Hindawi
Advances in Agriculture
Volume 2022, Article ID 5741528, 12 pages
https://doi.org/10.1155/2022/5741528

Review Article

Economic Viability and Use Dynamics of the Enset Food System in Ethiopia: Its Implications for Food Security

Teshome Sirany,[1] **Esubalew Tadele**,[2] **Tewabe Hibistu**,[2] **Alemayehu Kefalew**,[3] **and Haimanot Reta**[3]

[1]*Department of Rural Development, Debre Markos University, Debre Markos, Ethiopia*
[2]*Department of Agricultural Economics, Debre Markos University, Debre Markos, Ethiopia*
[3]*Department of Biology, Debre Markos University, Debre Markos, Ethiopia*

Correspondence should be addressed to Teshome Sirany; siranyselam@gmail.com

Received 28 December 2021; Accepted 23 February 2022; Published 15 March 2022

Academic Editor: Laszlo Vasa

Food security is a key issue worldwide and must be considered in both spatial and temporal contexts. Securing the availability of food somewhere in a country does not ensure food security in other areas. Similarly, securing food available today does not guarantee its availability tomorrow. Therefore, parameters such as rapid population growth, urbanization, changing consumption patterns, and globalization, as well as climate change and depletion of natural resources, must be kept in mind while planning the issue of food security. In this regard, Enset, which is a large perennial herbaceous crop native to Ethiopia, is highly stapled to approximately 20 million people in the southern, eastern, and central parts of Ethiopia. It is a common practice in the agricultural system of these areas, making these areas Enset belt regions of the country. On the other hand, the remaining parts of the country often do not practice such farming systems despite the fact that there are good opportunities to do so. One way of expanding the experience of Enset culture is through promoting its food system and multiple-use dynamics. Hence, decision-makers and policy designers in the area of agriculture would consider intensifying Enset to its nonbelt areas, to transform agricultural and food systems to end hunger, achieve food security, and improve nutrition.

1. Introduction

Nearly one in three people worldwide sustains at least one type of malnutrition. Fast climatic, demographic, and nutritional changes have caused living situations and consumption habits, leading to the coexistence of overnutrition and undernutrition [1].

Certainly, it is not always uncommon to locate humans with different forms of malnutrition living side-by-side in one country, in one community, or even in the same household. In the same manner, billions of people suffer from hunger yet in the universe. Food security and nutritional status are among the main challenges countries face. Finding a radical solution to this problem is a matter of a country's survival [2, 3].

The issue of food security has remained a sensitive issue in the hearts of the United Nations Programs. The Food and Agriculture Organization (FAO) recommends widening preferable food choices beyond being local staples to satisfy consumers' preference for taste and quality. Furthermore, the United Nations (UN) Sustainable Development Goals (SDGs) adopted in 2015 stressed the need to transform agriculture and food systems to end hunger, achieve food security, and improve nutrition by 2030. In addition, UN SDGs call nations to reshape their food systems [4] that also go with the theory of change [5].

All of these suggestions from the FAO are to produce more productive crops that would be more inclusive and take into account poor and marginalized people. Moreover, crops targeted for sustainable development goals (SDGs) are also recommended to be environmentally sustainable and resilient and able to deliver healthy and nutritious diets.

People in Ethiopia suffer food-related challenges due to major factors such as internal conflict, drought, climate

change, famine, and traditional farming system practices. Indigenous knowledge exchange on agronomic practice and feeding culture on historical food crops within Ethiopian people is becoming an approach to determine domestic solutions to the existing famine and food shortage in the country.

In this sense, Enset (*Ensete ventricosum (Welw.)*) Cheesman) is a crop that tolerates prolonged periods of drought, floods, and many diseases. Due to its tolerance to drought, it is considered a priority crop in Ethiopia, where it makes an important contribution to the country's food and nutritional security, as it is a staple food crop [6, 7].

Furthermore, the Enset crop has proven potential for famine, and its food culture saves millions of people in southern, southwestern, and central Ethiopia during prolonged periods of famine [8]. It can also qualify to be a target crop to achieve the UN SDGs to end hunger, achieve food security, and improve nutrition, particularly in countries such as Ethiopia, where it is more at risk of famine due to unpredictable factors, population growth, unfavorable weather conditions, and unstructured food systems.

Therefore, the Enset crop is versatile and has to be promoted to a wider area as a subsistence crop on the agricultural systems of other parts of Ethiopia, as there are clear possibilities and opportunities for adapting and growing it. However, there are challenges in improving Enset's existing farming practices outside of the current narrow distribution [9]. We suggest two major challenges that hamper the expansion of existing Enset farming practices elsewhere. One is the poor characterization of the culture, and the other is poor documentation of existing knowledge and practices associated with the Enset culture. However, the authors of this article also create some other challenges (understanding the food system and its use dynamics) other than the two mentioned by Barrel et al. [10] that still contain crops that should not be grown in other areas of the country. Accordingly, this review was initiated to analyze scenarios from the relevant literature on the botanical description, spatial distribution, and food system and to use the dynamics and nutritional potential of Enset with respect to common stable crops to intensify it elsewhere to improve the palatability of crops throughout the country and achieve the UN SDGs.

2. Review Methodology

This review article is based on agreed concepts, empirical results, and information collected by researchers from areas of Enset farming regions. In addition, the authors' experience and long-term exposure to people who have long-term Enset farming practices were considered in the entire review work. Temporal and spatial attributes that can filter content, including recent and older works that indicate the dynamic role of the food system and its nutritional potential of Enset with respect to common stable crops for Ethiopians, are also used as tools to organize this review.

Furthermore, to see the position of Enset crop in the food system, the authors tried to comprehend scientific facts from different articles and produce maps on the food system that interlinks between how we produce, process, transport, buy, consume, and dispose the food we eat and the way this affects us as individuals and communities from our country experience. In addition, the authors also address the following questions that help the reader obtain a full image of the proposed crop to combat hunger. What is the crop link with the food security? What are the used dynamics for individuals, communities, societies, and the environment? And search, has it nutritive potential with respect to common staple crops?

The information content by Google Scholar, Web of Science, Scopus, MPDI, and SAGE, a research gate that mainly focused on peer-reviewed published journal articles, books, reports, periodicals, and proceedings, was used to develop this review article. The search was filtered using important keywords such as "Enset," "food system," "Enset contribution," food security "Enset farming," "nutritional composition of Enset," and recent issues of Enset production in Ethiopia. Overall, more than 90 journal articles, books, proceedings, thesis works, and agency reports related to the topic were browsed, and approximately 64 materials were prioritized specific to the topic to be used for this review work.

3. Enset Crop Botanical Description

Robust perennial with swollen base up to 3 m circumference. Pseudotrunks can grow to approximately 12 m in height, but usually only 2–5 m, basal rosette of leaves only when young; approximately, 40 are produced during the lifetime of the plant. Leaves oblong to oblanceolate-oblong, up to 7×1 m, bright to dark-green, midrib, petiole, and margin sometimes pale to dark red or dark purple, rarely the lower side reddish. Leaves die back before flowering, and after fruiting, the whole plant dies. The male flowers produce copious pollen, and the female flowers produce much nectar, which attracts large numbers of honeybees [11].

Enset (*ventricosum* (Welw.)) Cheesman) is an indigenous subsistence crop in the home garden system of Ethiopia. Morphologically, it has more resemblance to the banana plant (Musa × paradisiaca), and as a result, Enset is also referred to as a false banana. It is a large, thick, single-stemmed plant with an underground corm, a bundle of leaf sheaths that form a pseudostem, and large leaves. Enset is larger than banana plants, with the largest plant reaching up to 12 m pseudotrunk tall and with a swollen base up to 3 m in circumference [9].

