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Review Article

Potential Contribution of Root and Tuber Crops to Food and Nutrition Security in Ethiopia

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Abstract

Root and tuber crops (RTCs), including Ensete, sweet potato, taro, cassava, yams, and anchote function as important staples in different regions of Ethiopia. In the north and central Ethiopia, these crops are secondary staples, whereas in the southern and south-western regions, they constitute a significant portion of daily dietary intake. Moreover, these crops act as insurance crops against crop failure to bridge the food deficit periods due to their agronomic and nutritional advantages, especially for the most vulnerable households. Despite their significant role in addressing food insecurity, research and policy focus to RTCs is lacking in the country. Urgent policy attention and investment are needed to improve yields, postharvest handling practices, and the integration of these crops in wider food systems in Ethiopia. Excellent opportunities exist to expand the potential of these crops for increased food and nutrition security in the country. This review aims to highlight the potential contribution of RTCs in solving the problem of food and nutrition insecurity in Ethiopia. How the crops can fit the four dimensions (*availability of food, access to food, utilization, and stability*) of food security and three determinants (*access to adequate food, care and feeding practices, sanitation, and health*) of nutrition security have been shown.

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INTRODUCTION

Assuring food and nutritional security remains an ongoing challenge for humanity. The global figure of undernourished people has fallen for decades, but in 2016, this number rose to 821 million from 777 million in 2015 (FAO, 2017). But the figure of the undernourished people has been reduced to between 713 and 757 million in 2023 (FAO, IFAD, UNICEF, WFP & WHO, 2024). In 2022, nearly 282 million people in Africa were undernourished (FAO, AUC, ECA & WFP, 2023). In these circumstances, meeting the Sustainable Development Goal to end hunger and prevent all forms of malnutrition by 2030 seems far away. With its population of over 120 million at this time, Ethiopia has the second largest population in Africa, which is projected to rise to 190 million by 2050. Ensuring food and nutritional security for its growing citizens is among the highest priorities of the Ethiopian government (Compact, 2025). The Ethiopian government has made a robust commitment to end child malnutrition by 2030 (Federal Democratic Republic of Ethiopia, Ministry of Health, 2015). The challenge is how to achieve practical action and have an impact on the ground in an environment that is continuously changing and among the history of droughts and associated chronic and transitory food insecurity in the country (USAID, 2018^a; CAADP, 2013). Ethiopia presents a unique opportunity to grow a large variety of crops because of its biodiversity,

diverse agroecology, and untapped irrigation potential (Demeke *et al.*, 2004). However, the country has not yet utilized its potential natural resources at the expected level to reduce food and nutrition insecurity.

To address the problem of food and nutrient insecurity, it seems better to focus on crops with potential productivity, good nutritional value, and resistance to harsh climatic conditions. Crops produced locally are essential for sustainability, human nutrition, and social value (Keatinge *et al.*, 2015; Pichop *et al.*, 2016). Among these, root and tuber crops (RTCs) are excellent examples; they are resistant to stressful conditions such as soil acidity, soil infertility, and drought (El-Sharkawy, 2012; Abera & Haile, 2015). It is estimated that the majority of undernourished populations depend on these crops as a source of food and nutrition, especially in sub-Saharan Africa (SSA), including Ethiopia. The main reason is that they produce large quantities of dietary energy and have stable yields under conditions in which other crops may fail. Therefore, they potentially contribute to the food system.

The term “*root and tuber*” indicates two edible parts: root crops are crops in which the edible carbohydrate-rich underground plant structures developed from modified roots (e.g., cassava, sweet potato and yams), whereas tuber crops are those crops in which the edible storage plant

organs develop wholly or partly from underground stems (e.g., potatoes and taro) (Eke-Okoro *et al.*, 2014; OECD/FAO, 2015). Root and tuber crops contribute to the diets and livelihoods as well as the energy and nutritional requirements of more than 2 billion people worldwide (Scott *et al.*, 2000^a, Scott *et al.*, 2000b). Root and tuber crops are among the staples with the largest shares of calorie intake in the tropics, subtropics, and sub-Saharan Africa (SSA) (Scott *et al.*, 2000b; OECD/FAO, 2019). In many regions of SSA, these crops constitute a vital part of the rural economy and help alleviate poverty, generate income and provide employment opportunities in their production, processing, and marketing (Scott *et al.*, 2000b). In addition to their use as food, root and tuber crops play important roles in providing feedstock for animal feed and industrial raw materials (Parmar *et al.* 2017b; Edem & Nkereuwem, 2015).

