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REVIEW OF FERTILIZER USE BY CROP AND BY PRODUCT TANZANIA

2014 – 2016



Edition 2018

Final draft

June 2018

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ABBREVIATIONS

AAR	Actual Application Rate
AASS	Annual Agriculture Sample Survey
AFAP	African Fertilizers and Agribusiness Partnership
AFO	AfricaFertilizer.org
AFRC	Association of Fertilizer & Phosphate Chemists
AGITF	Agriculture Input Trust Fund
AOAC	Association of Analytical Chemists
CAADP	Comprehensive Africa Agriculture Development Programme
CRBB	Cooperatives and Rural Development Bank

FAC	Fertilizer Apparent Consumption
FAO	Food and Agriculture of the United Nations
FAR	Fertilizer Application Rates
FCA	Fertilized Cultivated Area
FoB	Freight on Board
FST	Fertilizer Society of Tanzania
FTWG	Fertilizer Technical Working Group
FUBC	Fertilizer Use By Crop
GDP	Growth Domestic Product
IFA	International Fertilizer Association
IFDC	International Fertilizer Development Center
IFPRI	International Food Policy Research Institute
ISO	International Standards organization
MA	Ministry of Agriculture
MAFC	Ministry of Agriculture Food Security and Cooperatives
MFP	Ministry of Finance and Planning
MIT	Ministry of Industry and Trade
NAIVS	National Agricultural Inputs Voucher Scheme
NAP	National Agriculture Policy
NBS	National Bureau of Statistics
NEPAD	New Partnership for Africa’s Development
NFU	Non – Fertilizer Use
PDB	Presidential Delivery Bureau
RECs	Regional Economic Communities
ReSAKSS	Regional Strategic Analysis and Knowledge Support System
SACCOS	Savings and Credit Cooperative Society
SAGCOT	Southern Agricultural Growth Corridor of Tanzania (
TADB	Tanzania Agriculture Development Bank
TAFSIP	Tanzania Agriculture and Food Investment Plan
TFC	Tanzania Fertilizer Company
TFI	The Fertilizer Institute
TFR	Total Fertilizer Requirements

TIB	Tanzania Investment Bank
TPDC	Tanzania Petroleum Development Cooperation
TRA	Tanzania Revenue Authority
TZNPS	Tanzania National Panel Survey
URT	United Republic of Tanzania

REVIEW OF FERTILIZER USE BY CROP AND BY PRODUCT IN TANZANIA

EXECUTIVE SUMMARY

The AfricaFertilizer.org (AFO) has been facilitating exchange of information about soil fertility, fertilizers and good agricultural practices (GAP) in Africa with the support of IFDC, IFA, AFAP, FAO, and the Africa Union Commission and its NEPAD Agency since 2009. The first component of the AFO program aims at improving access and availability of essential fertilizer statistics in Africa on production, trade, consumption, production capacities and fertilizer use per crop, with a special emphasis on **real consumption** (as opposed to apparent consumption) and **fertilizer use by crop data** (FUBC).

The importance of improving access and availability of essential fertilizer statistics in Tanzania has driven to the undertaking of the consultancy work that has provided best estimates of current (national) fertilizer consumption and FUBC statistics. The overall objective of the work was to update the 2014 - 2016 Fertilizer consumption statistics and report on National consumption and Fertilizer Use by Crop (FUBC) for Tanzania for the periods 2014/15 to 2016/17. This has been the basis of creating a database on fertilizer use that requires putting together available data and collecting missing data from various sources including literature survey and interviews with relevant stakeholders.

The consultant, prior to finalizing this report had an opportunity to collect and share information with Inputs Section and Statistics Section staff of the Ministry of Agriculture (MA) and the Monitoring and Analyzing Food and Agricultural Policies (MAFAP) team which was also looking at fertilizer price build up. Furthermore, the consultant visited the Tanzania Fertilizer Company (TFC), the Fertilizer Society of Tanzania - Private Fertilizer Manufacturers, Importers and Exporters), the Tanzania revenue Authority (TRA) and had discussions with the Director of Policy and Planning and the Director of Crop Development.

This report provides information on fertilizer data for 2014 – 2016; updates on the agricultural sector; agricultural policies and trade environment; fertilizer trade trends and developments; calculation of fertilizer consumption by crop and type of fertilizer; calculation of Fertilizer Use by Crop (FUBC); reviewed fertilizer recommended application rates; Actual Application Rate (AAR) of fertilizers by farmers; observed gaps during data collection and how to deal with missing data.

During the study, the consultant revealed the following:

- (a) Area under cultivation for all crops was not the same from one year to another (2014 – 2016) as there has been some significant changes leading to different levels of fertilizer demand and use by farmers.
- (b) Fertilizer demand, availability and utilization in Tanzania is very low when compared to the total demand as recommended by the Department of Research and Development of the Ministry of Agriculture. Fertilizer requirements for 2014 was 3,688,685 Metric Tons, 2015 (4,023,169 Metric Tons) and 2106 (3,688,897 Metric Tons) as compared to the apparent consumption of 301,120 Metric Tons (2014), 249,389 Metric Tons (2015) and 330,880 Metric Tons (2016) respectively for major crops as indicated in **Appendix VI**.
- (c) Fertilizer imports reached 417,242 MT (2017) as compared to 371,256 MT (2016) a 12 percent increase.
- (d) Apparent Consumption of fertilizers has been on increase from 249,389 Metric Tons in 2015 to 349,491 Metric Tons in 2017. This is an increase by 5% from 333,631 Metric Tons in 2016.
- (e) Despite the fact that apparent consumption been on increase, the real consumption of fertilizer by farmers were 288,100 MT (2014), 267,037 MT (2015) and 289,687 MT in 2016.
- (f) Exported fertilizers have increased by 95% from 44,837 MT (2016) to 87,510 MT (2017)

Otherwise, efforts are required in order to improve agricultural productivity for increased economic growth, reduce rural poverty, improve food security and recognize the crucial role of improved fertilizer use by farmers in addition to other productivity enhancing inputs to meet national targets.

1 INTRODUCTION

This report provides information on collected data from various stakeholders in the agriculture sector, and updates on the agricultural sector, agricultural policies and trade environment of fertilizer and fertilizer trade trends and developments. It indicates the major crops cultivated area, production and yields and fertilizer use leading to calculate fertilizer consumption by crop and type of fertilizer; calculation of Fertilizer Use by Crop (FUBC). The report also contains the reviewed fertilizer recommended application rates; actual application rate of fertilizers. It has some observations on how to capture accurate and reliable information on fertilizer availability, distribution and monitoring fertilizer use by smallholder farmers in Tanzania.

The consultant, prior to finalizing this report had an opportunity to collect and share information on import, export, distribution and use of fertilizer with Tanzania Fertilizer Regulatory Authority (TFRA), Agriculture Inputs Section and Statistics Section staff of the Ministry of Agriculture (MA) and the Monitoring and Analysing Food and Agricultural Policies (MAFAP) team which was also looking at fertilizer price build up. Furthermore, the consultant visited the Tanzania Fertilizer Company (TFC), the Fertilizer Society of Tanzania - Private Fertilizer Manufacturers, Importers and Exporters, the Tanzania Revenue Authority (TRA) and had discussions with the Director of Policy and Planning and the Director of Crop Development.

