Biodiversity Conservation of Neglected and Underutilized Nigerian Horticultural Crops

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Abstract
Biodiversity is fundamental for ecosystem functioning, sustainable crop production, soil health and the attainment of food and nutritional security. It is vital for current and future human well-being. Loss of biodiversity in Africa and across the globe and its negative impacts on food security, wealth, climate, nutrition and health must be curbed. African indigenous and underutilized crops are not likely to cause diet-related diseases. In addition some of them can not be adversely affected by climate change and they also require minimum agronomic input to yield optimally. Besides supplying appropriate proportions of essential minerals, underutilized horticultural crops can also reduce hunger and alleviate poverty. While abiotic stresses like low/high temperature, drought, light intensity, and sub-optimal relative humidity will have negative impacts on exotic plants growth and development, indigenous crops are seldom affected. It is of great importance that neglected and underutilized plant species (NUS) also serve a dual purpose as food for man as well as animal feed. Despite these crucial roles that NUS occupy, some are still threatened with neglect and potentials not maximized. This paper discusses strategies that can be adopted to conserve (NUS) for their optimal utilization, with the Nigerian rain forest species as prototypes. Deliberate identification and cultivation of the NUS, Establishment of gene- and field- banks, Recognition and promotion of (NUS) through national and special research and development programmes, use of media, including social, Extension Agents and agencies, linking (NUS) to relevant industries including foods, feeds and pharmaceuticals, biodiversity conservation through diversified farming systems etc are major key strategies for Climate smart and sustainable agriculture.

Key words: Biodiversity, Climate-smart agriculture, Food security, Value chain.

Introduction

Horticulture is one of the agricultural enterprises in accelerating the growth of economy over the years. Its role in ensuring nutritional security, climate change/pollution control, poverty alleviation, environmental aesthetic appeal, employment generation programs and in health is very crucial (Adejumo, 2003; Oloyede, 2021). Horticulture offers a wide range of options to the farmers for crop diversification as it involves the cultivation of a wide range of high value crops encompassing fruit and nuts, vegetables, roots and tubers, spices, aromatic and medicinal and ornamental crops both in rural areas, and within cities and in their surrounding areas (Lutaladio et al., 2010). However, horticultural crop species have suffered genetic erosion due to over-exploitation of a few exotic and popular species at the expense of the indigenous counterparts also known as the underutilized species (Adejumo, 2003; Oloyede, 2021, Oloyede et. al., 2022).

Neglected and underutilized horticultural crop species (NUHS) are often considered 'minor crops' because they are taken to be less important than staple crops and agricultural commodities in terms of global production and market value. However, from the standpoint of the resource-poor farmers who depend on many of these species for their food security, nutrition and income, they are hardly minor

(Osewa et al., 2013). They are also considered as underutilized in terms of their potential to contribute to the income and well-being of the global food security in general (Oloyede et al., 2011). (NUHS) are also described as "neglected" or "orphan" crops since they have received scant attention from research and development, and there is little scientific information about them (Padulosi and Houschle-Zeledon, 2004; Dansi et al. 2012; Oloyede, 2017).

(NUS) play a major role in aleviating nutritional problems and poverty. They are not likely to cause diet-related diseases. They have been found to be viable and potent sources of food, feed, shelter, and medicine, contributing thus to improve in various ways, the quality of life well-being of mankind (Oloyede et al. 2012a ; Osewa et al., 2013; Oloyede, 2017). In addition some of these crops can not be adversely affected by climate change and they also require minimum agronomic input to yield optimally (Oloyede, 2011; Oloyede et al. 2012b; Oloyede et al. 2014).

Biodiversity is used to refer to the collective of ecosystems, species, and genes which together comprise the earth (Shannan and Grant, 2007). Crop biodiversity is one of the major inventions of humanity through the process of domestication It is an important resource for crop improvement to adjust crop production as a measure to mitigate the adverse effects of climate change and to satisfy consumer preference (Hufford et al., 2019). The biodiversity in crops, cultivated crops, and particularly in horticultural crops naturally underpins sustainability, nutritional security, and above all a diversified food basket (Lutaladio et al., 2010; Hufford et al., 2019). Together with natural resources overall, biodiversity in horticulture is the key to crop and dietary diversification, and indeed human well-being and survival (Lutaladio et al., 2010).

