

# 17 Securing the Genetic Base of Indigenous Food Plants

## *Their Role in Promoting Sustainable Food Systems*

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## 17.1 INTRODUCTION

The UN 2030 Agenda for sustainable development provides a valuable framework to put sustainability at the heart of a wide range of human activities. Ten years to this achievement, the United Nations "Decade of Action" calls for fast-tracking viable answers to current challenges in the world in which poverty, gender, climate change and inequality are topmost (United Nations, 2015). The "Decade of Action" on the

Sustainable Development Goal (SDG) Goal 2: Zero Hunger provides opportunities for Food Security and Nutrition to champion new drives to eradicate all forms of hunger and malnutrition which could be in the form of loss or lack of micronutrient, issues around overweight and obesity as well as avenues to reduce diet-related illness (United Nations, 2015).

Agriculture and more broadly food system activities are no exception and have a great deal of opportunity to contribute to accelerating solutions to attaining SDGs. However, this is not the case now as the global food system is unsustainable with food production, distribution and consumption practices being environmentally unfriendly. The rising population even makes the issues of un-sustainable food system worse, contributing to food insecurity to low nutrition, malnutrition and poverty, in extreme cases leading to death. The world is seeing a raise in over 848 million people being nutrition deficient of which over 60% of these figures are accounted for within sub-Saharan Africa and South Asia and require calorie intake. As reported by Fernandes et al. (2017), one in every three children in developing countries accounting for about 178 million children are stunted in growth as a result of prolonged under-nutrition and poor-quality diets. This can result in high risk of permanent damage to their growth and perceptible development (Fernandes et al., 2017).

For the “Decade of Action” to be very successful, food systems all over the world needs to be sustainable. A sustainable food system according to the United Nations (2019) should be a structure that can guarantee food availability and quality diet for all without having any effects on the economic, social and environmental bases for future generations. Sustainable food systems according to Borelli et al. (2020) are therefore defensive and take into cognisance biodiversity and environments, as well as human safety and collective fairness. As such they provide cultural standards which are said to be economically affordable as well as nutritionally safe/abundant in a way that balances agro-ecosystem integrity and social welfare (Figure 17.1).

Kahane et al. (2013) report that sustainable food systems can also be looked at from the perspective of rapid growth of world population, urbanization as well as change in consumer spending and consumption. It can also be considered in the context of globalization as well as change in climate and the depletion of natural resources (Kahane et al., 2013).

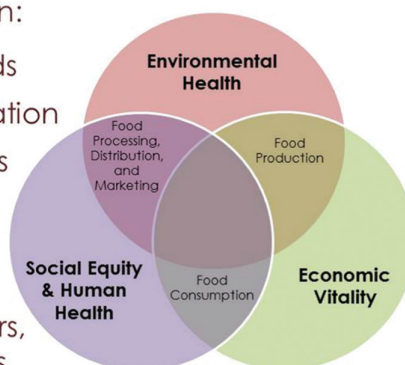
## 17.2 LIMITATIONS OF CURRENT APPROACHES TO SUSTAINABLE FOOD SYSTEMS

Irrespective of land area expansion for food production, self-sufficiency in food remains elusive as environmental change will continue to affect crop failures especially the conventional ones; these failures will continue to increase with increased change in climate. According to Levin and Pershing (2005) the most significant limitation to sustainable food system affecting developing nations is climate change. As the world experiences climatic change, it is estimated that over 5,000 plant species will be reduced in population, creating a shift in species ecological niche (Levin and Pershing, 2005). Low rainfall across regions is also fast becoming a leading indicator for climate change, thus more uncertainty among farmers as well as loss in their

## Sustainable Food Systems

**A Healthy, Sustainable Food System** focuses on:

- Local, seasonal foods
- Health of the population
- Building communities
- Local economic development
- Supporting local producers, processors, distributors & retailers



**FIGURE 17.1** Showing sustainable food system vital to environmental health, social equality, human health and economic vitality. (Source: <http://www.foodsecuritynews.com>)

local agricultural understanding and adaptive approaches. Thus, land for agriculture will continue to degrade with increased low-level rainfall and change in temperature patterns.

