

Production Trends of Food Crops: Opportunities, Challenges and Prospects to Improve Tanzanian Rural Livelihoods

Msafiri Y. Mkonda^{1,2,*}, Xinhua He^{1,3}

¹Centre of Excellence for Soil Biology, College of Resources and Environment, Southwest University, Chongqing 400716, China

²Department of Physical Sciences, Faculty of Science, Sokoine University of Agriculture, Morogoro 3038, Tanzania

³School of Plant Biology, University of Western Australia, Crawley 6009, Australia

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Abstract Tanzanian agriculture employs about 80% of the national labour force and most of these are rural dwellers. The country has about 44 million hectares of arable land but less than 24% of the area has been harnessed. Similarly, the country has inland rivers, lakes and other water bodies that could supply water for irrigation, however only 2% of the irrigation potential has been exploited. Here we reviewed 54 scientific publications on potentials, challenges and prospects of agriculture in the country and found that; its production trend has been fluctuating over time in a decreasing manner. Tanzania Agricultural Policy aims at stimulating agricultural growth from 3.6% to at least 6%. However, inadequate market systems, transportation and storage infrastructures among others things, have been the major hindrances to make agriculture a commercial industry. On top of that, the adverse impacts of climate change have exacerbated the situation. Similarly, lack of political willingness and shortage of capital for agricultural investment have increased the magnitude of the problem. This paper highlights on the opportunities, challenges and prospects of agriculture with the aim of transforming it from subsistence to commercial farming. Therefore, to increase agricultural productivity and transform the sector to commercial industry; innovative strategies and technologies with great political willingness of the government are urgently needed to address both natural and man-made challenges facing the sector.

Keywords Food Crops, Irrigation Potential, Potential Agricultural Regions, Soil Fertility, Tanzania

1. Introduction

The welfare of large populations around the world depends on access, stability and availability of food [31].

Similarly, it is a source of food, trade and raw materials for industrial development [1,44,45]. Likewise, it supports livelihoods of the majority rural dwellers in most developing countries. However, climate change impacts have adversely affected the sector in the region [1] [25]. This situation has subjected a large percentage of the African population to live in extreme poverty.

Tanzania as a country, her people are facing the same consequence as a result of climate change impacts [44,45]. The problem has been more pronounced because the irrigation potential has not been harnessed. The country has about 44million hectares of arable land that is potential for agriculture but less than 24% of this area is cultivated. Similarly, poor technology, poor infrastructures and shortage of capital are among the hindrances for agricultural development.

According to the report by the Ministry of Agriculture and Food Security and Cooperatives [39] about 10% of the cultivation is done using tractor while the 90% is under traditional cultivation. The report further, declares that agriculture is dominated by small holders who cultivate an area averaging from 0.9 hectares to 3.0 hectares using traditional method and entirely dependent of rainfall. Thus, despite of having numerous inland drainage and lakes; the country has not succeeded to harness these potentials. To support this fact, the report by Food and Agricultural Organization showed that only 2% of the arable land is under irrigation agriculture. This implies that about 98% of irrigation potential is not in use. This reveals that; Tanzania agriculture has a long way to go before being an industrial and commercial sector. It is hoped that, effective utilization of irrigation potential would curb the impacts of climate change in the country.

Despite of the aforementioned challenges, agriculture has remained significant to peoples' livelihoods [19]. Ahmed et al. [1] added that agriculture contribute to about half of gross production, and employs about 80% of the labor force.

Similarly, the government report show that, the current agriculture annual growth is 3.3% and is expected to be 6% through the transformation from subsistence to commercial agriculture [39]. Thus, to make best use of the available opportunities; the country need increase the yields of food, feed and fibre crops in order to curb food insecurity, energy shortage and mitigate the emission of greenhouse gases. To implement this, the production of *Jatropha* plant should be advocated as they offer bioenergy potential [5,20,24,30,34]. This will reduce the use of food crop for energy production.

This study aimed to show out the available potentials to boost agricultural production in the country, highlight the challenges facing agriculture and lastly giving the way forward to focus the future destination. The paper is segmented into sections with earmark on introduction, description of the study area, highlight of the major crop produced in the country, the existing agricultural policy, rural dependency on agriculture and a detailed discussion on the opportunities, challenges and prospects of agriculture. Then, conclusion comes at the last to summarize the most important aspects.

