Chapter

Traditional African Vegetables Agrobiodiversity: Livelihood Utilization and Conservation in Tanzania Rural Communities

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Abstract

The agricultural sector is challenged to fulfill the nutritional requirements of ever-increasing population. Rates of growth in crop productivity have declined, among many reasons is due to climate change and the decline of water and land resources. Dependence by 50% on few cereal crops like wheat, maize and rice for total food intake and calorie requirements has countersigned loss of biodiversity and decline in crop productivity. The genetic diversity of traditional crop varieties offers resilience to environmental risks, socioeconomic shocks, adaptation and mitigation to climate change which is crucial for crop production. Traditional African Vegetables (TAVs) are an integral constituent of the diets of many rural and urban communities. They are important sources of essential macro and micro-nutrients. In addition, they offer a source of livelihood when marketed, and also contribute to crop biodiversity. Tanzania needs to conserve the Traditional African vegetables and their genetic resources against stressful conditions and increased selection pressures which causes loss of genetic variation and a decrease in fitness by a process called genetic erosion. Conservation and use alleviate genetic drift and inbreeding depression, then, is critical to guarantee TAVs persistence in rural areas. This review explores agrobiodiversity of traditional African vegetables (TAV) from livelihood of Tanzanian rural communities' perspectives and how the country has managed to conserve these species.

Keywords: traditional African vegetables (TAVs), agrobiodiversity, genetic erosion, genetic drift, inbreeding depression, conservation, utilization

1. Introduction

Agriculture and food systems are both drivers and recipients of major changes in global health and socioeconomic systems in this era of intense human interaction with the planet "Anthropocene" [1]. The agricultural sector is challenged to fulfill the food and nutritional requirements of ever-increasing population [2–4]. For instance,

feeding 9.7 billion people in 2050, and 11 billion in 2100, is one of if not the most important challenge facing mankind during the remaining years of the century. Global population, which was only 1.7 billion at the turn of the century in 1900, is now 7.3 billion. The world has added approximately 1 billion people in the span of the last 12 years. It is expected to climb to 9.7 billion by 2050, and to 11 billion at the end of this century in 2100. Globally, 870 million people are currently chronically hungry and 2 billion are malnourished. Rates of growth in crop productivity have declined, among many reasons is due to climate change and the decline of water and land resources.

In an attempt to safeguard food security, the homogenization of the agricultural system through the green revolution led to a calorie-based food system [5]. It is only less than 20 plant species out of 5000 that are key source of food [4]. Such scenario has led to 40% of arable land globally be dedicated to only three crops which are wheat, maize, and rice. These crops are the main focus of plant breeding programmes, account for the largest share of the global seed market, they are depended for calorie requirement by over 50% of total food intake and are excessively prioritized [2]. Although these crops have contributed to resilience and long-term sustainability of human wellbeing, but the dependence on such few crops has countersigned loss of biodiversity and decline in crop productivity [6].

Agrobiodiversity which is defined as the variety and variability of animals, plants and micro-organisms that are used directly or indirectly for food and agriculture, including crops, livestock, forestry and fisheries as the key driver of the ecological transition of agriculture. Agrobiodiversity is significant to resilience to environmental risks, socioeconomic shocks, adaptation and mitigation to climate change. It delivers valuable and response diversity to agroecosystems, potentially making them more robust, and may offer solutions to prevent pests and diseases and it plays an important role in nutrients recycling, soil organic matter maintenance and reduces the need for chemical pesticides and fertilizers. It also creates more favorable habitats for useful macro and micro-organisms and then improves soil quality. Its interactions with farmers provide key dimension of human and nature in agro-systems [7]. The genetic diversity of traditional varieties of crop in agrobiodiversity is the most economically valuable part which is crucial for future world crop production [8]. Therefore, this review intends to explore the contribution of Traditional African Vegetables (TAVs) as a biodiversity component in the livelihood of Tanzania rural communities and how these communities can conserve TAV species.