In addition to food provision, biodiversity in agriculture is important for ensuring nutrient cycling, carbon sequestration, soil erosion control, greenhouse gas emissions reduction and control of hydrological processes (Chivenge et al., 2015). Around 30,000 of the total of approximately 250,000 flowering plant species in existence are edible, with the vast majority of the edible species being "minor crops." These may be culturally important cultigens, semi-wild species, wild species, or weeds; in turn they may be locally cultivated on a small-scale, semi-cultivated in and around settlements, gathered from the wild, or tolerated in cultivated areas, respectively (John, 2015). The broad range of traditional crops, which were previously grown on a sustainable scale in some parts of the world, has been replaced by a narrow range of major crops, grown as large-scale monocultures over a couple of decades leading to a vast reduction in horticultural and agricultural biodiversity among popular species. This has consequently narrowed the number of species upon which global food security depends (John, 2015).

Biodiversity conservation of horticultural crops is essential to achieving two of the United Nations Millennium Development Goals (MDGs): halving the proportion of people who suffer from hunger and ensuring environmental sustainability. Diversifying crop production is no doubt a viable climate smart agriculture that must be embraced by all and sundry. This paper assesses the importance of Nigerian underutilized horticultural crops, the need and how of their conservation for maximal exploitation.

Why neglect and underutilization?

Ignorance of the crops and their potentials by the elites

According to Oloyede (2011), many NUHS in Nigeria are becoming unknown to the new generation, especially the urban dwellers that have the means to explore their potentials in food, feed, pharmaceutical etc. industries. Rural women cultivate some of the crops for their immediate use and no serious cultivation attention is given to them by any farmer in the country.

There is deficiency of documented knowledge in the nutritional composition of NUHS as well (Amujoyegbe, 2007; Amujoyegbe et. al., 2015, Oloyede, 2021).

Seed constraints and difficulties in the propagation process

Due to under-cultivation, the seeds/planting materials of NUHS are scarcely available for potential researchers and farmers. Hence, commercial cultivation of the NUHS is impaired (Oloyede, 2011). Solanecio biafrae (Worowo) grows as understory in tree crop plantation, while the seeds of Crassocephalum crepidoides (Ebolo) are carried away by air, being very light for instance, hence, the domestication of NUHS has been very difficult because of the mode of propagation and the facts that some seeds of NUHS are also dormant (Oloyede et. al. 2011; Amujoyegbe et al., 2015). In addition, Adebooye and Ajayi (2008) noticed the restriction in production time, as the crops are mostly grown under rain fed conditions and are only available seasonally.

Lack of adequate acceptance by people

Salami (2011) identified lack of adequate acceptance of some of the NUHS by people, thereby making them uneconomical and less profit oriented. Oloyede (2011) reported that NUHS carry the "poor-man-food" label. Some people feel those that still eat such crops are poor, and show same in their action towards the crops. Most especially, some NUHS like pumpkin (Cucurbita pepo L.) many times are utilised during the off-seaon after storing for a number of months and fresh produce especially tomato and other fruit vegetables are scarce.

Some NUHS are considered as weeds

Many NUHS are generally harvested from the wild. Some grow as weed on cultivated arable field but they are harvested and utilized as food components in Nigeria. Some grow as volunteer weeds under fallowed land e.g. Amaranthus viridis (Tete Abalaye), Crassocephalum crepidoides (Ebolo), Solanum nigrum (Odu) and Solanum nodiflorum (Ogumo while Launea taraxacifolia (Yanrin) grows around homesteads as weed (Amujoyegbe et al., 2007; Oloyede et al., 2014; Amujoyegbe et al., 2015).

Constraints in production techniques and processing

Amujoyegbe et al., (2015) reported that despite the economic, nutritional and medicinal importance of NUHS, they are being endangered by several socio-economic factors that serve as constraints in the cultivation of most of them. These constraints relate to inadequate knowledge of NUHS production techniques and processing. Oloyede (2012b) reported that exocarp of pumpkin fruit which is very hard at maturity makes its processing by the rural dwellers to be very laborious. This challenge is adequate to frustrate the processing of the crop manually.

Lack of organized markets

According to Dansi et al., (2012), farmers highlighted lack of organized markets as one of the main reasons behind the desertion of NUHS.

