



## The Status of Banana Production in Tanzania; a Review of Threats and Opportunities

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**ABSTRACT:** The word “banana” refers to a crop that cuddles a number of species commonly known as *Musa spp.* In Tanzania, the crop is the fourth most important crop for food and income generation for more than 30 percent of the total population. In East Africa, Tanzania is the second banana producer after Uganda. The country has the highest world’s consumption rate between 280-500 kg per person. Despite the crop’s importance its production has declined from 18 t/ha in the 1960s to 5-7 t/ha/year in 2016. This review examined the status of banana production by identifying threats and opportunities with the aim of providing readily available resource for Researchers and Agriculture Extension Officers for better banana production. Through online resources, the review identified the challenges impeding banana production and ascertaining prevailing opportunities. Banana production in Tanzania is faced with many challenges including major pests (weevil and nematode) and diseases (fusarium wilt disease, black sigatoka, and banana xanthomonas wilt disease), poor soil fertility, moisture stress, poor management practices, lack of improved banana varieties and many social economic factors. The review identified that, since 1990s there are few introduced improved banana varieties and that most of these varieties are faced with low consumer’s acceptability. Again the country is faced with shortage of banana breeding centers that could produce desirable banana hybrid cultivars. This review also identified the lack of banana information resources and research platforms that involves all banana stakeholders, making targeting of varietal attributes to consumer preferences very difficult. Therefore, in order to improve production there must be an inter-link among different research disciplines, involving governmental and non-governmental organizations, coming together and seek solutions to current and future problems for sustainable production of banana.

**KEYWORDS:** Consumer Preferences, Moisture Stress, Musa Species, Nutrient Deficiency, Staple Food, Yield Decline.

### 1. INTRODUCTION

#### 1.1 General Background

The word “banana” refers to a crop that cuddles a number of species commonly known as *Musa spp.* of the Musaceae family (Umuhoza, 2014). The crop is the fourth most important cultivated monocot herbs that embrace the diploid, triploid and some tetraploid cultivars (Nelson et al., 2006; Perrier et al., 2011; Pillay, 2012). The origin of cultivated banana is South eastern Asia and Pacific regions (Masanza, 2003; Castillo and Fuller, 2010, 2012). To date, they are the world’s leading fruit crop and an important export commodity (Aurore et al., 2009, Kilimo Trust, 2012; Plötz and Evans, 2015). Edible cultivars were derived from crosses of two wild species, *Musa acuminata* colla and *Musa balbisiana* colla (De-Langhe, 1995; De-Langhe et al., 2009; Ortiz 2013). Diploid AA includes the *Acuminata*, whereas diploid BB includes the *Balbisiana* (Nelson et al., 2006). Triploids AAA comprise (Gros michel and all EAHB, cooking banana, beer banana, Cavendish and Red banana whereas Triploids ABB (Kayinja), AAB comprises (Kamaramasenge) and Plantains (Mizuzu), the Tetraploids AAAA which contain all FHIA (Karemera, 2014). The crop is reflected as poor man's apple and it is the inexpensive among all other fruits in many SSA countries including Tanzania (Heslop-Harrison and Schwarzacher, 2007). Moreover, bananas’ ability to produce fruits throughout the year ranks them above other staple food crops (Nayar, 2010). It is also reported that banana improvement investment holds great potential for improving food security as these crops feed more people per unit area of production than other staple crops (West et al. 2014).

It is believed that in Africa banana cultivation began around three thousand years ago (De-Langhe, 1995). Their introduction in sub-Saharan Africa was initiated by Arab traders after the birth of Jesus Christ (Price, 1995). However, after their introduction they

diversified to more than 60 cooking banana types in the East African Highlands and more than 120 plantain types in West and Central Africa (INIBAP, 2006).

Several ethnic groups in East Africa rely exclusively on bananas. For example, the Ganda and the Haya in the north and west Lake Victoria, the Gishu of Mount Elgon, the Chagga of southeastern Kilimanjaro and the Nyakyusa of Tukuyu (Simmonds, 1966, Mpangala, 1992; Maruo 2002; Maruo 2007). The region has the highest consumption rate of 500–1500kg per head (Yamaguchi, 2004). Uganda is the leading banana producer among African countries, third in the world ranking with 11.8MMT followed by Cameroon 4.94MMT ninth in the world ranking and Tanzania 4.08MMT tenth in world ranking (figure 1) (Phumelele, 2016).