2. Agrobiodiversity of traditional African vegetables

2.1 Terminologies and definition of African traditional vegetables

Traditional African Vegetables (TAVs) have been in the spotlight in recent years in academic papers for agricultural biodiversity, nutritional and dietary diversity and society livelihood at large. Many other names have also been assigned to refer to these species in different contexts of studies including Indigenous African Vegetables (IAV); African Indigenous Vegetables (AIV) Traditional Leafy Vegetables (TLV); African Leafy Vegetables (ALV); Traditional African Leafy Vegetables (TALV or TLV), orphan and neglected or underutilized vegetables and all are subject to contested meanings [9–11]. In the context of this review, traditional vegetables follow the FAO definition [12], and refers to all categories of plants whose leaves, fruits or roots are acceptable and used as vegetables by urban and rural communities through

custom, habit and tradition. It also refers to the review by Towns and Hackleton [13] who proposed the name Traditional African Vegetables (TAVs) and defined them as plant species that are indigenous or naturalized to Africa, well adapted to or selected for local conditions, and whose plant parts are used as a vegetable, and, preparation, and consumption is deeply embedded in local cuisine, culture, folklore, and language.

2.2 Typology and diversity of African traditional vegetables

Towns and Hackleton [13]] reported that, 207 species out of 275 TAVs generalized as Traditional Vegetables are grown in Africa [14]. In their review, [13] most academic papers as a result it renders it difficult to focus on options and possibilities to manage, use, conserve, cultivate, market and disseminate knowledge specific to particular TAV species since different species will require distinct strategy from the other. Therefore, the need to establish a well-documented typology for TAVs based on botany, uses, useful parts, mode of cultivation and management practices of a particular species with respect to the context in which they are utilized is vital.

2.3 An overview of traditional vegetables of utilization in Tanzania

Traditional vegetables are important sources of nutrition which have potential to sustainably address malnutrition, a growing problem in sub-Saharan Africa [14, 15]. The TAVs hold excellent potential to improve nutrition and increase the dietary diversity of rural households however their consumption is limited by negative perceptions and lack of awareness on nutritional benefits [14]. In their study, Lotter et al. [15] and Afari-Sefa, et al. [16] found that, traditional vegetables have been known among Tanzanians for a long time, and utilization is affected by the difference in socioeconomic background, food and eating habits of one community to another. The same author noted that TAVs have been initially preferred for their taste, medicinal properties, availability and access while in recent years increased awareness of their nutritional value is the main focus. In Africa and Tanzania in particular, most of the traditional vegetables are used as folk medicine due to their nutritional properties and medicinal value [17]. Despite this fact, most of these have not been satisfactorily studied to substantiate their medicinal properties besides studies on diversity and conservation [17]. The medicinal value of these indigenous vegetables is an important element in the African traditional health systems. In some of African countries, it has been estimated that over 80% of the population consult traditional healers using indigenous plant species [18]. This shows high demand for these vegetable species that necessitates their deeper studies on their use and conservation. Bottlenecks in the production of TAVs are among many others, poor quality and availability of seeds, lack of market information and high postharvest losses which discourage farmers [19, 20]. Furthermore, Afari-Sefa et al. [16] noted that, the low adoption of indigenous vegetables is the inability of formal and centralized seed systems to meet their complex and diverse seed requirements.

3. The livelihood utilization of traditional vegetables in Tanzanian rural communities

The livelihood of Tanzania's rural communities depends on agricultural activities. Jackson et al. [21] used indicators of livelihoods capitals namely; natural, physical,