Another impact of climate change as reported by the FAO (2018) is on the health and productivity forests, marine resources and increased occurrence of pests and diseases. FAO (2018) equally reports direct or indirect effects of climate change to all mechanisms of food security including the availability of food, access to food and its proper use and stability. The question remains how the resilience of societies be reinforced to help them manage with threats to food security? According to Kuhnlein et al. (2019), indigenous food systems based on indigenous food plants are significant pools of distinctive traditional understanding grounded by generations that has helped these locals manage their resources over time. These kinds of food systems provide an essential knowledge about diets and their significance to fast-tracking the “Decade of Action” of the SDGs.

### 17.3 INDIGENOUS FOOD PLANTS

Indigenous Plants are those that are relatively common in specific areas; they are said to be readily available, well-adapted, easy and inexpensive to produce within specific areas. According to Quiroz and van Andel (2018) they are traditionally connected to the people that use them as their cultivation and utilization usually draws on indigenous knowledge. Many indigenous plants are important as household food items, and their contribution to food security is unquestionably significant. They have been seen to play significant part in relieving hunger in sub-Saharan Africa. In most cases they are termed Neglected and Under-utilized Species (NUS). According to van Rensburg

et al. (2004) indigenous plants are a vital source of micronutrients (vitamins A and C, iron) and said to contain more nutrient sources than regular vegetables. Indigenous food plants are said to be potential for the reduction of non-communicable diseases, such as diabetes, obesity, heart disease and certain types of cancer which are some attributes of processed food diets.

Padulosi et al. (2013) defined indigenous plants as those to which little consideration has been given and no serious research work carried out by agricultural scientists including plant breeders and policymakers. Majority of them are still extracted from the wild and in some cases semi-domesticated. Many of these varieties and species, including their traditional understanding about their agronomy and use, are lost at an unprecedented rate. Furthermore, Cloete and Idsardi (2013) and Venter et al. (2007) reported that the use of these plants as food are affected by the perception as most times, they are classified as “food for the poor” or the “Elderly”. Therefore, in securing the genetic base of these plant resources, NUS present incredible prospects for poverty alleviation, starvation and malnutrition reduction. They also can provide the much needed resilience for agricultural production systems. These crops can be acknowledged as potentials for providing economic and social empowerment for local people (women in particular) and reiterates their uniqueness (Padulosi et al., 2013). In Nigeria, there are over 63 families of indigenous plants (Table 17.1, Figures 17.2–17.4).

## 17.4 ACHIEVING THE SDGs WITH INDIGENOUS FOOD PLANTS

In keeping the promise of achieving the SDGs by 2030, according to United Nations (2015) especially the SDG goal 2 (Zero Hunger), the need to outline alternative innovative ways for increased supply of safe and nutritious foods in sufficient quantities is therefore necessary without undermining the environment. For sustainable food system to gain this feat, there is a need for more and innovative use of the many and diverse indigenous crops and their wild relatives. Therefore, the promotion and diversification of crops including indigenous crops have been supported by many UN treaties (the Rome Declaration on Nutrition (FAO and WHO, 2015) and Recommendation 10 of the Framework for Action (FAO, 2014a)). These treaties have recognized the important roles which biodiversity plays as backbones to sustainable food systems and balanced diets.

## 17.5 NEED TO SECURE THE GENETIC RESOURCES BASE OF INDIGENOUS FOOD PLANTS

### a. Indigenous food plants as potentials to fight hunger and malnutrition:

With approximately 20% or more populace in sub-Saharan Africa experiencing food insecurity, it is safe to say that hunger and malnutrition threaten millions of persons in this region. According to the FAO (1996), many individuals are unable to meet nutritional requirements and food choices for a healthy life. Preschool children are most hit by malnutrition in this region. Many indigenous food plants especially vegetables contain