3.1. Enset Crop Spatial Distribution. Globally, Enset grows in many tropical countries, although its corms and pseudostems (also called pseudotrunk) are not often exploited as a food resource [13]. For instance, it has been reported to grow in North and Central Vietnam (Asia), as it was once used as emergency food during the Second World War (WWII) [14].

In Africa, the wild Enset is found in East, Central, and South Africa [15]. However, what makes this crop unique to Ethiopia is that it is the only country in the world to cultivate

Enset in the farming system for subsistence purposes [16]. It is estimated that Ethiopian farmers domesticated Enset possibly approximately 6000 [13] and/or 8000 years ago [14] and even 10,000 years ago [17]. The center of origin and initial domestication of the crop is speculated to be the northern highlands around Lake Tana, Gondar near the Simien Mountains, and Adigrat areas [18], whereas the center of its cultivation is the mountain area of southwestern Ethiopia [19].

Studies on the spatial mapping of Enset culture regions in Ethiopia indicate that it is abundantly cultivated as a home-garden system in southern, southwestern, and central parts of the country (Figure 1) [20]. These areas are called Enset belt areas in the country, as the crop is the source of staple food for the areas [21]. The crop is a multipurpose plant in which all parts are utilized for different purposes [22]. Some of these materials are used as human food, animal forage, fiber, construction materials, medicine, and cultural practices [23]. It also improves the soil nutrient balance [24]. Moreover, it is also an important component of agro-biodiversity and provides shadows and thus moderate temperatures to the farming system [25].

The plant is cultivated for human consumption. The main foods obtained by Enset are locally called Kocho (cooked flatbread obtained from a fermented mixture of peeled leaf sheath and corm), bulla (water-insoluble starchy product obtained by squeezing collected pieces of leaf sheath and corm), and amicho (inner part of the corm eaten after being boiled). These foods are used as staple foods (Figure 2) for approximately 20 million people in the belt area [27].

It is estimated that each Enset crop produces up to 40 kilograms of food from the fully mature plant in four to five years. A study conducted by [26, 32] revealed that Enset produces the highest yield per hectare and highest energy content per kilogram of edible yield when compared with most of the major edible crops in Ethiopia. Moreover, Enset foods were found to be rich in nutrients, particularly rich in potassium, calcium, and iron, but low in protein. To balance this protein content in the Enset belt areas, people do have their traditional food management system, and they often use Kocho with some protein-rich foods, such as milk and meat products.

Historically, 1985 was remembered as being the bad year in Ethiopia, where there was a prevalent famine in most parts of the country. The only nations who were resilient to that hunger incidence were the Enset people. This indicates that the crop is a true crop to resist food insecurity.

4. Enset Food System Concept Map and Its Use Dynamics

4.1. Food System Map of Enset Crop. The food systems approach emphasizes the interconnected nature of global agricultural concerns. It depicts the interactions between production systems, consumer behavior, food security, climatic change, natural conditions (i.e., available natural resources), and socioeconomic developments. It avoids people from becoming trapped in silo thinking, in which opportunities to improve food security are sought within a particular subsystem without considering the impact of an intervention on other sections of the system, oblivious to potential trade-offs [33]. Hence, the food systems approach allows us to look beyond production activities alone. The increased attention to sustainability and climate resilience (and adaptability) in food system activities reflects this shift in focus from production chain activities to their outcomes. This reflects the food system's socioeconomic outcomes and environmental implications.

In general, as indicated in Figure 3, this multipurpose tree crop is interconnected with related resources, such as the boundaries of Enset production, inputs, transport, processing, trading, profitability, the key challenge, determination of producers, and consumption of food, as well as its impacts on the environment, income on producers, and society. This framework provides opportunities for more efficient use of social welfare, sheds light how important social welfare is, and sheds light on the trade-offs between different intervention strategies. It encompasses raw material suppliers to end consumers along with the production, processing, and overall distribution of Enset products. Within the boundary of Ethiopia, it highlights various positive (+) casualties that reinforce others and have a favorable impact on the Enset food system.

In addition, one can observe that some negative (−) sign in the system contributes to the unfavorable impact on the interlinked system. The latter requires further intervention for improvements, such as lack of skill, information, and knowledge, which unfavorably influence Enset production, and this needs to be addressed in the system. Furthermore, key challenges that have been verified from the rich picture include lack of value addition and diversification and lack of bargaining for smallholder Enset producers. This leads to low income for smallholder Enset producers and Enset tree potential for reducing land degradation that is not fully utilized.

4.2. Use Dynamics of Enset Crop. Enset crop is all things for millions of Ethiopians. Enset farmers testified that "there was no life" without Enset. It has dynamic importance, such as cultural, economic, environmental, social, and industrial fiber, is used for research purposes to produce culture media, and is used as traditional medicine. Enset has high implications for the daily lives of farm households producing this crop as a staple food. Farmers show that it is their food, clothes, house, bed, livestock feed, and plate. The major uses are presented below in the rich picture analysis of Enset use dynamics (Figure 4) [17, 34].

Lack of food in terms of quantity and quality is a major problem affecting livestock production and production in Ethiopia (Figures 4 & 5). Enset is a short-lived monocarpic plant that is widely grown in the central, southern, and southwestern parts of Ethiopia. Enset trees have a high water content (85–90%) and are used as animal feed during the dry season when other foods are scarce [22]. Pseudostems and corm are the most important components in terms of biomass. Enset leaves have a high protein (PC) content, which increases their potency during the

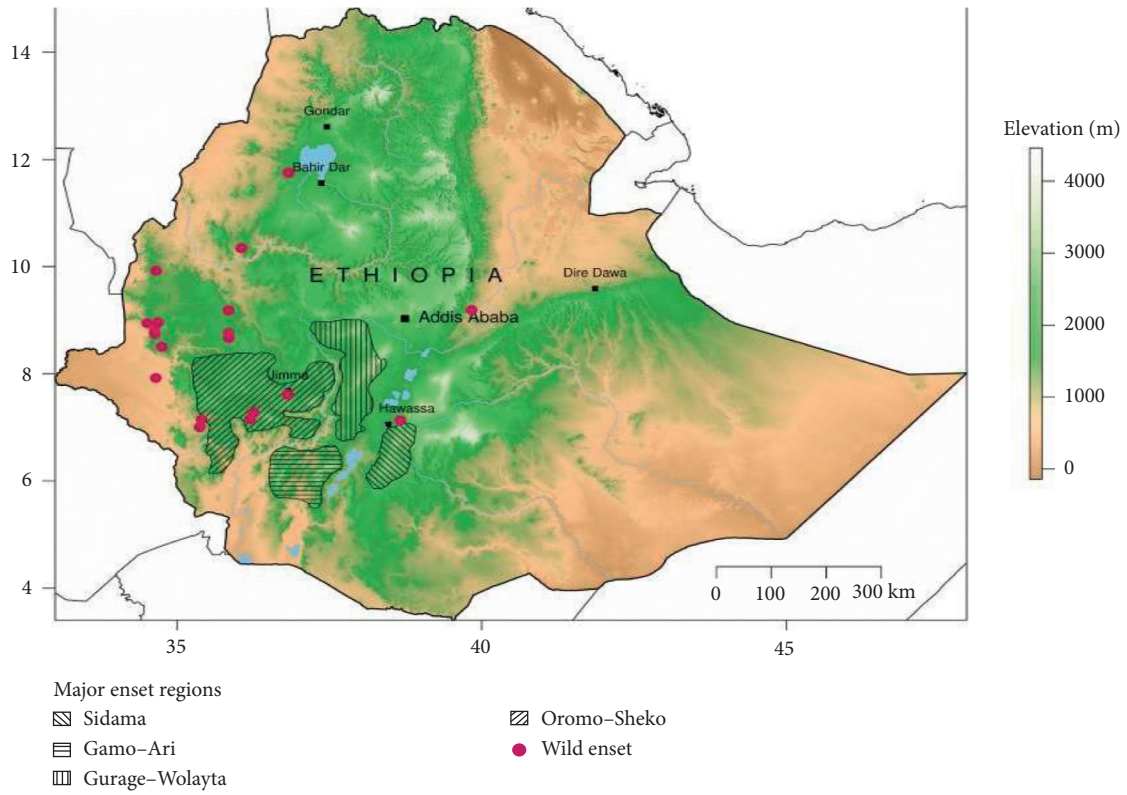

Figure 1: Distribution of major domesticated enset-growing regions, also called Enset belt areas (shaded polygon) and wild enset records (red points) in Ethiopia (Source: [20].