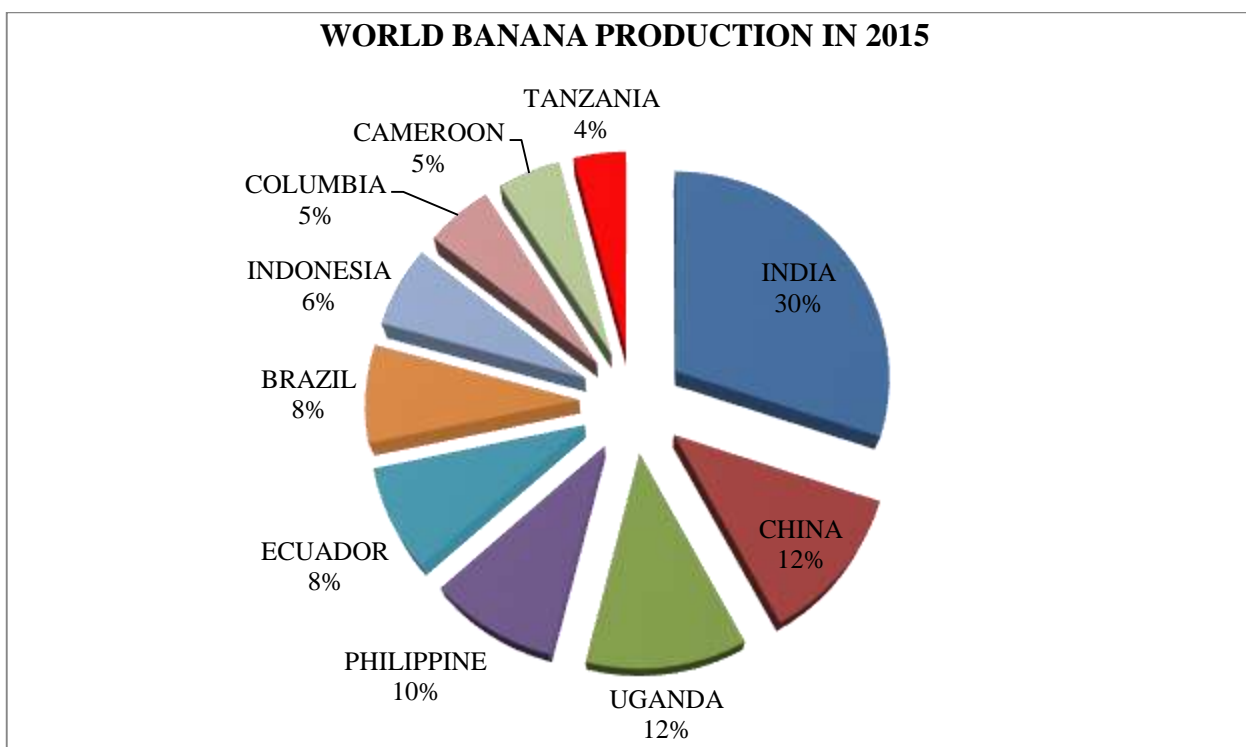


Figure 1: world statistics of banana production in 2015

Source: Phumelele (2016)

Statistics shows that Tanzania produces about 4 MMT annually with consumption rate between 280-500 kg/person/year (Kilimo trust, 2012; Phumelele, 2016). Over 900,000 farming households are engaged in banana production in Tanzania for food and market (NBS, 2012). In the comprehensively banana-based agricultural systems (Kilimanjaro, Kagera and Mbeya), about 70–95% of households grow bananas for food and/or economic reasons (Byabachwezi and Mbwana, 1999; Kilimo trust, 2012). The areas contributes more than 60% of bananas grown in the country, which embrace their native farming system (Yamaguchi, 2004). The overall banana production in the country is reported to be very low, not exceeding 10% of the crop’s potential of over 60-70 tone/ha/ year (Van Asten et al., 2005; NBS 2012).

### 1.2 Banana production areas

In Tanzania, banana production is divided into major and minor producing regions. Major producing regions are the highlands of Kagera region in the Lake Zone, followed by Kilimanjaro, Arusha, and Tanga in the Northern Zone; Mbeya, in the Southern Highlands Zone; Coast and Morogoro in the Eastern Zone; and Zanzibar Islands (NBS, 2012; Kilimo trust, 2012). Minor producing regions are Kigoma, Mara, Ruvuma and Iringa In all regions, the major varieties cultivated are the East Africa Highland banana that includes; Matooke, Uganda, Mchare, Kisukari, Mzuzu, Kimalindi, Ndizi Ng’ombe and Bokoboko (Kilimo trust, 2012). The crop is grown in association with various other crops, such as coffee, beans, maize, cocoa yams and fruit trees. Farmers apply no chemical control measures to protect the crop (MAFC, 2009).



## 2.0 MAJOR BANANA PRODUCTION CONSTRAINTS AND OPPORTUNITIES

Horticulture industry in Tanzania contributes 38% of foreign income earnings and is the fastest growing at 9-12% per annual as a sub-sector within agricultural sector (Match Marker Associates, 2017). Tanzania as other developing countries in the world, farm entrepreneurs are confronted by several challenges which constrain growth and development of the agriculture sector (Mbuga, 2019). Due to challenges faced by many developing countries imports a significant volume of food crops which could otherwise be produced in the country (URT, 2016; Mbuga, 2019). FAO, (2011), noted some challenges facing banana industry in Great Lake Region of Africa as pests and diseases, poor soil fertility, a low genetic base and various other socio-economic factors. Whereas Harrison and Schwarzacher, (2007), added the challenges to banana production in United Kingdom as new demands for sustainability, quality, transport and yield. The following are discussions of the challenges and opportunities that are existing in banana industry in Tanzania.