human, social and financial capitals to determine status of agrobiodiversity. There is a wide range of vegetable crops grown in different parts of Tanzania [22]. The poor households rely mostly on TAVs for production and consumption. Approximately 40% of farmers are involved in cultivation of TAVs, of which 25% are relatively large scale farmers [23]. The share of both marketed and non-marketed TAVs in total house- hold income is on average, nearly 13% indicating significant contribution to overall household incomes Weinberger and Msuya [23], ATVs have rapid canopy expansion rates which allow them to accumulate vegetative biomass within a short period. This guarantees food and nutrition security. The ATVs have ability to grow all year round in warm subtropical environments and have co-evolved adaptive mechanisms to ensure broad adaptation to drought. Some species has a remarkable recovery rate after exposure to a prolonged drought. Most TAVs come into production within a short time after the first rains, and harvesting commences three to six weeks after emergence. Chepkoech et al. [24] found a high correlation between adaptive capabilities to climate change and five livelihood capitals. In their study, Berg et al. [25] noted that human capital was built by critical thinking, innovation, confidence and quality of life; social capital by mutual trust, bonding, collective action, networking and emancipation; natural capital was enhanced by improved field practices, food production, agricultural diversification and food security while financial capital by increased income and profits, savings and loan schemes. The framework described by Kissoly et al. [26] (**Figure 1**) show that livelihood assets directly affect agrobiodiversity and food security status of a particular community. Understanding how livelihood assets affects utilizations of traditional vegetable agrobiodiversity will enable establishment of policies that will be community specific thus result to expected outcomes.

3.1 Natural capital

The livelihood of rural populations of farmers and pastoralists relies on natural resources and ecosystem services to a greater extent [25]. Subsistence farmers in environments too adverse to support high yielding crop and livestock varieties rely on wide range of crop and livestock types [27]. Barbier, [28] reported that rural communities which depend on ecologically fragile environments face a vicious cycle of declining livelihoods, increasing ecological degradation and loss of resource commons as well as declining ecosystem services on which they depend. Therefore, in the context when yields for major crops go rancid globally, marginal crops could increase yields and food security and encouraging environmental sustainability [29].

Tanzania is among the regions rich in diversity of traditional vegetables particularly of wild species in Africa [30]. The study by Keller et al. [31] found considerable variation in richness of traditional vegetable diversity across different agroecologies of Tanzania although analysis showed even distribution.

3.2 Social capital

Social capital yields a flow of mutually beneficial collective action which serves as the basis for enhancing sustainable resource management to improve productivity, equity and the environment in farming communities [32]. A study by Jackson et al. [21] suggest that although social capital is not strongly associated with natural capital in agrobiodiversity management, it goes hand in hand with human capital such that individual knowledge of social–ecological system by maintaining dynamic set of social norms and institutions that support ecological intensification. Kessy et al. [33]

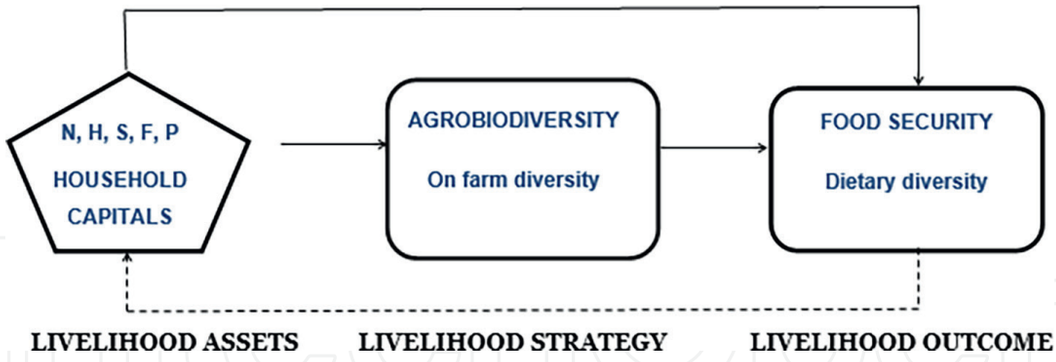

Figure 1.
Conceptual framework of relationship between livelihood asset, agrobiodiversity and food security. Source: Kissoly et al. [26].

reported that socio-demographic characteristics such as age, sex and educational level of head of household affect perception of traditional vegetables and thus utilization, other factors being size of household. Lambrou and Laub, [27] proposed understanding gender sensitivity in livelihood roles as an important approach of devising solution for conservation of biodiversity and alleviate poverty. The authors argued that, depletion of natural resources and decreasing agricultural productivity place additional burden on women's work and health while impede their participation in decision making processes and income generating activities.