Poor financial support

Another major cause of neglect and underutilization of NUHS is poor financial support from both private and public quarters (Dansi et al., 2012).

Lack of national promotion policies

Lack of national promotion policies for the NUHS is another bottleneck in popularizing the usage and exploitation of the crops (Dansi et al., 2012).

Table 1a: Lists and descriptions of selected neglected and underutilized leaf vegetables

Botanical name	Family Name	Plant Description
Launaea taraxacifolia (Willd.) C. Jeffrey	Asteraceae	*Launaea taraxacifolia* also known as wild lettuce is found mainly in Tropical Africa. The plant over the years has been reported to possess many ethnopharmacological properties on disease conditions such as conjunctivitis and diabetes mellitus among others (Adebisi, 2004; Adinortey et al., 2012; Laleye et al., 2015).
Hagenia abyssinica (Bruce) J.F.Gmel.	Rosaceae	It is attractive an African tree with soft leaves and hanging flower that grows up to 18 m high. An infusion of the flowers is used widely against tapeworms (Assefa et al., 2010).
Amaranthus viridis	Amaranthaceae	Extracts of *A. viridis* have high medicinal and good nutritive content with reference to essential elements like calcium and iron (Adetutu and Alani, 2013) as well as safe when consumed in large quantities (Emmanuel et al., 2018). They are also good source of thiamine, niacin, riboflavin, folate, and dietary minerals (USDA, 2014).
Solanum americanum Mill.	Solanaceae	In Africa, *S. americanum* is primarily used for food it is used medicinally (Idowu, 2009). Other traditional medicinal uses include the treatment of heart pain and conjunctivitis using raw leaves while fruits have been used to treat worms in poultry in Nigeria.
Momordica charantia L.	Cucurbitaceae	It is an annual climbing vine probably native to tropical and subtropical Africa and Asia (Englberger, 2009). Leaves are used as pot-herbs and fruit are boiled, fried, pickled or used in curries. Both young shoots and immature fruits are eaten as vegetables; although the immature fruits are very bitter unless blanched, or steeped in salty water. Its seed helps ameliorate the effects of *diabetes mellitus* (Holm et al., 1997; Osewa et al., 2013).
Gongronema latifolium Benth.	Asclepiadaceae	*Gongronema latifolium* has a host of medicinal uses and is widely used in West Africa (Mosango, 2011). An infusion of the aerial parts is taken to treat cough, intestinal worms, dysentery, dyspepsia and malaria. It is also taken as a tonic to treat loss of appetite. It is also taken for controlling weight gain in lactating women and overall health management. Asthma patients chew fresh leaves to relieve wheezing (Mosango, 2011).

Table 1b: Lists and descriptions of selected neglected and underutilized leaf vegetables (cont'd)

