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

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Abstract
This study identified the major field crops produced and the challenges faced by farm households in Gerado small scale irrigation scheme in Amhara regional state, Northern Ethiopia. The study exploited both primary and secondary source of data. The primary data was obtained from 97 sampled irrigation using farm households through interview schedule. Moreover, the study also used FGD and key informants interview to obtain additional data. The secondary data was obtained from various reports, websites, literatures, journals and other sources, which are relevant to the study. Descriptive statistics such as mean, frequency, percentage and range were used to analyze the collected data. Accordingly, the result of the study revealed that teff, wheat, barley and maize were the major cereal crops produced using small scale irrigation in the study area. In addition, the result also pointed out that carrot, potato, cabbage and tomato as the main root and tuber crops as well as vegetables produced by irrigation canal using farm households in the study area. Furthermore, the study figured out that lack of clear water use rights between users, shortage of fuels and lack of spare parts, marketing related problems, occurrence of disease and pests, high cost of imported farm inputs and others as the main constraints in exploiting the irrigation potential the study area has. Therefore, future actions should focus on 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: Crops, Farm household, Small Scale Irrigation canal, Geredo, Ethiopia

1. INTRODUCTION

Agricultural production 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 earnings for many developing countries. In Ethiopia, agriculture employs more than 80% 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. 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.

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). World Bank (2006) report 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. To enhance irrigation usage the country has designed and implemented various strategies like ADLI, in which 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.

Particularly, 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 hectares of land 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 farm households in using the small scale irrigation in the study area.

2. METHODOLOGY

2.1. Description of the Study Area

Gerado is located in South Wollo of the Amhara Regional state, North Eastern highland of Ethiopia. Gerado consists of two kebeles, Gerado-Bilen and Gerado-Endod-Ber, in which both of them are located between 10^0 10'N latitudes and $11^0$41'Nand 38028'E and 40S'E longitudes. The 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 (temperate). 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 of the study area was 18,372 and the total number of household heads in the study area was 2,939.

2.2. Sampling Technique and Sample Size Determination

The study employed two stage purposive sampling technique to draw sample households. In the first stage, Geredo irrigation canal, which covers two kebeles namely Gerado-Bilen and Endo-Ber, was selected purposively. In the second stage, a total of 97 sample households were selected randomly based on probability proportional to the size of household heads in each kebele. The reason for directly selecting 97 sample households was almost all the households in those two kebeles were irrigation users.

The sample size for collecting quantitative data for this research was determined by using Yemane formula (Yemane, 1967).

$$n = \frac{N}{1+N(e)^2}$$

The following steps were used to determine sample size derived from the above formula to collect quantitative data using semi-structured interview schedule.

Where; n =designates the sample size the research uses; N= designates total number of households heads which is 2939 household heads: e =designates maximum variability or margin of error 10%; 1=designates the probability of the event occurring.

Accordingly, given a total household's heads list of 2090 and 840 in Bilen and Endod-ber respectively, the sample size obtained in each kebeles was determined as Follows:

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

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

2.3. Data Sources and Methods of Collection

In order to collect the reliable data, both primary and secondary data sources were used. The primary data that are qualitative and quantitative in nature are obtained from sampled households using interview schedule. Moreover, the study also used FGD and key informants interview to supplement the data obtained using interview schedule. The secondary data was obtained mainly from various reports, websites, literatures, journals and other sources, which are relevant to the study.

2.4. Methods of Data Analysis

The study employed descriptive statistics to analyze the collected data. Descriptive statistics such as mean, frequency, percentage, range and standard deviation were used to assess different demographic and socio-economic characteristics of the sampled households, the major crops produced in the area and the major

challenges facing the sampled households.

3. RESULT AND DISCUSSION

3.1. Demographic Characteristics of the Households

Age of the Household head

The descriptive statistics result pointed out that the majority (60.87% & 71.43%) of the respondents in both kebeles (Bilen & Endod-Ber, respectively) were 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 *kebeles*. There by, the study showed that the majority of the sampled households were within the age category of labour force. Generally, almost all the households in the study area fall in working age. ILO (2013) also recommended that the country with such labour force should focus on investing productions of good through using different technologies such as irrigation, improved methods, etc.

Educational status of the households

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 not attended formal education 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 not attended formal education in Gerado-Endod-Ber.

Table 1: Demographic characteristics of the sampled households

Demographic variables	Gerado-Bilen		Gerado-Endod-Ber	
	Frequency	Percent	Frequency	Percent
Age status of respondents				
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)

Sex of the Household head

The majority of the respondent in both *kebele*s were male headed households taking around 69.57% in Bilen and 71.43 in Endod-Ber, respectively (Table 1). Female headed households accounted around 30.53% and 28.57% in Bilen and Endod-Ber, respectively. Female headed households in both kebeles were small in number as compared to the number of male headed households.

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). The result revealed that 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 (Table 1). In addition, 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 (Table 1). In line with Dessie zuria rural kebele crop assessment and information office (2014) report which indicated that the average family size of the study area was 5 and 4 people per household in Bilen and Endod-Ber, respectively.