3.3 Physical capital

High physical capital coupled with financial capital supported agricultural intensification hence food security [21]. TAV species despite having the potential to improve dietary requirements of households in Tanzania, 30% - 40% of the produce is lost after harvest due to inadequate handling skills, poor infrastructure, lack of appropriate processing technology and poor market information, lack of storage facilities and supporting system [33, 34]. Musebe *et al*., [35] recommended that it is necessary to provide processing and market infrastructure to the processors of African indigenous vegetables. Owusu and İşcan, [36] estimated the likelihood of market participation of farms in Tanzania to be 41% and probability of a farm transition from subsistence to commercial is 30%, the authors argued market participation of a farm is highly influenced by land size, labour use and mechanization such that a unit increment increase likelihood of market participation by 5%.

3.4 Human capital

Training farmers in modern production techniques, quality control and standardization of selling unit as well as linking them to the market will open up market outlet of traditional vegetables [11]. Chepkoech et al. [24] associated high indicator of human capital such as farming experience, educational attainment of the household head, percentage of adults with primary education, type of training on farming, technical assistance, and access to climate information with capabilities to cope with environmental changes in crop production. Women dominate the traditional African value chain in sub – Saharan Africa from production to marketing thus improving traditional African vegetables is improving and the livelihood of resource-poor women [37].

3.5 Financial capital

Developing countries in general and Tanzania in particular exhibit inconsistence relationship between economic growth, rate of poverty reduction and nutrition outcome despite positive agricultural growth [38]. **Figures 2** and **3** show that the rate of declining poverty headcount ratio is relatively slow compared to the rate of increasing GDP per capita in Tanzania. This may be attributed to the need to shift in labour out of agriculture and into industry and service in order to diversify sectoral production [39], the author noted the fall of agricultural employment share from 72% in 2015 to 46.9% by 2030. However, agricultural sector will continue to be the backbone of many developing countries, hence, there is an urgent need for financial support to vulnerable small scale farmers whose livelihood depends on subsistence farming.

Growing vegetables for sale have been a reliable source of alternative income in many households in both rural and urban areas while offer dietary diversity from wide range of nutrients. Traditional African vegetables have been equally important nonetheless, however, in addition to many other challenges, lacking financial support at most if not any point in value chain of traditional vegetables limit growth of the sector and in turn household livelihood. A study by Ambikapathi et

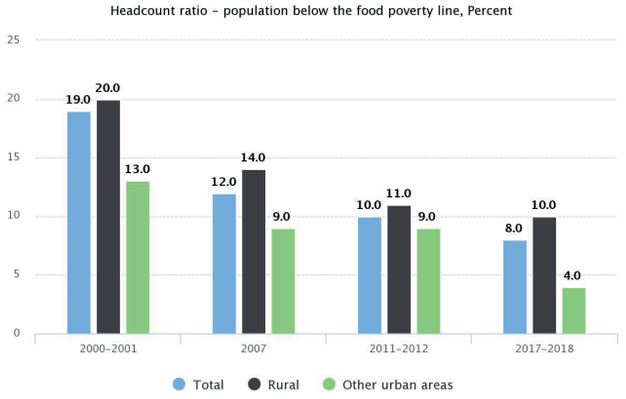

Figure 2.
Poverty headcount ratio.

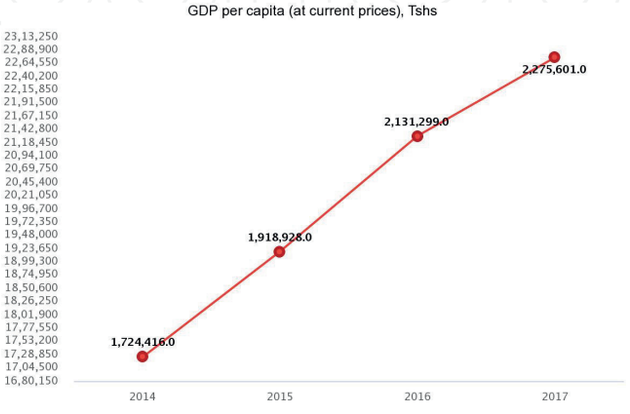

Figure 3.
GDP per capita from 2014 to 2017. Source: NBS [22].

al. [40] showed that only 3.3% of green leafy vegetables are sold in formal market and 26.8% and 58.0% are sold semi-formal and informal respectively in urban regions of Tanzania suggesting even lower percentage of formal vegetable marketing in rural areas.

