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Irrigated Agriculture and Nutrition Linkage in Ethiopia

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ABSTRACT: In recent years, there has been a greater emphasis on the relationship between agriculture and nutritional outcomes. Since early 1980s, the relation between agriculture and nutrition became a matter of debate. Though little said about irrigated agriculture's link to nutrition, there is evidence as nutrition problems could only be solved through multisectoral approaches. Nutritious food is threefold costly than only energy food in Ethiopia. From the recent survey, lack of dietary diversity, mainly vegetables, and fruits in children and adults, is the main reason for malnutrition. The national nutrition programs, strategies, and revised food and nutrition policy focus on the country's potential to promote irrigated agriculture to contribute to nutrition-sensitive irrigation programs to avoid malnutrition adverse impacts on human health and nutritional status. Irrigated agriculture provides year-round production and improves household food security through production and market diversity and improving household income to spend on food and non-food expenses.

I. INTRODUCTION

During the past two decades, the world has made great improvements in reducing hunger yet, over 821 million people are starving. The food production increase by 300% in the globe since the mid-1960s was not proportional to the demand. Malnutrition remained a nagging problem being the leading cause of morbidity and mortality (Food System and Nutrition). According to the World Health Organization (WHO, 2010), undernutrition contributes to about more than eight million children death worldwide. Children, young girls, pregnant and lactating mothers are more prone to be affected, resulting in intergenerational malnutrition cycles in developing countries, especially in Sub-Saharan Africa (Mwaniki et al., 2013).

Undernutrition is still a top priority for many developing low- and middle-income countries. This is particularly apparent in the Sustainable Development Goals (SDGs), where nutrition is addressed in 12 of the 17 (roughly 70%) goals (Nutrition and the Sustainable Development Goals). In Ethiopia, 35 percent of the population is exposed to the risk of undernourishment due to insufficient food consumption to meet daily energy requirements, and lack of dietary diversity resulted from high dependence on staple foods and lower protein consumption (HLPF 2017). Cereals and starchy roots are the two main food groups consumed by Ethiopians. Maize, sorghum, and Teff are the most common cereals, while Ensete, potatoes, and sweet potatoes are the most common starchy roots. All other food groups have limited supplies. In most households, both in Ethiopia's rural and urban areas, their diet lacks animal source proteins, fruit and vegetables due to lack of access (FAO 2004).

Ethiopian national Food and Nutrition policy designed a food-based approach as a long-term and sustainable solution to nutrition security.The approach aims to enable the community to choose healthy diets from different combinations of food groups. In line to this, policy and strategic documents to support food and nutrition like National Nutrition Strategy (NNS), School health and nutrition strategy, Food security strategy, Seqota declaration, Social protection policy, and Growth and Transformation Plans (GTP) developed. The nutrition-specific and nutrition-sensitive interventions are given equal emphasis and supported by the government. The

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nutrition-sensitive interventions and programs that contribute indirectly to address the underlying determinants of nutrition include agriculture and food security, social safety nets early child development, maternal mental health, women's empowerment, child protection, school feeding, hygiene and sanitation, and family planning services. Agriculture and other sectors' integration with nutrition is key to archive the nutrition goals and actions to address underlying causes of malnutrition (Ruel et al., 2013).

Dietary diversity has been recognized as essential for adequate nutrient intake. Lack of diversity in the diet is strongly associated with inadequate nutrient intake and is a risk for deficiencies of essential micronutrients (USAID, 2011). Agricultural food production has a great role in contributing to nutrition through livestock, fisheries, and forest products. The food processing industry also plays an increasingly important role in shaping food security and nutrition. Though erratic rainfall in rainfed agricultural systems has far-reaching and destructive effects for already fragile livelihoods and local economies, addressing food and nutrition insecurity is a priority development area for the country. Currently, it's understood as irrigation Agriculture provides year-round production and improves household food security through production diversity. Increased irrigation coverage is one of the priority strategies outlined in the Seqota Declaration, which aims to eliminate stunting in children under the age of two by 2030 by ensuring that three million people have year-round access to sufficient food (including animal-source protein). Irrigation agriculture plays a crucial role in enhancing agricultural biodiversity, which serves as a foundation for food and nutritional stability. Increasing agricultural production diversity and amount, in turn, advances the poverty reduction in the country by contributing to dietary diversity (MoWR, 2002)

According to a recent study, the capacity for irrigation to influence nutrition and health outcomes by assisting year-round production has yet to be fully explored (Domènech 2015). Also, the concept of food diversity has yet to be fully incorporated into agricultural and food systems and policy planning and evaluation (Remains et al., 2011). This article aims to fill the information gap existing between the link of irrigated agriculture and nutrition by reviewing the existing literature on the topic.