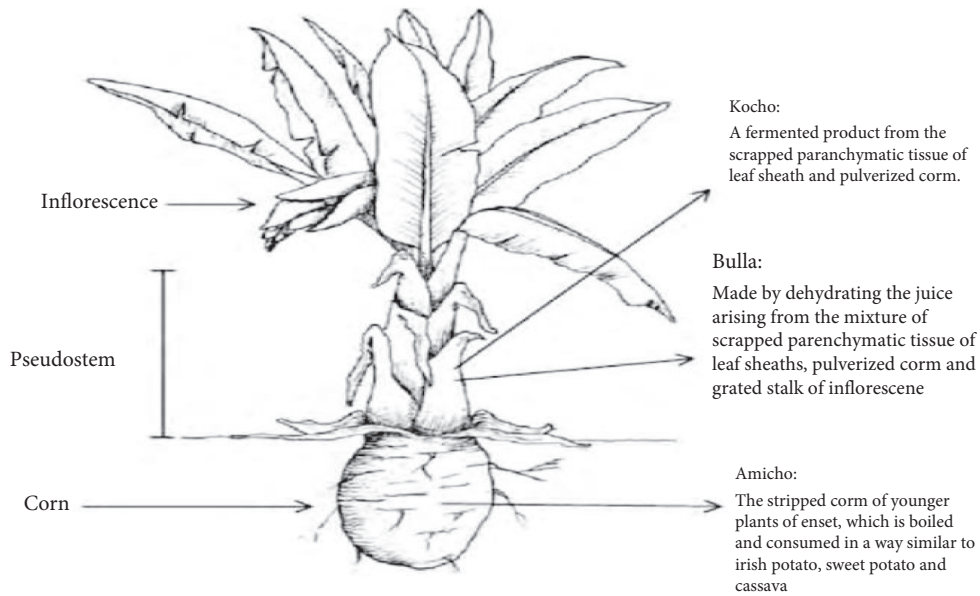

Figure 2: Morphology of the Enset plant and its major food products (Source: [26]).

dry season [31]. Additionally, [32] Enset leaves have a higher nutritional value than other crops. Its leaves are the main source of food for farm dwellers. The leaves and the stem of the middle shoot are used as a better forage. Therefore, this helps reduce livestock mortality during droughts.

Enset crops and animals are closely linked (Figure 5). The win–win strategies forced the farmers to cultivate Enset crops in their backyard throughout the year. Enset provides year-round food to the farmer, but its cultivation requires organic fertilizers obtained mainly from animals. Therefore, trees are used as animal feed, and animal solid and liquid

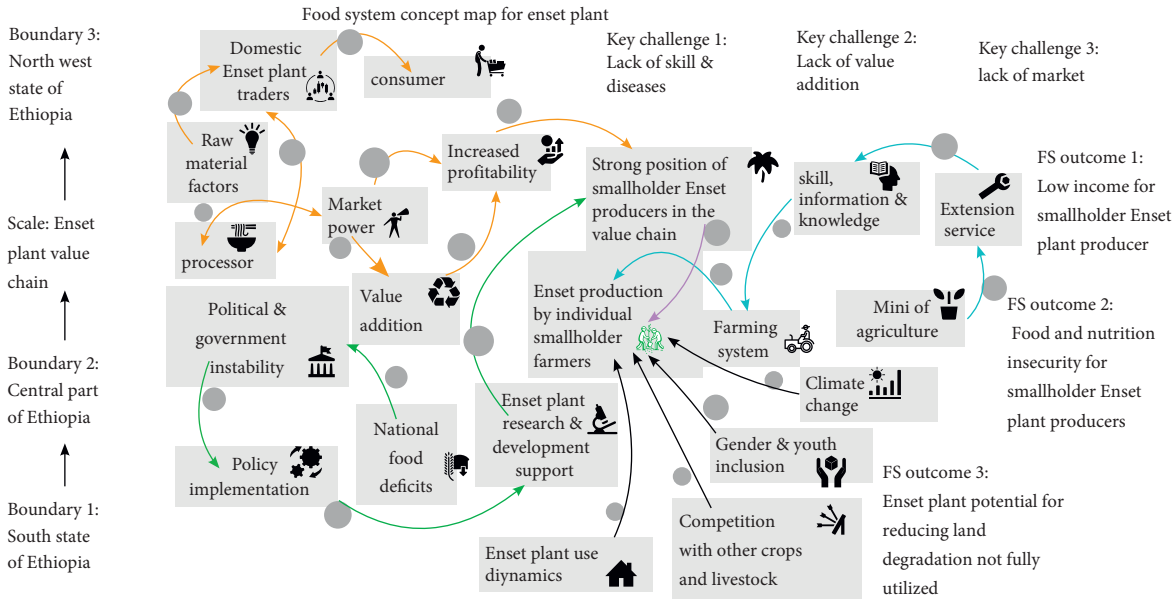

Figure 3: Food system concept for Enset trees. Source: authors own elaboration.

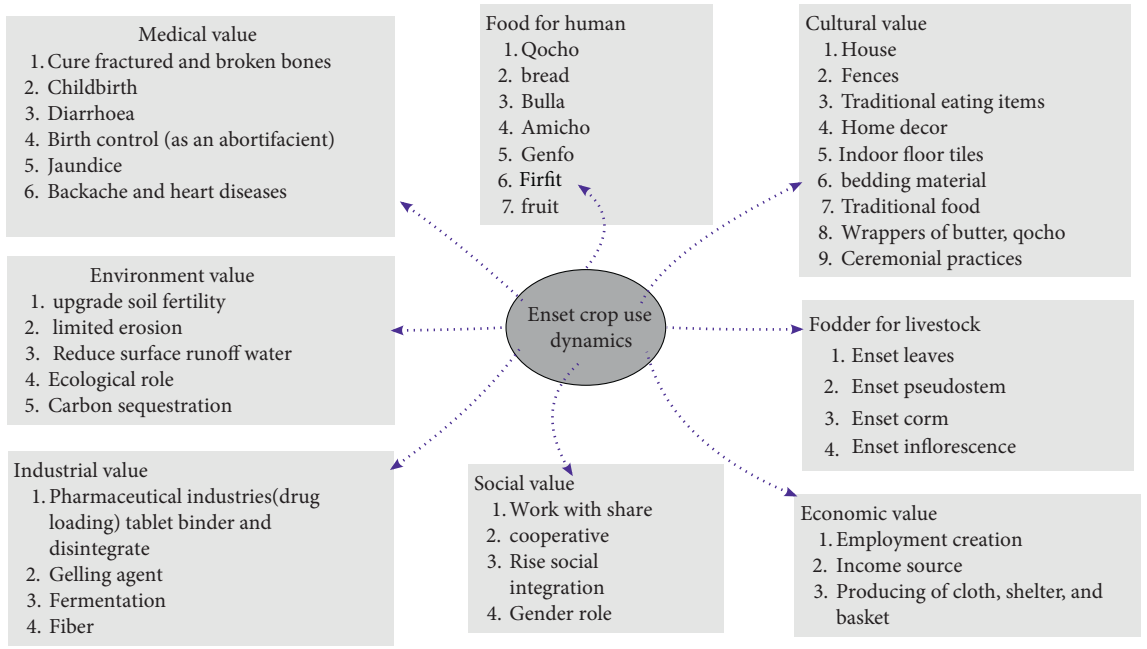

Figure 4: Use dynamics of Enset crop. Source: authors own elaboration.

urine produce manure, which is used as a fertilizer for growing Enset trees [33].

