# Identification of Major Field Crops and Challenges Facing Farm Households in Case of Gerado Small Scale Irrigation Canal, Southern Wollo, Ethiopia

[1]Biruk-Kemaw, [2]Gebre-Egziabher Fentahun
[1]Department of Plant Science, College of Agriculture and Natural Resource Science,
Debre Berhan University, P.O.Box 445, Debre Berhan, Ethiopia
[2]Department of Agricultural Economics, College of Agriculture and Natural Resource, Assosa University,
P.O.Box 18, Assosa, Ethiopia

**Abstract**
The objective of this study is to identify the challenges and major field crops by using small scale irrigation with special reference to Gerado-Bilen and Endod-Ber kebeles of small scale irrigation scheme in Dessie zuria district of Amhara regional state. In order to undertake this study, both qualitative and quantitative methods of data analysis were employed. The qualitative data was used to capture perception and opinions of the respondents on the contribution of small scale irrigation to farm household income by using personal interview. Quantitative data on the household's resource ownership and demographic characteristics were collected using semi-structured questionnaires. The study result indicated that the contribution of small scale irrigation was very imperative especially in those areas where insufficient and erratic rainfall was existed. The study also showed that the major challenges that hinder the optimal utilization of irrigation schemes were: lack of clear water use rights between users, shortage of fuels and lack of spare parts, marketing problem, occurrence of disease and pests, high cost of imported farm inputs and others. Based on the study result, the researcher recommended that; implementing clear water use rights between users, supplying durable and efficient motor pump to the irrigating farm households, creating a market linkage that connects farmers with the consumer to have fair marketing margin distribution, encouraging and advising the farm households to produce variety of crops that have high market price and providing modern farm inputs at a reasonable and subsidized price by the concerned bodies will help the farmers to produce the desired farm products.
**Keywords:** Small Scale Irrigation, Farm household

## 1. INTRODUCTION

Agricultural production provides contributes a substantial share to the GDP of many low income countries. It is often the leading sector of the economy as source of income, employment and foreign exchange. In Ethiopia agriculture employs more than 70% of the total population and contributes 41% of the GDP (MOFED, 2010). Even if agriculture is the mainstay to the economy, the sector is struggling with subsistence nature of farm production with low productivity. By and large, agriculture in Ethiopia is subsistence. This is particularly true to the major food crops grown in the country and covered in the survey (CSA, 2015/16)

Hence, to increase agricultural production and productivity, irrigation plays a key role in increasing the performance of agriculture in that, it helps to increase farm income and for economic growth (Hussain and Biltonen, 2001). A study conducted by Zhou *et al.,* (2008), reported that the contribution of irrigation to agricultural production can be seen in two ways; by increasing crop yields and enabling farmers to increase cropping intensity and to produce high value crops. According to a study conducted by Awilachew *et al.,* (2010), irrigation has the potential to increase both the agricultural productivity and cropping intensity in turn income of the farm household. Therefore, irrigation can be an indispensable technological intervention to increase household income and irrigation development helps to offset the negative effect of rapid population growth (2.6% per year, CSA, 2007).

According to CSA (2015/16) report, agricultural production in Ethiopia faces frequent failure due to the primary dependency on rain fed. In line with the above data, about 86.4 percent of agricultural households own a land with areas of two hectares or less, in that farm households were unable to produce with the help of irrigation due to its expensive nature (Girum, 2010). Hence, producing agricultural production with the help of small scale irrigation is inevitable. In addition, small scale irrigation scheme gets a prior attention in Ethiopia as a means to alleviate the farmers from rural poverty and to bring the desired economic growth (MOFED, 2006). Annual report indicated by World Bank (2006) showed that only 5% of irrigable land was irrigated and less than 5% of total renewable water resources were used by the farm households annually (FAO, 2006).

As the nation Ethiopia designed ADLI strategy, the construction of small scale irrigation scheme is on top agenda to bring about the accelerated economic growth through a rural-centred development program (MOFED, 2010). Hence, there was a considerable scope for expansion of small scale irrigation by Ethiopian government. When we came to the study area, Gerado irrigation canal was used by farmers traditionally long years ago.