Botanical name	Family Name	Plant Description
Ocimum gratissimum	Lamiaceae	It is an erect small plant less than 1m high found in tropical and subtropical regions of the world. Its leaves are used in traditional medicine to treat upper respiratory tract problems, skin diseases, pneumonia, cough, headaches, fever and conjunctivitis among others (Ilori et al, 1996)
Murraya koenigii (L.) Spreng.	Rutaceae	It is used mainly as a spice and culinary herb owing to its essential oils. There are few reports of its role in medicine and traditional folklore.
Basella alba L.	Basellaceae	*Basella alba* plant parts are used as a laxative, rubefacient, demulcent, diuretic, febrifuge, an astringent; and to treat conjunctivitis, catarrh, dysentery, diarrhoea, indigestion, constipation, boils and sores and as an antidote to poison (Kumar et al., 2013; Useful Tropical Plants, 2017)
Ceratotheca sesamoides Endl.	Pedaliaceae	It is an annual herb up to 1.2m tall, sometimes with woody rootstock, with prostrate, ascending or erect, pubescent stems. The leaves are steeped in water and the slimy liquid is used to treat conjunctivitis (Bedigian and Adetula, 2004).
Telfairia Occidentalis - Hook.f.	Cucurbitaceae	It is a perennial climbing, dioecious plant that can be found in West tropical Africa and can grow up to 15 m long. Medicinally, the plant is used for convulsion, malaria, anemia, and cardiovascular diseases (Plants for A future, 2020).
Cucurbita pepo L.	Cucurbitaceae	An annual, coarsely herbaceous, climbing, trailing or bushy, polymorphic plant. The plant is, of course, grown principally for the fruit. The pulp is eaten as a vegetable or in soup. The young leaves and shoots, and as well as the flowers, are used as a potherb (Burkill, 1985) and recently has been found to have antioxidant potential (Oloyede, 2017).
Crassocephalum creppidioides (Benth.) S. Moore	Asteraceae	*C. crepidioides* is an erect, sparingly branched aromatic annual weed about 0.5 -1m tall with a seemingly stout stem. It is used in traditional African medicine to treat indigestion, stomach ache, epilepsy, sleeping sickness, and swollen lips. Studies also show it possesses antitumour and antioxidant potentials (Aniya et al., 2005; Tomimori et al., 2012). Additionally, it has been shown to possess pharmacological properties that promote the prevention and the treatment of several human pathologies such as hypertension, headaches, breast cancer, burns, inflammations, injuries, liver complaints and sexually transmitted diseases (Dairo and Adanlawo, 2007; Adjatin et al., 2013).
Bidens pilosa L.	Asteraceae	The leaves of *Bidens pilosa* are reported by the local population to possess antibacterial, anti-dysenteric, anti-inflammatory, antimicrobial, anti-malarial, diuretic, hepatoprotective, and hypotensive activities (Hassan et al., 2011).
Vernonia amygdalina	Asteraceae	It is a perennial plant that grows up to 1.5 m. It is believed to contain secondary metabolites in tie form of phytochemicals, vitamins and minerals.

Table 2: Lists and descriptions of selected neglected and underutilized fruit vegetables

Botanical names	Family Name	Plant Description
Solanun melongena L.	Solanaceae	It is used for medicinal purposes which include for curing diabetes, cholera, bronchitis, dysuria, dysentery, otitis, toothache and skin infections and is also ascribed narcotic, anti-asthmatic and antirheumatic properties. (Daunay and Chadha, 2004; Weese and Bohs, 2010; Bidaramali et al. 2020)
Solanium marcrocarpon L.	Solanaceae	It is a perennial plant that grows up to 150cm tall with dark purple stem and no trichomes. Phytochemicals present in are tannins, flavonoids and alkaloids (Kadiri and Olawoye, 2015). The leaves are used for a variety of medicinal uses (Komlaga et al., 2014; Olanipon et al., 2020).
Solanum nigrum L.	Solanaceae	The plant possesses antioxidant activity and anticancer properties (Aboul-Enein et. al. 2014)
Piper guineense Schumach. & Thonn.	Piperaceae	It is a climbing dioecious non-pubescent plant with ripe reddish brown fruits found in Tropical and East African countries (Hutchinson and Dalziel, 1954).
Trichosanthes cucumerina L.	Cucurbitaceae	Studies indicate the presence of free radical scavenging ability and antioxidant property in *Trichosanthes cucumerina***.** Alkaloids, flavonoids, carotenoids, phenols, tannins and other active compounds present in this plant makes it pharmacologically and therapeutically active (Adebooye et al., 2008; Stephin and Gangaprasad, 2015).
Aframomum melegueta K Schum.	Zingiberaceae	It is also known as alligator pepper, with stems up to 1.5 m high with pink or white inflorescences found at the forest floors. Medicinally, it is used as analgesics, laxatives and depressants (Burkill, 1985; Osewa et al., 2013).
Cucumis melo L.	Cucurbitaceae	The fruit has high water content but with a delicate flavour and very refreshing. It is rich in vitamins B and C. The flesh of the fruit can be dried, ground into a powder and used with cereals when making bread, biscuits etc (Plants for A future, 2020).
Cucurbita pepo L.	Cucurbitaceae	The plant is grown principally for the fruit. The pulp is eaten as a vegetable or in soup. The young leaves and shoots, and as well as the flowers, are used as a potherb (Burkill, 1985, Oloyede, 2017).