Enset could be a soil amendment tree, as shown in Figures 4 and 5. As a perennial tree, it does not necessitate tilling, and its large plant canopy intercepts rainfall: erosion is thus limited. Deep roots increase water penetration and reduce surface runoff, resulting in more water both within the soil and aquifers. Water volume, handiness, and duration of discharge to springs are increased, thus decreasing the effective length of the dry period [17]. Furthermore, after corm and pseudostems are cultivated, Enset leaves may be important for mulching and protecting soil, and enhancing organic matter. It has been reported that Enset raises soil fertility to a level greater than those of adjacent fields or pastures [34].

Enset growth is a cultural symbol and an expression of identity for Enset producers. Enset tree plants have special cultural meaning and value in millions of Ethiopians. The wealth status of a household is decided by the extent of Enset trees harvested. When the Enset tree is said to be the cultural pillar of the community, their houses, fences, traditional eating items, home decor, indoor floor tiles, bedding material, and traditional foods are all made from Figure 4. Moreover, the leaves are the most widely used wrapping

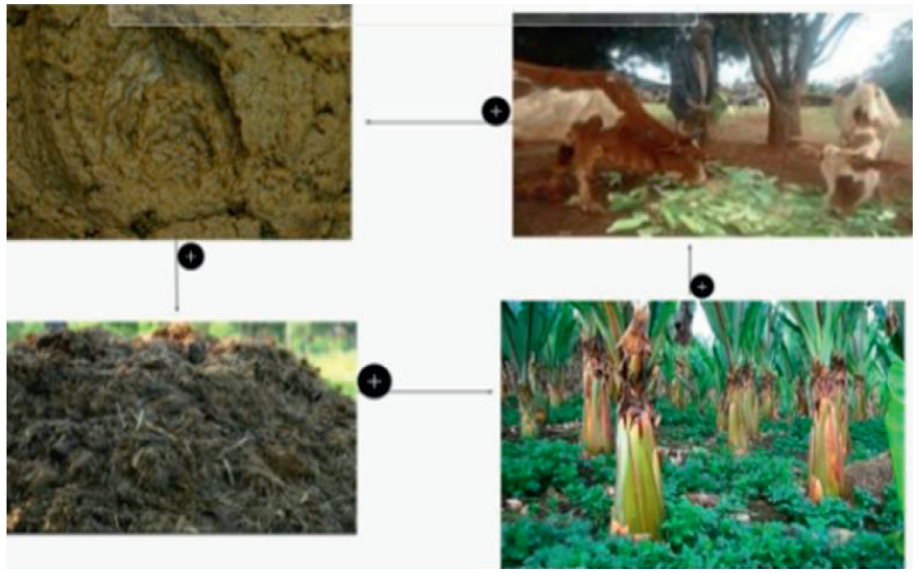

Figure 5: Enset tree nexus with livestock; source: authors own elaboration.

material, particularly for butter and other products that need to be kept cool and moist. Temporary ovens for baking special bread are made out of Enset leaves on which smoldering dung cakes are placed. In Ethiopia, the plant's fiber is also widely used for making bags and ropes and for basketry. Particularly in the dry period when grasses are scarce, Enset is significant for cattle forage; likewise, it is utilized as a source of fuel [35].

Another name of the Enset is the tree for living. It has more than 700 landraces and has different nutritional values for different races [36]. Enset food's function is both as staple regular diets and on occasions of cultural celebration; hence, Enset foods have various values for society. A tree is a food product that is used year after year over again; it is a plant that is very suitable for the body and is known to make the body very strong. It primarily utilizes food in three forms: bulla, kocho and amicho (see Figure 2).

Not only does Enset show a major contribution, as we discussed above, but it also plays a major role as an asset. It is a form of financial security based on income-generating and medicinal values (Figure 4). Additionally, it is important to pay annual land taxes and qualify as a buffer in the case of illness or any unexpected expenses. Specifically, landraces of Enset are also medicinally important for both humans and livestock to cure fractured and damaged bones, childbirth problems, diarrhea, birth control, jaundice, backache, and heart diseases [37].

4.2.1. The Potential and Use Map of Enset Crops for Food Security. The concept of food security varies, and the details have been published in various studies and policy practices. There were approximately 200 definitions of food security in the published literature [38]. The last adjustment to this definition occurred at the 2009 World Summit on Food Security, which added a fourth dimension (food availability/sufficiency, food access, food utilization, and food stability) [39].

The shift of smallholder farms from subsistence agriculture to the cultivation of stable and export crops and the use of high input uniform varieties by small subsistence farmers have worsened the situation of food security. In marginal areas, high-quality farming methods are not possible, as their natural costs are not tolerated by low-income farmers who do not have the resources and expertise to implement such practices. Producers of this level need low-input crop varieties that can adapt to the ecosystem and produce under unusual conditions [40, 41].

Diversification of crops is also essential from a nutritional perspective to balance people's regular diet. Root and tuber crop as well as Enset for their pseudostem and corm, grown together with vegetables, provide carbohydrates, valuable minerals, vitamins, and amino acids, making a significant contribution to household food quality and security [42].

In general, Enset is a new track to addressing food insecurity strategies by contributing largely to family food security and helping as a means of survival during times of drought, famine, shock, and risk. Enset has historically been attributed as a "tree against hunger" [17] because houseplants have important ascribes that help the food security of the communities that grow it. It has an important quality to cope with environmental stress, including periods of drought [43].

In this regard, food from Enset addresses the abovementioned four key dimensions of food security for the farming scheme of the densely populated highlands of the south, southwestern, and central surroundings of Ethiopia [44, 45]. However, agronomic practices and food cultures were not equally distributed to all Ethiopian people because food insecurity is a growing issue in Ethiopia. To conceptualize all roles of Enset, its detailed use maps in relation to the food security contribution of the community are presented in subsequent Figure 6.