However, the regional government had developed the canal for the purpose of irrigating 80 hectare merely, but currently the canal was used to irrigate around 150 hectare of land. Despite varies purposes of small scale irrigation, majority of small scale farmers in the study area were not receiving the potential benefits. Rather the inhabitants of the area suffer from hunger and malnourishment. Irrigation canals were not providing the required benefits for the majority of the small holder farmers.

Traditional system of production, irrigation water conflicts, lack of improved seed for vegetable, poorly developed marketing system, weak extension, credit, local community rules and research support and lack of collective action at each stage of the market participants were some of the major problems the farm households were facing in the study areas. In addition, in the study area, even if irrigation canal was used by farmers' traditionally long year ago, the farmers who are producing with the help of irrigation canal produces cereal crops instead of producing high marketable valued crops such as field crops and vegetables. Thus, the study was conducted in order to explore the contribution of small scale irrigation through identifying and differentiating the major field crops and vegetables grown by using small scale irrigation scheme and assessing the major problems and challenges facing the selected sampled farm households in using the small scale irrigation in the selected study area.

## METHODOLOGY

### Description of the Study Area

Gerado is located in South Wollo of the Amhara Regional state, North Eastern highland of Ethiopia. South Wollo, which is one from the eleven administrative zones of Amhara regional state, Gerado consists of two kebele, Gerado-Bilen and Gerado-Endod-Ber, in which both of them are located between $10^0$ 10'N latitudes and $11^0$41'N and 38028'E and 40S'E longitudes. The selected kebeles were far from Dessie town by 7 Km and 10 Km, respectively. Topographically, Gerado-Bilen has 34% mountainous, 63% Plains and 3% valley; Gerado-Endod-Ber has 25% mountainous, 65% plains and 10% rugged. Altitude of Gerado ranges between 2200-2800 above sea level and has total land size that covers a total of 9,036.76 hectares.

The climate of the district Gerado is in general 4% Dega (high land) and 96% Woyna-dega(temprate). The average annual temperature of the district ranges between 15-20$^o$C with average annually rainfall of 900mm-1000mm. According to the district BoARD (2016), report, the total population in the study area is 18,372, of which 4418 are male and the rest were females with the average family size of 4 persons and 2,939 household.

### Sampling Technique and Sample Size Determination

The household data collection was undertaken in two kebele Gerado-Bilen and Endo-Ber that have irrigating households. The sampled households were selected by using the following stages. The first stage is selecting both kebele as the study area purposively because of physical proximity, time and other potential resource (irrigation water availability). In the second stage, the irrigator household lists in those kebele were obtained from the Dessie zuria rural kebele agriculture and irrigation development office. Then different type of small scale irrigator households were selected from the list by using random sampling technique using a random number table. Based on this multistage sampling process the total households were selected on random sampling from both kebeles. We would show sampling as follow:

1) Total population of Gerado = 18,372 and the total household = 2,939. Then the study was conducted by using only 97 irrigator households through simple random. By using Yamane formula (1967) with 90 percent confidence level to determine sample respondents.

Formula**:**   $n = \dfrac{N}{1+N(e^2)}$ ,

Where; n=sample size = 97

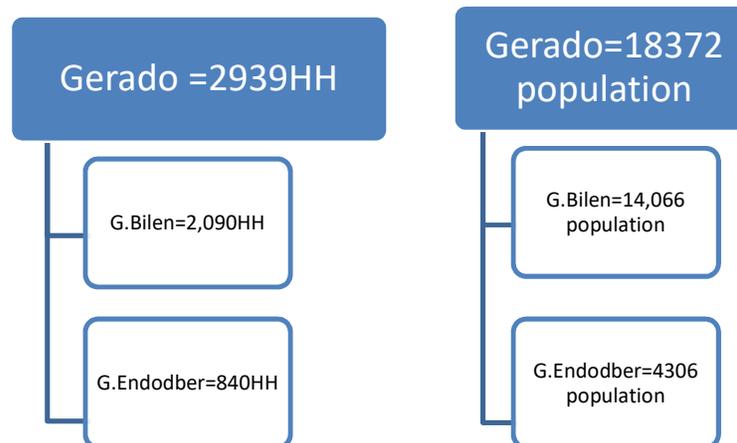N=total number of household in both kebeles = 2,939

e=margin error=0.1

Figure 4: Total population and household of the study area

2)  Multiplying both stratification by proportion ($p = \dfrac{97}{2939}$)