### 2.1 Pests and diseases

Musa species (bananas and plantains) are susceptible to a wide range of pests and diseases, although the exposure rate depends on the cultivars (Nkuba and Mgenzi, 2002). Some pests and diseases are very contagious and easily spread, though some are not (Nelson *et al.*, 2006). The persisting level of pest and disease weakens the confidence to invest into banana production (Nelsons and Associates, 2014).

In Tanzania, banana production is significantly threatened by weevils (*Cosmopolites sordidus*) (Mbwana & Rukazambuga 1999; Gold *et al.*, 2001; Viljoen *et al.*, 2016), nematodes (e.g. *Rodopholus similis*) (Sikora *et al.*, 1989; Viljoen *et al.*, 2016), black sigatoka disease (*Mycosphaerella fijiensis*), Viljoen *et al.*, 2016), Fusarium wilt (*Fusarium oxysporum*) (Ploetz, 2015; Viljoen *et al.*, 2016) and banana Xanthomonas wilt (BXW) (*Xanthomonas campestris* pv *musacearum*) (Gallez *et al.*, 2004; Swennen *et al.*, 2013; Nkuba *et al.*, 2015; Shimwela *et al.*, 2016).

Fusarium wilt disease is one of the most serious and devastating banana fungal diseases worldwide (Rong *et al.*, 2013) and can result in yield losses up to 100% (Pushpavathi, 2014). According to Speijer *et al.* (1999) and Wairegi *et al.* (2010) banana weevils and nematodes can reduce yields by 30-70%. It was reported that weevil pest caused the decline and disappearance of highland cooking banana in central Uganda and western Tanzania (Mbwana and Rukazambuga, 1999). Romero and Sutton (1996); Barekye *et al.* (2011); Viljoen *et al.* (2016) also reported that Black sigatoka disease can cause yield loss of 30 to 50% on bananas and plantains. A production loss of up to 100% in susceptible varieties such as *M. acuminata* Cavendish Grande Naine (*Musa* cv. AAA) and Prata (*Musa* cv. AAB) has also been observed by Brito *et al.* (2015).

However, there are minor pest and diseases like, Speckle/Septoria leaf spot, a foliar disease which is not yet serious in Tanzania but very damaging and cause yield losses of about 40-100% (Kimunye *et al.*, 2020). Another is Cigar End rot caused by *Verticillium theobromae*, and *Trachysphaera fructigena*, a disease which kills banana fruits while the fruits are being transported as well as fruits in storage (Maina *et al.*, 2013). Mole rat (*Tachyoryetes splendens*) is one of the most devastating underground rodents that attack various plants including bananas (Makundi and Massawe, 2010). Baboons which take root and tubers of crops ignored by other primates and feed on banana more frequently (Naughton-Treves *et al.*, 1998). On the other hand, significant and extensive damage by *Armillaria* has been reported in Africa (Otieno, 2002). The armillaria corm rot disease of banana was first reported in Mitarula, Mbeya, Tanzania more than 38 years ago (Lindqvist, 1980; Ploetz *et al.*, 1992), suggesting that armillaria corm rot may be an obstacle to banana production.

Currently there are no significant research outputs on developing durable resistant banana genotypes to the major pests and diseases. The low progress is largely due to challenges associated with polyploidy, low fertility and long generation time (Taylor, 2005). The possibility also exists that the durability of introduced resistance may be overcome by heritable mutations within the pathogen (Jones, 2013). The challenges call for more researches to identify ways to mitigate the effects of these economically important pest and diseases.

### 2.2 Poor soil fertility

Many agricultural lands in the tropics are succumbed to nutrient loss through many processes which include, erosion, nutrient mining, weathering, decrease in organic matter and soil bioactivity, soil acidification, denitrification, leaching, salinization, alkalization, poor soil management and pollution (Tisdale and Nelson 1975; Bosch *et al.* 1996; Bajjukya and de Steenhuijsen Pitersa 1998; Van Asten *et al.* 2004; Nyombi *et al.*, 2010; Wairegi *et al.* 2010; De Bauw *et al.* 2016). The more widespread deficiency of



plant nutrients in soils has adverse consequences for crop production and soil fertility maintenance (Henao and Baanante, 1999, 2006; Pilbeam and Morley, 2007; Nyombi 2014; Majumdar et al. 2016). Nkuba and Mgenzi, (2002), reported that, the expansion in cultivated land and intensification of banana productivity are limited by declining soil fertility. Deficiencies of potassium (K) and nitrogen (N), can cause between 20 and 68% yield loss in banana crop (Nyombi et al., 2010). Thus applications of nutrients are important for growth and development of plants as well as to beneficial microorganisms (Agrios, 2005). Since, Africa's consumption of modern inputs, particularly fertilizers, is comparatively reported to be very low (Boniphace et al., 2015). It is reported that, the average application rates of fertilizer for arable crops in East African countries are estimated to be below 30 kg/ha/year which is far less than the world average of 100kg/ha/year (Wiggins and Jonathan, 2010). Suhasini et al., (2018) reported that, application of inorganic fertilizers in banana crop increased yield substantially, but could not sustain the fertility status of the soil. Inorganic fertilizers caused several undesirable consequences in the fragile soil eco-system leading to gradual decline in productivity (Suhasini et al., 2018). This calls for research that will lead to specific fertilizer recommendations based on soil eco-systems for better performance of banana crop.

