

PROMOTION OF UNDERUTILIZED INDIGENOUS BOTTLE GOURD (*Lagenaria siceraria*) FOR FOOD AND HEALTH SECURITY IN SOUTHEASTERN NIGERIA.

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Abstract

The promotion of bottle gourd by implementing initiatives is essential as it tackles food and health security problems. Many plants are currently underutilized and very few are known, developed and used. The green fruits of bottle gourd are sliced and fried, steamed or boiled as a vegetable in much the same way as pumpkin (*Cucurbita spp*) is cooked. The leaves can be dried and stored for later use. The mature fruit can be used as a container to serve and store liquids, food and to fashion pipes and musical instruments. The extract from the plant seed contain antibiotic properties and the fruit juice is helpful in constipation, premature greying hair, urinary disorder and insomnia. The crop contains high levels of choline which is compound that heals mental disorder. In spite of its numerous relevance, bottle gourd remains underutilized in the southeastern Nigeria. The utilization of bottle gourd (*Lagenaria siceraria*) in southeastern Nigeria is most seriously constrained by a number of factors such as lack of appropriate knowledge on its nutritional values, uses and health benefits. Addressing these enormous challenges encumbering the utilization of bottle gourd (*Lagenaria siceraria*) in this zone will further help in promoting and developing of bottle gourd production, strengthen the national plant reserve base and as well alleviate the devastating effects of the global food and health crisis, particularly in Nigeria.

Keywords: Bottle Gourd, Underutilized, Indigenous, Promotion.

Introduction

The term “Indigenous crops” refer to crops originating in a particular place or country. The terms “local” or “traditional” crops have also been used as another name for such crops. Underutilized indigenous crops are those crops which are generally underexploited but have the potential to contribute to food security, health (nutrition/ medicine), general income and environmental services (Anon, 2006).

They can contribute greatly to the socioeconomic and industrial development of a country, providing food security and alleviating poverty. Depending on the geographical distribution, species could be underutilized or underexploited in some regions but not in others. To understand these local species and varieties of food, new identification, food analysis and dietary assessment methods are required to help establish the utilization and application of the food into the community (Umeh *et al.*, 2018). Crops such as; *Cucumis sativus* (cucumber) *Lycopersicon esculentum* (tomato), *Allium cepa* (onion), *Cucumeropsis manii* (egusi melon) are well known, studied and widely distributed.

The Calabash or Bottle gourd [*Lagenaria siceraria* (*Molina Standly*)] is a member of the Cucurbitaceae family together with pumpkin, water melon and cucumber (Decker-Walters, 2004). It is generally accepted that *L. siceraria* (previously known as *L. vulgaris* Ser.) is indigenous to Africa and that it reached temperate and tropical areas in Asia and the Americas about 10,000 years ago, with human help or probably as a wild species whose fruits had floated across the seas. Fruits are known to float in the sea for many months without the seeds losing their viability (Yetisiret *et al.*, 2008; Decker-Walters *et al.*, 2004; Nkanyiso *et al.*, 2016). The mature fruit can be used as a container to store water, food and as a musical instrument (Milind and Satbir, 2011). A lot has also been documented about its medicinal properties, especially in countries like India and Pakistan. Bottle gourd has been reported to contain high levels of choline which is a compound that is reported to heal mental disorders (Rahman, 2003). In India, it has been reported to cure stomach complications (Milind and Satbir, 2011).

Botanical description of the Plant:

Bottle gourd belongs to the genus *Lagenaria*, which is derived from the word ‘lagena’ meaning ‘the bottle’ (Milind and Satbir, 2011).



