated problems of population growth, agricultural land and production of the study area.

- 1) The majority of population (96%) of the woreda depends on agriculture. However, the size of agricultural land per households is decreasing from time to time. So that it is very difficult to totally depend on agriculture as means of livelihood. Alternative ways of income generation has to be emphasized, which decreases the level of dependency on agriculture. Hence, nonfarm activities should be promoted by increasing access to credit and training.
- 2) Application of modern farm inputs by peasants of the area has increased in response to the declining fertility of soil. However, the utilization of modern input was

not fully exploited due to economic constraint i.e. lack of purchasing power of peasants. In addition to this, its high price also limited farmers in the usage of farm inputs. Therefore; the local, regional and national governmental authorities should facilitate the ways peasants get modern inputs in a fair price through subsidy and long term credit policies.

- 3) As a result of increments of population, crop cultivation is highly moving in to forest area especially in kola agro ecological zone. The newly introduced population resettlement is further aggravating the situation through expansion of settlement and agricultural production in to marginal land. Balancing population and resource condition of the area would create, if resettlements are undertaken in the area where there is no forest cover. Thus, it should be encouraged. Furthermore, forest resources should be protected by government from human interventions.
- 4) The development of modern transportation routes plays a vital role, for easy, access of farmers in to market in order to bring modern inputs and to transport agricultural products. However, access to road transportation is poor in the region. Therefore, all concerned bodies or agents need to work hard to improve transportation services of area.
- 5) In order to prevent soil erosion terracing are used by some of the surveyed peasants. However, it is not commonly applied by peasants of the area. For this reason, the best experiences or practice of one farmer should be disseminated to others. Moreover, the effective training and counseling of farmers on issues of environmental protection must be emphasized.
- 6) Almost all peasants of the area own local livestock types. These are less productive with existing livestock feeding shortage of the area. The need to improve the breed quality and feed system of livestock. Peasants of kola area have relatively large grazing land which supports large animal population. However, as reported by some of surveyed household, prevalence of animal disease (trypanosomiasis) is seriously affecting the livestock productions. Emphasis need to be given to improve the situation through provisions of continuous livestock vaccinations and treatments.
- 7) Bamboo tree concentration is high in the area. In the region it is used only for traditional and local consumption such as for construction of house, fuel wood and fencing. However, it can be used for many other purposes if new and modern technologies are employed in the area. Thus, governmental bodies of the area should bring commendable experience of other areas. They also have to invite organizations which have experience of this work. It would create massive job opportunity for increasing labor force of the area.
- 8) In the study area peasant households are characterized by having a large family size which is high in relative to resources base of area. Population, family life and



environment related information that balances the situation should be provided for peasants by the relevant authorities.

- 9) Peasants of the study area have low educational status. This plays its own role for increased domination of tradition based farming system of the area. So that education of peasants should be improved through implementation of adult education program or other means.
- 10) Increasing of eucalyptus tree especially dega and woina dega zone is the most significant change of the area in response to population growth. In the region, every farm plot of peasants is invaded by this tree and land serving for crop cultivation and grazing were threatened as result of its expansion. For this reason farmers have to be advised to plant tree at area far away from land serving agricultural activities.

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