2. Study Area

Tanzania is located on the eastern coast of Africa, south of the equator between latitudes 1° 00' S and 11° 48' S and longitudes 29° 30' E and 39°45'. Eight countries – Kenya and Uganda in the north, Rwanda, Burundi, Democratic Republic of Congo and Zambia in the west, Malawi and the Republic of Mozambique to the south shore boundaries with Tanzania. The eastern side of Tanzania is a coastline of about 800 km long marking the western side of the Indian Ocean.

Tanzania has a total of 945 087 km², and out of this area, water body's cover 61, 495 km² which is equivalent to 6.52%

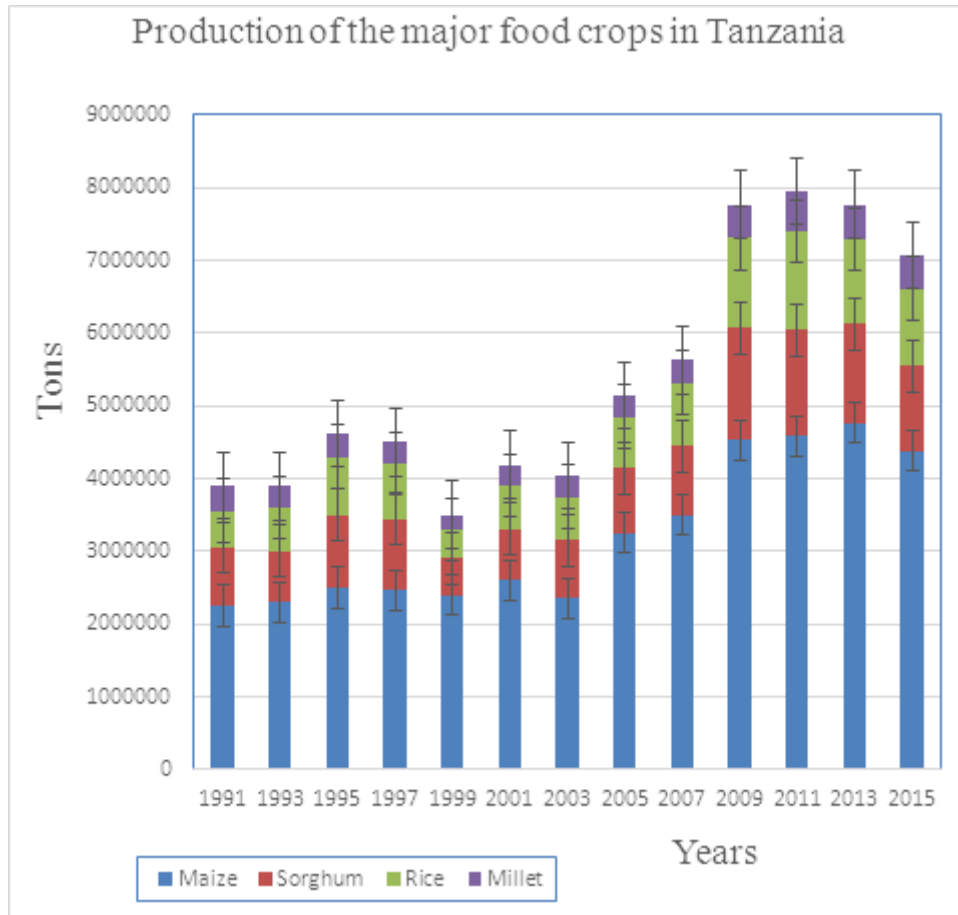
of the total area. Tanzania has been endowed with diverse natural resource among others are arable land ~44 million hectares, rivers, lakes and forest that are potentials for agriculture [36,39]. In terms of climate, average temperatures range between 17°C and 27°C, depending on location. The hottest period spreads between November and February (25°C - 31°C) while the coldest period occurs between May and August (15 °C - 20 °C). The mean annual rainfall varies considerably from place to place ranging from less than 400 mm to over 2,500 mm per annum. Similarly, soil fertility ranges from poor, moderate to high fertility.

Here we reviewed 54 publications all from authentic sources. Papers published in international journals, government report and publications by international organizations were given high consideration in the vetting. It is obvious that the results from this sort of screening are authentic and representative.

3. Major Food Crops Produced, Production Trends and Food Security

The dominant cereal crops produced in Tanzania are maize, beans, millet and rice. These are the main staple food for the majority Tanzanians [18,39]. These crops are produced depending on climate and soil requirements of the area or geographical biome [19,20]. The major food crop production regions in Tanzania are; Rukwa, Iringa, Mbeya, Ruvuma, Morogoro and Kigoma. These regions produce surplus food while other regions which are mostly located in semi-arid they have deficit production [9].

