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# Challenges and Opportunities of Irrigated Wheat (*Triticum Estievum* L.) Production in Jimma Zone South West Ethiopia: A Review

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**Abstract:** Wheat Production Initiative was designed to make the country self-sufficient in wheat production. The highlands of the central, south-eastern, and North West parts of the country are the main wheat-growing areas, however, there was no/little experience of wheat production in the lowland. Poor irrigation management that results in either excessive or inadequate water application can significantly reduce the potential for profitability. Increasing irrigation efficiency by applying improved water management strategies could be the prime objective for sustainable irrigated agriculture. In Jimma zone, even though there are a plenty of available natural resources such as land, water and suitable agro-ecology, there were some water deficit because of their location (physical nature) in the gorges and not suitable for surface irrigation and demand sophisticated irrigation technology. In this study different literatures were seen in addition to site observation at different irrigated wheat cluster farming to identify the different challenges and opportunities of irrigated wheat production. The major challenges for the production of irrigated wheat in Jimma zone were limited study on the suitability of the specific area of land for irrigated wheat farming, limited agricultural inputs, in adequate and low performance of small scale irrigation schemes, disease and pest problem, lack of market access, lack of financial support for irrigated wheat, and low quality of wheat products. Availability of water resources and irrigable land and high demand of wheat from the consumer side are among the opportunities that encourage farmers and other stakeholders to involve in the irrigated wheat production in Jimma Zone. The quality of irrigated wheat has to get an attention from the producer side.

**Keywords:** Challenges, Constraints, Irrigated Wheat, Jimma Zone, Opportunity

## 1. Introduction

Wheat (*Triticum aestivum* L.) is one of the important grain crops produced worldwide with larger area of cultivation than any other crop [18]. It is one of the highly grown cereal crops in Ethiopia and makes it at the second place under Sub-Saharan African countries in area coverage [14]. Due to improvements in seed supply, fertilizer applications and increase in extension support, wheat production is increasing and hence the government planned to reduce the import [5]. Because of the government initiative to make the country wheat self-sufficient through supplying the required input, wheat production will reach a projected 4.6 million metric tons in 2019/20 and it intends to stop the import [15].

The goal of Ethiopia's Wheat Production Initiative was to increase the nation's ability to produce wheat on its own. Ethiopia anticipated harvesting 160 million quintals of wheat by the end of July, of which 52 million would be produced through irrigation. Ethiopian farmers cultivate both bread and durum wheat; bread wheat, also known as common wheat, makes up more than 90% of the nation's wheat output. The majority of the country's wheat is grown in the highlands in the center, south, and west; however, there is no or very little production of wheat in the lowlands. While production and productivity increased at average yearly rates of 8.75 percent and 5 percent, respectively, wheat area coverage significantly increased from 1,696,082.59 hectares in 2016 to 1,897,405.05 hectares in 2020. The largest amount of area cultivated is allocated for wheat production which is not a guarantee to reduce the wheat yield gap in Ethiopia [24].

For the production of Wheat, farmers use both flood irrigation and furrow irrigation in the traditional way of growing wheat, and are reliant on traditional knowledge, as well as the tools and resources available. However, most irrigated wheat expanding areas are experiencing water scarcity as a result of farmers using this irrigation technique to irrigate excess water resources for the production of wheat. Poor irrigation management that results in either excessive or inadequate water application can significantly reduce the potential for profitability. Agriculture productivity and impact are dependent on fertilization and irrigation decisions. Increasing irrigation efficiency by applying improved water management strategies could be the prime objective for sustainable irrigated agriculture [8], which could be achieved through improving farmers' knowledge, particularly on how much and when to irrigate [2].

Jimma Zone is one of a potential area for the production of cereal crops like maize and sorghum. Due to the government initiate to substitute the exported wheat in the country, there is a high cluster irrigated wheat farming in Ethiopia. Jimma Zone is producing wheat after the government initiative, however there are a lot of constraints for the production. In this study different literatures were seen in addition to site observation at different irrigated wheat cluster farming to identify the different challenges and opportunities of irrigated wheat production. In this paper the challenges and opportunities of irrigated wheat production were reviewed.