Sample size in G.Bilen= $\dfrac{97}{2939} * 2090 = 69$

Sample in G.Endod-Ber = $\dfrac{97}{2939} * 840 = 28$

### Type and Source of Data Collection
In order to collect the reliable data, both primary and secondary data were used as a major source of the study. The secondary data was included information that is obtained mainly from report, website, Literatures, journals and newspaper and other sources, which are relevant to the study. The primary source of data has been collected from the household of both the qualitative and quantitative information.

### Data Collection Methods
To collect the qualitative and quantitative data this study was used following main instruments namely questionnaire, interview and organization document from quantitative data collection technique and key information interview from qualitative data collection techniques.

### Methods of Data Analysis
Different types of analytical methods were used to evaluate the research result. In this study, descriptive analysis was used to reduce the data in to a summary format by tabulation (the data arranged in a table format) and measure of central tendency were used as a means of presenting data (mean and standard deviation), percentage and frequency distribution.

### RESULT AND DISCUSSION
#### Demographic Profile of Respondents
#### Educational status of respondents
According to Getaneh (2011) finding, economic growth is driven by change in people's capabilities or their human capital, as affected particularly by their education. In addition, as Maddison *et al.,* (1970) indicated, educated people have the contribution in generating and applying new technologies than those who are not educated; and education level of the household head is one of the major determinant that have a positive impact on adoption of irrigation technologies. From the table 1, the study revealed that 83.32% of the respondents were literate while the remaining 15.95% of them were illiterate from the irrigating household head of Gerado-Bilen. On the other hand, 71.41% of the irrigating sampled household head are literate and 28.59 of them are illiterate in Gerado-Endod-Ber. The reason for the existence of high percentage of educated irrigating household heads in both *kebeles* was the provision of basic education (*Meserete timhirt*) during the military regime (Dergue). As a result, hence, education can improve the working habit of the respondents and education level can increase the irrigation technology reception (adoption) rate of the farmer and ultimately better enhancement in agricultural production of the irrigating respondents.

Table 1: Demographic characteristics of the sampled households

| Study Area | Gerado-Bilen | | Gerado-Endod-Ber | |
|---|---|---|---|---|
| Age status of respondents | Number | Percent | Number | Percent |
| 20-40 | 23 | 33.33 | 6 | 21.43 |
| 41-60 | 42 | 60.87 | 20 | 71.43 |
| >60 | 4 | 5.79 | 2 | 7.14 |
| Educational status | | | | |
| Illiterate | 11 | 15.94 | 8 | 28.57 |
| Elementary | 38 | 55.07 | 10 | 35.71 |
| Secondary education | 15 | 21.73 | 4 | 14.28 |
| Diploma and above | 5 | 7.25 | 6 | 21.42 |
| Sex of the respondent | | | | |
| Male | 48 | 69.57 | 20 | 71.43 |
| Female | 21 | 30.43 | 8 | 28.57 |
| Family size | | | | |
| ≤3 Family size | 13 | 18.84 | 6 | 21.42 |
| >3 | 56 | 81.16 | 22 | 78.57 |

**Source:** Own survey (2016)

### Family size of the Household Head
From the national annual report made by CSA (2015/16), the average family size at the national level in Ethiopia was 4.7. The family size was vital for formulating various development plans and can be used by the different stakeholders for monitoring and evaluation purposes (Getaneh, 2011). Table 1 indicated majority (81.16%) of the sampled households have the family size of greater than 3 and (18.84%) of the respondent have household sizes of less than 3 in Bilen. Around 78.57% of the respondents in Endod-Ber have family size of greater than 3 and the rest 21.42 have less than 3 family sizes. According to Dessie Zuria rural kebele information and assessment of crop office (Dessie zuria rural kebele crop assessment and information office, 2014), the average family size of the study area was 5 and 4 people per household in Bilen and Endod-Ber respectively. As a result, around (20%) of the irrigating households were faced to lacked of adequate labour force.