Figure 1 below shows the production trends of maize, sorghum and rice as major food crops in the country.



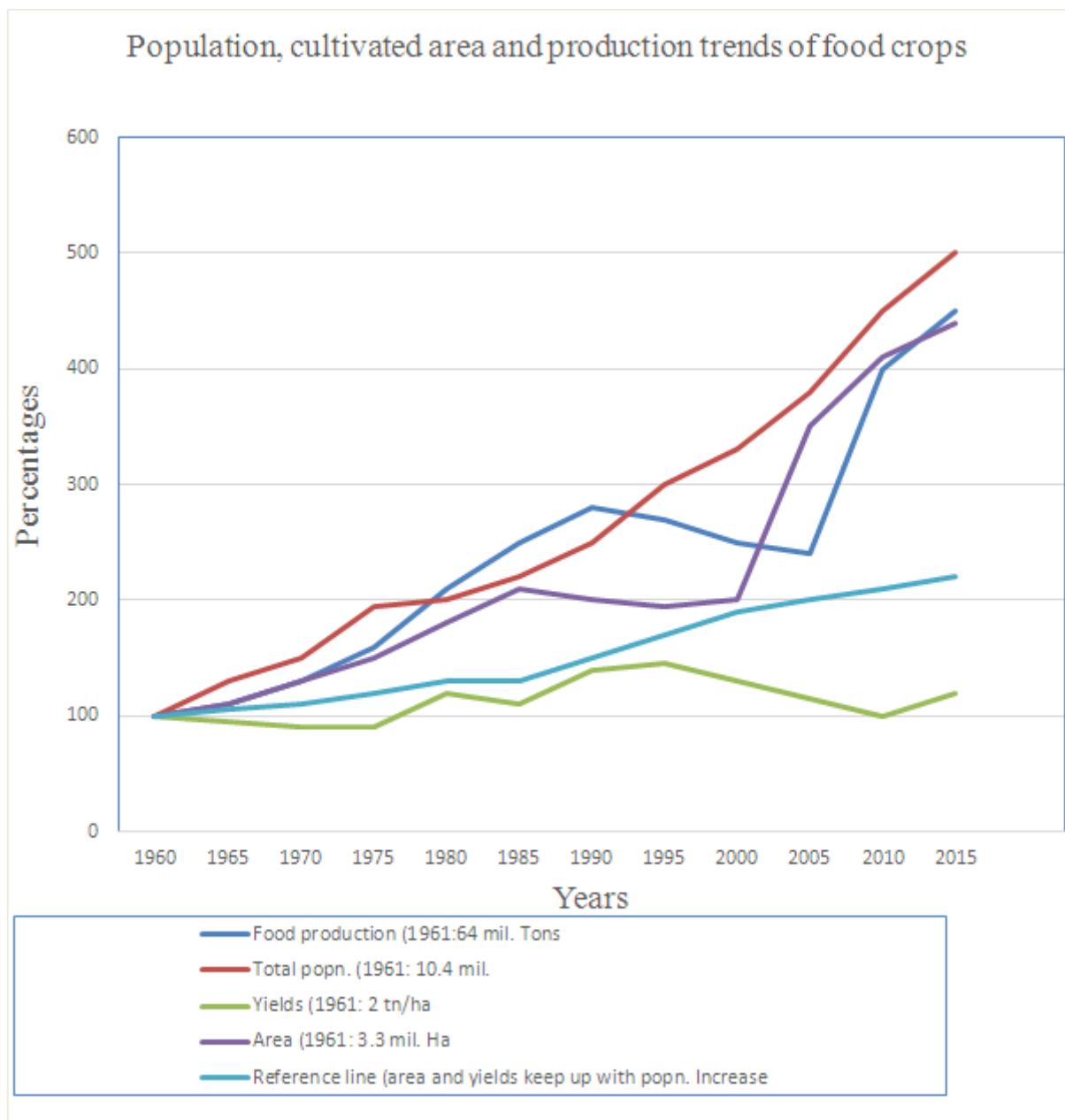
Source: Modified from Mkonda, [22,39]

Figure 1. Rice, Maize and Sorghum Production in Tanzania (1990- 2010)

The production trend of maize, sorghum and rice has temporal fluctuations. This fluctuation was more pronounced in rural areas where rainfed agriculture is dominant [1,22,31,39]. Despite of these crops (maize, rice and sorghum) being produced in large areas by many people (about 3millions households or 65% of the households involved in agriculture), still they have failed to fulfill the needs of the entire rural population as hunger and famine are still persisting in many households [24].