During the study, the following were observed:

- (a) Area under cultivation for all crops was not the same from one year to another (2014 – 2016) as there has been some significant changes leading to different levels of fertilizer demand and use by farmers.
- (b) Fertilizer demand, availability and utilization in Tanzania is very low when compared to the total demand as recommended by the Department of Research and Development of the Ministry of Agriculture. Fertilizer requirements were 2.66 million Metric Tons (2014); 2.54 million Metric Tons (2015); and 2.58 million Metric Tons (2016) if all cultivated area was fertilized.
- (c) Fertilizer imports has been on increase from 308,119 Mt (2014); 317,094 Mt (2015); 371,356 Mt (2016); and 417,242Mt in 2017.
- (d) Exported fertilizers have increased by 95% from 44,837MT (2016) to 87,510 MT (2017).
- (e) Apparent Consumption of fertilizers was 279,211 Metric tons (2014). This was followed by a slight decrease to 249,389 Metric Tons in 2015 and an increase to 330,880 Metric Tons in 2017.
- (f) Fertilizer real consumption was 279,211 Mt (2014); 249,389 Mt (2015); and 289,687 Mt (2016).

Otherwise, efforts are required in order to improve agricultural productivity for increased economic growth, reduce rural poverty, improve food security and recognize the crucial role of improved fertilizer use by farmers in addition to other productivity enhancing inputs to meet national targets.

1.1 Background of the study

The AfricaFertilizer.org (AFO) has been facilitating exchange of information about soil fertility, fertilizers and good agricultural practices (GAP) in Africa with the support of IFDC, IFA, AFAP, FAO, and the Africa

Union Commission and its NEPAD Agency since 2009. The first component of the AFO program aims at improving access and availability of essential fertilizer statistics in Africa on production, trade, consumption, production capacities and fertilizer use per crop, with a special emphasis on **real consumption** (as opposed to apparent consumption) and **fertilizer use by crop data** (FUBC).

The importance of improving access and availability of essential fertilizer statistics in Tanzania has driven to the undertaking of the consultancy work that has provided best estimates of current (national) fertilizer consumption and FUBC statistics. The overall objective of the work was to update the 2014 - 2016 fertilizer consumption statistics and report on National consumption and Fertilizer Use by Crop (FUBC) for Tanzania for the periods 2014/15 to 2016/17. This has been the basis of creating a database on fertilizer use that requires putting together available data and collecting missing data from various sources including literature survey and interviews with relevant stakeholders.

This report provides information on methods that were used to collect data, information on collected data, updates on the agricultural sector, agricultural policies and trade environment; fertilizer trade trends and developments; detailed reviewed fertilizer recommended application rates; Actual Application Rate (AAR) of fertilizers; calculation of fertilizer consumption by crop and type of fertilizer; calculation of Fertilizer Use by Crop (FUBC) in Tanzania for the mentioned period.

1.2 Purpose of the study

The objective of this consultancy is to study and provide timely and accurate updated information for 2014 - 2016 fertilizer consumption statistics and report on National consumption and Fertilizer Use by Crop (FUBC) for Tanzania for the periods 2014/15 to 2016/17. Estimates of fertilizer use from the study will supply basic information needed by all stakeholders, public and private sector, for decision making for both short and long term planning for the purpose of improving agriculture in the country.

2 METHODOLOGICAL FRAMEWORK

The importance of accurate and reliable fertilizer statistics cannot be overemphasized in particular for planning and evidence decision making. Fertilizer statistics are required in order to determine the growth and benefit of the sector and stimulation of agriculture development in the country. There have been so many challenges in fertilizer data quality and quantity in developing countries, and Tanzania is among them. In order to capture relevant fertilizer data, development and use of a methodological framework was a prerequisite. The methodological framework was important to help to improve the availability and quality of national and international fertilizer statistics. For the purpose of this study, the developed concept framework for accurate and reliable data is shown in **Table 1**.

Table 1: Conception Framework for Data Flow

Concept development item	Reason	Key variables	Institutions or organizations involved
Fertilizer Supply	Knowledge of quantities of available fertilizers	Imports, local manufacturing and blends	MA, TRA, TFRA, TPA, FST
Apparent Consumption fertilizer	Knowledge of broad trends of fertilizer utilization	Local distribution, exports	FST through Agro-dealers, MA, LGAs, NBS
Fertilizer use by regions	To determine spread of fertilizer demand and application, to generate average fertilizer application rates (based on local practices)	Country estimated fertilizer use data, regional /localized fertilizer application rates	MA, NBS, LGAs, FST

Fertilizer Use By Crop	To establish actual fertilizer quantities by type used by specific crops	Crop area planted, area applied with fertilizer, average fertilizer application rates by crop type and regions.	MA, LGAs
Fertilizer nutrients utilization	To establish fertilizer nutrients annual uptake by each crop	Fertilizer types used by each crop annually	MA

2.1 Methodological approach

The main focus for the study was on data quality. The methodological approach involved visiting key stakeholders for collection for primary data; and literature review especially on the FTWG reports for 2014/2015 – 2016/2017.

2.1.1 The data sources

For the purpose of the study, for updates of 2014 – 2016 on national consumption and fertilizer use by crop, primary data were collected from (i) the Inputs Section of the Ministry of Agriculture on type and quantity of fertilizer availability, distribution to the grass root and utilization by farmers; (ii) Tanzania Fertilizer Regulatory Authority (TFRA) and Tanzania Revenue Authority (TRA) for data on fertilizer imports and exports; (iii) Tanzania Fertilizer Company (TFC) and Fertilizer Society of Tanzania (FST) on fertilizer imports, exports, sales and marketing.

Secondary data were collected from (i) the Fertilizer Technical Working Groups (FTWG 2014 – 2017) reports for trade trends to obtain fertilizer validated data; (ii) Department of Agricultural Statistics of the National Bureau of Statistics (NBS) and Ministry of Finance for information on imported fertilizer statistics, utilization and values; and (iii) the Statistics Section of Ministry of Agriculture for crops, area cultivated (hectares), crop production (metric tons), and crop yields (tons/ha).

2.1.2 The targeted structures

Tanzania has targeted structures for information on fertilizer imports, manufacturing, and exports and non – fertilizer use that can provide a quick response of specified queries that arises. The presence of institutions (public and private sector) such as the MA, MIT, LGAs, TFRA, TRA, TPA, FST and other key players in the fertilizer sector are normally facilitating availability of data whenever required for any use. The collaboration of these institutions can lead to development of a single source of data that will contain all necessary information on fertilizers.

2.2 Techniques and Data Collection Instruments

The actual data collection activity took 8 days as proposed in the contract. The only method used for data collection was face to face interview without any questionnaire. No field visits were made to the regions and districts where fertilizers are used for crop production and productivity. The data gathered were through the national level network, fertilizer companies, Inputs Section – Ministry of Agriculture, and other relevant informative.

2.2.1 Collaboration with Ministry of Agriculture / Public services

The Ministry has adequate human resource capacity in many fields related to agriculture with regards to provision of extension services at village level to deliver quality agricultural services. It provide a conclusive environment to stakeholders, build capacity of Local Government Authorities (LGAs), and facilitate the private sector to contribute effectively to sustainable agricultural production, productivity and cooperative development. For the success of this study, there was a high level of collaborations

between the Consultant and the Ministry of Agriculture responsible Departments for Policy and Planning (Statistics Section) and Crop Development (Agricultural Inputs Section and TFRA)

2.2.2 The interviews

The direct consultation of all stakeholders was carried out in the first 8 days of the study. This was the appropriate method for all information required in completion of the study.

2.2.3 The questionnaires

No formal questionnaires were designed for data collection for this study. The available data were collected by the consultant in order to calculate the Fertilizer National Consumption and Fertilizer Use by Crop (FUBC)

2.3 Treatment method

The data quality was kept in mind and carefully digested by the consultant from the time for collection, validation and data cleaning. It is believed that the data presented to this report are accurate and represent what was collected from the stakeholders.