II. LITERATURE REVIEW

2.1 Irrigated Agriculture in Ethiopia

Small-scale subsistence agriculture dominates Ethiopia's economy, accounting for 46 percent of GDP, 85 percent of export goods, and 85 percent of jobs (Makombe et al., 2007). The bulk of this industry is reliant on rainfall in the country and only small areas covered with irrigated agriculture. Irrigation is a very old agricultural method commonly used by several early cultures, including the Egyptians and Ethiopians, according to Grove (1989) cited by (Chazovachii 2012). According to evidence, irrigation has also been practiced for a long time in Egypt, China, India, and other parts of Asia. In certain countries, irrigation is the pillar of life. Irrigation and better agricultural water management enable farmers to cope with the effects of climatic fluctuations while also increasing productivity per unit of land and volume of output. (Diao and Nin Pratt, 2007). Egyptians, for example, have relied on the Nile for irrigation for a long time and on a wide scale (Zewdie et al., 2007). Irrigated agriculture is not a new phenomenon in Ethiopia. According to some literature works, small-scale irrigation has been practiced for decades in the highlands, where small farmers diverted seasonal rivers for limited dry season cropping (FAO, 1994).

Ethiopia is a water-rich country, and it is sometimes referred to as the "water tower of East Africa" owing to its ample water supply (Adugna, Ermias, Mekonnen, & Mihret, 2014). It has a large water supply capacity, with an annual surface runoff of 122 billion-meter cubes and 2.9 billion-meter cubes groundwater (Tesfa and Tripathi, 2015). However, the country has a strong potential source, been using a limited percentage of its plentiful water supplies for irrigation. The gross irrigable land capacity is projected to be 5.3 million hectares (ha), with 1.6 million hectares available by rainwater irrigation and groundwater (Awulachew, 2010). In the 1960s, large irrigation projects in the Awash Valley were planned to grow food crops for domestic consumption and industrial crops for export. It was widely believed that rain-fed agriculture should be supplemented by irrigation to achieve national and household food security. Ethiopia has a total irrigation capacity of 3,798,782 hectares, but irrigation programs have only covered 368,160 hectares, or 10% of the full irrigation capacity (MoFED, 2013).

Irrigated agriculture is a substantial entry point for malnutrition reduction as water is frequently a limiting factor for crop and livestock production. Even though irrigated agriculture has a

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inordinate potential for expansion in small-scale agriculture, nationally, only 3% of the total cultivated area is irrigated. Nearly 97% of the food crops in Ethiopia are produced by rainfed agriculture from total production (FAO, 2015). The capacity of the country to promote agricultural production through irrigation growth has been low (Beyera, D., 2004). There are more pieces of evidence on the impact of agricultural interventions on nutrition outcomes, especially for children and women. From the reviews at various times, the contribution of home gardens and irrigation interventions to nutrition were rarely considered (Berti, Krasevec, and FitzGerald, 2003; World Bank, 2007; Masset et al., 2012; Girmard et al., 2012; Webb, 2013).

2.2 The Nutrition Situation of Ethiopia

The Ethiopian population is over 110 million, making it the country's second-most-populous in Africa, next to Nigeria. (World Bank 2019) The population has been rising at a 2.6 percent annual rate (CSA, 2007). The rapid growth of the population exacerbates critical gaps in food and nutrition security and basic health services. In Ethiopia, the social and economic burden of child malnutrition was 5.5 billion dollars in 2009, accounting for 16.5 percent of the total GDP. Subsistence agriculture is the main source of income and economic productivity to 84% of the Ethiopian population living in rural areas. The country faces significant undernutrition problems, including restricted dietary diversity, inadequate food and micronutrient intake, and poor health services. According to the Ethiopian Demographic and Health Survey, there are declining chronic and acute malnutrition trends over the last two decades. Despite recent developments, Ethiopians continue to suffer from chronic and acute malnutrition (CSA & ICF 2017).On a technical level, the chronic malnutrition (stunting), wasting, and underweight for children 6-59 months has decreased significantly from 51% to 37%, 12 % to 7 %, from 33% to 21% respectively between 2005 and 2019 but the percentage of children 6-23 months who fed according to the minimum acceptable diet standards showed a small increase from 4% in 2011 to 7% in 2016 (FDRE 2019).