For better banana yields, regular checking of soil nutrient status is suggested in order to ensure that macro and micro nutrients exist in a balanced ratio (Van Asten et al. 2004; Baijukya et al. 2005; Yamaguchi, 2004). There is little information regarding relationship between soil nutrient, climate and banana crop performance. More researches are needed on nutrient modelling to curb the challenge related to banana plant nutrient.

### 2.3 Moisture stress

Banana production system in Tanzania is mostly rain fed (Nkuba and Mgenzi, 2002). Water is reported to be the most limiting non-biological factor affecting banana production (Turner, 1995). As a rule of thumb, bananas require 25 mm of rainfall per week for satisfactory growth (Nyombi, 2013). Climate change has caused unpredictable or irregular rainfall patterns (below, average or high) compared to the required amount of 1300 mm of rainfall per year (Nyombi, 2013; Ndamani and Watanabe, 2013). Due to low or excess moisture in the soil, there is accelerated poor performance of banana in many areas (Bosch et al., 1996; Baijukya et al., 2005; Nyombi et al., 2010; Van Asten et al., 2011). The apparent changes in rainfall patterns are reported to be due to anthropogenic activities and natural processes (Udayashankara et al., 2016). The climate can shift because of natural changes either within the climate system or outside of it such as in the amount of solar energy reaching the Earth (Trenberth et al., 2000). Additionally, changes in land use through activities such as deforestation, agriculture expansion, burning, the building of cities, industrialization, storage and use of water, and the use of energy are all important anthropogenic local factors contributing to climate change (Trenberth et al., 2000). Banana plants require regular watering, from rainfall or irrigation, all year round (Diczbalis, 1993). The crop performs best in well drained soils which are maintained at or near field capacity (Diczbalis, 1993).

Therefore, more researches are needed on breeding moisture tolerant banana which can tolerate moisture stress. The researches can also focus on nutrients that enhance tolerance to moisture stress like silicon by identifying genes responsible for.

### 2.4 Poor management practices

In Tanzania, smallholder farmers are resource deprived who basically miss the mark of banana agronomic practices that could enhance yields (Lokina et al., 2011; FAO, 2015; Siedek, 2016). Low productivity has been linked to a combination of several factors, including over-reliance on rainfall, utilization of rudimentary and unsustainable production methods, poor access to inputs and low extension service capacity (FAO, 2013; URT, 2016). Even though a number of banana farm management procedures have been developed and recommended to farmers, they are practiced irregularly and sometimes not at all (NARO, 2001). The use of poor agronomic practices has been reported to encourage infestation of pests and diseases, and soil nutrient depletion (Bakry et al., 2009). There is failure in almost every stage of production starting from selection of suitable varieties of banana seeds to management practices like de-trashing, de-suckering, weeding, mulching, fertilizer application, intercropping, and corm removal (NARO, 2001; Van Asten et al., 2010). Good management practices have been reported to increase banana yield (Wairegi et al., 2010; Van Asten et al., 2010). Examples are mulch from crop residues, fertilizer application and weeding has been reported to increase productivity in bananas (Wairegi et al., 2010; NHM, 2012) and intercropping (Van Asten et al., 2010). At farm level, the damage can be minimized effectively by using integration of several cultural methods (Masanza et al., 2005; Tripathi et al., 2016). FAO, (2012) reported that, the use of cultural practices such as application of Nitrogen, Potassium and Calcium, sanitation/pruning, irrigation and drainage improvement can reduce sigatoka disease.



Integrated pest managements (IPM) have been proved to improve yield through minimized effects resulted from pest damage and disease pressure. This call for banana production stakeholders; the government, agricultural extension workers and banana producers to come together, discuss and identify best IPM for banana production. Additionally, the government can fund researches on banana IPM so as to come up with best IPM strategies for implementation.