2.3.1 Constraints and limitations of the method used

During the study, there were some constraints and limitation faced that (a) Data produced were at national and regional level and were not meant for district level estimates, (b) There are more than 150 types of perennial and non-perennial crops in the country and due to the objectives of this study, analysis concentrated on limited number of crops which are known to us fertilizers, (c) Variation of data from the main sources of information, the NBS and MA, on area cultivated (ha), production (tons) and yield (ton/ha) for different crops. For example, in 2016 the area cultivated for Cereals was 8,608,727 ha as compared to 6,032,730 ha as provided by AASS – 2018 and Statistics Section – MA 2018 respectively, (d) Data for fertilizer use for fiber crops mainly cotton and sisal were missing despite the fact that the crops were cultivated in a total of 478,688 ha and have been contributing significantly to the country's economic development in 2014 - 2016, and (e) data set for Tanzania on National fertilizer consumption and FUBC for cassava, chick peas, pigeon peas, garden peas, green gram, soya beans, cashew nut and pyrethrum crops are not included due to unavailability of fertilizer use of missing RARs.

3 OVERVIEW OF AGRICULTURE IN TANZANIA

The United Republic of Tanzania (URT) with a projected population of 54.2 million persons (NBS, 2018) of which 52.6 million people are in the Mainland and 1.6 million people in the Island. It has a total land area of 944,800 square km (94.5 million hectares) of which Mainland Tanzania occupies 99.7 percent, and the rest is occupied by the Zanzibar Islands. Out of 94.5 million hectares of the mainland, 44.5 million hectares of the land is classified as arable land and 50 million hectares as range land. Only 24.5 percent of the arable land is under cultivation.

Tanzania's main economic pillar is embedded in the agricultural sector, as it employs 65.5 percent of the total population and contributes up to 100 percent of food availability in years with good distribution of rains (MA, 2018). The 2016/2017 Annual Agriculture Sample Survey (AASS), identified a total of 8,763,267 operators who are engaged in agriculture, of which 8,574,452 (97.8%) were in the Mainland and 188,814 (2.1%) were in Zanzibar. The identified 4,777,530 operators (59.9%) are directly engaged in growing crops

only, 3,594,870 (41.8%) are engaged in crop and livestock keeping and those who keeping livestock only are 202,053 (2.4%) (AASS, 2018).

It is approximated that 85 percent of the cultivated land is dominated by small-scale farmers who operate between 0.9 and 3.0 hectares and traditional agro-pastoralists (MAFC, 2015). The country is estimated to have 17.7 million cattle, 12.5 million goats, 3.5 million sheep and 47 million poultry. Forests and woodlands occupy about 38.8 million hectares (NBS, 2014). It is estimated that 62% of farming is done by hand-hoe, 24% by draught power and 14% by tractors. Low use of improved farm power pose another challenge to agricultural development in the country.

The contribution of the agriculture sector in the country's Growth Domestic Product – GDP has been on increase from 28.9% in 2014, 29.0% (2015) and in 2016 it contributed 29.1% followed by construction (12%), wholesale and retail trade (10%), public administration (7%), and manufacturing (6%) (The Economic Survey 2015 and 2016, Deloitte & Touché, 2017). The sector is the main source of food, employment, raw materials for industries and foreign exchange earnings. It is also assumed to contribute much in the country's effort of poverty alleviation.

Potential land for irrigation is 29.4 million hectares out of which 2.3 million ha is high potential, 4.8 million hectares medium and the 22.3 million hectares is low potential. The total of 342,199 hectares were cultivated and planted crops in 2016 under irrigation by 407,190 farmers for production of different crops, whereby Kilimanjaro region was leading in irrigated agriculture by 22.6% followed by Dar es Salaam (18.2%) and Mbeya (10.2%).

Achievements for the growth of the sector has been attributed by a number of initiatives set down by the Government of Tanzania that included:

(i) The Kilimo Kwanza Initiative

The Kilimo Kwanza (Transforming Agriculture) is stressing the importance of agriculture as it remains the largest employer of labour and biggest contributor to the national economy. Kilimo Kwanza was entailed to modernizing agriculture, increase crop production, improve livestock husbandry and undertake fish farming. In crop production, the aim was to increase the acreage under cultivation by using modern farm implements such as tractors and power tillers, improving knowledge and increasing acreage under irrigation, using improved seeds and fertilizers, pest control and investment in large scale farming.

(ii) Tanzania National Agricultural Policy (NAP) of 2013

NAP has the following specific objectives which are to:

- a) Strengthen agricultural support and technical services;
- b) Increase production, productivity and profitability from utilization of the factors;
- c) Enhance national food and nutrition security and production of surplus for export;
- d) Improve agricultural processing with a view to add value to agricultural produce and create jobs;
- e) Enhance production of quality products in order to improve competitiveness of agricultural products in the domestic, regional and international markets;
- f) Increase foreign exchange earnings from exportation of agricultural products;
- g) Provide enabling environment to attract private sector investment to take advantage of existing comparative and competitive advantages;
- h) Strengthen inter-sectoral coordination and linkages to increase efficiency and effectiveness;

- i) Protect and promote integrated and sustainable utilization of agricultural lands; and
- j) Promote implementation of cross cutting issues in agricultural undertakings.

(iii) Tanzania Agriculture and Food Investment Plan (TAFSIP)

TAFSIP was developed in 2011 and it involved all key stakeholders including public, private, donor communities, RECs, NEPAD-CAADP Pillar Institutions, African Union Commission (AUC), ReSACKSS/IFPRI (TAFSIP, 2012). TAFSIP is a 10 year development which maps the investments needed to achieve the CAADP target of six per cent annual growth in agricultural sector GDP. It is a sector wide plan for coordinating and harmonizing the resources needed to accelerate implementation of existing initiatives and to launch new initiatives which address national, regional and sectoral development. The main areas of interventions are:

- a) Irrigation development, Sustainable Water Resources and Land Use Management;
- b) Production and Commercialization;
- c) Rural Infrastructure, market access and trade;
- d) Private Sector Development;
- e) Food and Nutrition Security;
- f) Disaster Management, Climate Change adaptation and mitigation; and
- g) Policy reform and institutional support.

(iv) The Southern Agricultural Growth Corridor of Tanzania (SAGCOT)

SAGCOT, a public – private – partnership its vision is to ensure a transformed commercially viable agriculture sector in Tanzania that enhances food security, improves livelihoods and ensure environmental sustainability aiming at catalyzing responsible and inclusive agricultural investments in the Tanzania's Southern Corridor. Building on Partners existing and planned investments, cluster development connects smallholder producers, commercial farms, input suppliers, processors, logistical and infrastructure hubs and research institutes all within a concentrated area. Clusters create the conditions of economies of scale; enhance efficiency and lower production and marketing costs.

(v) Presidential Delivery Bureau (PDB)

In an effort of pushing forward agricultural development, the Government established the PDB where six priority areas have been picked, agriculture being one of them. Within agriculture, there are three main objectives of increased food security and reduce poverty; increased smallholder income and increased agriculture GDP contribution growth through priority crops of maize, rice and sugarcane.

(vi) Tanzania Investment Bank (TIB)

The Tanzania Investment Bank was established in 1970 and is wholly owned by the Government whose main mandate is to provide various types of loans, equity partnerships, management services and export/import financing. It has a special window for agricultural support. For instance, in 2014/2015, TIB issued agricultural loans through 78 SACCOS, 121 private companies and 11 microfinance institutions.