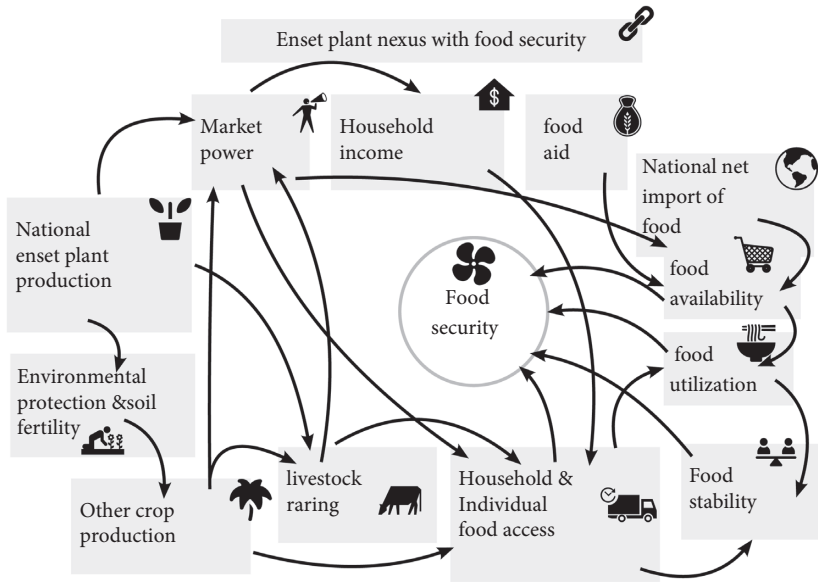

Figure 6: Enset crop link with food security. Source: authors own elaboration.

(1) Food Availability/Sufficiency. It is the convenience of adequate quantities of food in the right quantity, supplied through domestic production or imports, considering food aid. Enset is an underused starch crop with significant potential in Ethiopia. Enset grows over a wide range of altitudes but thrives at altitudes between 2,000 and 3,000 m a.s.l. in rainy conditions [42].

More than three million hectares of land are enclosed by Enset in Ethiopia, and approximately 0.69 million tons of Enset's crop is produced per year [46]. As a food crop, it is readily available, as food can be stored for a long time, grow in a wide range of environments, produce high yields per unit area (Table 1), and tolerate drought [32, 49, 50]. As a result, Enset Agriculture provides a long-term sustainable food supply capable of buffering not only seasonal and periodic food defects with minimal off-farm input but also demonstrates the potential that exceeds its current use in Ethiopia.

(2) Food Access. It refers to our capability to source good, quality food—food that is filling and enough for our individual needs. USAID [51] and Diskin [52] described that "individuals have sufficient income or other resources to purchase or trade to acquire levels of suitable foods needed to maintain consumption of a decent diet/nutrition level." On the one hand, Enset needs a relatively smaller area per unit of production than other crops, such as cereals, pulses, and oilseeds. As shown in Table 1, for 2012–2018, the average quintal per hectare is 1447. This number indicates that it has a higher quintal per hectare than other common stable crops. It creates an environment conducive to reduced productivity and food shortages in areas with large populations and arable land. On the other hand, everyone can obtain a portion of the Enset product (fermented kocho or bulla from nearby markets to fulfill household needs at any time). Enset, therefore, can support a larger population per unit area than regions relying on growing cereals [53].

In addition, not only food access, but also the issue of food safety becomes paramount nowadays due to the modern food industry taking a decisive share for the tourists' destination everywhere [54]. Food production and processing require special attention as various influences, manipulations, and reactions can occur regardless of the technological process or the cleanliness of the environment. Food and food ingredients can be contaminated at a very early stage because modern industrial agriculture cannot guarantee chemical-free soil conditions.

As Zsarnoczky [55] argues, addressing the long-term sustainability of local food production requires openness to technological development, the use of renewable technologies, and the production of nontraditional but sustainable types of food. Today's mass-produced products can be shipped anywhere in the world within hours of production. In free-market competition conditions, any margin of safety is considered a possible risk.

(3) Food Utilization. Available food, sanitation, clean water, and health issues are necessary to achieve a state of nutritional well-being in which all physiological needs are met [56]. The eatable elements of the plant are the underground stem (corm) and the pseudostem, which are pulverized and fermented right into a product wealthy in starch. Kocho, Bulla, and Amicho were the vital products received from Enset and were significant (Table 2). Kocho is used for consumption after being baked in the type of pancake, while Bulla, which is a solidified residual byproduct of Enset, is getting in the manner of producing Kocho. The former is the most costly of all products, and it is mostly used on holidays and cultural occasions [57].

Table 1: Comparison of Enset yield quintal per hectare nexus with common stable crops for 2012–2018.

Year	Enset	Teff	Barley	Wheat	Maize	Sorghum	Millet	Oats	Rice
2012–2018	1477	15.24	19.27	24.39	33.86	23.42	19.45	18.16	28.25

Source: Gizaw& Assegid [47] & CSA [48].

Table 2: Comparison of the nutritive value of the food nexus with wheat, maize, rice, and teff.

Food & its description	Local name	Composition in terms of 100 grams edible portion							
		Food energy Call	Moisture %	Protein gm	Fat gm	Fiber gm	Ash gm	Calcium mg	Phosphorous mg	Iron mg
Enset: Flour	Nset duqyet	196	49.7	0.9	0.2	1.2	1.6	77	60	10.1
Enset: bulla	Bulla	180.5	54.9	0.2	0.1	0.3	0.1	41	20	2.6
Enset: bulla, bread	Bulla, dabbo	186.1	53.3	0.3	0.1	0.3	0.3	45	18	4.6
Enset, bulla, porridge	Bulla, genfo	80.3	81	0.2	1.1	0.5	0.3	30	10	2.6
Enset: kocho	Qoch'o	211.1	46.7	0.6	0.3	1.2	0.9	32	36	3.7
Enset: kocho, bread	Qoch'o, Daboo	219.4	43.7	1	0.2	1.3	1.7	93	43	2.4
Enset, kocho, porridge	Qoch'o, genfo	90.6	78.9	0.7	2.2	1.3	1.2	50	21	4.9
Black wheat broad	Sindye, t'iqur, dabbo	205.30	47.5	5.7	0.5	1.3	1.8	76.00	222.00	19.60
BlackWheat porridge	Sindye, t'iqur, genfo	157.30	67.4	2.7	6.1	0.9	0.9	14.00	68.00	6.00
Black wheat whole boiled	Sindye t'iqur, yaltefetege, nifro	178.00	55.9	4.3	0.8	1.7	0.6	21.00	106.00	1.60
White wheat, bread	Sindye, nech', dabbo	222.00	44.5	6.8	0.8	1.2	1.0	27.00	213.00	2.70
WhiteWheat porridge	Sindye, nech', genfo	142.70	67.9	3.3	3.5	1.8	0.8	18.00	89.00	3.80
White wheat whole boiled	Sindye, nech', yaltefetege, nifro	211.30	47.0	7.1	0.9	1.6	1.3	30.00	125.00	4.00
Yellow, Maize, bread	Beqqollo, byich'a, dabbo	233.00	43.3	5.1	2.2	1.0	1.2	5.00	156.00	2.90
YellowMaize, porridge	Beqqollo, byich'a, genfo	141.40	69.4	2.6	4.6	1.0	1.0	14.00	72.00	2.40
Yellow maize whole, boiled	Beqqollo, byich'a, yaltefetege, nifro	182.80	55.7	3.8	1.9	1.3	1.0	5.00	106.00	2.70
Yellow maize, whole, roasted	Beqqollo, byich'a, yaltefetege, qolo	404.20	3.10	9.1	4.2	3.1	1.1	13.00	252.00	4.00
White maize, porridge	Beqqollo, nech', genfo	154.70	67.4	2.4	5.5	0.8	0.8	5.00	82.00	1.90
White maize boiled	Beqqollo, nech', Nifro	88.10	78.0	2.1	0.5	0.4	0.6	3.00	36.00	0.90
Rice whole-grain boiled	Ruz, yaltefetege, qiqqil	110.90	71.5	2.1	0.1	0.2	0.9	5.00	47.00	0.50
Tef, red, enjera	Tyef, qeyy, Injera	155.90	60.2	3.4	0.7	1.8	1.7	50.00	115.00	14.70
Tef, red, bread	Tyef, qeyy, dabbo	220.00	44.1	5.4	1.2	2.5	2.4	73.00	234.00	21.40
Tef, red, porridge	Tyef, qeyy, genfo	165.40	66.5	2.2	7.4	1.2	1.4	36.00	108.00	11.70
Tef, white, enjera	Tyef, nech', injera	145.00	63.8	3.0	0.6	1.0	0.7	56.00	100.00	7.00
Tef, white, bread	Tyef, nech', dabbo	214.30	46.2	5.0	1.1	1.6	1.6	71.00	225.00	11.50
Tef, white, porridge	Tyef, nech', genfo	193.70	68.8	0.4	14.5	1.2	0.9	13.60	111.00	7.20

Source: food and agriculture organization, n.d.