Dietary diversity is a proxy indicator for adequate micronutrient density of foods. Tubers and cereals dominate food consumption baskets in rural households. According to recent studies, low dietary diversity in rural areas can be explained by a lack of product diversity, market diversity, or purchasing power. The production and consumption of HHs may be influenced by a lack of knowledge about the health benefits of different diets. Access to markets in areas where food crop production is not diverse helps to diverse diets than households in similar neighborhoods. Still, with bad access to markets, even if they have access to markets and are aware of the advantages of various diets, low-income families cannot afford nutrient-dense foods (Warren & Frongillo 2017). Certainly, understanding poor dietary diversity in Ethiopia, prices, and availability of nutritious foods need more focus and study. WHO recommends 146 kilograms per year per adult fruits and vegetable consumption but, in 2011, the average Ethiopian household ate just 42 kilograms of equivalent per year (Hassen Worku, Dereje, Minten, & Hirvonen, 2017, Hall, Moore, Harper, & Lynch, 2009).

The affordability of a diet depends on two factors: the cost of the diet and the income a household has at its disposal. The cost of a diet that meets nutrient needs is more expensive than one that meets calorie needs only. A diet providing enough macro-and micronutrients would cost on average 3.4 and 3.8 times more than a diet meeting energy needs only in Amhara and Oromiya, respectively. The cost of an adequate nutrient diet was rising in 2020, one in ten households cannot afford an energy-only diet, and seven in ten households cannot afford a nutritious diet. Consuming a nutritious diet is three times more expensive than an energy-only diet. The cost of an energy-only diet is ~0.90 US $ and the cost of a nutritious diet (~2.60 US$ per day per household. (Cost of the Diet: EPHI/WFP, Oct 2020). Currently, the country faces high staple food prices and is lower than typical income because of locusts, the COVID-19 pandemic, and conflict. (Cost and affordability of nutritious diets bulletin Issue 2—December 2020)

2.3 Irrigation Agriculture and Nutrition Linkages

Malnutrition causes are multifaceted, and single-sector approaches may not bring intended results in the reduction of undernutrition. It is Confirmed that single sector; the healthcare alone with dietary or micronutrient supplementation and the promotion of optimal feeding and caregiving practices efforts couldn't improve children's nutrition and health as effectively as hoped (Dewey and Adu-Afarwuah, 2008; Humphrey, 2009). As a result, the correlation between agriculture and nutritional outcomes has received more attention in recent years (Dorp et al. 2011). The effect of agricultural production on nutrition has been

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studied, and potential pathways for the relation have been established (Masset et al., 2012; Girard et al., 2012). Ethiopia's multisectoral nutrition program planning and implementation have been the topic of few studies. Little is also said about the relation between irrigated agriculture and nutrition outcomes, especially for children and women. Kennedy et al. (2010) conducted a longitudinal study that identified key nutrition issues such as undernutrition, food security, and micronutrient deficiencies. Low levels of understanding were also a concern, as were issues of leadership, teamwork, cooperation, advocacy, and a lack of dedicated budget lines. (Webb, 2014; Berti, Krasevec, and FitzGerald, 2004; World Bank, 2007; Masset et al., 2012; Girard et al., 2012)

When comparing farmers who use irrigation systems to those who depend on rainfed agriculture in Ethiopia, the former generated twice as much, if not three times as much, in a single cropping season. (Aseyehegn et al., 2012). Irrigated agriculture resulted in reduced crop loss due to more secure water supply, multiple cropping due to the ability to plant during the dry/lean season, and a larger area of cultivated land due to the use of areas where rainfed production was previously unfeasible (Lipton et al., 2003). Household expenditure is influenced by agricultural activity. When there are business imperfections, the effect becomes more evident (Villa et al., 2010 cited in Carletto et al., 2015). Even with market limitations, production and consumption still become inextricably linked (Singh et al., 1986 cited in Carletto et al., 2015).

Diversified farming practices are viable options in the face of declining farmlands, land loss, climate change, and sustainability issues. Increasing evidence suggests practices like poultry and small ruminant production and fruit, vegetables, and pulses help biodiversity (Romeo et al., 2016). Irrigation agriculture is regarded as a basic strategy in Ethiopia for alleviating poverty and ensuring food security. It is beneficial to convert a rain-fed agricultural system that is reliant on rainfall into a rain-fed and irrigation agricultural system. This is thought to be the country's most influential means of long-term growth. However, further research into the development of irrigation practices in Ethiopia is needed.