Compared with many other crops, root and tuber crops also help provide sustainable food production, are versatile staples used to address food and nutrition security, and produce more food per unit area of land (Sanginga and Mbabu, 2015). In Ethiopia, RTCs contribute significantly to traditional food systems. Some of the most important RTCs contributing to food security in the country are Enset, Potato, Sweet potato, Ethiopian potato, Anchote, Cassava, Taro and Yams. Among these, Enset (*Ensete ventricosum*), Anchote (*Coccinia abyssinica*), Ethiopian potato (*Plectranthus edulis*) and Yams (*Dioscorea* spp.) are

RESULTS AND DISCUSSION

The Status of Food and Nutrition Security in Ethiopia

The terms “food security” and “nutrition security” are quite different, although they are sometimes used interchangeably. Food security is achieved when “All people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life” (FAO, 1996); however, nutrition security narrows this definition as “Food and nutrition security sufficed when all people at all times have physical, social and economic access to food, which is safe and consumed in sufficient quantity and quality to meet their dietary needs and food preferences and is supported by an environment of adequate sanitation, health services and care, allowing for a healthy and active life” (CFS, 2012; Acharya *et al.*, 2014).

In Ethiopia, the diet of societies is composed mainly of cereals (*teff*, maize, sorghum), root and tuber crops (enset, potatoes, sweet potatoes), pulses and oilseeds (FAO, 2008). According to the Central Statistical Agency (CSA) of Ethiopia, the production volume of RTCs is second next to that of cereals (CSA, 2016). Crop production in the country is insufficient to feed the population, especially due to climate disturbances such as drought and floods. As a result, the country is severely affected by poverty, food insecurity and morbidity; mainly, rural populations are highly exposed to undernutrition and micronutrient deficiencies (FAO, 2008). Recent reports have suggested that the challenges faced by Ethiopia due to exponential population growth can include economic collapse, starvation, and food insecurity (Gebremeskel, 2018). The increase in food demand would be fulfilled by increased agricultural production, which may be achieved through the expansion of agricultural land and improved agricultural productivity (PBL, 2012). However, uncultivated areas of land suitable for agriculture are depleting, making the expansion of agricultural land difficult. Therefore, improving agricultural productivity and reducing food loss and waste may be the best way forward.

Ethiopia's patients have taken several measures to reduce food and nutrition insecurity. In its *National Nutrition Program 2013–2015*, the country established a strategic objective to increase fruit and vegetable production from 894,000 tonnes in 2011 to 5,905,000 tonnes by 2015 to improve the food diversification of the community (NNPISD, 2013).

believed indigenous to Ethiopia (Mekbib & Deressa, 2016; Girma & Hailu, 2007). There is considerable potential for the production of these RTCs in Ethiopia because of their adaptability and conducive agroecology.

In this review, the potential of RTCs to support efforts to ensure food and nutritional security in Ethiopia was evaluated. The productivity and nutritional value of the most common RTCs were assessed, and their possible advantages for promoting development and improvement are indicated. The possible links of the different benefits of crops with food security and nutrition security are presented. Finally, policy directives were recommended to the concerned body on the basis of the reviewed benefits of the crops and the Ethiopian CSA report about their production and productivity.

METHODS

To evaluate the contribution of RTCs to the improvement of food and nutrition security, a narrative review method was applied. The overall background information about the productivity, nutritional values, and contribution to food and nutrition security of RTCs has been thoroughly assessed. Recent studies about RTCs significance in the food system were reviewed, evaluated, and compiled in a way that clearly shows their role and fitness in food and nutrition security in Ethiopia. The reviewer tried to select recent and relevant papers to extract valuable and up-to-date study results and global changes.