## 2.5 Variety preferences

Smallholder farmers grow different banana cultivars preferred by local communities, due to their cultural affections and the perceived importance (Smale and Jayne, 2002; Kilimo trust, 2012; Karamura et al., 2016). Cultural preferences have delayed the expansion of the banana production and market because not all banana cultivars have won acceptance (Kilimo trust, 2012; Dale and Tushemereirwe, 2016; Reis et al., 2016). Due to these reasons above and the other smallholder farmers do not select suitable varieties of banana in relation to their ecological requirements (NARO, 2001). Many of the local cultivars preferred by consumers are less productive, susceptible to pests and diseases which lead to low yield (Setimela et al., 2004). Statistics indicated that, adoption of new varieties which are high yielding and resistant to pests and diseases like Giant Cavendish, Williams, Chinese Cavendish, and FHIA 17, FHIA 21, FHIA 25, FHIA 29, Valery, Robusta and Paz, in Tanzania caused the increased production from 2.6 MT/hectare to 6.5 MT/ hectare (Kilimo trust, 2012). However, some farmers have failed to adopt the introduced new varieties due to sensory reasons, cost, accessibility, loss of resistance to pests and diseases, and reliability of variety types from trusted sources (Karamura et al., 2016; Nabuuma et al., 2018). Karamura et al. (2016), found that nearly all introduced varieties, with the exception of locally bred ones, had no participatory variety selection conducted.

Breeding and development of new banana varieties, should focus on targeting end-users, this will help identify consumer characteristics that will guide breeding strategies. We therefore suggest that, the ongoing breeding program researches should focus on client driven because banana markets are based on consumer's preference.

## 2.6 Lack of finance

Tanzania has 94.5 million hectares of land of which 44 million hectares are classified as arable, but only 24% of the arable land is under cultivation (Agricultural development strategy II, 201/16-2024/25). Among the major constraints that held back the agriculture sector in Tanzania from performing at its utmost is, poor access to finance by smallholder farmers (Molela, 2017). Resource is a key factor to purchase inputs and invest in farm improvements in the farm (Molela, 2017). Similarly Mbuga, (2019) reported that insufficient credit and equity have negatively affected technology innovations, crop production, and socio-economic development of the farm entrepreneurs. Miller et al. (2013) reported that many money lending institutions refrained from investing in smallholder famers because of the delinquency risk associated with the agriculture sector. Molela, (2017) and Mbuga, (2019), identified the factors that hamper farmers from securing external finance including lack of enough capital, poor collateral management, use of traditional method of cultivations, low business capacity, poor character and failure to meet the credit terms and conditions set by lenders.

Therefore there is a need for government to put in purposive efforts to support the Tanzania Invest Bank and create favorable environment for smallholder farmers to be able to secure capital to invest in banana and other fruit crops production and marketing.

## 2.7 Poor market of agricultural produce

Farmers are both producers and consumers, sell processed or fresh bananas, processed products can either be for home consumption or marketing, and for the latter, traders, retailers, and urban consumers are also actors (Marimo *et al.*, 2019). Lyatuu et al., (2015), reported that proper functional markets in Tanzania is a major problem, due to the fact that, present markets are incomplete as result of insufficient access to market information, low access to finance and insurance market, poor linkage of small producers to the established market, unnecessary restrictions and controls on the sale and purchase of agricultural products and lack of proper standards for quantifying and grading products. Other are insufficient borrower information, cumbersome legal procedures and high transaction costs, that many financial service providers are reluctant to serve smallholder farmers (Lyatuu et al., 2015). The Tanzania government in 2001 adopted Agricultural Sector Development Strategy (ASDS) for the purpose of improving agriculture in the country (Leyaro and Morrissey, 2013). The ASDS emphasized the need to improve the efficiency of input markets and product marketing, increase access to credit, enhance the provision of extension services and increase investment in rural areas (especially for irrigation and transport (Leyaro and Morrissey, 2013). With all this endeavors strategized by the government still market is a challenge for agricultural products including banana. Farmers are mostly albeit indirectly affected not only by the prices of their



own outputs, but also by the incentives non-agricultural producers face, that is both absolute but relative prices and relative rates of government assistance affect producer incentives (Anderson and Masters, 2009).

There are need to involve multilateral cooperation within the country and without for the purpose of availing new markets and platform for banana and plantain market.

## 2.8 Poor infrastructures

Infrastructure is a very important stimulant of agricultural trade and lack of it lead to high transaction costs in the developing world (Eskola, 2005). A common dispute in favor of infrastructure development is that, economic liberalization policies would yield greater comebacks if combined by investments in infrastructures (Eskola, 2005). Infrastructures can decrease the transportation costs and integrate the currently isolated agricultural production areas and markets (Key et al. 2000, Heltberg and Tarp 2002). Insufficiencies of road and irrigation infrastructures are named to be the limiting factors that affect agricultural production in Tanzania (NBS, 2014). It is farther reported that a total of 31% of land (90,400 km<sup>2</sup>) are potential for irrigation, but currently only less than 1 percent are under irrigation (Lyatuu *et al.*, 2015). To stress the important of infrastructures in the year 2018, Tanzanians were digging deeper into their pockets to buy green bananas as the shortage worsens due to poor supply as heavy rainfall has disrupted infrastructure in areas where the crop is grown (Allafrica.com, 2018). Another important factor is lack of transportation infrastructure including storage and transportation facilities (Lordachescu et al., 2019). Due to market globalization need for better long distance transportation systems and handling methods to preserve produce quality is a pre-requisite (Vigneault et al., 2009).