### Age of the Household head
Here from the above table, majority of the respondent are within the age of 41-60 years followed by those categorized under the age category of 20-40 and the remaining of the respondents were under the age category of the above 60 years in both *kebele*. There by the study showed that majority of the sampled households were within the age category of labour force. According to ILO (2013), the country with such labour force should focus on investing productions of good (i.e. irrigation). On the other hand, the dense population under the age of 15 should invest on school and those household members aged to greater or equal to 65, their investment should focus on health service. Due to practically eligible age group for labour force which is greater or equal to 18 in our country, the study took this age as a base line for age classification.

### Gender of the Household head
The majority of the respondent in both *kebele*s are male headed households taking around 69.57% in Bilen and 71.43 in Endod-Ber, respectively.  Female headed households accounted around 30.53% and 28.57% in Bilen and Endod-Ber, respectively. Female headed households in both kebeles indicated that they were challenged by labour shortage and depending on rain fed agriculture in which they produce irregular farm output due to erratic rainfall in the production period or year.

Table 2: Descriptive summary of demographic profile

| Variable | Frequency | Min | Max | Sum | Average |
|---|---|---|---|---|---|
| Age of the house hold | 97 | 20 | 64 | 2028 | 40.5 |
| Educational status | 97 | 0 | 13 | 278 | 5.58 |
| Family size | 97 | 2 | 8 | 249 | 4.98 |

**Source:** Own survey (2016)

### Resource Ownership of the Respondents
### Land holding size and production type
Land is one of important resources to achieve the objective of increasing income of the household and boost economic development. The average land holding size of Gerado-Bilen was 0.5 hectare which was lower than

the national (1.06), regional (1.16) and zonal (0.82) (CSA, 2015/16); were as, the mean land size for Gerado Endod-Ber was 1 hectare, which was lower than national and regional but higher than the zonal land holding size. Since the land holding size has a profound effect on the participation decision making behaviour of farm households on the users of small scale irrigation, a larger land size will have a positive impact on generating farm income by the households (Kinfe *et al.,* 2012). Likewise, 0.25 average land in Gerado-Bilen and 0.75 hectare of land in Gerado Endod-Ber was covered by various crops through irrigation scheme. But the total average land covered by rained was more as compared to irrigation in both selected kebeles.

Table 3:  land holding in hectare and production system

|  | Gerado Bilen | | | Gerado Endod ber | | |
|---|---|---|---|---|---|---|
|  | Mean | Min | Max | Mean | Min | Max |
| Total land size (ha) | 0.5 | 0.3 | 2 | 1 | 0.3 | 2 |
| Irrigable land (ha) | 0.5 | 0.3 | 2 | 1 | 0.3 | 1.5 |
| Irrigated land (ha) | 0.25 | 0.3 | 2 | 0.75 | 0.3 | 1.3 |
| Rain fed land (ha) | 0.5 | 0.3 | 1.5 | 1 | 0.3 | 2 |

**Source:** Dessie rural kebele Agricultural Office crop Assessment and Information, 2015/2016)

**Major Crops Grown by Using Small Scale Irrigation Scheme**
According to CSA (2015/16) report, around 181,039 hectares of land was dedicated for the production of irrigation in 2015/16 cropping season, of which around 6,248 hectare of land was found in South Wollo zone. In the study area, farmers produce mainly teff, corn, onion, sweet potato, potato, rice and others through rain fed agriculture at the cropping season ranging between June to November. Also, sampled farmers in the selected kebeles were producing different kinds of grains (cereals, pulses), fruits and vegetables for home consumption, market sale and for seed as well during the dry season ranging from December to April mainly by irrigation. In the above table, the selected sampled households were producing mainly grains in Gerado-Bilen and Endod-Ber kebeles, respectively. As Saleth *et al.,* (2003) indicated, access to irrigation has been regarded as a powerful factor that enabled farmers to produce multiple cropping, cropping intensity and crop diversification, farmers in the selected kebeles were producing grains that are consumed at a regular basis with low market price as compared to other alternatives like cash crop production that have a high market price per a given hectare of land. Farmers in the study area were producing different agricultural products twice a year who have the access to small scale irrigation scheme in their locality.