However, the CSA of Ethiopia reported the production of only 1,258,143.4 tonnes of vegetables in y 2015 (CSA, 2016). In the same year, the production of root crops was reported to be 7,215,002 tonnes, indicating its large contribution. However, the production of RTCs was reduced to 4,136,957 tonnes in 2020 (ESS, 2021). The strategy designed to overcome food insecurity, reduce food wastage, and sustain economic growth in Ethiopia includes sustaining growth in crop production through the diversified agro-processing of local and global investors (Gebremeskel, 2018). The country has also developed several food security and nutrition policies and strategies to support its development goals. These include the Food Security Strategy (2002), the National Nutrition Strategy and the National Nutrition Program (2008), and the Growth and Transformation Plan I (GTP I) covering 2011-2015 (FAO, 2015), which has also developed the second stage of its 5-year development plan, GTP II, covering the period 2015/16-2019/20 (NNPISD, 2016). These plans incorporate improvements in nutritional status. The government of Ethiopia demonstrated a policy commitment to nutrition by developing a National Nutrition Strategy as well, 2016-2020 (NNPISD, 2016). The country also recently launched the Food and Nutrition Policy, 2019 (USAID, 2018^b). This could support efforts to achieve food and nutrition security.

Despite these efforts, Ethiopia still ranks 126th out of 157 countries in progress toward meeting the Sustainable Development Goals (USAID, 2018^a). The Global Nutrition Report (2015) also revealed that Ethiopia ranks at the top in both Sub-Saharan Africa and the world for malnutrition, and millions still suffer from chronic and acute malnutrition. USAID (2014) reported that a quarter of reproductive-age women were undernourished in the country at the time. Furthermore, the FAO (2015) reported that Ethiopia was the 4th country in terms of the number of undernourished people, showing a slight decrease. The trend confirms that the prevalence of undernourishment decreased from 74.81% in 1991 to 28.8% in 2015 in Ethiopia (Abegaz, 2018). The decrease was due to political stability and food and agricultural policy. Furthermore, Ethiopia's prevalence of undernourishment decreased to 16.2% from 2018–2020 (Ethiopia Policy Brief, 2022). However, recently, the prevalence of undernourishment has increased because the internal conflict in the country has caused internal displacement. Therefore, the use of RTCs to tackle the problem of food and nutrition security became immense. The ten-years (2021-2030) plan of the Ministry of Agriculture

seems significant since RTCs are recognized as the most productive agricultural crops (Ministry of Agriculture, 2022).

Although many efforts have been made thus far, addressing the deep-rooted causes of malnutrition and ending hunger in Ethiopia calls for highly integrated and coordinated interventions (NNPISD, 2016). Consequently, more efforts are needed to rapidly and sustainably improve the nutritional status of the population (FAO, 2008). It was forecasted that satisfying the expected food demand will require a substantial increase in global food production of 70% by 2050, requiring an additional quantity of nearly 1 billion tonnes of cereals (FAO, 2009). Later, the FAO (2017) forecasted that an additional 120 million people will be vulnerable to undernourishment by 2050, of which 24 million will be children; approximately half of the increase is expected to be concentrated in Sub-Saharan Africa. Therefore, the growth of domestic food production is important for ensuring food security in a sustainable manner in landlocked countries such as Ethiopia (Demeke et al., 2004). In general, policy commitment and the implementation of nutrition-sensitive agriculture are vital in addressing food insecurity and malnutrition problems.

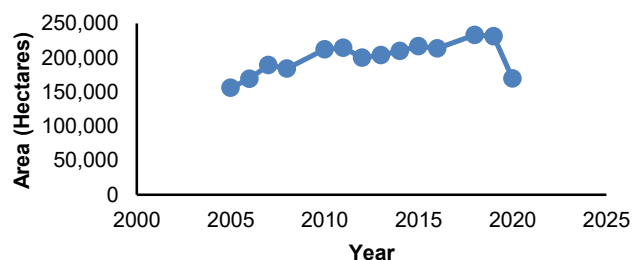
Production and Utilization Trends of Root and Tuber Crops in Ethiopia

Food production per capita (the amount of food grown per person) on the African continent rose slowly in the 1960s, then fell from the mid-1970s, and has only just recovered to the 1960 level by 2011 (Foresight, 2011). Food production on the continent, specifically, in Sub-Saharan Africa, depends on traditional agriculture, and RTCs are among the major products. In Ethiopia, agriculture employs 80% of the population, forming the basis of its economy (EU, 2016). Unfortunately, agricultural development efforts over the last three decades have failed to address the problem of food security in the country (Demeke et al., 2004). Reports have indicated that approximately 40% of rural farm families cultivate their land less than half a hectare from where they produce only half of their annual food demand, and they do not have enough purchasing power (CAADP, 2013). The cultivation of root and tuber crops was recognized early as one of the agrotechnology pillars in traditional rural Ethiopia (World Bank, 1995).