(4) Food Stability. Access to enough food at all times, autonomous shocks (such as economic or climate-related crises), or cyclical patterns. This includes issues of seasonal food instability, similar to the agrarian period before the crop known as the hunger season [56]. Enset plants are resistant to both drought and heavy rains. It can survive up to seven years without rain by storing water in its leaves, and every part of the plant has some sort of use. Most significant are the corm and the pseudostem, which contain large quantities of starch reserves readily available to humans [14, 43]. The corm can be harvested at almost any stage of harvest and cooked and eaten in the same way as other root and tuber crops, alleviating hunger during times of severe food shortages. Kocho can be reserved for a long period of time (for 10 years and even more) without being spoiled [17].

A study [58] found that 71.6% of households are food insecure through the use of household food insecurity access scale measures. These food-insecure households could not meet the required daily food from the income generated by their main activity of subsistence farming and nonagricultural activities, both in quality and quantity. Enset is the main staple starchy food for Ethiopians, where its unique attributes enhance food security [49].

4.2.2. Nutritional Potential of Enset with respect to Common Stable Crops in Ethiopia. Acute and chronic food insecurity has many adverse effects for millions of Ethiopians. Children and pregnant women are the first victims of this issue. It also has long-term well-being, far-attaining consequences for human capital, economic productivity, and national development overall. As a result of these issues, working on production, productivity, and nutrition is one way of tackling this problem.

Table 3: Nutritional composition of Enset crop grain compared to maize, wheat teff, and rice.

Nutritional content	Enset	Maize	Wheat	Teff	Rice
Ash	9.13	1.4	1.6	2.8	1.4
Crude protein (CP)	5.98	8–11	11.7	11	7.3
Crude fat (CF)	0.84	4.9	2	2.5	2.2
Crude fiber (CF)	9.48	—	2	3	0.6–1.0
Carbohydrates	74.57	64.77	64.72	73	78.24
Starch	60.62	72	71	73	64

Source: [59]; [60–63] [64, 65].

The nutritional potential of Enset with respect to common stable crops in Ethiopia is promising. It is a major carbohydrate, starch, and food security crop for the country. This crop type has more than 700 landraces, and different empirics indicate that nutritional characteristics have been reported for a few of them. Here, we attempt to show different indications about the nutritional composition and nutritive value comparison with the major crop in the country. The ash, crude fiber, and carbohydrate contents of Enset were higher than those found in maize, wheat, and teff, but they were comparable to those of rice (Table 3).

Currently, a huge number of people in Ethiopia are afflicted with micronutrient deficiency. A dysfunctional food system, a failure to consistently supply enough of the essential nutrients to meet the nutritional demand of sensitive groups, leads to this malnutrition. Overcoming malnutrition in all its forms, calorie malnutrition, micronutrient deficiencies, and obesity, requires a combination of interventions in various areas that guarantee availability and access to healthy diets. To solve this problem, the Enset crop is one of the most important crops among Ethiopian farmers. As seen from Tables 2 and 3, the Enset crop food products are particularly rich in carbohydrates, moisture, fiber, calcium, phosphorus, ash, and starch but low in protein and fat.

Similarly, bulla, the main energy source food, was rich in 180.5 calories, calcium (41 gm), and phosphorous (20 mg) but had lower protein (0.2 gm) and fat (0.1 gm) contents than other crops. Qoch'o has the main source of carbohydrates, calcium, and phosphorous. It also has a better source of iron than maize and rice but has similarities within the wheat crop. The Enset contributes severalfold to nutritional security for humans (see Tables 1–3).

5. Summary and Conclusion

Enset crops are abundantly cultivated as a home-garden system in the southern, southwestern, and central parts of Ethiopia. Enset is a paradox crop in Ethiopia. Its product is staple and costaple with multidimensional use dynamics in many parts of Ethiopia. In contrast, it is not in the food and farming systems elsewhere.

In essence, the crop is a multipurpose use plant, and its dynamics in which all parts are utilized for different purposes. It has been used in human food, animal forage, fiber, construction materials, medicine, and cultural practices. Enset farming provides a long-term, sustainable food supply capable of buffering not only seasonal and periodic food deficits with minimum off-farm input but also demonstrates the potential that exceeds its current utilization in Ethiopia.

This tree crop has been regarded as a food crop in the identified belt areas of the country to ensure a sustainable food system in such a way that it is profitable throughout (economic sustainability), has broad-based benefits for society (societal sustainability), and has a positive or neutral impact on the natural environment (environmental sustainability).

5.1. Possible Suggestions. Enset crops are versatile crops, and they have to be promoted to a larger region as subsistence crops in other parts of Ethiopia's agricultural systems, where there are clear possibilities and opportunities for adapting and cultivating them.

Analysis of wild Enset has to be thoroughly investigated for its food value. It provides opportunities for more efficient use, sheds light on how important social welfare is, and sheds light on the trade-offs between different intervention strategies.

Enset can be regarded as a recommended crop to achieve SDGs of the UN to end hunger, achieve food security, and improve nutrition by 2030. Hence, it has to be promoted to all areas to ensure food security, particularly to poor and marginalized populations.

Additionally, further research and development are needed to protect against various biotic and abiotic stresses to enhance their production and productivity.

Data Availability

Not applicable.

Conflicts of Interest

The authors declare that they have no competing interests.

Authors' Contributions

All authors investigated the Enset use dynamics and food system, verified the analytical methods, and reshaped the script. All authors read and approved the final manuscript.

References

[1] WHO [World Health Organization], *The Double Burden of Malnutrition-Policy Brief WHO*WHO, Geneva, Switzerland, 2016.

[2] M. Hermanussen, M. Bilogub, A. C. Lindl, D. Harper, L. Mansukoski, and C. Scheffler, "Weight and height growth of malnourished school-age children during refeeding. Three historic studies published shortly after World War I," *European Journal of Clinical Nutrition*, vol. 72, no. 12, pp. 1603–1619, 2018.

[3] R. Shrimpton and C. Rokx, "The double burden of malnutrition: a review of global evidence," 2012, https://elibrary.worldbank.org/doi/abs/10.1596/27417.

[4] J. V. Braun, K. Afsana, L. Fresco, M. Hassan, and M. Torero, *Food Systems—Definition, Concept and Application For the UN Food Systems Summit*, UN Food Systems Summit 2021 Scientific Group, Rome, Italy, 2020.

[5] L. Starr, "Theory of change: facilitator's guide. Washington, DC: the technical and operational performance support (TOPS) program," 2019, https://pdf.usaid.gov/pdf_docs/PA00MP9Z.pdf.

[6] K. Jacobsen, G. Blomme, K. Tawle, S. Muzemil, and Z. Yemataw, "Dietary diversity associated with different enset [Ensete ventricosum (Welw.) Cheesman]-based production systems in Ethiopia," *Fruits*, 2018.