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TABLE 17.1

## Some indigenous plants belonging to 62 families in Nigeria

S/n	Indigenous Plants	Family	Local Nigerian Names
1.	<i>Abelmoschus esculentus</i>	MALVACEAE	okra, okro, lady's finger
2.	<i>Amaranthus cruentus</i>	AMARANTHACEAE	amaranth, pigweed and green
3.	<i>Celosia argentea</i>	AMARANTHACEAE	Sokoyòkòtò(YORUBA) 'Make husbands fat and happy'
4.	<i>Colocasia esculenta</i>	ARACEAE	Cocoyam (EN), Gwaázaá (HAUSA) édenkiti (IGBO) ìçukókò (YORUBA).
5.	<i>Cucurbita</i> spp	CUCURBITACEAE	Pumpkin (EN), úgbògùlù(IGBO) apala (YORUBA), sàádò (HAUSA).
6.	<i>Digitaria exilis</i> and <i>D. iburua</i>	POACEAE	Fonio millet, and hungry rice (EN), Sùurù (Yoruba), Acha (HAUSA).
7.	<i>Gnetum africanum</i>	GNETACEAE	òkazi° (IGBO) áfàng (EFIK) àjàabalè (YORUBA).
8.	<i>Gongronema latifolium</i>	ASCLEPIADACEAE	Utazi (IGBO) arókéké (YORUBA).
9.	<i>Heinsia crinita</i>	RUBIACEAE	Atama (EFIK)
10.	<i>Hibiscus sabdariffa</i>	MALVACEAE	Roselle (EN), isapa (YORUBA), yakuwa (HAUSA), Capsule cover: Zoborodo or Zobo.
11.	<i>Irvingia gabonensis</i>	IRVINGIACEAE	African mango, bush mango (EN), Dika or Ogbono (IGBO).
12.	<i>Momordica charantia</i>	CUCURBITACEAE	Akbanndene (IGBO), Akaraaje (YORUBA), Daddagu (HAUSA).
13.	<i>Piper guineense</i>	PIPERACEAE	Black pepper (EN), Iyere (YORUBA), Uziza (IGBO).
14.	<i>Pterocarpus</i> spp	LEGUMINOSAE-PAPILIONOIDEAE	Oha-Igbo (YORUBA), Oha (IGBO).
15.	<i>Solanum aethiopicum</i>	SOLANACEAE	Garden egg (EN), Anara, efo (IGBO), Àrgúngù (HAUSA).
16.	<i>Tamarindus indica</i>	FABACEAE	Tamarind (EN), Tausami (HAUSA).
17.	<i>Terapleura tetraptera</i>	FABACEAE	Uhio (Uhiokrihio) (IGBO)
18.	<i>Tetracarpidium conophorum</i>	EUPHORBIACEAE	African Walnut (EN), Awusa or Asala, (YORUBA), Ukpa (Igbo), Gawudibairi (HAUSA), Okhue or Okwe (BINI).
19.	<i>Treculia africana</i>	MORACEAE	African breadfruit (EN), Ukwa (IGBO) Afon (YORUBA).
20.	<i>Vernonia amygdalina</i>	COMPOSITAE.	Bitter leaf (EN), Onugbu (IGBO), Ewuro (YORUBA), Etidot (EFIK).

Source: <https://plants.jstor.org/>.

high nutritional value and have the needed requirements capable of solving dietary and malnutrition needs. According to Keatinge et al. (2011), many traditional vegetables are high dietary value when equated with worldwide vegetables like tomato and cabbage. Results from traditional home gardens have shown that these vegetables and legume crops such as mung bean have



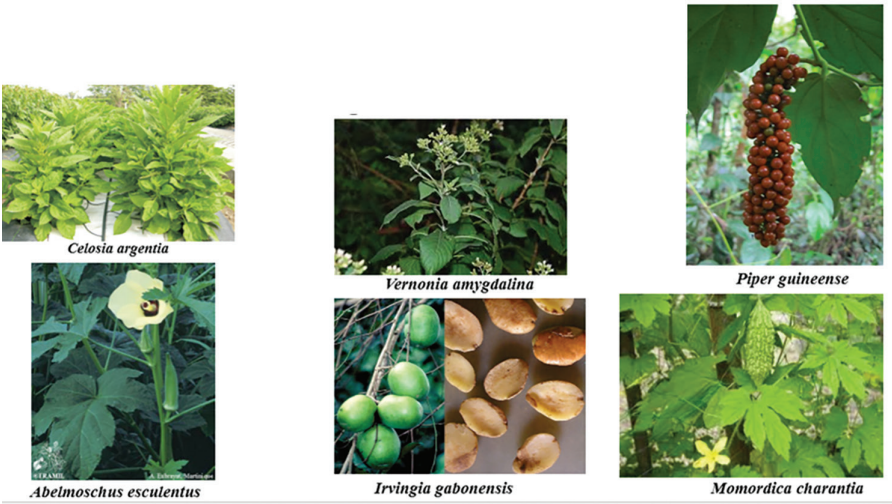


FIGURE 17.2 Examples of Nigerian indigenous plants.