There is a long history of traditional cultivation and utilization of RTCs for food in Ethiopia (Mekbib & Deressa, 2016). Some RTCs, such as yam, cassava, potato and sweet potato, have shown tremendous growth over the past three decades relative to other crops (Sanginga & Mbabu, 2015). They are most important in the southern, southwestern, eastern and northwestern parts of Ethiopia in terms of production area, distribution and consumption (EIAR, 2008). There was no significant increase in the production of RTCs from 2013-2017, except in Taro (Kusse, 2021). The country's statistical report revealed that potato and taro production slightly increased from 2017-2019, but the production of sweet potatoes decreased by 19.3% during this period (CSA, 2019). Conversely, the yield of sweet potato was 2.5 and 1.3 times greater than the yields of potato and taro, respectively. This could indicate a policy direction to improve average productivity by promoting the most productive crops. However, there is a slight overall increase in yield and utilization of the RTC. Their recurrent use is as a food security crop and disaster relief, and there are emerging uses of processed food commodities made from them as market niches with population growth and urbanization (Scott et al., 2000a). The trends showed that the utilization of RTCs has increased, and good prospects for similar developments in the future could be expected (CIAT, 2002). Crops have shown increasing production and utilization practices among the population. Furthermore, there is a bright future for the development of seed propagation methods that can simplify their cultivation so that they may contribute to improved food and nutritional security (EIAR & ARARI, 2013).

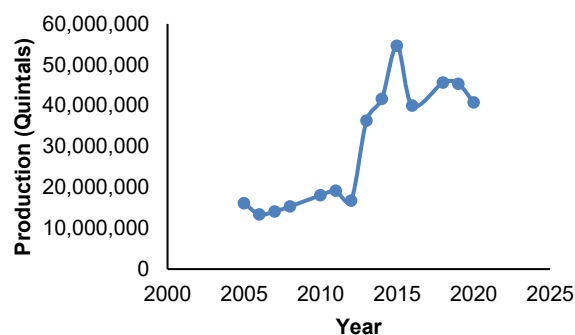
Recent innovations have demonstrated the potential to mitigate different constraints and position crops to meet current and future food security and industry demands. For example, demand for potato is increasing in Sub-Saharan Africa, and the goal is to increase potatoes production (Sanginga & Mbabu, 2015). The production of crops that are important to the poor in many agriculture-based countries has declined relative to the total population (Wik et al., 2008). This decline occurred because the population growth rate was higher than the increasing rate of production. Despite the small harvesting area relative to other food crops, such as cereals, pulses and oilseeds (CSA, 2016; Yimer & Babege, 2018), root and tuber crops were the second most common in Ethiopia from 2007-2016 (CSA, 2016). The major crops in the production volume during the period 2011-2015 were potato, taro and sweet potato (CSA, 2016; Yimer & Babege, 2018). The trends of area coverage and RTC production in Ethiopia from 2005-2020 are shown in Figure 1. Both the coverage and production of RTCs in Ethiopia decreased in 2020, which should call for policy attention since these crops can highly contribute to food and nutritional security. For many reasons, enhancing the cultivation and production of these crops is beneficial for highly populated countries. Among the plausible reasons to enhance and encourage the production and productivity of RTCs in Ethiopia are high yield per unit area, nutritionally rich staple foods, suitability for double cropping, and ensuring sustainable food availability (Kusse, 2021).