(vii) Tanzania Agricultural Development Bank (TADB)

Tanzania Agricultural Development Bank is a State owned bank in Tanzania that is dedicated to farmers. The bank was founded in August 2015. The primary objective of the bank is to provide short, medium and long term financing to the agricultural sector. The key objectives are: to catalyze credit delivery to the

agricultural sector and thereby accelerate agricultural growth; to lead as an apex agricultural financing bank in capacity building strategies and programs to strengthen the agricultural financing value; to be an important initiative in the implementation of the Government Second Generation Financial Sector Reform as well as furtherance of agricultural development in the country; and catalyze agro financing activities through financing short, medium and long term facilities through institutions (Commercial banks, Community banks, SACCOS and Microfinance) in lending to agricultural sector.

(viii) Agricultural Inputs Trust Fund (AGITF)

The AGITF was started in 1994 (semi-autonomous owned by the Ministry of Agriculture) after the poor performance of the Cooperative societies who were earlier getting loans from the Cooperative and Rural Development Bank (CRDB) could no longer be able to buy inputs for the farmers due to poor repaying capacity, it resulted into a widened input supply gap which called the Government to intervene and hence the formation of AGITF. The AGITF has been providing loans on all agriculture inputs (crops, animals and farm machinery) and of late they have started providing loans for value addition enterprises in agriculture produce. The loans interest rates ranges between 6 and 8 per cent with the interest guidelines being as follows: 6 per cent (farmer groups), 7 per cent (Private companies) and 8 per cent (for large scale enterprises).

(ix) Fertilizer Bulk Procurement System

Since the era of fertilizer trade liberalization, each fertilizer importer (supplier) was indulged in importation of fertilizers on his/her own from any source at any (FoB) price fixed by the producers. This has been triggering and definitely increasing overhead costs of fertilizers. From 2017 + 2017/2018, the Government through the private sector has introduced the Fertilizer Bulk Procurement System whereby all the needed fertilizer in the country is announced by the Ministry of Agriculture. Bids for importation are assessed and the winner (lowest bidder) is allowed to procure the agreed quantity at the agreed price thus reducing overhead costs and farmers get the fertilizers at cheaper price.

Despite these development initiatives, the agricultural inputs, especially fertilizers has been on low intake by smallholder farmers because of the following reasons:

- (a) Affordability of fertilizers in the context of:
 - i) Importation (lack of domestic manufacturing facilities; small batches which results in paying high prices on the world market, poor port infrastructure results in high port charges);
 - ii) Internal distribution (poor road and rail networks result in high transport costs, shortage of warehouses results in inadequate stock, inadequate access to credit: high interest rates and stiff collateral requirements);
 - iii) Retail (few agro-dealer operating next to the farm gate so poor access for farmers; lack of access to credit poses a barrier to entry at retail level, retailers lack business management and marketing skills, and technical knowledge
 - iv) Farm-level demand (lack of farmer knowledge of the correct use and benefits of fertilizers, use of inappropriate fertilizers due to outdated fertilizer recommendations, lack of farmer access to credit; poor access to output markets and using inappropriate fertilizers because of inadequate soil mapping).
- (b) Profitability (low marginal returns)

Farmers sometimes find it difficult to use fertilizers when convincing profitability is not attained. The non-attainment of the profitability is mainly due to:

- i) Low marginal returns, in quantity as a result of:*

- Lack of knowledge of farmers regarding fertilizer use;
- Fertilizer availability at wrong time (timely deliveries);
- Poor soil quality;
- Lack of adequacy of fertilizer to soil, crop or climate;
- Limited irrigated area;
- Impact of climate (e.g. drought and floods); and
- Lack of crop insurance.

ii) Low marginal returns, in value:

- No or limited market access to crops;
- Low output prices; and
- Volatility of output prices

3.1 Cropping systems and agro-ecological zones

The FAO defines a farming system as “a population of individual farm systems that have broadly similar resource bases, enterprise patterns, household livelihoods and constraints, and for which similar development strategies and interventions would be appropriate. Depending on the scale of the analysis, a farming system can encompass a few dozen or many millions of households.” We use the farming systems as defined by the Food and Agriculture Organization (FAO) for Sub-Saharan Africa. The analysis used the Tanzanian National Panel Survey (TZNPS) LSMS – ISA which is a nationally representative panel survey for the years 2010/2011 conducted from October to September, published in December 2013 identified the FAO farming systems and zones as 1) maize mixed, 2) root crop, 3) coastal artisanal fishing, 4) highland perennial, 5) agro-pastoral millet/sorghum, 6) tree crop, 7) highland temperate mixed, and 8) pastoral in the map.

Crop Cultivation in eight Farming Systems

Description of the farming system and cultivated crops in different agro-ecological zones and regions is classified in **Table 3**.

Table 2: Crop Cultivation in Farming Systems

No.	Farming System Name	Coverage by Agro ecological Zone/ Regions
1	Maize mixed	Southern Highlands (Iringa, Mbeya, Njombe, Ruvuma, Rukwa, and Katavi), Central (Tabora, Dodoma and Singida), Eastern Zone (Morogoro, Tanga and Ruvuma), Western (Tabora and Kigoma),

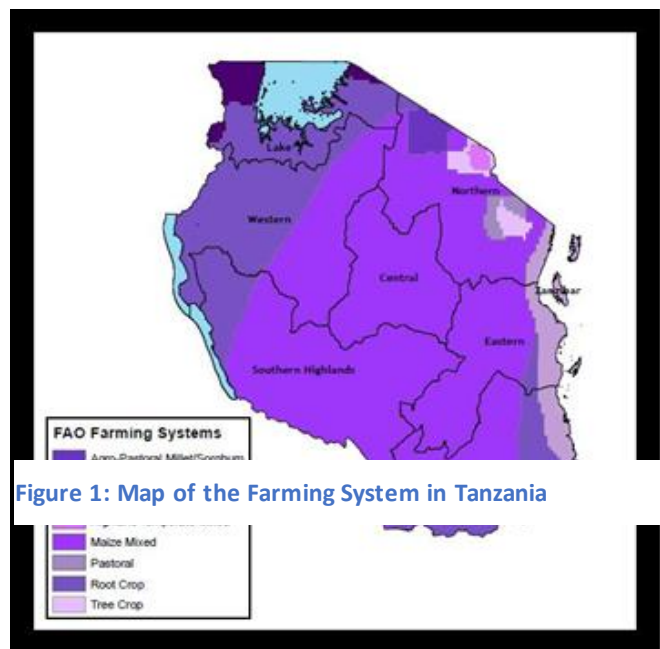


Figure 1: Map of the Farming System in Tanzania

		Northern (Manyara, Arusha and Kilimanjaro) and Southern Zone (Lindi and Mtwara).
2	Root Crops	Eastern and Southern Zones (Morogoro, Tanga, Pwani, Lindi and Mtwara)
3	Coastal Artisanal Fishing	Eastern (Tanga, Pwani and Dar Es Salaam), Northern (Kilimanjaro and Arusha) and Southern Zone (Lindi and Mtwara)
4	Highland Perennials	Lake Zone (Kagera, Mara and Kigoma) and Southern Highlands (Iringa, Njombe, Mbeya and Ruvuma)
5	Agro-pastoral Millet/Sorghum	Lake, Western and Southern Highlands Zone (Geita, Mwanza, Simiyu, Mara, Shinyanga, Kigoma, Rukwa and Katavi)
6	Tree Crops	Southern and Eastern Zones (Tanga, Lindi, Mtwara, Morogoro)
7	Highland temperate mixed	Northern Zone (Kilimanjaro and Arusha)
8	Pastoral	Lake, Eastern and Southern Zones (Mwanza, Shinyanga, Simiyu, Geita, Lindi, Mtwara, Morogoro, Tanga)