# 2. Irrigated Wheat Production Challenges in Jimma Zone

### *2.1. Limited Study on the Suitability of the Specific Area of Land for Irrigated Wheat Farming*

The most basic important factors that influence crop production are soil fertility, availability of water, climate, and diseases or pests. These factors can pose a significant risk to farms when they are not monitored and managed correctly. In Jimma zone, even though there are a plenty of available natural resources such as land, water and suitable agro-ecology, there were some water deficit because of their location (physical nature) in the gorges and not suitable for surface irrigation and demand sophisticated irrigation technology.

For the successful achievement of expected yield from the crop, suitability of the land for irrigation has to be studied in terms of Slope of the land, Soil physical properties such as soil depth, soil texture and soil drainage and chemical properties such as soil salinity, soil acidity, and soil alkalinity, land use, and available irrigation water based on distance from water source has to be identified clearly. If the location of the command area is near to the river it is classified as suitable for surface irrigation. The land's appropriateness for a particular application which quantifies the land's quality has to be evaluated. According to Bagherzadeh, A. et al. [7], land evaluation is a complex process including numerous judgments that may be related to biophysical, socioeconomic, and organizational elements. But in this regard there is a limitation.

Physical land suitability is concerned with the components of adaptability that are permanent, such as climate, landform, and soil characteristics [19]. FAO, F. [13] state that the standard method for evaluating land takes into account the most pertinent climate, soil requirements, and land terrains (including soil physical properties, soil fertility and chemical properties, soil salinity and alkalinity, topography, erosion risk, and drainage) for each crop [26-27].

The agro ecology of Jimma Zone consists of highland (12%), midland (78%) and lowland (10%) [10]. However in this regard there was no deep study conducted for its suitability. While giving technical feedback on the irrigated wheat at Shebe Sombo district it was observed that a land which was previously under a rice crop that was productive was out of production, because there was no significant work done on its suitability, except implementing the government initiative.

### *2.2. Limited Agricultural Inputs*

In a mechanized farm, fertilizers, seedlings, and seeds are agricultural inputs for growth. Pesticides are the inputs for protection and other crop protection products and inputs for mechanization include tractors, ploughs, planters, harvesters, and other farm equipment. In Jimma zone farmers are complaining because of the unavailability and late accessibility of fertilizer inputs and agro ecology based improved seeds. In addition to the unavailability of inputs, the cost of the inputs is very high and farmers have no enough capital to purchase the inputs. These are the major constraints for the production of irrigated wheat. Because of these in accessibility, advances subsistence farmers to shift to marketable crops such as potato, tomato and other vegetable crops.

### *2.3. In Adequate and Low Performance of Small Scale Irrigation Schemes*

For the full development of the crop the required amount of water has to be supplied for the crop through irrigation canals and other mechanisms. However, some of the irrigation schemes are nonfunctional and are unable to supply the required quantity of water on time because of sedimentation of canal head work, shortage of the main canal and lack of canal up to their field (figure 1).

The above scheme at Shebe-Sombo small scale irrigation scheme requires maintenance and repairs. There was no timely scheme management, due to this problem there was a high loss of water because of seepage. Additionally, most part of the scheme is earthen canal. These were among the constraint observed at Kishe small scale scheme at Shebe-Sombo District of Jimma Zone.

***Figure 1.*** *Irrigation scheme at Seka–Chekorsa District (Kishe scheme).*

The other constraint is on the construction of the small scale irrigation scheme. For example, in 2019 there was an irrigation scheme constructed by a non-governmental aid from the Menshen for Menshen at Seka-Chekorsa District and completed in 2022. Even though it was a recent constructed irrigation scheme, the canal is filled in some parts by sediment. In addition to this, the canal is earthen canal except at gorges which is constructed by concrete as a flume and covered by geo membrane (Figure 2). The soil is porous and due to this the productive lands are out of production. Generally, the scheme primary canal has to be constructed by concrete. There was also no secondary and tertiary canal for the conveyance of water to the field. Because of this the required quantity of water takes a long hour to reach the middle and the downstream side (from three to four hour from the head work to the downstream).