Area covered by RTC in Hectares over 15 years



(a)

Production of RTC in Quintals over 15 Years



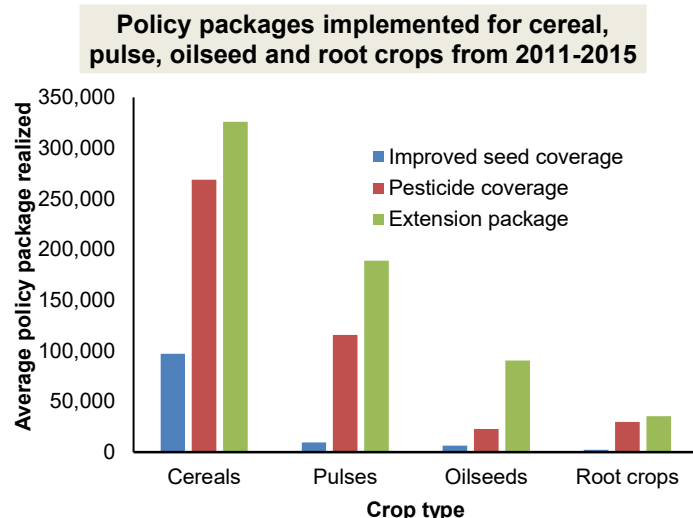
(b)

Source: CSA (2016)

Figure 1. Trends of area coverage (hectares) (a) and production (quintals) (b) of RTCs in Ethiopia over 15 years (2005–2020).

Root and tuber crops are marginalized in terms of policy packages (Figure 2) in Ethiopia to support food and nutritional security. A relatively small area was harvested, and fewer policy packages were

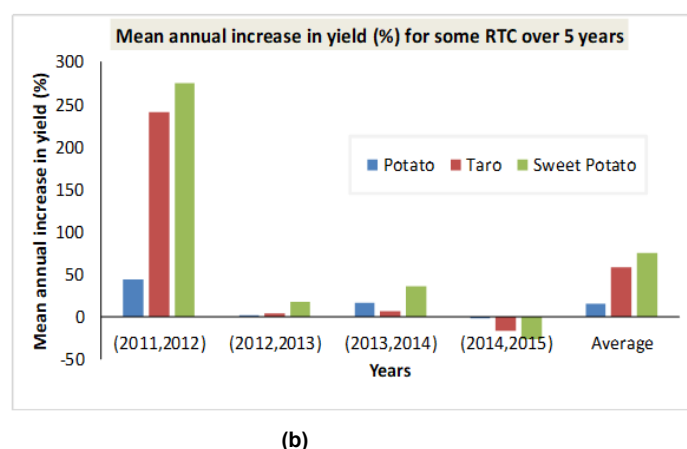
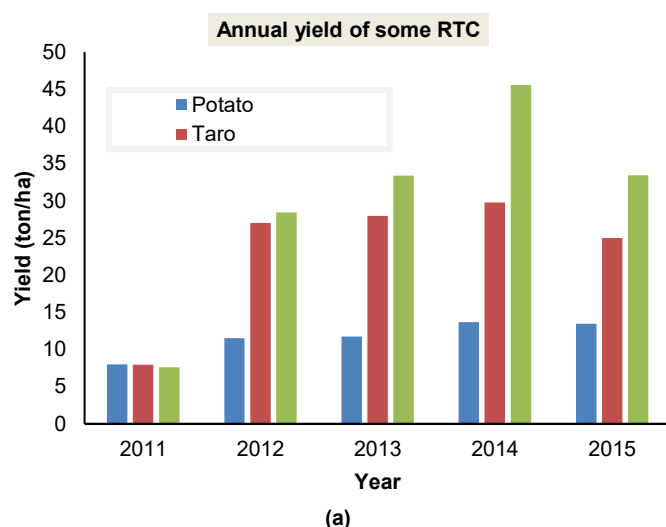
implemented for RTCs than for the other food crops according to the assessment made over the five years (Figure 2). These data revealed that less attention was given to RTCs than to other food crops. However, assessment reports indicated that the yield of RTCs, such as potato, taro, and sweet potato, increased linearly from 2011–2014; however, it decreased in 2014–2015 (Figure 3). The increase in yield was attributed to the expansion of the area cultivated rather than an increase in productivity (Yimer & Babege, 2018). The data revealed that the yield and annual yield increase were greater for sweet potatoes.