3.2 Crop Calendar of Major Crops

SEASON	CROPS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Major Season (Long Rains)	Maize												
	Fertilizer peak demand												
	Sorghum												
	Fertilizer peak demand												
	Millet												
	Fertilizer peak demand												
	Rice												
	Fertilizer peak demand												
	Wheat												
	Fertilizer peak demand												
	Bean												
	Fertilizer peak demand												
Minor Season	Maize, Millet, Sorghum, Beans												
	Fertilizer peak demand												

Key: Fertilizer peak demand ■ Sowing ■ growing ■ harvesting ■

Source: FAO/GIWS Crop Calendar

Since the sector relies heavily on rainfall, in Tanzania there are two rainy season namely short rainy season and long rain season. The former begins in October to January of the following year while the later begins in March to May. Tanzania has three cropping calendars which differs in amount of inputs sold as (a) largest sales in between February and April each year in the northern highland regions and parts of the eastern regions of the country; (b) the lowest sales in June to November each year, and (c) highest sales in the southern highlands, western, central and lake regions of Tanzania are between October and December and the lowest in these zones is between April and May. The gap in the months with the lowest sales in the northern zone in the second half of the year is related to some fertilizer sales associated with the short rains that prevail between October and December in northern Tanzania. The major crops cultivated in Tanzania are classified in groups as:

Table 3: Group of crops

Group	Crop
1.	Cereals (Maize, Rice, Wheat, Barley, Sorghum, Bulrush millet, and Finger millet)
2.	Roots and tubers (Cassava, Round potato, Sweet Potatoes, Yams, and Cocoyam)
3.	Legumes (Common beans, Soybean, Chick peas, Green gram, and Cowpea)
4.	Oil crops (Coconuts, Oil palms, Sesame, Groundnuts, and Sunflower)
5.	Vegetables (Tomatoes, Onions, Spices and Ginger)
6.	Fruits (Banana, Avocado, Grapes, Pineapple and Mango)
7.	Traditional cash crops (Cotton, Sisal, Coffee, Tobacco, Tea, Sugar cane and Cotton)

The average cultivated area for the major crops from 2014 – 2016 is summarized in **Figure 2** which shows that maize occupied an average of 31% of all area cultivated. Next to maize was paddy with 10% in terms of cereals. A group of other crops including cereals (sorghum, finger millet, bulrush millet, wheat and barley); legumes (chickpeas, garden peas, green gram and soybeans); fiber crops (sisal and cotton); oil crops (sesame, sunflower, groundnuts, coconuts and oil palms); roots and tubers (cassava, cocoyam and yams); tree crops (cashew nuts, mangoes and cocoa); and fruits and vegetables (banana, amaranths, okra, tomato, onions, ginger, avocado, grapes and pineapples) occupied 40% of the area cultivated. The remaining crops and area cultivated is elaborated below.

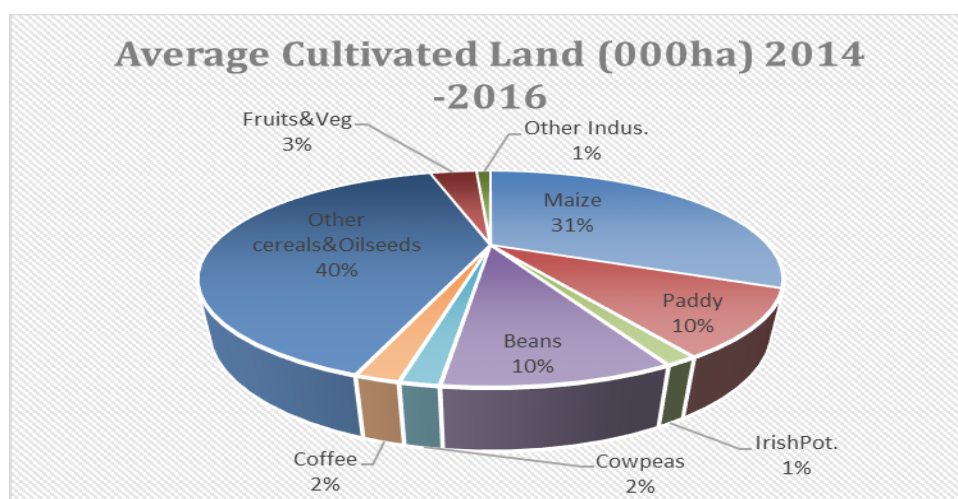


Figure 2: Average Area Cultivated on Major Crops 2014 - 2016

3.3 Agricultural statistics (areas, production, yield)

The average area cultivated and fertilized from 2014 -2017 is estimated to be 13,010,661.67 hectares (**Appendix I**). From the cultivated area, the total amount of crops harvested were 19,269,210 tons (2014); 20,492,400 tons (2015) and 17,804,077 tons (2016).

3.4 The main actors in the agricultural sector

Tanzania's main economic pillar is embedded in the agricultural sector, as it employs a big percent of the total population. At farm level, the 2016/2017 Annual Agriculture Sample Survey (AASS), identified a total of 8,763,267 operators who are engaged in agriculture, of which 8,574,452 (97.8%) were in the Mainland and 188,814 (2.1%) were in Zanzibar. The identified 4,77,530 operators (59.9%) are engaged in growing crops only, 3,594,870 (41.8%) are engaged in crop and livestock keeping and those who keeping livestock only are 202,053 (2.4%). approximately 85 percent of the cultivated land is dominated by small-scale

farmers who operate between 0.9 and 3.0 hectares and traditional agro-pastoralists (MAFC, 2015). The main actors in the sector are private agro-dealers and agricultural input companies who import and manufactures fertilizer; LGAs to support agriculture development initiatives; the Ministry of Agriculture for policy issues and support programs; and other supportive institutions of TRA, TPA and TBS.

3.5 Agricultural policies

The agriculture sector has been largely influenced by the past and current macro-economic reforms, which have helped to open up the sector to private investment in production and processing as well as input importation, manufacturing and distribution, while the Government has maintained its position in the facilitation of regulatory and public support functions. Today, farmers are allowed to sell their crops both to cooperatives and to private traders and, as a result of increased competition, normal producer prices for food and export crops have also increased, making it easier for farmers to sell their products at a faster pace. Achievement of these are the result of the following instruments for agricultural inputs and outputs that guard farmers' interest and give guidance to farmers are in place as:

The National Agriculture Policy

The National Agriculture Policy of 2013 requires a machinery to ensure proper utilization of productive enhanced agricultural inputs in a cost-effective, financially and environmentally manner. TFRA is overseeing the fertilizer sector in Tanzania but is constrained by insufficient budgets for its functions and inadequate staffing for every District Councils (MAFC, 2015).

Macro Policy and Market Development

Fertilizer business in Tanzania is liberalized and is driven by private sector participation. Despite this factor, there are constraints which hamper farmers' access to quality fertilizer. The macro policy, market development and technical issues have constraints on fertilizer supply and utilization as:

- (i) The Macro policy constraints includes foreign exchange rate, high interest rate, and poor rural infrastructures. The recent depreciation of Tanzanian Currency (Shilling) creates risk and uncertainty for suppliers and high prices for farmers and thereby discourage development of well-functioning markets. This situation also leads to high interest rates, which made input business development costly and risky. Poor condition of rural infrastructure increase transaction cost and reduces incentive for supplier to reach out to rural areas.
- (ii) Market development and technical issues constraints relate to policy, human capital, access to finance and market information, and regulatory frameworks. An independent assessment of these factors has revealed that human capital is inadequate, access to finance and market information is limited, and enforcement of regulation is not as effective as planned. There is a paucity of dealers in rural areas. Most wholesalers and dealers are concentrated in cities and big towns. The four Ps of marketing (price, product, place, and promotion) imply that the product should be sold closer to the farmer. Due to high bank interest rates and stringent collateral requirements, it is not easy to borrow funds from commercial banks to develop input business.
- (iii) The supply side of fertilizer is affected by uncertain policy environment as policy makers be thinking that private sector is incapable of supplying inputs. Also there is inadequate human capital to strengthen extensive input distribution to the level of farmers. Supply of fertilizer is constrained by limited access to finance to all stakeholders. Lack of market information is another challenge to the fertilizer industry as no plans are in place to reduce transaction costs of fertilizer and size of the market.