***Figure 2.*** *Canal filled with sediment at Seka-Chekorsa district on Gibe-Kechema Scheme.*

### *2.4. Inadequate Farmer's Knowledge and Skill in Irrigation Water Management*

For effective crop development through irrigation knowledge of crop water requirement and irrigation water requirement are the basic. Crop water requirements (ETc) is the depth of water needed to meet the water loss through evapotranspiration of a crop, being disease-free, growing in large fields under non restricting soil conditions, including soil water and fertility, and achieving full production

potential under the given growing environment [11]. The requirement is ether applied by rainfall or irrigation. The term "irrigation water requirements" (IWR) refers to the amount of water that must be delivered through the irrigation system in order to meet the crop's complete water needs. Climate and water, which restrict plant growth, are the main environmental elements affecting ETc [25]. It is possible to directly measure or indirectly estimate a crop's need for water. Because it is costly and time-consuming, direct measurement is difficult [4]. The most popular in-direct method is ETc, which is calculated by fusing ETo and Kc. Because too little water significantly reduces growth without withering in crops, accurate predictions of ETc are essential [22]. According to Yohannes, D. F. et al. [31], Poor irrigation water management associated with water scarcity was the major reason for underperformance of most small-scale irrigation schemes, which leads to low production.

In Jimma zone and most parts of South West Ethiopia, irrigated wheat production is a new initiative, and water need of the crop, irrigation water requirement of the crop, irrigation interval, method of irrigation, and other inputs required for the crop were a challenge in addition to the attitude of farmers. Farmers have a little know-how about the relationship of water and yield, but they randomly apply water to their field based on the drying of the soil and wilting of the crop leaf. Those farmers who have a little know how use small channels, pumps, and other traditional methods to deliver the irrigation water to the filed, however they face a problem on water control mechanism. It was clear that, the farmers technical perception towards irrigation water management practice of the Jimma Zone was practiced based on the farmers indigenous know how and with their long years of experience in irrigation water management on vegetable crops.

Even though the farmers have an indigenous knowledge on irrigation water management on a small plot of land for vegetable crop production, it is not enough to meet a long lasting government initiative through a cluster based farming on a large hectar of land. Farmers apply water over or under the crop water requirement and the problems of applying high amount of water to field may cause yield reduction, outbreak of disease, water logging, quality reduction, and soil erosion and land degradation; and the problem of applying low quantity of water may cause water stress and leads to yield reduction and may cause crop failure. Even though the farmers get a little know how from the agricultural experts to irrigate after 10 days (irrigation schedule), there was no scientific irrigation scheduling practices practiced based on soil field capacity. But farmers schedule their irrigation simply by observing soil moisture and crop status. These means, they apply the next irrigation when soil starts cracking and plants start to wilt during sunny days.

The other constraint is on the method of irrigation and how to manage the irrigated water at the field. Lack of facilities, knowledge and capital of the farmers were the major constraints to use different methods. The method of irrigation which was practiced by the farmers were furrow irrigation, flood irrigation, a water can and combinations of irrigation methods. In a cluster based irrigated wheat farming, they use a furrow irrigation method, however there was a water application challenge related to furrow length. Because of its simplicity for operation, use of unskilled labor force and low initial investment, furrow irrigation is one of the most common surface irrigation method practiced in Ethiopia [1, 6]. It is widely used in almost all small and large-scale irrigation schemes [28].