[7] T. U. Woyesa and S. Kumar, "Tree against hunger: potential of enset-based culinary tourism for sustainable development in rural Ethiopia," *Journal of Cultural Heritage Management and Sustainable Development*, 2021.

[8] Z. Yemataw, S. Muzemil, A. Bekele, and E. Derso, "Achievements, experiences and strategies on enset (Ensete ventricosum (Welw.) Cheesman) research in Ethiopia," *Ethiopian Journal of Biological Sciences*, vol. 17, pp. 163–189, 2018.

[9] J. S. Borrell, M. Goodwin, G. Blomme et al., "Enset-based agricultural systems in Ethiopia: a systematic review of production trends, agronomy, processing and the wider food security applications of a neglected banana relative," *Plants, People, Planet*, vol. 2, no. 3, pp. 212–228, 2020.

[10] B. Garedew and A. Ayiza, "Major Constraints of Enset (Ensete ventricosum) Production and Management in Masha District, Southwest Ethiopia," *International Journal of Agricultural Research*, vol. 13, pp. 87–94, 2018.

[11] S. Tamrat, J. S. Borrell, M. K. Biswas et al., "Micronutrient composition and microbial community analysis across diverse landraces of the Ethiopian orphan crop enset," *Food Research International*, vol. 137, Article ID 109636, 2020.

[12] K. A. Lye and S. Edwards, *Musaceae in: Flora of Ethiopia and Eritrea, Volume 6 (Hydrocharitaceae to Arecaceae)*, S. Edwards, S. Demissew, and I. Hedberg, Eds., Addis Ababa University and Uppsala University, Addis Ababa, Ethiopia, 1997.

[13] V. Heuze, H. Thiollet, G. Tran, P. Hassoun, and F. Lebas, "Enset (Ensete ventricosum) corms and pseudostems. Feedipedia, a programme by INRA, CIRAD, AFZ and FAO," 2017, https://www.feedipedia.org/node/21251.

[14] A. Tsegaye, "On Indigenous Production, Genetic Diversity and Crop Ecology of Enset (Ensete ventricosum (Welw.) Cheesman)," Doctoral Thesis, Wageningen University, Wageningen, The Netherlands, 2002.

[15] L. P. A. Oyen and R. H. M. J. Lemmens, *Plant Resources of Tropical Africa. Precursor*, PROTA Programme, Wageningen, The Netherlands, 2002.

[16] S. James, J. S. Borrell, M. Goodwin et al., "Enset-based agricultural systems in Ethiopia: a systematic review of production trends, agronomy, processing and the wider food security applications of a neglected banana relative," *Plants, People, Planet*, vol. 2, pp. 212–228, 2019.

[17] S. A. Brandt, A. Spring, C. Hiebsch et al., *The "Tree against Hunger": Enset Based Agricultural System in Ethiopia*American Association for the Advancement of Science, Washington, DC, USA, 1997.

[18] J. Bruce, *Travels to Discover the Source of the Nile*, G.J. and J. Robinson, London, UK, 1790.

[19] E. Bekele, "The center of origin and domestication of *Ensete ventricosum* (welw.) cheesman and its phylogenetic relationship to some musa species," in *Proceedings of the International Workshop on Enset (Ensete Ventricosum) for Sustainable Development*, Addis Ababa University, Addis Ababa, Ethiopia, 2016.

[20] S. James, J. S. Borrell, M. K. Biswas et al., "Enset in Ethiopia: a poorly characterized but resilient starch staple," *Annals of Botany*, vol. 123, pp. 1–20, 2019.

[21] Z. Yemataw, *Agro-morphological and molecular characterization of Enset (Ensete ventricosum (Welw.) Cheesman) Landraces from Ethiopia*, PhD Thesis, Addis Ababa University, Addis Ababa, Ethiopia, 2018.

[22] G. Yemata, "*Ensete ventricosum*: a multipurpose crop against hunger in Ethiopia," *The Scientific World Journal*, vol. 2020, Article ID 6431849, 10 pages, 2020.

[23] Z. Asfaw, "Enset (ensete ventricosum) ethnobotany: research trends, gaps and hints to forward steps," in *Proceedings of the International Workshop on Enset (Ensete Ventricosum) for Sustainable Development*, Addis Ababa University, Addis Ababa, Ethiopia, 2016.

[24] A. W. Tensaye, B. Linden, and L. Ohlander, "Enset farming in Ethiopia: soil nutrient status in Shoa and Sidamo regions," *Communications in Soil Science and Plant Analysis*, vol. 29, no. 1-2, 1998.

[25] T. Abebe, "Determinants of crop diversity and composition in Enset-coffee agroforestry homegardens of Southern Ethiopia," *Journal of Agriculture and Rural Development in the Tropics and Subtropics (JARTS)*, vol. 114, pp. 29–38, 2013.

[26] S. Fikreyesus, H. P. V. Rupasinghe, and T. Astatkie, "Antioxidant capacity, total phenolics and nutritional content in selected Ethiopian staple food ingredients," *International Journal of Food Sciences & Nutrition*, vol. 64, no. 8, pp. 915–920, 2013.

[27] A. Ayele and O. Sahu, "Extension of enset plant product for rural development in Ethiopia," *Journal of Agricultural Economics, Extension and Rural Development*, vol. 2, no. 3, pp. 31–40, 2014.

[28] A. Zewdu, "Nutritional profile of enset based food products: current knowledge, research gaps and future, directions to exploit its nutritional and health benefits," in *Proceedings of the International Workshop on Enset (Ensete Ventricosum) for Sustainable Development*, Addis Ababa University, Addis Ababa, Ethiopia, 2016.

[29] S. Van Berkum, J. Dengerink, and R. Ruben, *The Food Systems Approach: Sustainable Solutions for a Sufficient Supply of Healthy Food (No. 2018-064)*, Wageningen Economic Research, Wageningen, Netherlands, 2018.

[30] G. Birmeta, "Genetic variability and biotechnological studies for the conservation and improvement of ensete ventricosum," Doctoral Thesis, Saint Louis University, Saint Louis, MO, USA, 2004.

[31] N. Fekade, M. Urge, A. Nurfeta, and G. Animut, "Effects of replacing maize with kocho in white leghorn layers ration on egg production, egg and chick quality, fertility and hatchability," *East African Journal of Sciences*, vol. 13, no. 1, pp. 65–74, 2019.

[32] A. Tsegaye and P. C. Struik, "Enset (Ensete ventricosum (Welw.) Cheesman) kocho yield under different crop establishment methods as compared to yields of other carbohydrate-rich food crops," *NJAS: Wageningen Journal of Life Sciences*, vol. 49, no. 1, pp. 81–94, 2001.

[33] S. M. Afele, "Livestock feeds and feeding system in enset (Ensete ventricosum) dominated mixed farming system of southern Ethiopia," *Online Journal of Animal and Feed Research*, vol. 4, no. 6, pp. 150–158, 2014.

[34] R. Shank and C. Ertiro, *A Linear Model for Predicting Enset Plant Yield and Assessment of Kocho Production in Ethiopia*, United Nations Development Programme Emergencies Unit for Ethiopia, Addis Ababa, Ethiopia, 2016.

[35] T. M. Olango, B. Tesfaye, M. Catellani, and M. E. Pè, "Indigenous knowledge, use and on-farm management of enset (Ensete ventricosum (Welw.) Cheesman) diversity in Wolaita, Southern Ethiopia," *Journal of Ethnobiology and Ethnomedicine*, vol. 10, no. 1, pp. 1–18, 2014.