Table 3: List and descriptions of selected neglected and underutilized cereals and legumes

Botanical names	Family Name	Plant Description
Phaseolus lanatus L.	Fabaceae	*P. lunatus* is an aggressive herbaceous vine, attaining up to 6 m in length with its seeds and leaves valued for their astringent qualities and consequently used for fever in traditional Asian medicine (Hernandez and Leon, 1994).
Lablab purpureus - (L.)Sweet.	Fabaceae	It is a climbing, pubescent herbaceous perennial pulse whose fresh seeds are poisonous but its flowers and pods are used as vegetables. (George, 2011).
Marcrotyloma geocarpum (Harms) Maréchal & Baudet	Papilionaceae	Kersting's groundnut leaf decoctions act as a vermifuge. The Igbo of Nigeria use the plant in the treatment of dysentery, venereal diseases, fever and diabetes (Achigan Dako and Vodouhè, 2006).
Pennisetum glaucum L.	Poaceae	Pearl millet is also known as pigeon grass. It is consumed in form of flour and it also used as beverage in some communities.
Cyperus esculentus L.	Cyperaceae	Tubers of Tigernut (*Cyperus esculentus*) are said to be aphrodisiac, carminative, diuretic, stimulant, potent antioxidant with anti-inflammatory properties (Adejuyitan, 2011). Tigernut tuber has also been reported to be used in the treatment of flatulence, indigestion, diarrhoea, dysentery, and excessive thirst (Adejuyitan, 2011). Owing to its high dietary fiber content, it is effective in the treatment and prevention of many diseases including colon cancer, coronary heart diseases, obesity, diabetes, and gastrointestinal disorders. (Ekeanyanwu and Ononogbu, 2010).
Sphenostylis stenocarpa	Leguminosae	African yam bean is a crop with food security potentials in Africa. It has a broader amino acid spectrum of most of the essential amino acids especially lysine, methionine, histidine, and isoleucine than those in other legumes including soybean (Ojiakor et al., 2010).
Vigna subterranea	Leguminosae	Bambara groundnut is a mineral rich underutilised crop with huge food value. It consumed boiled as eaten as pudding. It has huge food values too and can be referred as a cheap substitute to cowpea and groundnut. (Amarteifio et al., 2006)
Cajanus cajan (L.) Millsp.	Fabaceae	Seeds of Pigeon pea are consumed as food and the leaves are cooked as vegetables too. It is a source of livestock feed and forage.

Table 4: List and descriptions of selected neglected and underutilized shrubs and fruit trees

Botanical names	Family Name	Plant Description
Garcinia kola - Heckel	Clusiaceae	Native to tropical Africa - Sierra Leone - South Western Nigeria and on into Zaire and Angola. The leaves are leathery. In Nigeria, these are eaten as a cure for body pains. Plant parts such as bark, fruit, seeds and nuts have been used in traditional medicine for the treatment of various conditions like coughs, fever, wounds, stomach pains and general body pains (Osewa et al., 2013).
Jathropha curcas L.	Euphorbiaceae	J. curcas is a shrub or treelet, 2-5 m tall, with watery latex with a smooth bark. Most of its plant pats are used in traditional medicine as a laxative, emetic, cough treatment, and for healing wounds (Heller, 1996; Crothers, 1998), as a purgative and styptic, for toothache and strengthens gums, and to treat diarrhoea. The oil is applied externally to treat skin disease, and for rheumatism and sciatica. According to Thomas (1989), the latex has been found to possess antimicrobial properties.
Rininus communis L.	Euphorbiaceae	It is a fast-growing shrub/small tree, evergreen glabrous, with toxic seeds, The main product is its oil which is used as a laxative (internally) and for various sores (externally). It seems to have more industrial use than nutritional (Seegeler, 1983; Moshkin, 1986)
Gnetum africanum - Welw.	Gnetaceae	It is an evergreen, perennial, shade-tolerant vine with woody stems of up to 12 m or more. The leaves has laxative properties and used in the treatment of constipation, enlarged spleen, sore throat, piles, high blood pressure, nausea, warts, and boils (Plants for A future, 2020).
Calotropis procera (Aiton) Dryand.	Apocynaceae	A perennial shrub/small tree, generally up to 2.5 - 4 m high with round stem (pale green), thickly covered with hoary pubescence which readily rubs off. It has more industrial and medicinal value probably due to the poisonous nature of most of its phyto-hormones and as a result rarely eaten as food by livestock and humans alike (Austin, 1998; Crothers and Newbound, 1998).
Irvingia gabonensis	Irvingiaceae	The fruits of Bush mango or Wild mango are eaten when ripe while the fruit nuts are consumed as well. There is paucity of information on other medicinal uses of Wild Mango
Hylocereus undatus (Haw.) Britton & Rose	Cactaceae	H. undatus is a perennial vine-like cactus fruit crop. The fruit flesh is white, juicy and delicious in flavour, with tiny black seeds. Studies show that the fruits is claimed to reduce cholesterol, help the digestive system and prevent cancer (FAO, 2004; Janick and Paull, 2008
Spondias mombim L.	Anacardiaceae	Also known as Hog plum, when ripe, the fruits turn yellow, with a sharp but sweet taste. The leaves have been found to possess sedative and antipsychotic properties (Ayoka et al., 2006).
Vitellaria paradoxa C.F.Gaertn.	Sapotaceae	Shea Butter Tree is a deciduous tree with a spreading crown and grows about 25 m in height. Medicinally, Shea Butter is used for topical medicines against rheumatic and joint pains, wounds, swellings, dermatitis and bruises (Plants for A future, 2020).
Chrysophyllum albidum	Sapotaceae	*Chrysophyllum albidum* has high antioxidant activities and phenolic compounds (Oloyede and Oloyede, 2014).