Though furrow irrigation is the most common and mainly practiced irrigation method, it is not optimal for water use efficiency and needs a critical study on the design parameters that determine the water efficiency in order to fix the length of the furrow with the respective correspondence of flow rate. Water applied for irrigation should meet the plant water requirements at the time of irrigation, should not exceed the available water-storage capacity of the soil profile, has to avoid leaching in excess of that required to prevent soil salinization and excessive runoff and minimize erosion and deterioration of the soil structure [3, 12]. The rate of infiltration of water into the soil, inflow rate of the water, slope of the field, time of irrigation, time of recession of water from the soil surface, soil moisture prior to irrigation, spatial variability of the soil, climatic conditions, and furrow shape affects the performance of an irrigation method [17].

According to Eldeiry, A. A. et al. [12], a furrow irrigation using a large inflow, a small furrow length, and a long cut-off time losses more water than using a large furrow length, a small inflow, and a small cut-off time. Schwankl, L. J. et al. [23], observed that variability of furrow physical characteristics on furrow irrigation performance were inflow rate, infiltration, geometry, and roughness. For a field with highly variable soil and infiltration characteristics, spatially varying infiltration may have a greater impact than variable furrow inflow on irrigation performance. Generally, furrow length and shape were among the major constraints in irrigated wheat production in Jimma Zone, because it has a factor on the seed rate and other fertilizer input and the consequence is low production and productivity. Therefore, determination of optimum combination of furrow length and flow rate to enhance irrigation efficiency and improve on farm water management under small holder farmer's condition in Jimma Zone for irrigated wheat production is critical.

The other constraint is attitude of the farmers for irrigated wheat production. During the commencement of irrigated wheat throughout the country for import substitution, the government supported input and some farm machineries to encourage the farmers, but still there are farmers that are expecting inputs, pumps, tractors, combiner for harvesting and other follow up from the government organization. Additionally, farmers had no awareness of routine pump maintenance. According to Degefa, K. et al. [10], farmers need training on routine pump maintenance to effectively use a pump and reduce maintenance costs. In this a scientific work is expected from Agricultural experts and extension worker, and those farmers with the highest performance has

to be recognized to initiate the other farmers.

### *2.5. Disease and Pest Problem*

Disease and pest are among the constraints affecting the production and productivity of irrigated wheat crop in Jimma Zone. The most common disease is rust which occurs during the tillering stage and smut which occurs at and before maturity stage. Farmers are losing a yield not only from the disease and pest problem, but also the non-availability and lack of awareness on the quantity of application. It was observed that in a cropping season of 2014 E. C, yield of irrigated wheat was affected by rust at Seka Chekorsa irrigated wheat cluster at Boyo kechema, but most of them didn′t get a pesticides.

***Figure 3.*** *Irrigated wheat affected by disease (rust) at Boyo-Kechema cluster at Seke-Chekorsa district.*

### *2.6. Lack of Market Access*

It is common that for sustainable growth and economic development availability and accessibility of market at the local and throughout the nation is essential. According to Urgessa, M. [29], agricultural production can face several problems in the absence of well-functioning markets. In Ethiopia, wheat is produced mainly for consumption. Besides its consumption, it is also used for markets; it contributes 80% of the total marketed quantity of cereal production, however there is a large demand-supply gap. Smallholder farmers market their wheat produce only 20% of production and 80% of their total production are used for consumption [30].

In Jimma Zone based on our observation made, there was a lack of local reliable market and in some districts there was also a transportation problem. Local market access, price instability and market facilities were the major constraints in irrigated wheat production that affect the income to be generated from its production for farmers [10]. Due to the market linkage constraints with the lack of road facilities the market price was dropping during harvesting season resulting in farmers often selling at a low price which does not cover the costs of production.

### *2.7. Lack of Financial Support for Irrigated Wheat*

For the production of irrigated wheat from sowing to harvesting, it demands a capital and the farmers has to be supported financially. However, there is no credit options organized for farmers to produce irrigated wheat. Credit

unions in Ethiopia are community-based organizations that offer a wide range of services to their members, including low-interest loans and savings. For raising the living standard of rural poor farmers and to initiate farmers produce more agricultural credit is considered as a tool for development. A greater consumption and purchase input increase which leads to raise the welfare of farmers can be attained if agricultural credit is available [21].