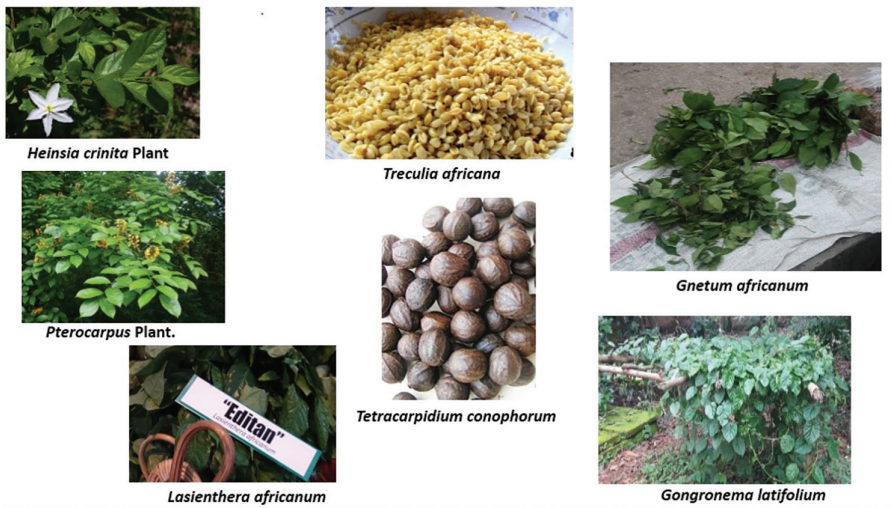


FIGURE 17.3 Examples of Nigerian indigenous plants.

the prospects of contributing to strategies that could aid attaining nutritional security (Keatinge et al., 2011). Apart from providing important vitamins, these plants are recognized as naturally nutrient-dense (Hughes and Keatinge, 2012; Yang and Keding, 2009).

Table 17.2 as reported by FAO (2018) compares the nutritional portion of quinoa and rice. The reports show 100 g of raw quinoa containing twice the amount of proteins (g), over four times the number of dietary fibre (g) as well as three times the amount of iron (mg).

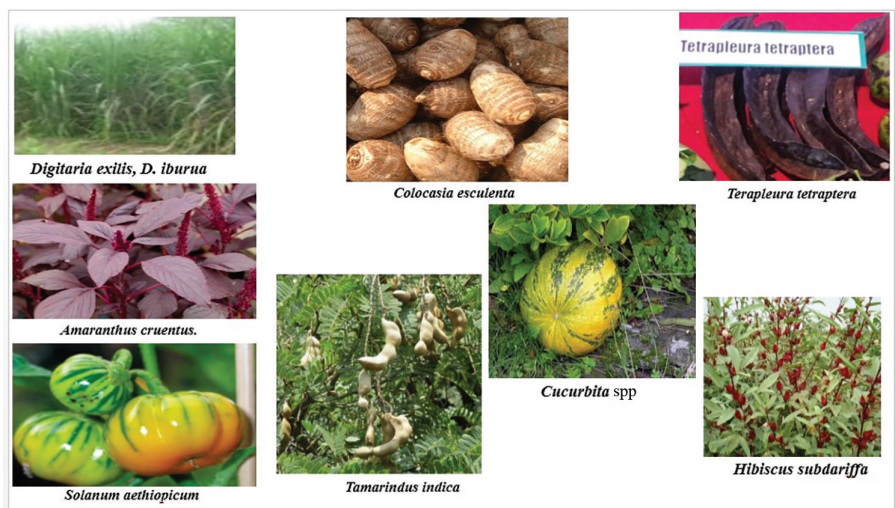


FIGURE 17.4 Examples of Nigerian indigenous plants.

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TABLE 17.2  
The Nutritional Composition of Quinoa and Rice

	Energy (kcal)	Protein (g)	Dietary Fibre (g)	Iron (mg)	Folate ( DFE mcg)
Quinoa* raw	354	14.1	7.0	4.6	184
Rice* white, polished, raw	365	7.1	1.3	1.2	8

\* USDA data in per 100 g edible portion on fresh weight basis.

Source: FAO (2018).

Providing substitutes to bioavailability of pro-vitamin A from plant foods which has long been a subject of international controversy brings to bear the nutritional contributions of indigenous vegetables (Jansen van Rensburg et al., 2004). In securing the genetic diversity of these species, we would have developed innovative ways by which their contributions to better nutrition of susceptible individuals through inter- and intra-specific evaluation of carotenoid composition and bioavailability can be achieved. By offering options that identify synergistic food combinations or preparation methods

plant diversity research may inform pro-vitamin “A” absorption (Jansen van Rensburg et al., 2004).