Plate 1: Fresh Bottle Gourd Plant
Source: Cindy, 2019



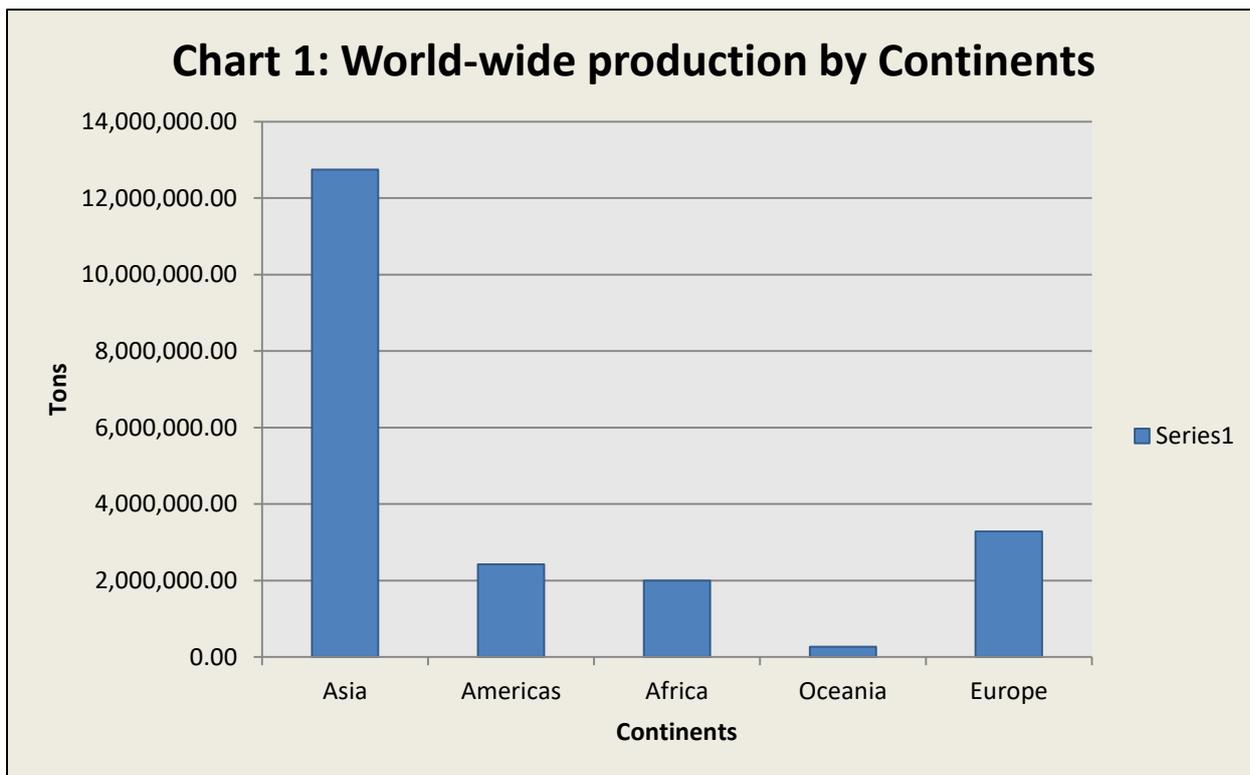
Plate 2: Dried Bottle Gourd Plant
Source: Veřislava, 2013

The botanical classification of bottle gourd by Milind and Satbir (2011). Kingdom: Plantae, Division: Magnoliophyta, Class: Magnoliopsida, Order: Cucurbitales Family: Cucurbitaceae, Genus: *Lagenaria*, Species: *siceraria*. Bottle gourd can be a tree or fence creeper; the latter can grow on the ground likemost other members of the pumpkin family. It is annual and dies at the end of each growing season. The vine stem is deeply grooved and angular incross-section. There are five longitudinal ridges which are deep on the main(1-3cm thick) stems, but smooth out toward the growing tips where the stems are 1cm thick. The stems are softly pubescent with jointed, gland-tipped hairs. The leaves are alternate and variable, and tendrils are almost always present. Bottle gourd has large, rounded hairy and kidneyshapedleaves with a pair of tendrils at the base of leaf stalk. Like the vine shoot, the root system is wide spreading. The roots are white to pale cream, smooth and circular in cross-section. The taproot can penetrate down from 60 to 80cm, but the bulk of the root system spreads out and inhabitsthe topsoil. Flowers of *L. siceraria* are monoecious in nature, where solitary male and female flowers are found on different plant axis of the same plant, thus cross pollination is highly favorable. Dioecious and andromonoecious sex