4. Conservation of traditional African vegetables in Tanzanian rural communities

Traditional African vegetables and their genetic resources need to be conserved against threats as they have high potential to contribute to healthy diets, climate resilience and food systems in Tanzania. TAVs are highly nutritious, easy to incorporate into crop rotation, and can generate more climate-resilient systems suitable for food production. Therefore, conservation of TAVs will support sustainably on food production, diversification and promote wider range of healthier foods Zonneveld et al. [30] especially in some areas of Sub-Saharan Africa which has some parts with acute nutritional deficiencies and highest level of hidden hunger in the world. Thus, world's sustainable food future depends on the response of plant biodiversity to global changes in climate and environmental impacts, market integration, demographical and nutritional transition and human health and disease Zimmerer and Haan [41] hence the need for integrative approach in conservation of agrobiodiversity. The conflicts between agricultural produce or and biodiversity are by no means inevitable if farming practices are not sustainable [42]. However, until recently relatively little effort on exploration of traditional vegetables as an important component of agricultural biodiversity have been done by researchers both ecologically and socioeconomically, Dinssa et al. [37] acknowledged the fact that farmers in sub-Saharan Africa have been the sole curators and developers of the neglected and underutilized traditional vegetables.

5. Erosion of diversity of traditional African vegetables and socio-economic implications in Tanzania rural community

Predominant pattern of agricultural growth has been at expense of eroded biodiversity of plant genetic resources, livestock, insects and soil organisms [21, 42]. Keller et al. [31] found that wild TAVs are under threat of genetic erosion due to increasing urbanization, encouraged the cultivation of exotic vegetables for sale and the disappearance of indigenous knowledge on where and how to collect, cultivate and prepare traditional vegetables. In their review Chaudhary et al. [6] noted that agrobiodiversity loss can be categorized into natural drivers for example specie's ability to tolerate biotic and abiotic stresses, disturbed habitat render inhabitable and anthropogenic drivers such as change in food preferences, market forces, gene manipulation, human response to climate changes and lack of transfer of traditional knowledge. Farmer's in a survey conducted by Keller et al. [31] in Tanzania mentioned threats of traditional vegetables to be the introduction of new vegetable species or cultivar replaced indigenous vegetables varieties, influence of politics on commercialization of exotic vegetables, loss of indigenous knowledge making young generation unable to utilize existing traditional vegetables, changes in food habits, loss of habitat of wild vegetables and climate changes led to excessive drought.

5.1 Natural drivers

Biodiversity is made up of ecosystems, species diversity, and genetic diversity which sustain our lives and to by preserving our culture, well- being, and to economic prosperity. Biodiversity is increasingly subjected to human-induced changes to the environment. To persist, populations continually have to adapt through natural selection to stressful changes including pollution and climate change. Natural selection is the process through which species adapt to their environments. When faced with new stressful conditions and increased selection pressures, organisms can respond in several ways. If they are not able to adapt, they will either go extinct or they have to avoid the stressful conditions: through changes in local behavior [43]. Small relatively isolated populations become increasingly subject to genetic drift and inbreeding, resulting in loss of genetic variation and a decrease in fitness by a process called genetic erosion. The genetic erosion in small populations, owing to fragmentation of natural habitats, is expected to obstruct such adaptive responses through genetic drift which causes a decrease in the level of adaptive genetic variation, thereby limiting evolutionary responses and inbreeding depression which reduces individual fitness and, consequently, the tolerance of populations to environmental stress. Genetic drift causes allele frequencies to fluctuate, which over time leads to random loss and fixation of alleles and an increase in homozygosity. Significantly, inbreeding mostly increases the sensitivity of a population to stress, thereby increasing the extent of inbreeding depression. As adaptation to stress is utmost frequently convoyed by augmented mortality (cost of selection), the rise in the 'cost of inbreeding' beneath stress is anticipated to harshly hinder evolutionary adaptive processes. Inbreeding therefore plays a fundamental part in this process and is anticipated to bound the chance of genetically eroded populations to effectively adapt to stressful environmental situations. Thus, the dynamics of slight fragmented populations may vary substantially from large non-fragmented populations. The resilience of fragmented populations to altering and deteriorating environments is expected to be greatly decreased. Alleviating inbreeding depression, then, is critical to guarantee population persistence.