- (iv) Other associated constraints include: absence of any alternative credit mechanism after the collapse of cooperatives; poor transport infrastructure; weak private sector response, weak farmer's organizations which are unable to access credits, markets and inputs on behalf of members; and inadequate competition and economies of scale. Low productivity against high costs which, in turn, is a disincentive to save for acquisition of agricultural inputs and superior production technologies is prevailing. Smallholder farmers and traders do not have readily acceptable collaterals to secure loans from formal financial institutions. The situation worsens where inputs requiring longer amortization period are involved. Therefore, agricultural inputs have not only become relatively more expensive, but even the little amount which is made available is not adequately and timely delivered.

Micro Policy

The micro factor affecting the fertilizer marketing in Tanzania includes:

(i) Price control

Since trade liberalization policy which the country has been pursuing in early 1990s, the Government is no longer controlling the prices (fertilizer included). This has been left for the market forces to regulate the prices. It is envisaged that trade liberalization would lead to strong competition within the input business.

(ii) Subsidies

The Government in 2003/2004 started offering subsidies on fertilizers until 2016/2017 with the major objective for availing inputs at cheap prices. This subsidies have been implemented through a number of models. Regardless of the model used to address previous challenges encountered, the aim was to increase crop productivity with much emphasis being on food crops (maize and rice). The models included:

- (a) Subsidy on Transport Cost and Part of Fertilizer Prices 2003/2004 – 2007/2008;
- (b) National Agricultural Inputs Voucher Scheme (NAIVS) 2008/2009 - 2013/2014;
- (c) Attempts to use the E-voucher;
- (d) Subsidy Loaning Scheme (Credit through Input Supply Companies) 2014/2015;
- (e) Re-introduction of Voucher Scheme 2015/2016;
- (f) Contractual Agreement between MALF and TFC to Supply Fertilizer 2016/2017; and
- (g) Fertilizer Bulk Procurement System 2017/2018.

4 THE FERTILIZER MARKET IN TANZANIA

Fertilizer business is totally liberalized and dominated by the Private Sector for manufacturing, importation through the port of Dar es Salaam, export to other land locked countries, distribution and sells to farmers. Imported fertilizer into the country has its main gateway through the port of Dar es Salaam. The port is a choke point because of an inability to achieve economies of scale in the order of fertilizer shipped in and insufficient off-loading facilities in term of berth and product handling equipment. Although, major fertilizer ports elsewhere in the world are able to unload more than 10,000 metric tons per day, in 2015 the average unloading rate of fertilizer at the Dar es Salaam port is 1,500 metric tons per day (TPA, 2015). Majority of fertilizer is then transported by road and very few by rail wagons to the regions or market centers and distributed to farmers by the existing 3,000 agro-dealers available countrywide (AFSP, 2013). Most of active agro-dealers are able to collect and sell around 3,000 bags of fertilizer.

This gives a bigger picture that fertilizer procurement, distribution and utilization is totally liberalized with little interventions from the Government through various interventions aimed to promote high levels of

fertilizer use by farmers in the country to enhance crop productivity and production. The suppliers mainly sell inputs to the farmers through a network of distributors scattered in different parts of the country who again sell them through a network of rural agro-dealers. However, some inputs are sold directly to farmers from both suppliers and distributors depending on the proximity of the farmers to the two sources. Few suppliers own their own distribution warehouses in some strategic areas.

4.1 Production, import, export and apparent consumption

The quantity of fertilizers that were produced locally, imported, exported and the balance for local consumption for year 2014 to 2017 is clearly verified in **Appendix II**. A summary for fertilizer trade trend is shown in **Figure 3** underneath.

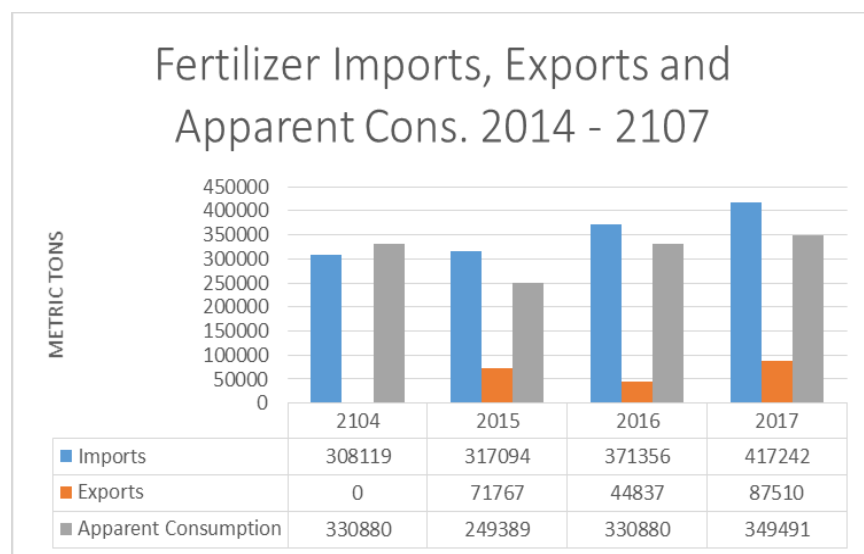


Figure 3: Fertilizer Imports, Exports and Apparent Use 2014 - 2016

4.1.1 Fertilizer production

The history of fertilizer production goes back to 1972, when the fertilizer plant with the capacity to produce 105,000 Metric tons of SA, TSP and blended NPKs was installed in Tanga region. The TFC plant operated for almost 20 years as it stopped production in 1991. After the collapse of the factory, almost all fertilizer products are imported except Minjingu Rock Phosphate (MRP). Given the extensive fertilizer raw material resources available in Tanzania and the fact that they are underutilized, the country has to undertake to promote national and regional fertilizer production and intra-regional fertilizer trade to capture a bigger market and take advantage of economies of scale through appropriate measures such as tax incentives and infrastructure development. The country has ample sedimentary rock and natural gas reserve that can be used for manufacturing of different type of fertilizer.

Minjingu Phosphate Rock

Minjingu phosphate deposit in northern Tanzania, is situated about 110 km south west of Arusha along the Arusha - Babati road. Minjingu Mines and Fertilizer Company is carrying out fertilizer blending and has produced two blends namely Minjingu Mazao (comprising phosphorus, nitrogen, sulphur with micronutrients such as zinc and boron) and Minjingu Nafaka (comprising of phosphorus, nitrogen, sulphur, potassium, zinc and boron). Both blends have shown encouraging results to a variety of cereal crops, legumes and roots and tubers. Fertilizer blending is now being seen to be the most appropriate way of addressing nutritional deficiency to a specific soil requirement. Substantial yield increases to almost all

crops are now becoming a reality in Africa due to inclusion of secondary and micronutrients into standard NPK fertilizers. Many farmers realize poor returns because common deficiencies of secondary and micronutrients limit their uptake. Inclusion of secondary and micronutrients in NPKs increases yields and returns to fertilizer investments and thereby encouraging farmers to use. (Msolla, 2016).