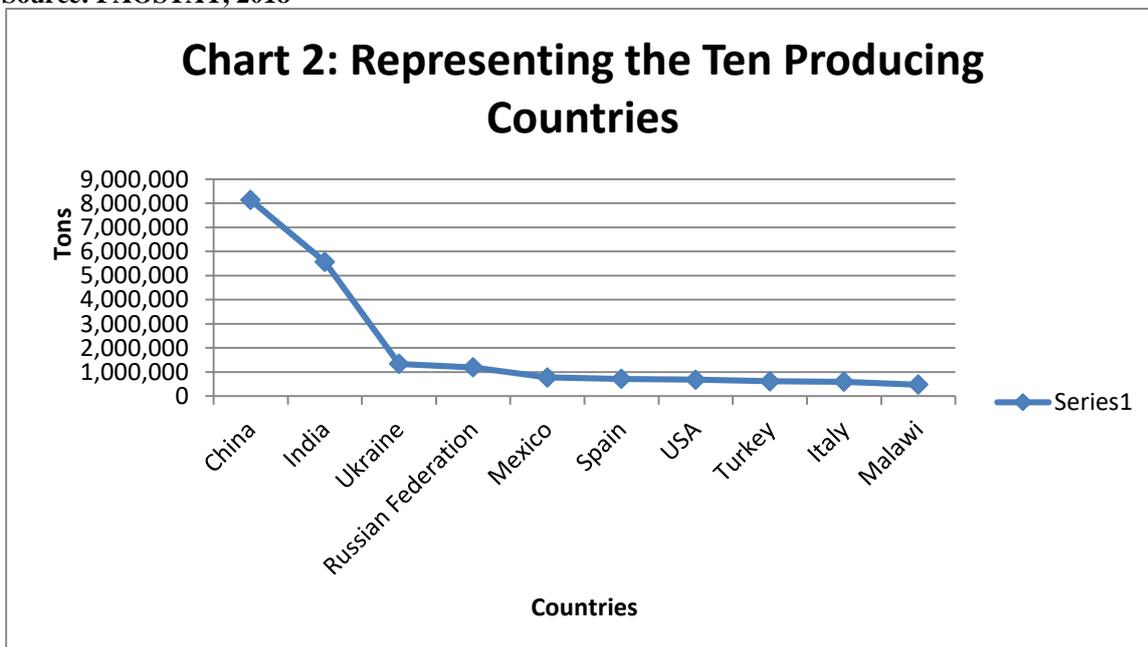
forms bearing hermaphrodite flowers also exist in wild, non-cultivated types. The large white flowers open at night. There are many forms, shapes, and varieties of gourds each producing a different-shaped and sized fruit, from small and round to large some with an elongated, narrow neck (Department of Agriculture, Forestry and Fisheries (2016)). The fruit is green at first, but becomes pale brown when it ripens and dries out. The dry fruit are popularly known as calabashes. They have six thin petals. A single female flower is found at the base of a male flower stalk. The flowers are mostly unisexual and white or yellow; they occur on the same plant (monoecious) or on separate plants (dioecious). Male flowers are fascicled, very small, and much shorter than the hispid petiole whereas female flowers on longer peduncles. The seeds of bottle gourd are flat, more or less rectangular to narrow trapezia, whitish to dark brown at the distal end. They develop inside the fruit and show great diversity in shape and size.

Global Production:

The world-wide production for all types of gourds amounted to 2,042,955 tons; the total area cultivated was 27,643,932 ha. The world-wide production of all types of gourd including pumpkin and squashes is distributed by continents in the following way:



Source: FAOSTAT, 2018



Source: FAOSTAT, 2018

In 2013, the world production of pumpkins, squashes and gourds combined was at 24.6 million metric tonnes from almost 1.8 million hectares. The highest producer was China with 7.1 million metric tons, followed by India at 4.9 million metric tons, the Russian Federation at 1.1 million metric tons, Iran at 897,293 million metric tons, the United States at 796,872 million metric tons and Ukraine 610,800 at million metric tons. For Latin America, the main producer was Mexico 544,998 million metric tons,

followed by Cuba at 412,028 million metric tons, Argentina at 302,324 million metric tons and Peru at 232,888 million metric tons. In Africa, the main producer was Egypt at 543,334 million metric tons followed by Algeria at 260,913 million metric tons, Rwanda at 239,182 million metric tons, Morocco at 224,314 million metric tons, South Africa at 181,315 million metric tons, and Cameroon at 158,801 million metric tons. Also included in the top 25 producers for Europe were Spain at 533,200 million

metric tons, and Italy at 530 000 million metric tons, then for Asia, Turkey at 388,785 million metric tons, Bangladesh at 375,000 million metric tons, Indonesia at 372,387 million metric tons, Korea at 323,364 million metric tons, Pakistan at 257,740 million metric tons, Japan at 227,303 million metric tons, the Philippines at 223,479 million metric tons, and Thailand at 207,000 million metric tons (FAOSTAT, 2013).

In Nigeria, the production of the bottle gourd has not been ranked, the objective has been on increasing the production of well known, widely distributed vegetable crop which have resulted in a substantial increase of the per capital availability of these crops whereas neglecting indigenous vegetable crops which are less deleterious to the environment and highly endowed with nutritional and medicinal values thereby threatening the existence of underutilized crops such as bottle gourd due to its neglect in the South Eastern agroecology and other parts of Nigeria. Neglected and underutilized food resources constitute the bed rock of the diversity in traditional and indigenous food systems of developing communities. Traditional and indigenous foods such as Bottle gourd are less deleterious to the environment, address cultural needs and preserve the cultural heritage of Southeast agro-ecology (FAO, 2014).

Composition and Nutritional Value

Bottle gourd flesh (devoid of seeds) contains 14.2–32.3% cellulose on a dry weight basis (Chung *et al.*, 2000). Bottle gourd contains almost 96% moisture and is rich in calcium, phosphorous and dietary fibers. The edible portion of the bottle gourd contains 0.3 mg niacin, 12 mg ascorbic acid, 87 mg potassium, 12 mg calcium and 37 mg phosphorus per 100 g (Sawateet *al.*, 2006). Potassium is the most abundant mineral followed by phosphorus and calcium (Hanifet *al.*, 2006). It contains cucurbitacins, fibers, polyphenols and two sterols namely campesterol and sitosterol (Ghuleet *al.*, 2007). The dietary fiber present in the bottle gourd makes it a very useful vegetable in preventing digestive disorders such as constipation and piles. A positive correlation has been found between fiber consumption and the reduction of coronary heart diseases and diabetes incidence (Hemeda, 2010). It is a vegetable with a good source of vitamin A, vitamin C, and minerals. It forms an excellent diet being rich in vitamins, iron and minerals. The approximate content iron in bottle gourd with and without peel is 11.87 and 2.33 mg/100 g, respectively (parle, 2001). The seeds are popular snacks in Africa and are reported to contain high proteins as is the case with the seeds of its closest relative pumpkins.

Table 1: Nutritional composition of *Lagenaria siceraria*, (Amount in 100 grams of edible portion)

Nutrients	Units	Fruit	Seed
Proximates			
Protein	g	0.62	24.54
Total lipids (Fats)	g	0.02	45.85
Carbohydrate, by difference	g	3.39	17.81
Fiber, total dietary	g		3.9
Minerals			
Calcium, Ca	mg	26	43
Iron, Fe	mg	0.2	14.97
Magnesium, Mg	mg	11	535
Phosphorus	mg	13	1174
Sodium, Na	mg	2	18
Zinc, Zn	mg	0.7	7,46
Copper, Cu	mg	0.026	1.387
Manganese, Mn	mg	0.066	3.02
Selenium, Se	mcg	0.2	5.6
Vitamins			
Vitamin C, total ascorbic acid	mg	10.1	1.9
Thiamin	mg	0.029	0.21
Riboflavin	mg	0.022	0.32
Niacin	mg	0.32	1.745