5.2 Anthropogenic drivers

Human activities are considered to be the main driver of agrobiodiversity erosion by population numbers, use of land, and of peoples' lifestyles, causes damage to habitats for various species. The global biodiversity decline by 30% is driven by land use through food production followed by 20% overexploitation of natural resources such as overharvesting, overhunting and overfishing for food, timber and medicines. The activities by rural communities of Tanzania in similar context affect agrobiodiversity. For instance, the study conducted in 1997 in the Udzungwa Scarp Forest Reserve of Tanzania, found human activities threatening the biodiversity [44]. This tells the fact that, biodiversity takes convert if progressively is exposed to human alterations of natural habitats, and abiotic and biotic environments are both changing swiftly, often unpredictably, and species and populations are progressively more subjected to stressful environmental situations [43]. Industrial pollution and the use of agro-chemicals have revealed to interrupt biodiversity dramatically. Large-scale destruction of natural habitats has triggered large populations of various species to become fragmented, resulting in small 'remnant' populations that become increasingly isolated. Subdivision of large populations in combination with limited gene

flow between the fragments has significant ecological and genetic consequences. Ecologically, habitat fragmentation will have demographic effects as small populations are progressively more affected by demographic and environmental stochasticity greatly increasing their extinction chance. The biodiversity needs to be explored and documented due to the fact that it consists of some of the species which are rare, endemic and threatened in such a way that they need protection and conservation measures [44].

6. Factors influencing conservation of traditional vegetables in Tanzania rural communities

Traditional African vegetables represent a diverse and widespread set of vegetables that are consumed across Tanzania. However, the knowledge base of traditional African vegetable conservation remains truncated due to a deficiency in research and policy support and impedes efforts to promote widespread cultivation, consumption and commercialisation. Therefore, even the conservation of traditional vegetable among rural farmers is generally low. Conservation is the wise utilization of natural resource that involves maintaining essential ecological processes and life support systems, preserving genetic diversity and ensuring sustainable utilization of species and ecosystems. Thus, conservation involves elements of protection, preservation, utilization and sustainable management of plant genetic resources that satisfy the increasing or matches with increasing efficiency, current and future needs of humanity and other organisms. Farmer's efforts in conservation, improvement and utilization of traditional vegetables currently under production serve as the basis of understanding different aspects of these crops by research community [37]. Dweba and Mearns [45] argued that it is vital to conserve indigenous knowledge on traditional vegetables to ensure the availability and utilization of these important food sources for resource-poor rural communities. Mpasiwakoma et al. [46] study found that most rural household in Tanzania depended on wild food plants during the periods of food crisis, this suggest that conservation by utilization is an effective method. Keller et al. [31] argued that socioeconomic status of rural communities has influence in the conservation of traditional vegetables such that a community with alternative sources of income and thus higher food security is more likely to forego utilization of traditional vegetables compared to a community whose members relies of on these species as source of their dietary requirements. Therefore, there is a need of Government and Non-Governmental organizations to encourage conservation of traditional vegetables in order to increase TAVs in natural habitats.

6.1 The effort to safeguard the biodiversity of traditional vegetables in Tanzania

Biodiversity in general and agrobiodiversity in particular are crucial for adaptation to climate change, for resilience and for human health as related to dietary diversity [47]. Chaudhary et al. [6] proposed utilization of crop wild relatives, farmer's fields, community seed bank, participatory crop improvement, and value addition of underutilized crops to be methods of in situ conservation while research stations, botanical garden, and national and international gene bank to be methods of ex situ conservation. Muhanji et al. [48] noted contribution made by institutions such as AVRDC in the conservation of traditional vegetables in Tanzania including awareness

creation, capacity building to farmers, development of improved TAV varieties, and establishing seed multiplication and distribution systems for few TAV species, business support and marketing of TAVs.