The Need for Biodiversity Conservation of the Neglected and Underutilised Plant Species (NUS)

Biodiversity is fundamental for ecosystem functioning, sustainable production (Jacobsen et al., 2013) and the attainment for food and nutritional security (Thrupp, 2000; Toledo and Burlingame, 2006; Chappell and LaValle, 2011), yet only a few crop species are utilized for food production throughout the world (Padulosi et al., 2001). Around the world, people are working to safeguard this irreplaceable natural wealth (horticultural crops), which is vital for current and future human well-being. For example, International Year of Biodiversity (IYB 2010) which was declared by the United Nations General Assembly focused its attention on the need to combat the loss of biodiversity by protecting, conserving and sustaining the use of food biodiversity. As a result, it provides a unique opportunity to explore and recognize the existing biodiversity in horticultural crop varieties and their nutritional composition, assess the use of nutrient content among the criteria used in cultivar selection and promotion and discover the importance of nutritional differences within the species and the micronutrient superiority of some lesser-known cultivars and wild varieties over some more widely utilized cultivars of horticulture based crops. (Lutaladio et al., 2010). According to Magbagbeola et al., (2010), many of the plant species that are cultivated for food are neglected and underutilized while they play a crucial role in the food security, nutrition, and income generation of the rural poor.

The intrinsic value of the consumption of a broad collection of edible plant species has been pinpointed, and international recognition of the potentials of minor crops have been encouraged by several plans of action involving worldwide participation. Further interest in NUS has been demonstrated in various local, regional, and general accounts, as well as in coverage of individual species, there has thus been a growing awareness of the vital role of a diversity of wild, semi-domesticated and underdeveloped species in food and livelihood security and their potential for further development and wider use (John, 2015).

The conservation of NUS is vital to the maintenance of plant biodiversity, as well as to the preservation of the much-needed genetic diversity (plant genetic resources), which is essential for traditional plant breeding (John, 2015). Genes for desirable traits are embedded in biodiversity and as such crop genetic diversity has a critical role to play in increasing and sustaining production levels and nutritional diversity throughout the full range of different agro-ecological conditions. In addition, natural pollination for horticultural crops remains important to sustaining the diversity of farmers' varieties that are adapted to the local environment and to climate changes. Thus, today's horticulture-based agricultural systems need a continuous supply of new cultivars and improved varieties, drawn from the available gene pool, in order to enhance food security and achieve balanced nutrition for rural and urban poor, adapt to drastic climate changes and sustain production systems on marginal lands (Lutaladio et al., 2010).

The synergy between pollinators and horticultural crops is critical to ensure optimal pollination and a number of best practices can be undertaken to maintain and enhance pollination services. Examples include maintaining pollinator habitat, providing alternative sources of nectar, and reduced use of pesticides (Lutaladio et al., 2010) as well as avoiding the use of insects' natural enemies. Promoting crop diversification in horticulture is as good as exploring and using biodiversity to produce a broad variety of species and cultivars, and producing a little bit of everything for people to eat in order to achieve balanced nutrition for the rural and urban poor and the world's population at large. It means encouraging biodiversity and nutrition and it can be shown that biodiversity and nutrition are linked at three levels: in ecosystems, in the species living in ecosystems, and in genetic diversity within species. Each level contributes to food security and improved nutrition (Lutaladio et al., 2010).