The Minjingu Rock Phosphate (MRP) can also be used for production of TSP, DAP, MAP, SSP and other complex fertilizers. The rock phosphate is enriched by treating it with sulphuric acid, phosphoric acid and or nitric acid (acidulation). However, treating RP with nitric acid produces NP slurry which is used in manufacturing complex fertilizers. Availability of various Minjingu Phosphates are shown in **Table 4**.

Table 4: Quantity of Fertilizer Manufactured by Minjingu Mines 2014 – 2017 (MT)

YEAR	MOHP (Powder) - MT	MOHP (Granules) - MT	Minjingu MAZAO (MT)	Minjingu NAFKA (MT)	TOP DRESSING IN MT	TOTAL IN MT
2014	0	123	18,183	173	-	18,479
2015	0	-	-	66	164	230
2016	1,491	762	-	3,855	1,253	7,361
2017	1,526	4,271	-	4,253	1,673	11,723
	3,016	5,156	18,183	8,347	3,090	37,793

Source: Minjingu Mines & Fertilizers Co. Ltd

However, data for the declared products by the Minjingu Mines and Fertilizer Company Ltd have never been validated due to non – representation of the company during the FTWG workshops and confidentiality by the company.

Natural Gas

Tanzania is endowed with natural gas. The volume of the gas reserves has been estimated at around 52.7 trillion cubic feet (tcf) but it is expected to rise to 200 tcf in the next two years. A urea fertilizer plant is expected to be installed in Lindi region by a consortium of Topsoe A/S, the Germany Company Ferrostaal Industrial projects GmbH and the Pakistan industrial enterprise Fauji Fertilizer Company Ltd to develop a large scale fertilizer complex together with the state owned Tanzania Petroleum Development Cooperation (TPDC). The fertilizer complex is expected to be on stream in 2019/2020 by producing 1.3 million MT of fertilizer per year for both local and international market. The natural gas can as well be processed to produce mineral fertilizers such as Urea and DAP.

4.1.2 Imports and exports

The landed fertilizers at Dar es Salaam port is cleared and transported to the warehouses and go-downs. Cost of clearing, transportation, handling charges, storage fee and a little profit margin of utmost 5% of the value of fertilizers at warehouses in Dar es Salaam affects the selling price. More than 95% of fertilizer that is imported in Tanzania its gateway is Dar es Salaam port. This is the only active sea port serving the entire country and other land locked countries of Zambia, Malawi, Rwanda, Burundi, Democratic Republic of Congo and Uganda. In 2014 – 2016, the volumes of imports and exports were as shown on **Figure 4** below.

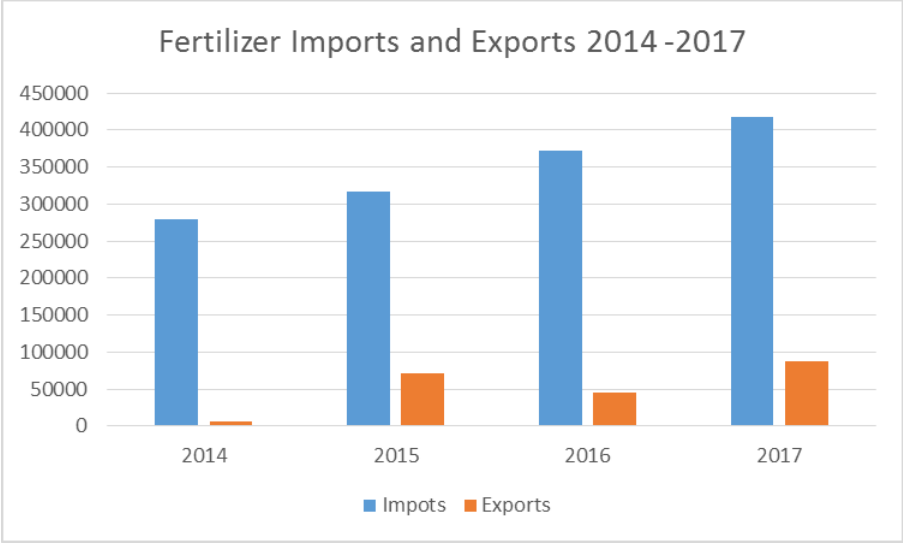


Figure 4: Fertilizer Imports and Exports 2014 - 2017

It is evidenced that the quantity of fertilizer imports have been on an increase from 2014 to 2017 as is shown on the chart. Fertilizer exports were very low in 2014 and it increased in 2015 and it was high in 2017.

4.2 Evolution of apparent consumption

The formal fertilizer sub-sector in Tanzania was established in 1968 when Tanzania Fertilizer Company was formed under Company Ordinance Cap. 212. From 1968 to 1992, TFC had the monopoly on production, importation, supply and distribution to smallholder farmers largely through the primary societies and cooperative unions that were also Government institutions. In 1972, TFC had the capacity for producing 105,000 Metric tons of SA, TSP and blended NPKs for use by farmers. The plant collapsed in 1991 and since then almost all products of fertilizer are imported except Minjingu Rock Phosphate (MRP).

The Government of Tanzania opened the fertilizer marketing to the private sector in 1994. The taking over of the fertilizer marketing by private sector has been slow since the withdrawal of government from the business. As a result smallholder farmers in the rural areas have not benefited from the current marketing system mainly because the private sector has been more active in responding to trading opportunities that are offered by the liberalized markets compared to input markets.

During the absence of well-functioning fertilizer legislation and regulations, availability and use of substandard fertilizer products such as unsubstantiated product claims, product adulteration, short weight, nutrient deficiency, non-fertilizer use and other abuse were availed to farmers. In the meantime, fertilizer business in Tanzania is governed by the Fertilizer Act No.9 of 2009 and the Fertilizers Regulations of 2011 for quality control at the levels of manufacturing, importation, distribution and utilization. The Act requires that all fertilizer manufactured, imported, and sold in Tanzania need be registered, packed, and labelled in accordance with the Act. It also requires that all fertilizer dealers must be registered, with a minimum level of knowledge concerning the product in which they deal with. All premises used for activities related to fertilizer must be registered. Importation of fertilizer in Tanzania, as well as export from the country, requires a permit. The Act has established a framework for a competitive set of regulations to govern how fertilizers are to be made available to Tanzanian farmers.

The Ministry of Agriculture (Agricultural Inputs Section and TFRA), National Bureau of statistics (Agriculture Statistics Section), Ministry of Trade Industries and Investment together with and other

supportive institutions such as TRA, TPA, TBS; and other key fertilizer stakeholders (importers, manufacturers and agro –dealers) meet regularly for dialogue on fertilizer data availability. This has eased the availability of data on the Fertilizer Apparent consumption (AFC) in the country. This is achieved after getting the quantity of fertilizer imports (I), manufactured (M), exports to other countries (E) and non-fertilizer use materials (NFU). The calculation for Apparent Fertilizer Consumption as referred to **Appendix II** for 2014 – 2016 has been derived by the formula of:

$$\text{Apparent Fertilizer Consumption} = \text{Imports} + \text{Manufactured} - \text{Export} - \text{Non Fertilizer Use}$$

4.3 Structure and size of the national market

Since the early 1990s, fertilizer business is solely managed by private sector who imports more than 95% of fertilizer that is used in the country. The fertilizer business is capital intensive as it requires facilitation from financial institutions. It is very common that fertilizer importing company borrows from a bank of a given size which is roughly proportional to the local market. This concept has affected availability of fertilizer as the majority of fertilizer importers imports small quantities that are affected by high transporting and operational costs and eventually the high prices of fertilizer in the market. The current move where the Government and the private sector in implementing the Fertilizer Bulk Procurement Scheme. The scheme allows fertilizer importers to bring in the aggregated quantities in a large volumes thus reducing overhead costs and farmers are getting fertilizers at cheaper price.