6.2 International agreements to safeguard agrobiodiversity particularly of TAV

Considerable efforts have been made by the international community to commit itself towards international agreements and treaties on the Convention on Biological Diversity (CBD), the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), and the Global Plan of Action for Animal Genetic Resources. These translate international obligations to conserve biodiversity into national laws and policies. These also increase the internationally agreed and effective mechanisms of access and fairly sharing the benefits from the use of the genetical resources which can contribute to the creation of a fair, more equitable economy and support sustainable agricultural development. The secretariats of the Convention on Biological Diversity (CBD) and the FAO International Treaty on Plant Genetic Resources for Food and Agriculture (FAO International Treaty) developed synergies implementing a joint initiative for on-farm conservation; working on sustainable use of plant genetic resources for food and agriculture and protected areas; promoting the importance of biodiversity and plant genetic resources for food and agriculture, food security and nutrition under a changing climate. Since 1996 Tanzania became a party to the Convention on Biological Diversity (CBD) and it adheres to its international obligation to protect and conserve its biodiversity as a global resource [49] (URT, 2015). The country Tanzania became a signatory to the Convention on Biological Diversity (CBD) in 1992 (URT). Tanzania has taken number of initiatives in order to conserve its biodiversity and to achieve the Article 6 of the CBD. The country formulated her National Biodiversity Strategy and Action Plan (NBSAP) 2015–2020 which sought to address national biodiversity targets based on the national priorities that contribute to the global targets on number of emerging issues such as climate change and variability, invasive species, and genetically modified organisms (GMOs) among others [49].

6.3 National legislature to safeguard agrobiodiversity particularly of TAV

Tanzania is one of the twelve mega-diverse countries of the world endowed with different natural ecosystems that harbor a massive wealth of biodiversity [49]. By then, the country hosted 6 out of the 25 world renowned biodiversity hotspots hosting more than one-third of the total plant species on the continent and about 20% of the large mammal population [49]. In Tanzania, the Biodiversity wealth contributes significantly to the socio-cultural, economic and environmental goods and services to the country and peoples` livelihood. The public policies, market dynamics, wholesale and retail distributors in agriculture have led to legislation of varietal registration and seed quality, and for supporting the increase in productivity. The legislation has conditioned agriculture, shifting it towards specialization and monoculture. This decreases diversity in farming methods. This review recommends for developing legislative mechanisms to support conservation of genetic biodiversity under in situ and ex situ conditions through the establishment of field gene banks and cryopreservation centres and establish a mechanism for capacity building, participation

and empowerment of farmers through legislative measures for conservation and utilization of such genetic resources.

7. Participation of different stakeholder of TAV

7.1 Farmers and traders

The global market of vegetables is still predominantly local because only about 5% of vegetables grown worldwide are marketed internationally [50] (Sumalan et al., 2021). According to Sumalan et al. [50] "the total volume of exports of vegetables reached at 47 million tonnes with a value of 42.3 billion US$ in 2018." In the same year, 64% of total vegetable exports were contributed by Netherlands (6.1 million tonnes), Mexico (5.8 million tonnes), Spain (5.1 million tonnes), China (4.3 million tonnes), France (3.5 million tonnes), Germany (2.7 million tonnes) and the United States (2.4 million tonnes). It was noted the exports were increasing at an average annual rate of 1.7%. Vegetable imports have also kept upward trend due the emergency of some countries with high vegetable requirements. In Tanzania, the Traditional African vegetables are mainly produced for subsistence and few for cash. The study carried out in northern and central part of Tanzania to investigate participation of farmers and traders in relation to gender in vegetable production and trading, found farmers reporting more balanced intra-household labour arrangements paired with less-balanced income and expenditure shares, while traders indicated less-balanced labour contributions which went hand in hand with more balanced shares of benefits [51]. The participation of farmers and traders in vegetables shows opportunities to farmers who benefit from trade by selling surplus produce and purchasing needed goods and services [52]. Benefits and challenges to market participation faced by vegetable farmers include lack of information about the markets and high transportation and transaction costs, among others, which do not allow traditional vegetable farmers to efficiently participate in markets [52]. African traditional vegetables if given interest can offer an important entry point which provides an important economic pillar upon which women's livelihood can be supported to improve welfare in rural areas.