Panthothenic	mg	0.152	0.339
Vitamin B-6	mg	0.04	0.224
Folate, total	mcg	6	58
Folate, food	mcg	6	58
Folate, DFE	mcg_DFE	6	58
Vitamin A, IU	iu	16	380
Vitamin A, Rae	mcg_RAE	1	19
Vitamin E	mg_ATE		1
Chlorine	mg	16.02/g [dry basis]	
Lipids			
Fatty acids, total saturated	g	0.002	8.674
Fatty acids, total monounsaturated	g	0.004	14.258
16:1 undifferentiated	g		0.099
18:1 undifferentiated	g	0.004	14.146
Fatty acids, total polyunsaturated	g	0.009	20.904
18:2 undifferentiated	g	0.009	20.702
18:3 undifferentiated	g		0.181
Amino acids			
Tryptophan	g	0.003	0.431
Threonine	g	0.018	0.903
Isoleucine	g	0.033	1.264
Lysine	g	0.021	1.833
Methionine	g	0.004	0.551
Cysine	g		0.301
Phenylalanine	g	0.015	1.222
Tyrosine	g		1.019
Valine	g	0.027	1.972
Arginine	g	0.014	4.033
Histidine	g	0.004	0.681
Alanine	g		1.158
Aspartic acid	g		2.477
Glutamic acid	g		4.315
Glycine	g		1.796
Proline	g		1
Serine	g		1.148

Source: USDA, (Goplanet *et al.*, 1996), (NRC, 1989), (NISC *et al.*, 1998)

Uses

The leaves and young growing shoots are harvested and used as vegetables. The green fruit are sliced and fried, steamed or boiled as a vegetable in much the same way as baby marrow is cooked. The leaves can also be dried and stored for later use. The mature bottle gourd can be used as containers for storing food stuffs, drinking water, palm wine and other liquids (Hanif *et al.*, 2006). It can also be used to

serve food by breaking and shaping it into plates, bowls and trays (Hanif *et al.*, 2006). Different parts of the bottle gourd especially the leaves and seeds are used as food and medicine in some countries like South Africa and India (Nkanyiso, 2014). In India, the bottle gourd is mostly consumed and can be made into dumplings, flat breads, sweets and juices (Rahman, 2003; Aneja *et al.*, 2002; Suprabha, 2016). The seeds are a very popular snack in Africa (Van

wyk and Gericke, 2001). Additionally, the fruit juice and the extract from the plant seeds contains antibiotics which can be used as medicine to cure constipation, urinary disorder and also premature grey hair and insomnia (DAFF, 2016). In countries like Bostwana, Zimbabwe and South Africa, the oil from the seeds are used as an alternative to vegetable oil. In india and other parts of the world, the young green fruit is a popular cooked vegetable. The crop contains high levels of choline which is compound reported to heal mental disorder (DAFF, 2016).

Bottle gourd (*Lagenaria siceraria*) contains 96.1% water, so is light on the stomach and aids digestion. It helps in losing weight quickly, because of its high dietary fiber and low fat and cholesterol content (Parte, 2011; Canty et al., 1994; Mattewet et al., 1995). However, in the south eastern part of Nigeria, the bottle gourd (Calabash) is used in traditional weddings to serve palm wine from the bride to the groom and is also used as musical instruments called "Ichaka". This instrument is used in ceremonies.

USES



Plate 3: Bottle gourd dish (lauki paste)

Source: Alexander, 2019



Plate 4: Bottle gourd juice

Source: Subodh, 2016



Plate 5: containers

Source: Red feather, 2014



Plate 6: Musical instrument

Source: Staxo, 2017



Plate 7: Traditional weddings

Source: Stefa, 2020

Health Benefits

The bottle gourd pulp is known for its treatment of diabetes, hypertension, flatulence, liver diseases, weight loss and considered to be cooling, diuretic, and ant lithic. The seeds are used to treat teeth and gum ulcers (Perry et al., 1980). It is used to treat beriberi and its anti-inflammatory properties are useful in treating abdominal swelling and swelling of the feet (Li, 2006). It is also used for treating mental health disorders. The dietary fiber present in the bottle gourd helps in preventing digestive disorders such as constipation and piles. It has been known that consuming fiber directly reduces coronary heart diseases and diabetes (Hemeda et al., 2008). Bottle gourd juice is used traditionally as a medicine for treating acidity, indigestion and ulcers. The bottle gourd can be used as an antidote to certain poisons and scorpion stings, and also has alternative purgative, and cooling effects. The extract from the plant seed was found to contain antibiotic properties and the fruit juice is helpful in constipation, premature greying hair, urinary disorder