According to FAOSTAT, most of the maize produced in Tanzania is for food consumption, with average waste of 10 percent [37,38] Maize food availability per capita has been decreasing overtime since 2000 from 70 kg person⁻¹ year⁻¹ to 60 kg in 2007, mainly because of the increased use of maize for feed [37,38]. Maize is the main staple food and is consumed by most households in both rural and urban areas. Its seed is usually processed into flour and mixed with hot water to make porridge or *ugali* (stiff porridge).

In the auspice of climate change impacts and cereal production interaction; Rowhani et al., [31] found that; i) intra- and interpersonal changes in climate impact agricultural production, ii) increased seasonal precipitation variability reduces cereal yields, iii) Better climate records in certain regions are needed to reduce errors in crop-climate studies. Thus it is further prescribed by different researchers that climate change is affecting biological and human systems in different ways depending on their level of susceptibility.



Source: Modified from Leliveld et al. [17,39]

Figure 2. Population and agricultural trends Tanzania 1961-2010 (Index year 1961=100)

The report by Leliveld et al. [17] specifically insist that; the production trends of the staple food crops such as maize, rice, paddy sorghum sweet potatoes and beans have increased significantly ($p > 0.05$). The production area for maize has increased from 790,000 hectares in 1961 to 3,288,000 hectares in 2011 with the increase in production from 590m/kg to 4,341 m/kg respectively [43,45]. Then, the yield of the crop has increased 747 kg /ha to 1320 kg/ha.

Whilst the area under the production of sweet potatoes has increased from 31,000 hectares in 1961 to 699,000 hectares in 2011 with the increase in production from 215m/kg to 3573m/kg respectively[42,44]. The production of these crops plus other flourishing ones is useful in securing food security at both local and country level. There should be

determination on the production.

4. Rural Dependency in Crop Production

Tanzanian rural population is mainly comprised of poor people who are not employed in formal sector [9]. Similarly, URT [42,43,44,45] added that land is the only resource that rural dwellers use for their entire livelihoods. Over 80% of the rural dwellers rely on land as the last resort in their life. Therefore, agriculture especially for food crop is their major living activity. From that they get food and some income from selling crop yield when possible. Professor Garrett

Hardin [4] in his book “The Tragedy of the Commons” concluded that the poor are the most degraders of the environment. However, the poor may have reason to depend on environmental resource (land) because it is the only source of their livelihood they can access. In the agricultural growing region like Iringa, Njombe, Mbeya and Rukwa; crop production is throughout the year. During growing season (rain season) they grow maize or other annual crops while during dry season (no rain) they grow tomatoes and onions in lowland areas under irrigation [47].

5. Opportunities

5.1. Land

Tanzania has very large arable land (44 million hectares) with excellent potential for agriculture and economic development of the country [44,45]. However, less than 24% of this arable land is under cultivation. Similarly, small scale farming is a major reason for this under-utilization as each small holder can cultivate an area between 0.9 to 3 hectares [21,35]. Therefore, having an approximate of 44 million hectares of arable land could make a good platform for the sector to excel well and increase its contribution to national [26,27,28,29,39]. Therefore, country needs more innovations to make use of available land resource.

5.2. Water Resources

About 6% of the Tanzanian land is covered by fresh water bodies (inland drainage) including rivers and lakes which are potential for irrigation agriculture. Some of these are rivers like: Rufiji, Ruaha, Wami, Pangani, Kilombero and Malagarasi. Lake Victoria, Tanganyika, Nyasa, Rukwa, Manyara to mention few are significant as they provide irrigation potentials to arable land [37]. It is only good management (integrated water resource management) of this vital resource to allow it to serve the multiuse functions particularly agricultural production. For effective utilization of water resources; different basins and approaches have been formed basing on these water resources. Some of the formed water basins are Rufiji basin, Pangani basin, Wami-Ruvu basin, and Kilombero basin [37,38]. Ruaha River is a main source of Mtera Dam (Hydro-Electric Power) in Iringa region whilst Kilombero River serves similar purpose in Kidatu Dam in Morogoro region [43-45]. Ruvu River is a major source of water for domestic use in Dar es Salaam city with the population about 5million [37]. Therefore, these rivers are potentials for agriculture if best used.