Irrigation, because of increased water availability for crop production and other uses, can dramatically alter smallholder livelihoods and food security (food availability, access, consumption, and stability). It has a direct effect on food supply due to increased productivity and improvements in cropping patterns. Furthermore, irrigation would likely increase the food supply's stability because its main purpose is to improve water control, reducing or removing the potentially negative effects of too little rain on production. However, is it true that having more food and probably having more money leads to increased food access and utilization? Greater food availability obviously fevers greater food consumption, but this isn't always the case, particularly if men make crop decisions. Irrigated crops are often cash crops, and cash crops are usually the domain of men. If the sale and the proceeds from the sale are included, intrahousehold food and nutrition outcomes do not change (Quisumbing et al., 1996)

Vegetables and fruits are an excellent source of micronutrients, vitamins, and minerals from a nutritional standpoint. Evidence from various programs showed as irrigation is also essential for rising vegetable production and consumption (De Fraiture and Giordano, 2014). Helen Keller International and others introduced homestead food production programs that increased the number of vegetables generated by intervention households (Olney et al., 2015; Iannotti et al., 2009). Homestead gardens can greatly contribute to improved and diversified diets because a large portion of the food produced in them is consumed within the household. Irrigation is used to grow vegetables and fruits in many of the papers studied, either exclusively or to some degree. Given the continued scarcity of supplies in much of Africa, farmers may sell vegetables and fruits locally to supplement their income while also benefiting the community's nutrition (Burney et al., 2013). Irrigation can help farmers become less reliant on rainfall, increase irrigated farmland, create jobs, encourage farmers to grow twice or three times a year, and use more inputs. In developing countries, small-scale irrigation was a way to boost productivity, reduce reliance on rainfall, and provide employment for the poor (Chazovachii, 2012). As a result, irrigated agriculture is widely recognized as critical to rising land productivity, improving food security, earning higher and more stable incomes, and increasing crop diversification and multiple cropping (Smith, 2004).

2.4 Ethiopian Food and Nutrition Policy and Implementation Challenges

Ethiopian Food and Nutrition policy is based on the global conceptual framework for nutrition security as a change model to address the existing causes of nutrition insecurity at various levels. The policy framework focuses on short, medium, and long-term strategies in an integrated

way to address the different layers of nutrition problems. Implementation of the policy relies on evidence-based approaches and implementation framework to ensure sustainability, cost-effectiveness, coordination, and community involvement. The revised National Food and Nutrition Strategy also reflects the integrated approach and recognizes agriculture as a key component to reduce undernutrition (Woldehanna, 2014). Mainstreaming nutrition into agriculture (nutrition-sensitive agriculture initiatives) is from the first initiatives government took as nutrition-sensitive interventions. As a result, the declaration's implementation framework considers the involvement of up to 11 relevant ministries (GoE, 2015).

Ethiopia's nutrition policy actually faces the greatest challenge in terms of execution rather than policy formulation. The second National Nutrition Program (NNP) promotes direct strategies as well as multisector approaches to minimize hunger through the life cycle. Ethiopia also faces two major challenges: inadequate policy planning and execution, which have hindered the transformation of nutrition policies and services into action and results. The implementation is disjointed, sluggish, or overly delayed. Ethiopia is not alone in facing political and economic challenges (Reich & Balarajan 2014; Balarajan and Reich 2016).

The government has recognized the importance of a multisectoral approach to nutrition policy, program design, and implementation since the launch of the first National Nutrition Strategy in 2008 (FDRE 2008). This also means that politicians are aware that nutrition is prejudiced and influenced by a variety of variables that interact in a variety of ways. At all levels, more engagement, coordination, and a focus on the country's available potential are needed for the implementation of both nutrition-specific and responsive initiatives. Unlike conventional approaches to nutrition initiatives, which tend to search for issues in the community that need to be addressed and a lack of resources to look for the current capacity and strengths that exist in the community and nation, the existing potential and strengths that exist in the community and country must be built on and centered (CORE, 2002)

III. CONCLUSION

This review paper thoroughly reviewed irrigated agriculture's contribution to improv the nutrition security of the country. The review of different articles, books showed as Ethiopia has the untapped potential of irrigated agriculture, which can be linked to nutrition from the design phase to be used for nutrition-sensitive agriculture. The main nutrition problem, dietary diversity, can be addressed at HHs with small landholdings if irrigated agriculture is linked to nutrition intervention promoted in a coordinated manner. Enabling platforms established policies and programs to use irrigated agriculture and nutrition linked to reduce the current national nutrition challenges related to production and dietary diversity. Through the Water Sector Development Programs and Ethiopian Irrigation Development Planare are yet to be sensitised, this work has thoroughly reviewed Ethiopia's policies and strategies that strongly support irrigation development, especially small-scale irrigation. Irrigation initiatives can boost nutritional outcomes in several ways, including improved efficiency and food supply access, and healthier diets (in quantity and quality).

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