Table 4 revealed that few number of crops were produced by the use of small scale irrigation scheme despite there was huge potential. According to the sampled respondents, the major reason why they were not producing a variety of farm products, including cash crops and other farm production that have high market price were market problem, cost of irrigation, topography of the land and fragmented land size.

Table 4: Types of major crop

| Crop type | Gerado-Bilen | | Endod-Ber | |
|---|---|---|---|---|
|  | Frequency | Percent | Frequency | Percent |
| Grain |  |  |  |  |
| Wheat | 60 | 86.96 | 20 | 71.43 |
| Teff | 69 | 100 | 28 | 100 |
| Maize | 40 | 57.97 | 20 | 71.43 |
| Barley | 43 | 62.31 | 16 | 57.14 |
| Others | 37 | 53.62 | 18 | 64.29 |
| Vegetables |  |  |  |  |
| Carrot | 48 | 69.56 | 24 | 85.71 |
| Potato | 30 | 43.47 | 22 | 78.57 |
| Cabbage | 19 | 27.53 | 18 | 64.29 |
| Tomato | 38 | 55.07 | 20 | 71.43 |
| Others | 48 | 69.59 | 14 | 50 |

Source: Own survey (2016)

The major grain crops grown by using small scale irrigation were wheat and teff. The two crops can be considered as major source of food and at the sometime they are the most important source of animal feed than any other crop. From the cereal crop, teff was grown by all (100%) of irrigating sampled household in both kebele. In addition to this, teff production is produced by the farmers along with other crops by coupling. Wheat crop was the second major field crop grown by 86.96% and 71.43% of households in Bilen and Endod-Ber kebeles through small scale irrigation respectively.

Vegetable were the other commonly produced crops by the small scale irrigation schemes. The major grown vegetable crops in both *kebele* were carrot, potato, cabbage, tomato and onion and carrot. From the root and tuber crop, carrot production showed a better yield than others. Secondly, potato was grown by 43.47% and 78.57% of sampled household in Bilen and Endod-Ber respectively.

**Cropping intensity**
As Getaneh (2011) indicated, the access of small scale irrigation by the farm households will have a positive impact on crop intensity. The selected farm households in the study area produce a variety of crops by using small scale irrigation scheme with different crop intensity and it was presented on the following table 5.

Table 5: Cropping intensity

| Intensity | Gerado-Bilen | | Endod-Ber | |
|---|---|---|---|---|
| | Number | Percent | Number | Percent |
| One | 8 | 11.59 | 6 | 21.42 |
| Two | 58 | 84.06 | 20 | 71.43 |
| Three | 3 | 4.34 | 2 | 7.14 |
| Total | 69 | 100 | 28 | 100 |

Source: Own survey 2016
From the above table, 84.06% and 71.43% of Gerado-Bilen and Endod-Ber farmers were producing a variety of crop products twice a year. This is due to the application of small scale irrigation scheme that helped farmers to produce even at the time of dry season.

**Challenges Facing Small Scale Irrigation Scheme**
Table 6: Problems affecting irrigation activities and income

| Challenges | Gerado-Bilen | | Endod-Ber | |
|---|---|---|---|---|
| | Number | Percent | Number | Percent |
| Lack of clear water use rights between users | 18 | 30.5 | 12 | 31.6 |
| Shortage of fuels and lack of spare parts | 12 | 20.36 | 7 | 18.4 |
| Marketing problem | 9 | 15.25 | 6 | 15.81 |
| Diseases and pests | 9 | 15.25 | 5 | 13.15 |
| Cost of imported inputs | 8 | 13.56 | 3 | 7.89 |
| Other | 3 | 5.08 | 5 | 13.15 |
| Total | 59 | 100 | 38 | 100 |

Source: Own survey (2016)
Even though small scale irrigation has a great potential in improving the household income, it's not free from problems (Getaneh, 2011). The scope of the problem ranges from individual attitude up to institutional arrangements.