5.3. Policy, Plans and Programmes

Agricultural Policy of 1997 aims to improve the production of crop to improve food security and the quality

of the people’s lives at large [37]. At the national level, there are two medium-term strategies for implementing TDV 2025: the National Strategy for Growth and Reduction of Poverty 2005/6–2009/10 (MKUKUTA I) and 2010/11–2014/15 (MKUKUTA II); and the Tanzania Five-Year Development Plan (FYDP) 2011/12–2015/16 [42,43]. Therefore, the policy and its programmes and plans need to be determined in order to meet the targets.

The recent “*Kilimo Kwanza*” This means “Agriculture First” [37,38,41,42]. The main aim of this program was to spearhead the efforts of government to bringing about Agriculture revolution in Tanzania. Southern Agricultural Growth Corridor of Tanzania (SAGCOT), Agricultural Sector Development Program (ASDP) aimed to revamp agriculture for increased productivity, profitability and farm income while District Agricultural Development Plans (DADPs) for preparing and implementing national plans at district level [39]. It is these programs and other legislation which aims to create legal and institutions aiming to boost agricultural annual growth to 6% with focus on changing the subsistence to commercial agriculture as well as ensuring food security in the country [41-45].

5.4. Improved Farm Inputs and Implements

Government reports show that agriculture is viewed as a back bone of Tanzania economy as it has an outstanding contribution to GDP as well as employs about 80% of the labour force. These inputs are mainly made to be found in low price to farmers through government subsidies [40-43]. As well, tractors “power tillers” were imported by the government to be distributed for low price.

Fertilizer and better agronomic application have contributed much to improvement of crop production especially in monoculture farming system [39-42]. However, the application of fertilizer in Tanzanian farming is not satisfactory as only 9kg of fertilizer is applied ha⁻¹ and about 10% of the farmers have adopted improved seed into utilization [36]. Some farmers have adopted to produce crops which demand little fertilizer and are drought resistant such as cassava, sorghum sunflower and groundnuts. Therefore, improved farm inputs are significant to agricultural production in the country.

6. Challenges of Agriculture Sector in Tanzania

6.1. Policy Implementation Gap

Policy plans and programmes may be well documented but implementation becomes a problem because it is not well harmonized with other sectoral policies related to agriculture [42-45]. Sectoral policy policies like Environment, Natural resources, Housing, Water and Livestock to mention few are having some conflicting interest against that agriculture.

These policies are not well harmonized with that of agriculture to make it more useful. Subsequently, financial issue is another hindrance to implement plans and programs of agricultural sector [36-39].

Despite of the increase in the yearly agricultural budget it has not reflected the demand of the sectoral growth. In the 2006/2007 to 2011/2012 the budget increased from 276.6 to 926 billion Tanzania Shillings, however 10 % increase of the yearly budget is need according to the target set by NEPAD [41-45]. This is how problem can happen despite of having policies.

6.2. Climate Change Impacts

In Tanzania and most developing countries; climate change and variability has severe negative effects to crop production. According to IPCC [7] report; Tanzania is among the thirteen most affected countries in the World by the impacts of climate change and it is vulnerable to further climate variability. Adaptation to climate change impacts is a challenge due to varied vulnerabilities of people's livelihoods from local to national level [51]. Tanzanian agriculture has grown to 7.2% with expectation to reach 7.5% by 2017.

A number of wealthier studies on climate change have been done in Tanzania and they indicates that agricultural sector suffers consequently through the decrease of crop yields [1,10,11,15,18,31].

Subsequently climate variability is stressing on the already affected areas [7, 8,11,25]. Climate change impact has brought severe drought due to unreliable and erratic rainfall [52]. A study by Rowhani et al. [31] showed that a 20% increase in intra-seasonal precipitation variability reduces agricultural yields by 4.2%, 7.2%, and 7.6% respectively for maize, sorghum, and rice which are the major food crops in Tanzania. And, it is projected that by 2050 climate variability will have effect on crop yields in Tanzania by 3.6%, 8.9%, and 28.6% for maize, sorghum and rice respectively [3,48,50].

6.3. Dissemination of Research Findings and Extension Services

Most African farmers are lacking clear umbilical cord to join them with research findings which would make them aware and progress in their farming [23]. Agricultural research institutes, universities and private organizations have been coming up with findings but remain un-utilized or partially utilized [46].

Despite of the budgetary crisis which has contributed to weak dissemination of these findings; political willing of the political leaders has been an obstacle. In most cases government officials have been politicized by the politicians and using that gap for political win. Research donors such as DFID, USAID, IDRC to mention few; have contributed much on funding research activities but dissemination of these findings to farmers has been a problem.