7.2 Consumers

Consumers in many parts of the world derive a major portion of their diets from vegetables of which 70% are sold as fresh (unprocessed) hortcultural products [50]. Traditional African Vegetables (TAVs) are an affordable and relatively inexpensive source of vitamins, essential minerals, dietary fibber, and various phytochemicals which have a role in reduction of malnutrition, stunting growth and poor health among consumers in different areas of Sub-Saharan Africa. However, these vegetables are often neglected and underutilized. The food basket regions of Tanzania lack of dietary diversity which is key factor causing hidden hunger in because the population consumes mostly maize. Women and children can use the traditional African vegetables to get an excellent means to complement maize for better nutrition. In order to increase consumption of traditional African vegetables, there is a significant role to be played in order to promote attitudes of consumers towards increasing the amounts of TAVs in their diets.

7.3 Research institutes and seed banks

The Traditional vegetables have received low priority of research and production, poor seed distribution and availability, and lack of awareness on their values (URT 2015). Researches on TAV in Tanzanian context are mainly in the fields of food and nutrition potential [19, 20, 37, 53], livelihood [14, 25, 35, 48], diversity and conservation [30, 31, 54], environmental conservation and resilience [37]. The work of institutions such as AVRD and affiliates in collaboration with stakeholders such as Universities, TARI, farmers and consumers must not go unnoticed, collection of germplasms of traditional vegetables [37] (Dinssa et al., 2016) is important for conservation and establishment of seed systems and marketing of TAV [16, 48] is vital for commercialization. This looks the same as other most of Sub Saharan African countries which have not prioritized these TAVs in their crop research, training and development programs. There are innovative ways required for conducting researches on TAV' varieties and promotion through posters, campaigns and other online and printed publications. Increased research and production of TAVs will offer multiple economic opportunities, reduce unemployment and poverty.

The gene bank is a reservoir of biodiversity that acts as a source of genes which are used in breeding programs [50]. The World Vegetable Center (WorldVeg) genebank of traditional African vegetables currently has 2500 accessions which originated from germ-plasm-collecting mission with national partners across Africa in early 2000s [55]. This genebank conserves, screens and distributes the germplasm to support plant breeding to agricultural research institutes and seed companies. Between 2013 and 2017, Tanzania, Kenya and Uganda received 42,514 seed kits (containing an average of four seed samples of different vegetable crops and varieties) and 183,193 seed samples from WorldVeg [55]. The genebank offers a huge diversity and variability of vegetables to researcher for breeding and genetic modifications.

8. Conclusion

Traditional African Vegetables (TAVs) are among the horticultural crops whose natural habitat originated in Africa. The prospect of TAVs lies on the effort of researchers to revive the once perceived as an important group of food for cultural identity of rural communities which in turn were utilized, conserved and the knowledge passed from one generation to another. Several studies have shown that TAVs have high market potential and can contribute substantially to food and nutrition security, and climate change adaptation. Their production in Tanzania has the potential to be highly profitable, provide employment opportunities and generate income. There are number of challenges that hinder the production of the traditional vegetable in Tanzania including but not limited to high perishability; unavailability of quality seeds; high price and post-harvest losses, and lack of will-structured and organized market linkages. The traditional vegetables constitute a valuable genetic pool of gene diversity, which can be exploited both in breeding programs for obtaining new commercial varieties with targeted traits. Thus, more effort should be kept in characterization of existing TAV germplasms both morphologically and genotypically so as to first understand the extent of genetic diversity existing within the species but also to exploit genetic potentials of these species especially wild relatives so as to maximize production. Emphasize must also be on the marketing of TAV in order to elevate the livelihoods of rural families that grows these species. To realize

the potential of TAVs, the value chain actors must improve the competitiveness of their vegetable production and marketing commodities to increase market share and profits.

Conflict of interest

No conflict of interest.

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