For Nigeria, indigenous food plants provide the potential to reduce malnutrition of children within the school age. These plants when introduced as part of the school feeding programme could provide better options for nutrition as well as rich protein sources.

**b. Indigenous food plants as potentials to alleviate poverty:**

According to Jaenicke and Hoschele-Zeledon (2006) for any nation to grow at an exponential rate, there is a need to reduce poverty levels; it is therefore critical to balance activities that will maximize economic growth without compromising environmental protection and safety. Freedman (2015) also reports the need for awareness and increased emphasis on the need to showcase the potentials for economic growth which indigenous plants especially indigenous vegetables can offer to livelihood of African societies. As interest in indigenous food plants grows worldwide, there is a need for a reflecting growth trend within agriculture which will identify and develop new crops with both domestic and export potentials. These inter-linkages therefore must leverage on an enabling environment that can empower disadvantaged farmer communities and include indigenous crops in smallholder agri-business (Morecroft, 2012).

*Dacryodes edulis* for example provides an excellent model for household income generation. According to Ayuk et al. (1999), there is a raise in income per household in Cameroon from US\$ 9 to US\$ 80 during the peak seasons and up to US\$160 during the early dry seasons. *Irvingia gabonensis* fruit, on the other hand, has provided direct income for 30% community households with 55% reported to be household secondary income source in the same region as reported by Schreckenberget al. (2006). Adebisi (2004) reported an average annual income of about 8% from sales of *Garcinia kola*. Again, annual income of *Dacryodes edulis* to household revenue was 5% as reported by Adewusi (2004) with about 40% of households producing *Dacryodes edulis* in the Sakpoba Forest Reserve in southern Nigeria.

However, as discussed by FAO (2014c), to completely achieve the diversification and economic growth via indigenous food plants, there is also a great need for modernization of related activities supported by efficient processing of the commodities for the purpose of value addition. This is expected to increase food production, create employment and generate income; hence the addition of value to food commodities after harvest will minimize the losses during preservation and processing, bringing more benefits as a result more income to the tribal farmers or processors (FAO, 2014c). Improvement of commodity value chain could enhance entrepreneurship development and will provide better quality of produce to the consumer (FAO, 2014c).

Opportunities to develop new products from indigenous plants for local and international markets have been reported by Van Wyk (2011). These species provide profitable ventures for new food and beverage products. However, creating public awareness on the importance of this species in new product development is key. This according to Van Wyk (2011) requires quality research in plant science which will guide genotype selection, horticultural research to inform development of new





**FIGURE 17.5** Value Addition for indigenous Food plants.

crops, Food Science research that will focus on analysing nutritional needs as well as marketing which hopes to understand and advance new marketing approaches (Figure 17.5).

## 17.6 STRATEGIES FOR SECURING THE GENETIC BASE OF NIGERIAN INDIGENOUS PLANTS

### a. Genetic vulnerability of indigenous plants:

In as much as there are opportunities for indigenous plants to thrive, there is a need to link the existence of rich agro-biodiversity in a specific place and the dietary status of the indigenous people. Unfortunately, issues of genetic vulnerability may occur from the nature of use of genetic diversity. According to Mehfuz and Hasan (2016), a reduction in the required diversity denies populations the ability to fight biotic and abiotic stresses thus making such population genetically vulnerable. In the same vein, when a large part of an area is cultivated by one particular cultivar, genetic diversity is said to be at a very low intensity and in most case scarce thereby making them very vulnerable (Mehfuz and Hasan, 2016). Since most indigenous plants are confined to particular places, the issues of genetic vulnerability cannot be overemphasized. Securing their genetic base offers opportunities for new techniques in plant breeding directed towards development of varieties with high yielding potentials. The utilization of molecular techniques also opens up new potentials for genetic improvements of these plants. Full genome sequences raise the hope for progress in solving issues for genetic diversity, genetic erosion and genetic weakness (Mehfuz and Hasan, 2016).

### b. Recognition of the importance of indigenous plants in the protection and conservation of indigenous knowledge:

According to Hanazaki et al. (2018), the protection of indigenous knowledge is an important component of conservation and sustainable development. The knowledge of these indigenous people is central to the protection of bioresources; therefore, the recognition of such knowledge especially for indigenous plants may just be a strategy for securing their genetic base. On the other hand, local knowledge is the development of new technologies. Tripathi (2017) has reported exploitation of indigenous knowledge by industries with no permission to share profit with these communities. The protection of traditional knowledge will ensure equitable and fair share of resources necessary to bring equity to such unjust and unequal relations.