Source: CSA (2016); Yimer & Babege (2018)

Figure 2. Policy package realized for RTCs compared with other common food crops

In Ethiopia, the supply of starchy roots and tubers is mostly composed of *enset*, potato, taro, yams, sweet potato, *anchote*, cassava and tannia (Yimer & Babege, 2018). A variety of roots and tubers are traditionally cooked (baked, boiled, or mashed) and serve as traditional meals with vegetables, stews, sauces and other spices. There are different types of cooking methods. The most common methods used for producing roots and tubers are boiling, roasting, steam cooking, and frying. Among these methods, boiling is the most commonly used method of cooking fresh roots and tubers adapted by farmers at the household level. Roasting and frying are also used to prepare chips or fries for local markets as value-added products. However, all cooking methods have their own advantages and disadvantages in terms of preserving and/or reducing nutrients and anti-nutritional factors (Ikanone & Oyekan, 2014; Sinha *et al.*, 2015; Fabbri & Crosby, 2016). Most RTCs are used as security crops against crop failure and to bridge food deficit periods in the country (EIAR, 2008). This could be due to a lack of awareness, strategy and policy priorities, technology support, and research attention.



Source: CSA (2016); Yimer & Babege (2018)

Figure 3. Average annual yield (a) and mean annual increase (b) in yield for the major root crops from 2011-2015

Contribution of Root and Tuber Crops to Food and Nutrition Security

Root and tuber crops provide energy as well as desirable nutritional and health benefits (Chandrasekara & Kumar, 2016). In addition, the crops are essential dietary components for humans and add variety to them. They play a prominent role in feeding the world, and these crops will also be essential components of the food security system in the coming decades (Parvathi & Subbulakshmi, 2016). Therefore, plants that produce starchy roots and tubers make enormous contributions to food and nutritional security. Different countries are already engaged in the planned utilization of these resources. For example, the Caribbean community has prioritized root and tuber crops as new pillars for enhancing food and nutrition security (Robin *et al.*, 2018). According to this report, achievements in the cassava industry (value chain), the addition of more genotypes to the narrow gene pool of taro, and studies on the effects of sweet potato accessions have increased food and nutritional security in this area. In addition, a variety of foods can be prepared from these crops, whose type and usage vary with country and region. Within the least developed regions, including Ethiopia, roots and tubers provide valuable starch alternatives and low-cost sources of energy (OECD/FAO, 2015). For example, the potato has a high potential to supply affordable and high-quality food within a short period of time (Tesfaye, 2016). Crops are excellent sources of carbohydrates, fiber, vitamins, and minerals. Generally, previous reports have indicated that

RTCs could play a vital role in alleviating food and nutrition insecurity in developing countries.

Productivity of Root and Tuber Crops

The high productivity of RTCs (e.g., potato, taro, and sweet potato) compared with other food crops, such as cereals (Table 1), can make them viable alternatives to supplement farmers' living at the subsistence level (Hunde, 2017). Because of their drought resistance and resilience, crops are considered feasible and inexpensive alternatives that offer farmers a way to cope with climate change (Lal et al., 2014). Therefore, RTCs are among the climate-smart crops that can fill the gap in food and nutrition insecurity. In addition, they can be grown in various agroecosystems and production systems ranging from highland to lowland areas prone to droughts or floods (Sanginga & Mbabu, 2015). Crops can yield as much as 40–60 tons ha⁻¹ and can support food security, especially in times of drought, famine and food shortages. The highest yield of commonly grown teff, the staple food of the country, is on average 1 ton ha⁻¹. This yield is sixty times lower per hectare of potato, with a yield of 60 tons ha⁻¹ (Hunde, 2017; Fanos & Belew, 2015). Thus, RTCs could play an essential role in food security because of their productivity in terms of both volume and yield. Table 1 clearly shows the 15-year development of taro and sweet potato production in Ethiopia in comparison with the most common cereals produced in the country. The sweet potato yield increased by approximately 70% during this period, which is very high compared with that of maize (~37%). These findings indicate that RTCs are potential food products for alleviating food insecurity in Ethiopia.

Table 1. Ethiopian yields by crop (ton/ha) for 2001/02-2015/16.