[36] Y. G. Egziabher, F. Kebede, D. K. Mengistu, H. K. Tadesse, M. Mahari, and Y. Welday, "Indigenous knowledge and socioeconomic significance of Enset (Ensete ventricosum (Welw.) Cheeseman) cultivation and food processing in Sidama, Southern Ethiopia," *Ethnobotany Research and Applications*, vol. 19, pp. 1–17, 2020.

[37] N. Morrow, "Autochthonous and introduced atores of biomass value: measuring resilience outcomes of Enset and Eucalyptus as green assets in three representative smallholder farm systems of Ethiopia," Doctoral Dissertation, University of Maryland, College Park, MD, USA, 2021.

[38] D. Maxwell and M. Smith, "Household food security: a conceptual review," in *Household Food Security: Concepts, Indicators, Measurements: A Technical Review*, S. Maxwell and T. R. Frankenberger, Eds., UNICEF and IFAD, New York, NY, USA, 1992.

[39] M. Grainger, "World Summit on food security (UN FAO, Rome, 16–18 November 2009)," *Development in Practice*, vol. 20, no. 6, pp. 740–742, 2010.

[40] FAO, *The State of Food Insecurity in the World*, FAO, Rome, Italy, 1999.

[41] M. Ma, J. Lin, and R. J. Sexton, "The transition from small to large farms in developing economies: a welfare analysis," *American Journal of Agricultural Economics*, vol. 104, no. 1, pp. 111–133, 2021.

[42] A. Negash, *Diversity and Conservation of Enset (Enseteventricosum (Welw.) Cheeseman) and its Relation to Household Food and Livelihood Security in Southwestern Ethiopia*, PhD Thesis, Wageningen University and Research Centre, Wageningen, Netherlands, 2001.

[43] R. J. Quinlan, M. B. Quinlan, S. Dira, M. Caudell, A. Sooge, and A. A. Assoma, "Vulnerability and resilience of sidama enset and maize farms in southwestern Ethiopia," *Journal of Ethnobiology*, vol. 35, pp. 314–336, 2015.

[44] I. F. Merga, L. Tripathi, A. K. Hvoslef-Eide, and E. Gebre, "Application of genetic engineering for control of bacterial wilt disease of enset, Ethiopia's sustainability crop," *Frontiers in Plant Science*, vol. 10, pp. 1–8, 2019.

[45] Z. Yemataw, H. Mohamed, M. Diro, T. Addis, and G. Blomme, "Enset (Ensete ventricosum) clone selection by farmers and their cultural practices in southern Ethiopia," *Genetic Resources and Crop 690 Evolution*, vol. 61, pp. 1091–1104, 2014.

[46] CSA, *Area and Production of Major Crops. Agricultural Sample Enumeration Survey Part III*, Central Statistics Agency, Addis Ababa, Ethiopia, 2011.

[47] W. Gizaw and D. Assegid, "Trend of cereal crops production area and productivity, in Ethiopia," *Journal of Cereals and Oilseeds*, vol. 12, no. 1, pp. 9–17, 2021.

[48] Central Statistics Agency, *Central Statistics Agency–Agricultural Sample Survey (Belg and Meher Seasons)*Central Statistics Agency, Addis Ababa, Ethiopia, 1995–2017.

[49] J. S. Borrell, M. K. Biswas, M. Goodwin et al., "Enset in Ethiopia: a poorly characterized but resilient starch staple," *Annals of Botany*, vol. 123, no. 5, pp. 747–766, 2019.

[50] D. Fekadu, "Characterizing farming practices from three regions of Ethiopia on which enset (Ensete ventricosum) is widely profited as a multipurpose crop plant," *Livestock Research for Rural Development*, vol. 21, no. 12, p. 213, 2009.

[51] United States Agency for International Development (USAID), *Definition of Food Security*, USAID Policy Determination, Washington, DC, USA, 1992.

[52] P. Diskin, *Understanding Linkages among Food Availability, Access, Consumption, and Nutrition in Africa: Empirical Findings and Issues from the Literature*, Department of Agricultural Economics, Michigan State University, East Lansing, MI, USA, p. 47, 1994, https://books.google.com.et/books?id=EhvEUzcpZksC.

[53] B. T. Mellisse, K. Descheemaeker, K. E. Giller, T. Abebe, and G. W. van de Ven, "Are traditional home gardens in southern Ethiopia heading for extinction? implications for productivity, plant species richness and food security," *Agriculture, Ecosystems & Environment*, vol. 252, pp. 1–13, 2018.

[54] M. B. Zsarnoczky, F. Zsarnoczky-Dulhazi, G. F. C. Adol, M. Barczak, and L. D. David, "Food safety challenges in the tourism processes," *Rural Sustainability Research*, vol. 41, no. 336, pp. 26–31, 2019.

[55] M. Zsarnoczky, "The importance of tradition and folk customs in gastro-tourism," *Intercathedra*, vol. 34, no. 1, p. 95102, 2018.

[56] C. Carletto, A. Zezza, and R. Banerjee, "Toward better measurement of household food security: harmonizing indicators and the role of household surveys," *Global Food Security*, vol. 2, pp. 30–40, 2013.

[57] T. Abebe, "Determinants of crop diversity and composition in Enset-coffee agroforestry home gardens of Southern Ethiopia," *Journal of Agriculture and Rural Development in the Tropics and Subtropics*, vol. 114, no. 1, pp. 29–38, 2013.

[58] A. A. Mota, S. T. Lachore, and Y. H. Handiso, "Assessment of food insecurity and its determinants in the rural households in Damot Gale Woreda, Wolaita zone, southern Ethiopia," *Agriculture & Food Security*, vol. 8, no. 1, pp. 1–11, 2019.

[59] K. Baye, "Teff: nutrient composition and health benefits," *International Food Policy Research Institute*, vol. 67, 2014.

[60] A. S. Hager and E. K. Arendt, "Influence of hydroxypropylmethylcellulose (HPMC), xanthan gum and their combination on loaf specific volume, crumb hardness and crumb grain characteristics of gluten-free breads based on rice, maize, teff and buckwheat," *Food Hydrocolloids*, vol. 32, no. 1, pp. 195–203, 2013.

[61] B. Mohammed, M. Gabel, and L. M. Karlsson, "Nutritive values of the drought tolerant food and fodder crop enset," *African Journal of Agricultural Research*, vol. 8, no. 20, pp. 2326–2333, 2013.

[62] USDA/ARS (U.S. Department of Agriculture, Agricultural Research Service), *USDA National Nutrient Database for Standard Reference, Release 27. Nutrient Data Laboratory*, USDA, Washington, DC, USA, 2014.

[63] A. Wolter, A.-S. Hager, E. Zannini, and E. K. Arendt, "In vitro starch digestibility and predicted glycemic indexes of buckwheat, oat, quinoa, sorghum, teff and commercial gluten-free bread," *Journal of Cereal Science*, vol. 58, no. 3, pp. 431–436, 2013.

[64] M. M. Gebremariam, M. Zarnkow, and T. Becker, "Teff (Eragrostis tef) as a raw material for malting, brewing and manufacturing of gluten-free foods and beverages: a review,"

Journal of Food Science and Technology, vol. 51, no. 11, pp. 2881–2895, 2014.

[65] K. F. Michaelsen, K. G. Dewey, A. B. Perez-Exposito, M. Nurhasan, L. Lauritzen, and N. Roos, "Food sources and intake of n-6 and n-3 fatty acids in low-income countries with emphasis on infants, young children (6–24 months), and pregnant and lactating women," *Maternal and Child Nutrition*, vol. 7, pp. 124–140, 2011.