In Ethiopia, small holder agriculture productivity are known by a low level of productivity, in adequate irrigation supplies, lack of farm technology like herbicides, fertilizers and improved varieties [9]. Farmers frequently suffer a deficiency of capital to adopt modern agricultural technologies where subsistence agriculture prevails and smallholder farming dominates the overall economy of the country.

According to Matous, P. et al. [20], Ethiopia's agriculture sector produces at a minimum level and the incomes are insufficient to cover farmers' consumption and expenditures, farmers frequently suffer a deficiency of capital to adopt modern agricultural technologies where subsistence agriculture prevails and smallholder farming dominates the overall economy of the country. Credit saving and payment are critical for agricultural potential improvement and expansion in Ethiopia [32]. Lack of access to appropriate credit services is among the main barriers to changing the livelihood of smallholder agriculture sector. The other constraint is the credit allowed from the bank is insignificant and absorbed by a large scale mechanized agriculture in the country.

In Jimma Zone, financial sources for irrigated wheat production, there was no credit provided for purchasing inputs like fertilizer, seed and chemicals required financially [10]. For the sustainable production of irrigated wheat, to provide farm inputs such as fertilizer, herbicides, high yield variety seeds, and machinery favorable credit and saving has to support the farmers. Additionally, a police has to be established for the management and controlling of the different expected bureaucracy that may be formed at the lower government level.

### *2.8. Low Quality of Wheat Products*

For import substitution and export the wheat products, it has to meet the marketable and food processing food quality parameters. It is clear that many stakeholders are involved in the wheat agree food industry from producers to consumer. The quality properties of a grain are affected by its genetic traits, the growing period, timing of harvest, grain harvesting and handling equipment, drying system, storage management practices, and transportation procedures [16]. Other Climatic factors such as temperature, precipitation, and drought type, soil factors such as soil type, soil organic matter content, and nitrogen fertilizer input can also affect wheat quality in addition to the yield.

In Jimma zone, the quality of the produced irrigated wheat is affected because of the post-harvest and storage problem. For harvesting the farmers are losing the yield as well as the quality awaiting for the government officials and others to get a media coverage. Even though, reporting the works done through the irrigated wheat to encourage the other farmers and other private sectors, awaiting the government bodies for reporting is declining the quality of the products. In this regard it has to be reported before the harvesting time. The other constraint is that there is little or no concern given from the agricultural experts on the quality of the product and has to be improved.

## 3. Opportunities of the Irrigated Wheat Production

Even though there are a lot of constraints that limit the production and productivity improvement of irrigated wheat production in Jimma Zone, there are a lot of opportunities that encourage farmers, government organization and policy makers to continue the production. Some of the opportunities but are not limited to are as listed below.

1. Availability of water resources and irrigable land.
2. High government attention and involvement for the production of irrigated wheat.
3. Increment of the farmer′s awareness on the production and productivity improvement of irrigated wheat.
4. High demand of wheat from the consumers and increase of the market cost additionally, there are food processing industries constructed in the zone and nearby areas which demand wheat and this opportunity create a market access and enhance the market cost.
5. There is a strong interest from Agricultural researchers to study and contribute new research and improve the previous work for the production and productivity improvement through the supply of improved seed, irrigation technology, efficient nutrient management, suitability of the land and respective irrigation method to be adapted.
6. Expansion of urbanization which demands agricultural production is also an opportunity for the production of irrigated wheat.

## 4. Conclusion

The production and productivity of irrigated wheat was challenged by socio-economic factors, biotic and abiotic factors. Input supply such as fertilizers, improved seeds, farm machineries, lack of water pumps, low performance of irrigation infrastructure for delivering the required quantity of water are among the constraints affecting the irrigated wheat production. Availability of water resources and irrigable land and high demand of wheat from the consumer side are among the opportunities that encourage farmers and other stakeholders to involve in the irrigated wheat production in Jimma Zone. Land use planning is essential from the local government bodies for its implementation and the quality has to get an attention from the producer side.

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