## 2.9 Taboos and traditions

Farmers and their families are part of the society in which their attitudes and desires are highly influenced strong by members of society (Pikalov, 2014). There are several taboos, habits, customs and norms set in many societies to ensure smooth running of the society which has economic and social impact (Stifel et al., 2011). Importantly; taboos are as proscriptions that one is not allowed to do, object one must not come into contact, words which must not be uttered and places which must be avoided, they are generally omnipresent in societies (Stifel et al., 2011). Traditional food production in the region was perceived and understood in cultural and spiritual terms (Chilver and Kaberry 1967). For example beliefs and taboos in Malawi reflect the life/death meanings symbolically represented in bambara groundnut, which influences how and by whom the crop is produced and consumed (Forsythe et al., 2015). Using cross-sectional data from Madagascar national household survey, Stifel et al. (2011), found that 18 % of agricultural households have two or more fady days per week that is associated with 6 percent lower per capita consumption level and 5 % lower rice productivity. Similarly banana growing and marketing in Tanzania is largely regarded as a work for women in some societies while growing and eating banana in nomadic families like the sukuma, masai etc. is not regarded as dish for dinner or lunch but rather fruits. This agree with what Alonzo *et al.*, (2017), reported that socially transmitted food prescriptions in many society for what should be eaten or what should not be eaten, this affect social access to food and food choices. In Tanzania, three ethnic groups are known as the banana-eaters with their preferred banana varieties, namely, the Wachagga with Mchare banana in the northern part of the country, the Wahaya with Matooke banana in the north-western part, and the Wanyakyusa with their popular Mzuzu plantain in the southern part (Lyana and Manimbulu, 2014). In the past banana and plantain were a symbols of the prosperity in these communities. The crop also mediates the gender values of the people in the society for example, in the rain-making ritual of the Wanyakyusa, the plantain symbolized man; and the sweet banana symbolized woman (Lyana and Manimbulu, 2014). The management of the perennial crops, including bananas, is basically the responsibility of men in haya tribe same as chagga. In contrast, in neighbouring southern Uganda, women perform this role (Lyana and Manimbulu, 2014).

## 2.10 Perishability nature of agricultural produce

Perishability is one of the major constraints in banana production and marketing, and is more serious in developing countries like Tanzania than in developed countries (Atanda et al., 2011; Elik et al., 2019). In smallholder farmer's vicinity, in the absence of modern technology and advanced harvesting practices, fruits are always susceptible to physiological and physical damages (FAO, 1989; Atanda et al., 2011; Akinyemi et al., 2017). Fruit perishability occurs during the handling, storage and disposal as a result of natural processes such as drying, evaporation, volatilization, spraying, hydrolysis, cooling, freezing, melting, oxidation, adhesion to walls of wagons or vessels in which they are transported, decomposition, leakage, soak, thickening, spreading, crushing, breakage, including fermentation processes or other biophysical processes, in the sales process in the distribution network wholesale, retail and catering (Iordachescu et al., 2019). The technologies employed by smallholder farmers in both production and utilization is



usually simple and a result of long established traditional practices (Atanda et al., 2011). It is estimated that post-harvest loss account for up to 60% yield loss in fruits and vegetables (Dube et al., 2018; Elik et al., 2019). In most cases farmers suffer a huge economic loss due to lack of proper understanding about nature and causes of these loss, proper preservation methods and their transportation and marketing techniques (Yahaya and Mardiyya, 2019). Therefore in these days of rapidly growing population in the developing countries of the world where food is not sufficient, there is a need to urgently do a better job of conserving mankind food supply in order to improve food security (Elik et al., 2019).

We therefore conclude here that examining the various concepts of banana postharvest losses, considering the importance banana in food security, assessing the causes of yield losses, environmental consideration and its influence on losses is a priority for better banana production. So designing of research projects is recommended on production and post-harvest handling of banana fruits.

## 2.11 Poor production base

In Tanzania HODECT, (2010) reported the consequence due to smallholder farmers owning small farm size of 0.1 to 2.0 acres of horticultural crops, being inability to supply large quantity or sufficient for buyers, to make them eye-catching suppliers and maintain the market. Unsatisfactory economies-of-scale and insufficient synchronization amongst smallholders makes it difficult to achieve the quantity of supply necessary to gain access to global markets. Smallholder farmers in Tanzania do diversify crops as a risk management stratagem to stabilize their income by growing many crops, this is to minimize their exposure to risk, such as price shocks (FAO, 2015). The size of landholdings and the type of tenure system often discourage investments in banana production, since banana crops are produced on small and fragmented landholdings in East Africa (Tinzaara et al., 2018). Land fragmentation is caused a combination of local customs and legal stipulations regarding land rights and ownership (Tinzaara et al., 2018). Agricultural expansion is hindered by legal restriction in relation to land tenure and cultural habits linked to the inheritance system expansion (Akinyemi et al., 2010).