Another reason that calls for protection of traditional knowledge of indigenous plants as reported by FAO (2014b) is to continue to promote practices of indigenous people in order to continuously preserve their knowledge including traditional life styles including food systems, cultural practices as well as the use of indigenous plants in folk medicine. This will not only preserve traditional knowledge but also provide avenue for self-identification.

**c. Build capacity in researching, teaching, policymaking, trading and farming:**

In securing the genetic base of indigenous plants, it is important to establish a link between research, nutrition and livelihoods. One sure way of doing this according to the FAO (2014a) is a collaborative link between educators and government who can guide the development of new curriculum to incorporate issues of indigenous food resources into the school system curriculum. Cromwell et al. (1993) also support the need to have policies for seed systems in the educational sector, encouraging programmes that would set up multi-partnerships between government and private sectors in the promotion of underutilized foods.

Tafadzwanashe et al. (2019) equally report the need to maximize research in indigenous food plants; this will help identify and deliver solutions to their breeding systems, climate adaptability as well vulnerability of the plants and their economic and nutritional values. Furthermore, research is expected to change their perception as unimportant “poor man’s food” by encouraging scientists and policymakers to optimize and promote their benefits. In setting up conservation programmes, their genetic base can also be optimized. Conservation programmes like in situ conservation of wild species and ex situ conservation in gene banks is recommended (FAO, 2014b).

**d. Improve value chains including innovative ways to upgrade market chains:**

Another way by which we can secure the genetic base of the indigenous food plants is the development of their value chain by providing innovative ways to upgrade their markets. According to Padulosi et al. (2014) as well as Lamers et al. (2016), for a successful development of markets for these plants especially indigenous vegetables, a holistic approach that considers all aspects of the value chain which includes genetic diversity and seed supply is adopted. By adopting a market system where high-quality seeds can be accessed, This offers the chance to evaluate the efficiency

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of value-added services as well as complete effectiveness along the supply chain to intensify growth, sales and the income generation for indigenous farmers. Padulosi et al. (2014) reported that these access can be achieved if inventories of indigenous food plants are created to define and promote a niche market for them as well as the creation of an open seed source that will allow for participatory varietal selection (PVS) offers a ways to increase value chain development.

Furthermore, the need to employ technology for value chain improvement cannot be overemphasized. Padulosi et al. (2014) report the need to invest in research and innovation to improve cultivation practices, train farmers on new techniques as well as strengthen the capacity of extension officers. In building capacity, traditional knowledge must be taken into account thus creating manuals on good practices, based on traditional knowledge (Padulosi et al., 2014). Improvement of post-harvest losses is also key priority for development of the indigenous food plants value chain.

FAO (2017) recommended that for value chains to shape improved nutrition and conservation, an improvement in value addition and marketing is necessary. Again, fostering investment in infrastructure and transportation to increase marketing options as well as share market information with producers and other stakeholders, e.g. on financial services for producers, including credit, savings and insurances, information on pricing, supply and demand of indigenous vegetables, can shape value chain improvement for nutrition and conservation of indigenous food plants.

**e. Legal frameworks, policies and financial incentives:**

For a secured food system which indigenous food plants offer, FAO (2014a) recommended the examination of legal instruments on wild indigenous foods. Rights of local communities will be upheld and at the same time encourage sustainable conservation use and farming systems that will support the domestication of some wild plants. Policies that can enhance farmers' incentives to maintain these species should be adopted. For example, the Central Bank of Nigeria's Anchor Borrowers Program can be extended to indigenous food plant farmers.

## 17.7 CONCLUSIONS

For Nigeria to build a sustainable food system, an expansion of the food system should be taken into account. Indigenous food plants offer opportunities for food system expansion (BERC, 2020). As the global coronavirus pandemic reveals major weaknesses, inequities and system-wide risks in global food systems, there is renewed urgency to foster pathways to greater food system sustainability and resilience. The crisis, however, offered a pointer to new and more resilient food systems, of which when communities come together and public authorities take extraordinary steps, the steps to secure our food systems become possible. Taken a cue from past experiences, we are able to understand that curbing the food crisis starts with the transformation of our food system to build resilience at all levels. Therefore, securing the genetic base of indigenous plants can contribute to achieving the SDGs Decade of Action for sustainable food systems in Nigeria.

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