and insomnia. The crop contains high levels of choline which is compound reported to heal mental disorder.

The fruit is believed to have ability to relieve pain and is effective against fever, and also found useful in the treatment of asthma and other bronchial disorders. They are also good source of natural antioxidants (Deoret et al., 2009; Ghule et al., 2006; Ghule et al., 2007; Duke, 1992). Instead of consuming vitamin pills or tonics, a cup of watermelon juice, mixed with green salad of a slice of bottle gourd, melon, snake gourd, cucumber, a little bitter gourd, and a handful of pumpkin seeds are enough for maintaining our health (Rahman, 2003).

Challenges of Promoting and Developing Underutilized Bottle Gourd in South Eastern Agro-ecology of Nigeria Industrialization and Urbanization in South Eastern Nigeria

The industrialization and the rate of Urbanization in Africa especially South Eastern Nigeria has proved detrimental to the future of the bottle gourd (Hanifet *et al.*, 2006). The primary use of the bottle gourd in the south east before modernization was to store water, palm wine, serve as plates and spoons, musical instruments etc, thus the introduction of stronger and more long lasting plastic, stainless and ceramic dishes, containers and even musical instruments has led to the decline in the use of the matured bottle gourd fruit also known as Calabash. Although the presence of the Calabash during traditional marriage ceremonies in the Southeast is strong, there is still a slow but surely replacement of it with plastic containers and glass cups.

Traditional Beliefs

The mature bottle gourd fruit (Calabash) is often considered fetish in some local communities in South Eastern Nigeria due to its use by native doctors as containers for native concoctions and other diabolical materials; and so there is the fear of stigmatization of people using it. This fear from the locals has also served as a challenge for researchers because the people are unwilling to discuss anything about it (Tafida, 2014).

Lack of appropriate Research

The potential of bottle gourd as a possible food security crop in the south east has been overlooked by many researchers due to the popularity of exotic members of the Cucurbitaceae family (pumpkins, water melon, butternut and squashes), the popularity and cultivation of bottle gourd landraces has faced neglect (Nkanyiso, 2014). There should be adequate knowledge on the various agronomic practices of the bottle gourd [*lagnerariasiceraria* (Molina Standly)] for its promotion and utilization. It is crucial to create awareness on the various biotic constraints to prevent the buildup of insect pests and pathogens to ensure compatibility with other crops in the production system (Ebert *et al.*, 2012). Pre-and post harvest handling techniques should reach markets and the end users, these techniques will improve the quality of the products such as minimizing contamination from microorganisms (Ebert *et al.*, 2012). The extent of current development through Research and Development (R&D), uses, nutritional, health benefits, and its socio-economic contributions to Southeast populace should be used as a yardstick for priority (Umeh *et al.*, 2018).

The promotion and development of this crop in the southeastern Nigeria will not only promote socio-economic development of communities where they are found, but, also substantially improve foreign exchange earnings locally in view of the global demand for the crop and its products. For this to be a reality, there will be a need to put in place in every state in the southeastern Nigeria, research agencies well equipped with researchers, developers and financial institutions under the Ministry of

Environment, Agriculture and Rural Development along with the Ministry of Science and Technology (Umeh *et al.*, 2018).