Therefore there are need for formation of associations for producers and establishment of production contractual agreements between farmers and buyers, this is of use as entry point to link farmers with buyers ultimately will enhance production and assured market.

## 2.12 Lack of banana product diversification

In East Africa including Tanzania banana are mainly used as food (cooked, roasted and chips/crips) and for brews (Karemera, 2014). Banana can also be processed into flour, canned slices, jam, jelly, puree, vinegar, wine and beer (SHEP PLUS, 2019), this implies that banana processing technologies are less or not widely used in banana industry. Therefore lack of banana product diversification is a challenge caused by poor technology, poverty, knowledge and lack of innovation. Setyadjit et al. (2017), reported that for farmers to increase production power, innovating banana-based products research are required on banana processing, by identifying the best technique of processing that can be used by farmers. Globally bananas are processed into various types goods such as banana flour, convection dried banana, banana flour modified with acid, banana fritters, banana Puree, banana-milk powder, ultrasonic dried banana, cookies, spray dried banana powder, rich fiber powder, high fructose syrup, Banana starch film, composite banana custard and banana starch (Setyadjit et al., 2017).

All these products are less prepared in the country by small holder farmers so the need for extensive studies on the banana product diversification is important area for the country to realize increased banana production.

## 2.13 Climate change

Assessing the impacts of climate change in relation to banana crop productivity and food security has been poorly studied in Tanzania (Lucas and Jomanga, 2021). A report by Rosenzweig et al., (2014) showed that most of the studies showing the impacts of climate change on food security mainly focused on major food grains. Very limited studies on the effects of climate change have been done in the country (Lucas and Jomanga, 2021). However, Wairegi et al., (2010) in Uganda showed that, the future state of climate change variations will affect banana productivity. This review therefore calls for more researches that will show how climatic factors affects banana crop in relation to plants growth cycle in Tanzania. This is because clear information in banana cropping and climate factors has the potential to promote high banana productivity.

## 2.14 Social protection and support policies to smallholder farmers

Practically, social protection and agriculture have a two way relationship, firstly, poor rural households mostly relying on agriculture for their livelihoods are often affected by limited access to resources secondly, idiosyncratic risks (FAO, 2013). Social protection



helps to improve credit, savings and liquidity constraints by providing cash and in-kind support and assist households to better manage risks and to engage in more cost-effective livelihood and farming activities (FAO, 2013). Characteristically majority of smallholder farmers in Tanzania have a relatively low socio-economic status, this is due to the fact that household income is mainly obtained from low on-farm sources involving crop and livestock (Anderson et al., 2016; Morisset, 2013b). The country has no social security arrangements for people who work in the informal, agricultural and extractive sectors, and the majority of unemployed individuals are not covered by any form of protection (Ulriksen, 2016). Therefore, the improvement and or establishment of social protection policies in agriculture is identified as a very important aspect will improve crop production. Social protection policies intend to decrease socio-economic risks, vulnerability, extreme poverty and deprivation, while smallholder agricultural policies focus on improving production in crops, fisheries, forestry and livestock and improving access to markets (FAO, 2013). This calls for government and other agriculture policy stakeholder come together and establish agricultural policies that will help improving banana crop production chain in the country.

## 2.15 Labour availability

East Africa smallholder farmers typically rely on family labour and rudimentary farm tools, rendering banana production a costly and less productive endeavor (Tinjaara et al., 2018). Similarly Anselm et al. (2005) reported that, in African farming system family members constitute the highest proportion of total labour involved in banana plantation management, activities included the planting, corm removal, making soil bands and trenches, de-suckering, and manure preparation and application. Small farms are tending to shrink with every generation. The small farms that are dependent on family labour, use very little machinery and several activities reflect the dominant type of agriculture in Africa. Labour shortage is common during the time of land preparation and planting, households that can afford it supplement their family labour with hired labour to meet labour requirements (Tizaara et al., 2018). Labour availability and cost of it is a major challenge in some banana growing areas that hampers good agronomic practices in Kagera (Mpoki and Jomanga personal communication).

The need for mechanization of banana production is urgent issue, to resolve challenges related to labour for better banana production.

## 2. 16 Low genetic base in banana and plantain.

Bananas and plantains are morphologically diverse herbaceous plants in genus *Musa*, with limited genetical diversity in Africa as compared to South-East Asia (Perreir et al., 2018). Although there is significant phenotypic variation observed among East Africa Highland Banana (EAHB), their genetic variation is low, making them mostly susceptible to biotic and abiotic stress (Nyine et al., 2017). The phenotypic differentiation is the result of long time selection process involved somatic variations, being maintained by vegetative propagation (Perreir et al., 2018). The declining in genetical diversity in crop varieties presents risks in varieties that carry same genes for resistance to diseases and pests, such that if a resistance is overcome in one variety the other become susceptible too (Schouten et al., 2019). Again due to inadequate genetic knowledge of banana genome and the nature of the crop implies that many breeding aspects and selection methods used in other crops cannot be used in the banana (Manzo-Sanchez et al., 2015). As it is reported that banana breeding is intrinsically complicated by the polyploidy nature of the crop characterized by abnormal meiosis in the cultivated triploid varieties that results in reduced fertility (Crouch et al., 1998). The abnormal meiosis is due to aberrant chromosome pairing and unbalanced chromosome segregation (Simonikova et al., 2020). Artificial pollination of cultivated banana varieties with resistant wild diploids generates hybrids which mostly are inferior due to linkage drag of unfavorable genes from the wild diploids (Simonikova et al., 2020).