No.	Crop	Yield		Difference
		2001/02	2015/16	
1	Teff	0.90	1.56	0.66
2	Maize	2.12	3.39	1.27
3	Taro	8.00	24.96	16.96
4	Sweet Potato	9.97	33.44	23.47

Source: (Cochrane and Bekele, 2018)

Table 2. Nutritional composition of selected root and tuber crops (raw)

Nutrients (per 100 g)	Potatoes	Sweet potatoes	Cassava	Yam	White Anchote	Red Anchote
Proximate composition						
Carbohydrate (g)	15.8	20.1	38.1	27.9	24.25	16.27
Protein (g)	1.85	1.6	1.4	1.5	2.77	3.58
Total lipid (fat) (g)	0.1	0.1	0.3	0.2	0.41	0.26
Dietary Fiber (g)	2.0	3.0	1.8	4.1	1.26	0.95
Energy (kcal)	69.5	86	160	118	111.77	81.78
Minerals						
Ca (mg)	9.5	30	16	17	81.16	59.13
Mg (mg)	21.5	25	21	21	50.30	50.33
K (mg)	431	337	271	816	315.83	313.01
P (mg)	61.5	47	27	55	80.41	98.72
Na (mg)	17	55	14	9	5.76	5.87
Fe (mg)		0.61	0.27		0.98	0.90
Zn (mg)		0.3	0.34		0.58	0.58
Se (μg)					42.3	7
Vitamins						
Total ascorbic acid (mg)	14.15	2.40	20.60	17.10		
Thiamin (mg)	0.08	0.08	0.09	0.11		
Riboflavin (mg)	0.03	0.06	0.05	0.03		
Niacin (mg)	1.11	0.56	0.85	0.55		
Vitamin B-6 (mg)	0.186	0.209	0.088	0.293		
Vitamin E (mg)	0.01	0.26	0.19	0.35		
Vitamin K (μg)	2.2	1.8	1.9	2.3		
Vitamin A (IU)	8	14187	13	138		
Folate (μg)	18	11	27	23		

Source: (Chandrasekara and Kumar, 2016; Parmar et al., 2017a)

The current food production and consumption trends highlight the importance of pursuing a profound transformation of the agricultural sector in Sub-Saharan Africa to increase income and mitigate food security problems (Chauvin et al., 2012). However, root and tuber crops offer greater genetic biodiversity and have the potential to improve food security (Chivenge et al., 2015). This is not only due to their potential for climate resilience but also their accompanying potential for simple and attractive processing and packaging (CARDI, 2014). This versatility is essential to ensure food security in a world of finite resources (Chivenge et al., 2015). In Ethiopia, there is untapped potential in the utilization of RTCs as important food sources, which could highly relieve food insecurity in the country.

Nutritional Value of Root and Tuber Crops

The contribution of RTCs to nutritional security depends on their nutritional composition. They are the second most critical global source of carbohydrates next to cereals in tropical countries (Chandrasekara & Kumar, 2016) and are significant sources of energy in developing countries that feed hundreds of millions of poor people (Vincent, 2010). Root and tuber crops are the most important food crops for direct human consumption in Africa (Sanginga & Mbabu, 2015). They play a large role in SSA, accounting for 16% of total calorie availability in 2016, which is expected to continue in the coming decade (OECD/FAO, 2017). These findings indicate that they are essential food and nutrient sources. Crops can be crucial supplemental sources of vitamins (e.g., vitamin C & vitamin A), minerals (zinc & iron), and essential amino acids such as lysine in food systems (Sanginga & Mbabu, 2015; Chandrasekara & Kumar, 2016; Parmar et al., 2017a; Ayalew et al., 2017). Although their composition varies from crop to crop, they can complement each other when used together. The nutrient contents (minerals, vitamins, carbohydrates, and fibers) of some common RTCs in Ethiopia are presented in Table 2. Compared with conventional cereal crops (maize, wheat, and millet), the starch derived from primary RTCs used in Ethiopia contains more carbohydrates, reducing sugars and fibers (Table 3). Generally, RTCs can contribute to nutritional security since they have good energy value and a proper composition of micronutrients.

Table 3. Proximate composition of root, tuber and cereal crops.

	MC (%)	RSC	Ash (%)	Protein (%)	CF (%)	TF (%)
RTC						
Cassava	16.50	0.255	0.31	0.52	0.55	4.90
Potato	13.67	0.200	0.26	1.82	0.318	8.17
Sweet potato	9.33	0.581	0.28	1.13	0.35	11.8
Average	13.167	0.345	0.283	1.157	0.406	8.29
Cereals						
Maize	13.65	0.555	0.54	2.20	2.95	3.81
Wheat	10.0	0.246	0.60	6.44	3.51	5.18
Millet	9.30	0.178	0.70	4.98	1.88	3.37
Average	10.98	0.325	0.618	4.440	3.093	4.12

MC=Moisture Content; RSC =Reducing Sugar Content; CF=Crude Fat; TF=Total Fiber

Source: (Nuwamanya, 2011)

How do Root and Tuber Crops Qualify for Food and Nutrition Security?