*Lack of clear water use rights between users*
There was no central principle and use right for the small scale irrigation in the study area. The major reason for the problem was there is no water use association that takes responsibilities to distribute among the users of irrigation in the rural households. In addition, there was an increasing conflict between upstream and downstream users for the available resources in the selected kebeles.

*Shortage of fuels and lack of spare parts*
One of the major reasons for the existence of reduced efficiency in the use of small scale irrigation was shortage of fuel (Benzene). Farmers in the study area used a motor pump (Robin, Haowmax and pedal pumped made in India). The above mentioned motor pump have different efficiency rates, in that Robin, made in Japan, was more preferred by the farm households because of its durability and low maintenance cost. A frequent problem facing farmers who were using a motor pump were inadequate knowledge base and low level of know-how of technical personnel on irrigation technologies and limited access to credit to initiate business in irrigated agriculture.

*Marketing problem*
Farmers in the study area were willing to produce fruits and vegetables because of its better market price including onions, potato, tomatoes and the like. Due to the existence of intermediaries who were mostly benefitted without taking risk in the production as farmers does, the market margin was very low for the farmer. This is because the price received by the farmer with the price that the final consumer pays show a huge gap in the study area.

*Diseases and pests*
Farmers in the study area cultivate the same crops for a long period of time and they are reluctant to diversify the type of crops they are going to produce. This is because they don't want to take a risk and are risk averse. Hence, the above indicated farm practice will have the problems of crop disease such as rot and cut warm.

*Cost of imported inputs*

In order to protect the crop from pests and disease in the farm field, pesticide and herbicides were used. Since all modern farm inputs were imported from the abroad, the price was very high showing an increasing trend from time to time. Even, due to the devaluation of Ethiopian birr in terms of foreign currency along with the pre-determined price of modern farm inputs in the foreign nation, makes the price of imported farm inputs expensive.

Apart from the listed challenges facing farmers who are producing agricultural products by using small scale irrigation scheme, they are facing with other technical challenges such as (limited knowledge in modern irrigation water management that includes irrigation scheduling techniques, water saving irrigation technologies, simple water lifting devices and operation and maintenance facilities, limited knowledge on characterization of hydro-geology of the study area and low productivity of existing irrigation scheme), socio-economic constraints (lack of or low level of awareness of users about irrigated agriculture and lack of irrigation infrastructure) and financial constraints and gaps such as (lack of survey and construction equipment, inadequate budget for study, design and construction and lack of financial management by the concerned bodies).

**Conclusion and Recommendation**

Access to irrigation increases the opportunity for crop intensity and diversification of crop, which increase cropping income. In addition to their normal rain fed cultivation, irrigating households cultivate a variety of fruits and vegetable as well as roots and tuber crops such as carrot, onion, potato and others.  The study identified many problem associated with this small scale irrigation through interview of the irrigating sampled households. The main problems encountered by the users of farm households were: lack of clear water use rights between users, shortage of fuels and lack of spare parts, marketing problem, occurrence of disease and pests, high cost of imported farm inputs and others.

Hence, from the listed challenges encountering sampled respondents, intervention points will be needed. The study recommends assessment of vulnerability of water source to climate variability before the development of small scale irrigation (climate proofing), developing small scale irrigation scheme project in the context of wider national resource management planning, supporting the development of accountable, well-trained water user associations or irrigation committees, reducing the interference of marketing intermediaries in order to increase marketing margin of the farmers and expanding the provision of credit especially by micro finance institutions that will upgrade farmers through increasing farm income and that help farmers to produce diversified crop products.

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