6.4. Technology

It is expected that hand hoe cultivation has been a history since ever but is still a major tool for cultivation [6,10,11]. Fertilizations of farms to improve soil fertility and crop yields are very low in most areas of the country [53]. This goes together with low application of insecticides and fungal-side to control pests and other infections [32]. Government reports show that an average of 9kg of fertilizer is applied per hectare. This is very far below the requirements. It is technology as well which is missing to harness the irrigation potentials as only 2% of the irrigable arable land is cultivated [39]. Thus, more technological advancement is needed.

6.5. Limited Loans for Agricultural Investments

Most small holders have no access to loans and grants for their agricultural production because of the conditions set by different financial institutions [14]. Most peasants are poor and have no collaterals to mortgage banks' loan. This has caused peasantry household to cultivate small piece of land mainly 0.9 to 3 hectares [1]. There is a need to establish agricultural banks which are government based. As well, implementation of "MKURABIRA" (formalization of assets/resources in English) especially land to enable poor people to have access to loans. Also, the interests for taking loans is very high so peasants can no to afford.

6.6. Infrastructure and Market

Transportation and storage facilities are hindering the smooth flow of goods from the farm or production areas to the market [36-41]. Domestic market has been exploitative to producers due to use of unequal dimension. Agricultural producing regions like Iringa, Rukwa, Ruvuma, Morogoro, Kigoma and Mbeya are the major source of crop yields but they are mainly not well linked by transport network from their rural areas where more crop yield are produced[42-44].

6.7. Lack of Incentive for Investment in Agriculture

In most developing countries; there is no special incentive package for agriculture to motivate its production [13]. This goes with weak producers association, advocacy and inadequate infrustrures available to facilitate the sector [9]. These include roads and other storage facilities. These facilities are significant as they control storage products and market transaction. There could be motivation to those who are involving in agriculture especially food crops. This motivation can be in the form of farm implements or loans.

6.8. Formalization of Land

Tanzanian formalization through MKURABITA (formalization of resources in English) has tried to formalize some assets but formalization of land has been insufficient

[16,33]. To make this possible, the Chilean Professor Hernandez De Soto recommended that for Tanzanian economy to develop there is a need to formalize land which every citizen especially in rural areas may have [37,39,45]. After that, legal pluralism should be advocated in order to give right to the right user of the resource

7. General Overview

Tanzanian agriculture is a main driver of national economy [36,54]. It employs over 70% of the labour force. It serves over 80% of the livelihoods of rural population who makes 72% of the total population [38]. Agriculture is severely affected by the impacts of climate change where the production of major food crops like maize, rice, beans and cassava is dwindling [7]. Any decrease in crop production has implications to peoples' life.

Food insecurity, malnutrition and abject poverty are mainly resulted from poor crop failure [12,49]. Despite of the availability of good policy, plans and program aiming at increasing agricultural production, yet adaptation strategies to climate change impacts, poverty, untilled land, lack of collaterals to mention few have been affecting the negatively the progress of the sector. However, it is anticipated that agriculture sector will flourish through curbing the challenges.

8. Conclusions

Basing on the review above; this study reaches the following conclusions. Poor agronomic practices and infrastructures, shortage of capital and political will are among the human factors affecting agriculture. Climate change impacts are regarded as a principal natural factor affecting rain-fed agriculture. However, other factors are shortage of advanced farm inputs, fertilization and organic farming can be the barriers to spearhead the production. Then, in areas with increased crop yields; storage and transport facilities are not sufficient to make smooth transportation of the products.

It is hoped that, adaptation and mitigation to climate change impacts, conservation agriculture and improvement of soil fertility can be the general recommended approaches to reduce challenges aforementioned challenges Conservation agriculture may include: agroforestry and better crop rotation. These can increase crop yields and mitigate the emission of greenhouse gases. Similarly, irrigation agriculture should be expanded from the present 2% in order to effectively harness the potentials of the irrigable land. For the sake of ensuring food security and transforming from subsistence to commercial agriculture; enough effort should be done to facilitate the move.

9. Future Prospects of Agriculture in Tanzania

Agriculture is expected to proceed as a main stay of Tanzanian economy employing the majority workforce and improving the livelihoods of the rural dwellers. According to government reports; agriculture growth is expected to increase from 7.2% to 7.5% by 2017. The government is using different plans and programmes to spearhead the development of the sector [2]. If the major challenges facing agriculture are tackled; it is obvious that the country's development is going to increase significantly.

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