Root and tuber crops can fit the four dimensions of food security (Table 4) and the three determinants of nutrition security (Table 5), which might contribute to filling a gap in food and nutrition shortages in the country. They are reasonably productive and can be produced in gardens as well as on large farmlands, increasing the availability of

food. The products can be easily accessed because they are affordable and adapt and tolerate harsh climatic conditions. Crops are healthy, safe and nutritional food sources that can be easily processed and consumed. In addition, their short harvesting time and continuous year-round production decrease the price fluctuations of crops, contributing to their stable availability domestically and on the market. Therefore, RTCs could obviously contribute immense shares to food and nutrition security.

Table 4. Fitting the contributions of root and tuber crops to the four dimensions of food security

Root and Tuber Crops' contribution	The four dimensions of Food Security (Von Braun, 2014; Bajagai, 2014)	References
High productivity Domestic production	– Availability of food	Cochrane & Bekele, 2018; Yimer and Babege, 2018; Chandrasekara & Kumar, 2016; Sanginga & Mbabu, 2015
Wide range adaptation Cheap	– Access to food	Scott et al., 2000b; El-Sharkawy, 2012; Abera & Haile, 2015; Lal et al., 2014
Nutritional composition Healthy Ease of processing Safe	– Utilization	Chandrasekara & Kumar, 2016; Parmar et al., 2017a;
Tolerant Low price fluctuations	– Stability	Lal et al., 2014; Bachewe et al., 2017

Because of their bulk productivity and domestic production in gardens, RTCs could be made available fresh as well as in processed forms all the time and in all regions of the country. All economic level communities can access these products because of their adaptation to different ecologies and low cost (Table 4). Furthermore, these crops

do not need special handling during production and processing relative to other food crops. Because RTCs are safe and nutritious, they can also provide support for efforts to achieve nutritional security (Table 5). Therefore, effective utilization of crops can be among the best options for ensuring food and nutritional security in Ethiopia.

Table 5 Fitting the contributions of root and tuber crops to the three determinants of nutrient security.

Root and Tuber Crops contribution:	Three determinants of nutrition security	References
Productive Domestic production Cheap	– Access to adequate food	Cochrane & Bekele, 2018; Yimer & Babege, 2018 Chandrasekara & Kumar, 2016; Sanginga & Mbabu, 2015; Bachewe et al., 2017
Nutritional Ease of processing	– Care and feeding practices	Chandrasekara & Kumar, 2016; Parmar et al., 2017a
Healthy Safe	– Sanitation & health	Chandrasekara & Kumar, 2016; Keatinge et al., 2015; Pichop et al., 2016

CONCLUSION

Root and tuber crops have both agronomic and nutritional advantages for addressing food and nutritional security problems. They are essential staples used worldwide, and their contribution to food and

nutrition security is immense. The current food production and consumption trends indicate the importance of promoting these crops to mitigate food and nutrition security problems. The approaches that integrate RTCs into the food system should receive serious attention. While the national average yields of RTCs are still far below the

attainable yields, ample opportunities exist to expand these crops' potential for increased food and nutrition security and income generation in Ethiopia. They can also provide essential nutrients such as carbohydrates, vitamins (vitamin C & vitamin A), minerals (zinc & iron), and essential amino acids.

Crops could contribute to food and nutrition security in Ethiopia by providing nutritious and inexpensive food products in sufficient quantity. Therefore, to maximize the contribution of RTCs to food and nutrition security, strategic national policy considerations should be considered. In particular, policy attention should be given to home-grown RTCs, such as Enset (*Ensete ventricosum*) and Anchote (*Coccinia abyssinica*), which can adapt easily to various ecologies. In addition to common RTCs such as potato and sweet potato, promoting highly productive crops such as taro and cassava is highly recommended because of their resistance to difficult climatic conditions. Potentially productive and adaptive RTCs are excellent options for highly populated countries to secure food and nutritional security. Therefore, policymakers and the government must pay ample attention to these crops.

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