With these progress above issue of incorporating resistance at the same time maintaining desirable traits in existing varieties is a big challenge in banana breeding that needs great attention. Therefore research should focus on unveiling the hidden knowledge of banana genetics for better breeding.

## 2.17 Impact of covid-19 on banana industry

The COVID-19 pandemic has affected many countries in the world and has led to the global activity downturn moment (Tomasselli, 2021). The strategies engaged to control the spread of the disease have disrupted the functioning of food systems in several ways, with a severe health and socio-economic repercussions associated with livelihoods (FAO, 2020; Chase and Roux, 2020). Banana the most exported fruit crop in the world has faced production, transportation and market challenges that have hampered its value chain in nearly all bananas producing countries (Chase and Roux, 2020). Conversely, in Tanzania, measures related to COVID-19 were not focused on restricted travel within and outside the country, but on sanitation and public gatherings were limited to some





extent. Most horticultural crops in Tanzania are directed toward export. As a result of the COVID-19 pandemic, the demand for these horticultural products has reduced by over 50.0%, which had a ripple effect on supply. Food and Agricultural Organization (FAO) reported that horticultural products worth about USD 63.69 million are exported monthly from Tanzania to international markets. The pandemic has significantly affected the export business for more than 80% (TFVM, 2021).

### 2.17.1 Production

During the COVID-19 labour has been restricted in many countries due social distancing measures to contain the virus (Muyiramuye and Addom, 2021). This has had significant negative impacts on agriculture, especially for farming activities that require constant assistance from farm workers. In many places, shortages of farm labour and planting material has led to reduced production. Where strict lockdowns were in place, farmers could not maintain fields a situation that contributed to loss of harvests. Therefore smallholder farmers in Sub-Sahara Africa are encountering numerous challenges including disruptions of food supply chains, unemployment, and all increases the risks of food insecurity now and in the future. In the eastern part of Africa, the pandemic added on existing challenges such as flooding disasters and the invasion of pests like desert locusts and fall armyworm, which devastated agricultural production (UN, 2020).

### 2.17.2 Transportation

In many countries in Africa, many governments instituted measures that imposed strict restriction of vehicular transport and movements, closure of hotels, restaurants and lodges, night-time curfews, closure of markets and imposition of strict rules for opening and operation of the markets (Chase and Roux, 2020). Another ways were partial closure of borders and a requirement of COVID-free certificates for cross-border truck drivers, prohibition of unnecessary travel, and requirement of disinfection of transport vehicles, requirement for personal protective equipment for truck drivers, night curfew. All these led to directly or indirectly affected banana (Chase and Roux, 2020). Delivery of new planting material was also negatively impacted leading to less field expansion and re-planting.

### 2.17.3 Marketing

The market for bananas has massively developed in the country owing to exports and local demand from consumers. Many hefty markets were closed, leading to major crop losses, however smaller local markets were more reliable in the midst of the virus. The export trade was impacted in many ways in many countries although the introduction of sanitary measures helped to maintain business. Moreover, prices crashed due to blocked markets in some places while in others, prices increased due to shortages. In Tanzania traders in the market largely depend on their already established network of customers, both large and small. Orders from clients who used to supply to hotels or schools have significantly decreased as nearly all hotels closed business and schools were closed for a period. In addition, the decreased trading activities in the market can be attributed to restrictions and a consequent decline in cross-border trade, as the market caters to domestic as well as foreign customers. For all intents and purposes, most traders are of the view that there are fewer clients and the purchasing power of the enduring customers has been negatively affected. This is reflected in the decreased orders for most food products (Kissoly, 2021).

Therefore, there is a need to stabilize the food production and supply, by strengthening producers and connecting them to markets through unadventurous and emergency channels. Maintaining supple and adjustable actions on rural and food markets are vital to allow them to remain open, while harmonizing this important with public health concerns for social distancing and hygiene protocols.

## CONCLUSION

Tanzania as other countries is struggling to improve her banana production, since the crop has been the foremost staple food, economic and social activity in major bananas growing areas. It is suggested that in order to improve banana production there must be an inter-link among different research disciplines, involving governmental and non-governmental organizations, which should embrace each other and seek solutions to existing current challenges in the banana value chain for sustainable production. There is a need to assess the magnitudes of each challenge facing smallholder farmers so as to prioritize limited resource allocation at farm level.



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