Strategies to Promote and Develop Underutilized Bottle Gourd in Southeast Agro-ecology Creating awareness on the socio-economic and nutritional value

These crops are neglected and underutilized because researchers, farmers and policy makers are generally unaware of their economic and nutritional value (Padulosiet *et al.*, 2013). In the South Eastern part of Nigeria, the bottle gourd (Calabash) is used in traditional weddings and also used as musical instruments in ceremonies. Little is known about its other uses, thus as a result, the crop is becoming forgotten and neglected. Awareness can be created by sharing information or advertising the crop through local agencies and the media to promote household consumption.

National publicity campaigns promoting the benefits of consuming the crop in the south east can bring to light products made with the crop. Markets and supermarkets in the south east should be encouraged to stock and sell the crop, its parts and its end products. Information should be provided to government bodies about this crop to bring benefits nationally and internationally. Researchers should collect and share information on the food and nutritional value of the bottle gourd and put in place formal databases on the socioeconomic contributions (Padulosiet *et al.*, 2013). The absence of breeding and crop improvement could be the reason for the high nutritional value of mostly neglected indigenous fruits and indigenous vegetables and this has inspired a scientific consortium to identify 'pre-domesticated' varieties of crops (mainly fruits and vegetables), which might contain significantly higher levels of nutrients than the varieties currently used for food production (Unilever, 2012).

Enhance research

The lack of appropriate research on underutilized indigenous crops such as the bottle gourd particularly on their nutritional aspects, prevents them from realizing their full potential. There are huge gaps in knowledge, such as the importance of these in the diets of the poor, the bioavailability of nutrients and their benefits in healthy diets (Garnett *et al.*, 2013). Lack of research data limits the marketing of the bottle gourd in the South East. The basis of any society's knowledge system is built on indigenous knowledge (IK) so combining scientific with indigenous knowledge of the bottle gourd such as farmers to incorporate local traditions and make the crop relevant to local people (Rao, 2006; Sillitoe, 2009). Value chain actors and consumers will be useful in identifying specific traits to focus on when selecting germplasm resources and selecting materials for crop breeding, assessing the

productivity, and susceptibility of the bottle gourd to pests and diseases (Padulosi, 2013). It is known that bottle gourd have been neglected in breeding programs in the south east. Breeding efforts are needed to improve the competitiveness of bottle gourd and to make them adaptable to different climatic conditions (Ebert, 2014; Ochatt, 2007 and Sthapit, 2010). For further research on the genetic and economic aspects of the bottle gourd, it is very necessary to document and characterize the crop. Tools and knowledge already developed for other crops can be used to research the crop, for example, using comparisons of related species and genes. There is need to study the adaptive traits in bottle gourd in breeding varieties that can with stand climate change, it's microbiology, soil and nitrogen assimilation to access it's productivity and it's susceptibility to pests and diseases, these helps in developing agricultural systems resistant to both abiotic and biotic stresses.

Develop value and market chains

There is a need to develop value chains of bottle gourd from the input side and the marketing of the produce (Grower, 2009). Value chains for bottle gourd need to be developed so as to make them commercial products that can be traded not only on the local market in the south east but also internationally (Ebert, 2014 and Mwangi, 2006). Developing and strengthening markets for this crop at the local, national and international levels will improve farmers' access to markets, encourage value adding and stimulate demand for a wider range of crops. Discovering various ways in which bottle gourd can be used will ensure sustained production, regardless of changes in agricultural policies, or dietary trends. Developing marketing strategies by the government will ensure a sustainable development for bottle gourd. Policy makers and other stakeholders can take advantage of rising interest in nutrition to develop markets for bottle gourd. Restaurants and local food retailers can play an important role in promoting the use of bottle gourd and adding value. The government can encourage the marketing of this crop in local markets by providing incentives for cultivation, processing and also provide better access to international markets, improve value chains, and promote collaborative platforms among value chain actors.

Conclusion

The utilization of bottle gourd in the South East agro-ecology has been on a fast decline primarily due to the outlined challenges discussed above. Their nutritional value, other uses and health benefits are not known. The promotion of bottle gourd in the South East agro-ecology by introducing government policies and community interventions will bring lasting solutions to various problems such as loss of the crop and its indigenous knowledge, food and nutrition security, non-diversification of food

consumption, and the underdevelopment of the indigenous crop.

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