Conservation Strategies for the Neglected and Underutilised Plant Species (NUS)

Conservation of the biodiversity of the neglected and underutilized horticultural crops can be achieved through one or the combination of the following means:

Establishment of Gene Bank:

Gene banks are a type of bio-repository which preserves genetic material and it various types are seed bank, tissue bank, cryobank, field gene bank (Wikipedia, 2017). Biodiversity, conservation and genetic resources are triple buzzwords that have come to assume significant position in most biological and environmental science flora of recent times (Ogbu et al., 2010). Plant genetic resources (PGR), as a vital segment of biodiversity in general and agro biodiversity in particular, constitute the genetic material of plants having value as a resource for present and future generation of human being (Dhillon and Saxena, 2003; LEISA, 2004). As genetic resource, the PGR may be of reproductive or vegetative propagule such as seeds, shoots, tissues, cells, pollen, DNA molecule etc, containing the functional unit of heredity in addition to corresponding information and knowledge about their use that can be applied in crop improvement programme and other product development. The categories of PGR range from landraces and farmers' varieties, modern cultivars, breeding lines, genetic stocks, wild relative, weedy races and potential domesticated species, exotic and indigenous species (Engels and Visser, 2006; Sharma, 2007). Horticultural genetic resources (HGR) are a subset of agro-biodiversity that is related to horticulture plant species or their wild gene pool, having genetic material of actual or potential value (Engels and Visser, 2006; Sharma, 2007).

Recognition: According to Dansi et al., (2012), it was reported that for the promotion of neglected and underutilised crop species, it will be important to put in place a national and special research and development programme under the joint umbrella of the ministries of agriculture and scientific research sponsored by the government involving all the possible actors including researchers, extension agents, rural farmers, developers, and producers. The conservation of Horticultural genetic resources (HGR) is extremely important to meet the present and future needs of various crop improvement programmes (Ogbu et al., 2010). The genetic material of neglected and underutilized horticultural crops can be conserved ex situ in cryo gene bank. In crops that produce seed, which is amenable to desiccation and can tolerate low temperature (orthodox seeds), germplasm conservation through seed, is the most common approach. Seeds, equilibrated from 3-5% moisture content, are stored at -20°C for long term conservation. However, many horticultural plants, being vegetatively propagated or having recalcitrant seed, require field gene bank facility for their conservation (Ogbu et al., 2010). The germplasm of major commercial fruits and ornamental trees in Nigeria are mainly being maintained in field gene banks by the horticultural and related research institutes.

On farm: To conserve the biodiversity of the neglected and underutilized horticultural crops, the production and cultivation of the indigenous vegetables in traditional farming systems is an effective strategy. (Diouf and Guarino, 1997; Adebooye et al., 2005; Janick, 2011). Botanical gardens, greenhouses, orchards and arboretum have an important role in the conservation of neglected and underutilized horticultural crops. Many fruits trees, medicinal and aromatic plants, spices, ornamentals, other plants of economic value and their wild relatives are being maintained in several botanical gardens round the world (Ogbu et al., 2010). The botanical gardens fill an important gap in the conservation of neglected and underutilized horticultural crop species which otherwise have not received much attention from traditional seed and field gene banks (Ogbu et al., 2010). On farm and home-garden conservation is of particular importance in country like Nigeria, to conserve neglected and underutilized horticultural crops and to provide diverse food and other products for household needs and local markets. Large percent of the national food needs still comes from the traditional farming systems characterized mostly by mixed cropping as seen in typical home-garden setting. Neglected and underutilized horticultural crop

conservation need to be carried out on-farm in the areas where landraces and locally adapted farmers' varieties are cultivated, it requires active farmers' participation to conserve landraces and traditional farmers' varieties. The novel genetic resources may be conserved even in home gardens (Tao, 2003; Rathore et al., 2005).