3.2. 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, with the maximum and minimum being 2 and 0.3 hectare respectively, 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, with the maximum and minimum being 2 and 0.3 hectare respectively, which was lower than national and regional but higher than the zonal land holding size (Table 2).

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 size 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 2).

Table 2: land holding in hectare and production system

Land	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: own survey result (2016)

3.3. Major Crops Grown by Using Small Scale Irrigation Scheme in the study area

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 from June to November. Also, sampled farmers in the study area were producing different kinds of grains (cereals, pulses), fruits and vegetables for home consumption, market sale and for seed depending on rain and they were producing these products during the dry season ranging from December to April by using irrigation. 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 study area 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 that have the access to small scale irrigation scheme in their locality.

The result of the study revealed that few number of crops were produced by the use of small scale irrigation scheme despite the huge potential the area has (Table 3). 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. Accordingly, 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 they are the most important source of animal feed than any other crops. From the cereal crop, teff was grown by all (100%) of irrigating sampled household in both kebeles. In addition to this, teff 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. Moreover, barley and maize ranked third in Bilen (62.31%) and Endod-Ber (71.43%) kebeles as the major crops produced by the majority of the farmers in the study area (Table 3).

Table 3: Major crops produced by the farmers using irrigation in the study area

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)

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 as well as vegetable crops, carrot was produced by the majority of households in Bilen (69.56%) and Endod ber (85.71%) kebeles. Secondly, potato was grown by 78.57% of sampled households in Endod-Ber and tomato was produced by 55.07% of the farmers in Bilen. Thirdly, tomato was produced by 71.43% of the farmers in Endod-Ber and potato was grown by 43.47% of sampled farmers in Bilen, followed by cabbage and other vegetables respectively (Table 3).

3.4. Cropping intensity

As to Getaneh (2011) finding having access to 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 (Table 4). From the table, 84.06% and 71.43% of Gerado-Bilen and Endod-Ber farmers were producing a variety of crop products twice a year, followed by once a year and three times a year in both kebeles, respectively (Table 4). This is due to the application of small scale irrigation scheme that helped farmers to produce even at the time of dry season.

Table 4: Cropping intensity of farmers in the study area

Intensity	Gerado-Bilen		Endod-Ber	
	Frequency	Percent	Frequency	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

3.5. Challenges Facing Small Scale Irrigation Scheme

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

The result of the study revealed that 30.43% and 32.14% of sampled household heads in Bilen and Endod-ber, respectively, identified lack of clear water use rights between users as the main constraint in using the irrigation scheme (Table 5). 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.

Table 5: Problems affecting irrigation activities and income

Challenges	Gerado-Bilen		Endod-Ber	
	Frequency	Percent	Frequency	Percent
Lack of clear water use rights between users	21	30.43	9	32.14
Shortage of fuels and lack of spare parts	14	20.29	5	17.85
Marketing problem	11	15.94	4	14.28
Diseases and pests	10	14.49	4	14.28
Cost of imported inputs	9	13.04	2	7.74
Other	4	5.81	4	14.28
Total	69	100	28	100

Source: Own survey (2016)

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). The result of the study revealed that 20.29% and 17.85% of sampled household heads in Bilen and Endod-ber, respectively, identified shortage of fuels and lack of spare parts as a crucial constraint in production of various products using the irrigation scheme (Table 5). 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. The result of the study indicated that 15.94% and 14.28% of sampled household heads in Bilen and Endod-ber, respectively, identified marketing related problems as a major constraint in production of various marketable products using the irrigation scheme (Table 5). 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. The result of the study indicated that 14.49% and 14.28% of sampled household heads in Bilen and Endod-ber, respectively, identified occurrence and spread of different disease and pests as the main challenge in production of various products using the irrigation scheme (Table 5). 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

The result of the study indicated that 13.04% and 7.74% of sampled household heads in Bilen and Endod-ber, respectively, identified high cost of inputs as their main challenge in production of various products using the irrigation scheme (Table 5). 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 were 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).

4. 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. This study identified the major crops produced by irrigation users and the problems facing this small scale irrigation using farm households. Accordingly, the result of the study revealed that teff, wheat, barley and maize were the major cereal crops produced using small scale irrigation in the study area. In addition, the result also pointed out that carrot, potato, cabbage and tomato as the main root and tuber crops as well as vegetables produced by irrigation canal using farm households in the study area. Furthermore, the study figured out that lack of clear water use rights between users, shortage of fuels and lack of spare parts, marketing related problems, occurrence of disease and pests, high cost of imported farm inputs and others as the main constraints in exploiting the irrigation potential the study area has.

Therefore, to enhance farm households potential of irrigation water usage concerned bodies should focus on:

- promoting research on identification of best crops and vegetables produced using irrigation as well as on introduction of improved varieties to improve farmers production and productivity, which intern encourages them to exploit the advantages of irrigation:
- assessing 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:
- reducing the interference of marketing intermediaries in order to increase marketing margin of the farmers :
- expanding the provision of credit especially by micro finance institutions that will upgrade farmers through increasing farm income and that help farmers to purchase farm inputs and produce diversified crop products: and
- developing mechanisms to reduce the occurrence and spread of disease and pests through providing different inputs as well as disease and pest tolerant seed varieties.

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