Media: Both print and social/electronic media have a major role to play in creating awareness on the great potential in terms of the nutritional, medicinal, and economic value embedded in NUS. Also, environmental education, awareness and training play a vital role in evolving strategies for conservation and preservation of the biodiversity of the neglected and underutilized horticultural crop. The media can help build public awareness to rural and urban dweller on the importance of most neglected and underutilized crops and how they can cultivated in home garden or on the farm field in other to sustain their diversity. The mass media are not the only methods that can be adopted to create awareness or popularize the importance on the neglected and underutilized crop to public, also seminars, workshops, rallies, training courses, public meetings, exhibitions, agro-tourisms are also need to be organized at regular intervals to spread the message of the importance of most neglected and underutilized crops and how they can be cultivated in home garden or on the farm field (Oloyede, 2011, Oloyede et al., 2014, Oloyede, 2021).

Popularization by Research: In recent times, there is an increasing awareness in the natural and herbal therapy, with a basic approach towards nature, due to people's awareness towards the side effects of the synthetic drugs (JothiKarumari et al., 2014). The potential of a particular fruit or food is determined primarily by its nutrients composition. Fruit, vegetables, nuts and seeds, provides a rich source of minerals, vitamins and antioxidant characteristics. Several studies and research have been conducted and some underutilized horticultural plants have been found to have medicinal properties and nutritional attributes. The medicinal value lies in some plant chemical substances called phytochemicals, which produce a definite physiological action on the human body. The leaf of Cleome gynandra consumed as vegetable has anti-inflammatory and lysosomal stability actions (Narendhirakannan et al., 2007), potent dose-dependent anticancer activity comparable to that of 5-fluorouracil (Bala et al., 2010) and free radical scavenging activity (Narendhirakannan et al., 2005, Muchuweti et al., 2007). It is also believed to improve eyesight and provide energy (van den Heever and Venter, 2007). Similarly, Launaea taraxacifolia is locally believed (indigenous knowledge) to have, through simple and regular consumption as leafy vegetable, lactogenic, aphrodisiaque, antibiotic, and antimalaria properties, a wonderful blood pressure regulating and haemorrhoids treatment capacity (Dansi et al., 2008).

Role of Extension Agent: New information are sometimes got by "political farmers" when there is an innovation whereas the real (needy) farmer is left in the dark. As a result of this, the role of an agricultural extension officer comes to play, as they are known to understand the language of the farm families as well as the researcher (Adesoji and Farinde, 2006). The availability of extension demonstration land/plot is absolutely crucial for effective awareness and adoption. This can be done with the help of the government, research institutes and agro-industries (Iwalewa, 2010). Since extension agents are the link between research institutes (academic institutions), agricultural policy makers and the clientele system, it is therefore necessary to extend the boundary of agricultural information dissemination of neglected horticultural crops to the "grassroot" farmers to ensure a firm grasp of the new scientific information with or without further external assistance. Not only will the level of biodiversity that can be accrued from shedding light on these underexploited crops be heightened but it will also provide a natural capital to consumers and farmers alike as these species will provide a means of land and agricultural sustainability with reduced input (Oloyede, 2021).

Conclusion and Recommendation

Neglected and underutilized horticultural crops are of great importance in food security. Nigeria has a great diversity of these neglected and underexploited crop species and most of these species have enormous nutritional, medicinal, and economic benefits. Embracing the conservation of the NUHS has to be done deliberately by all stakeholders including the government at all level, non-governmental entities, farmers' groups and individuals. This will highly contribute to poverty reduction in rural areas and the Country at large. Improvement of both nutritional and health status of the populace, enhancement of food security and also improvement of the farmers' economy can be fostered. Through campaign on media and training of potential farmers, NUHS's cultivation in home gardens and farm should be popularized. Furthermore, awareness of the great potential in terms of the nutritional, medicinal, and economic values embedded in NUHS should be created and made known to the people in the society through various platforms. Also, agro-tourism to areas where the neglected and underutilized crops are cultivated is an important avenue to create awareness to people in the society. Finally, for the conservation and promotion of NUHS, the role of standard gene and field banks cannot be overemphasized. With the huge significance of biodiversity conservation of NUHS, especially as a means to mitigate and adapt to climate change, their promotion for industrial exploitation should be the priority of the national, continental and global agricultural research system and the government at all levels.

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