4.3.1 *The main distribution channels*

Fertilizer procurement, distribution and sells is totally liberalized with little interventions from the Government through various interventions aimed to promote high levels of fertilizer use by farmers in the country to enhance crop productivity and production. The current available 11 suppliers mainly sell inputs to the farmers through a network of hub distributors scattered in different parts of the country who again sell them through a network of about 3,000 rural agro-dealers. However, some inputs are sold directly to farmers from both suppliers and hub distributors depending on the proximity of the farmers to the two sources. Few suppliers own their own distribution warehouses in some strategic areas and most of the agro-dealers have little space to store fertilizers, thus leading to non-availability of the commodity when needed by famers. The vertical integration in supply chains of these functions are summarized below.

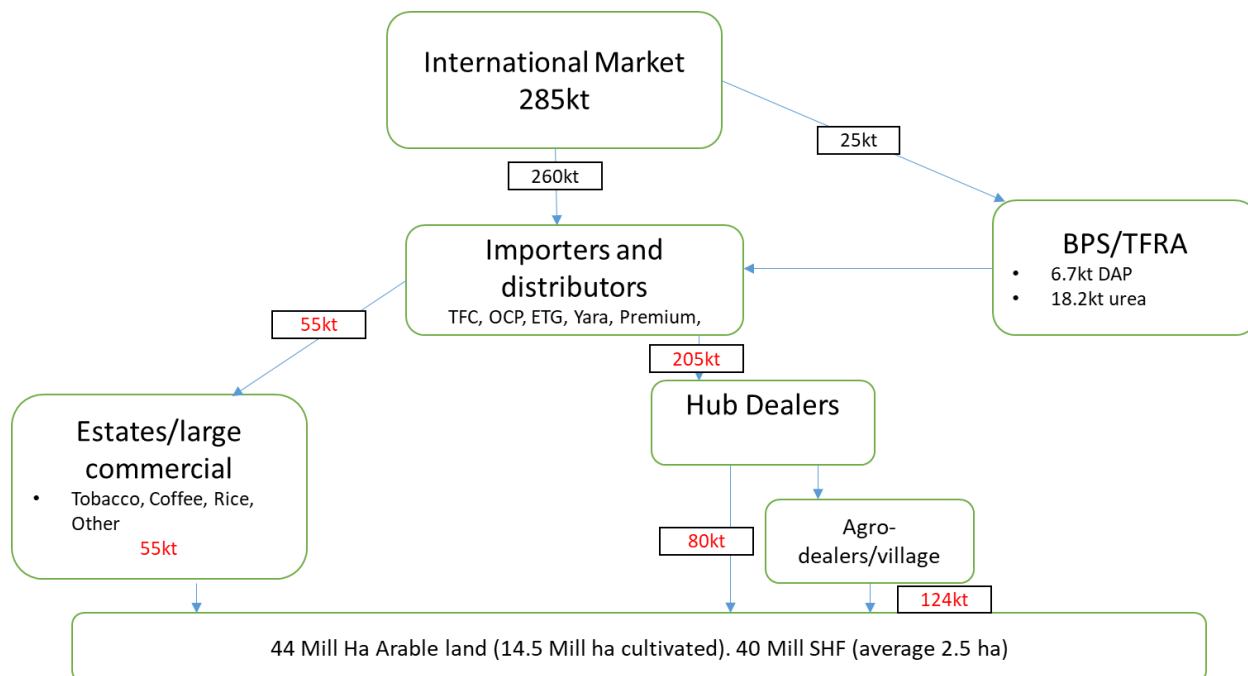


Figure 5: Vertical Supply Chain of Fertilizers in Tanzania

4.3.2 The key players in the fertilizer market

The key players in the fertilizer market are the 9,558 trained extension officers and 334 scientific officers who have the first hand information on targeted crops, fertilizer demand estimates, availability and utilization by farmers. Through the LGAs, the information is channeled to the Ministry of Agriculture - Agricultural Inputs Section that informs the private fertilizer companies on fertilizer demand established for the season. Availability of fertilizer is made public through mass media (radios and television programs) and mobile phones for transparency of information. Other key players are the supportive institutions that are in place such as the TFRA, TRA, TPA, and TBS just to mention a few.

4.3.3 The market size

The demand of fertilizer is attracted by a number of factors including (a) the price of the crop produced as an incentive; (b) the price of fertilizers, (c) prices of other inputs that complement fertilizers, and (d) the parameters of the fertilizer production functions. In a world of perfect information and well-functioning markets, a farmer would demand the amount of fertilizer that maximizes financial returns as per profit margin obtained. Fertilizer demand in Tanzania has been on an increase as a result of farmers' awareness in using improved agricultural inputs as a result of the re-introduction of a subsidy program that led to a low cost of input by farmers. Fertilizer demand increased tremendously from 385,000 Metric Tons in 2011/2012 to about 485,000 Metric Tons recently. For the period under study, the real fertilizer consumption was 288,211 Metric tons (2014); 267,073 Metric tons (2015); and 289,687 Metric tons in 2016/2017 as per IFA FUBC **Appendix III**.

The average market share of fertilizer per major crops known to use fertilizer is summarized in **Figure 6** below:

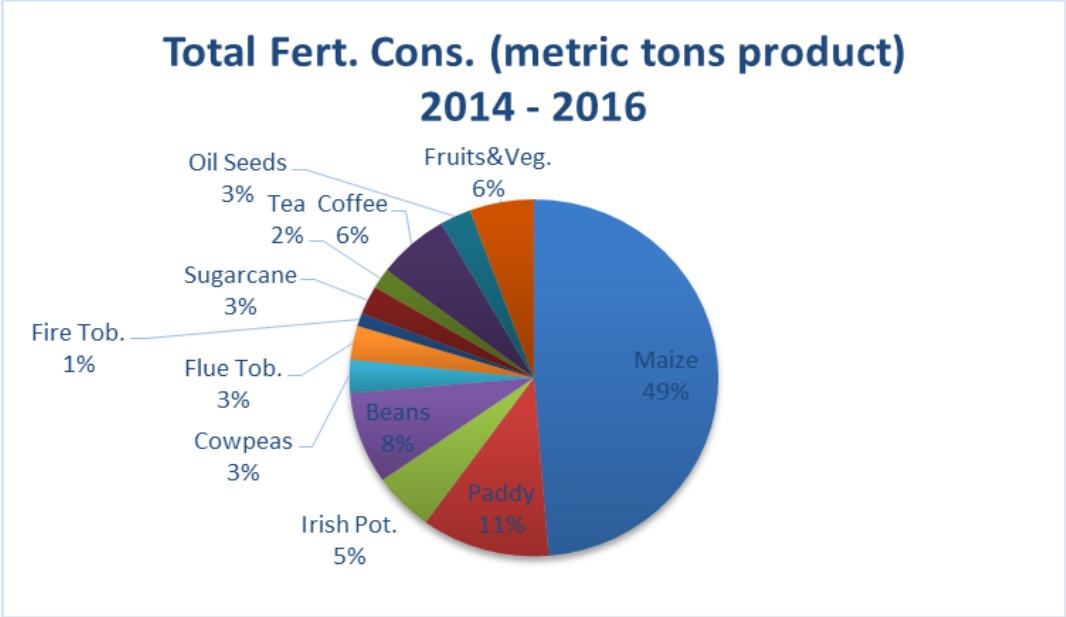


Figure 6: Average Fertilizer Consumption by crop 2014 – 2016

4.4 Fertilizer Sector Value Chain Environment

Fertilizer intended for importation to Tanzania has to undergo analytical testing to meet the specific requirement of fertilizer as set by the Tanzania Bureau of Standards (TBS) so as to benefit the end user. This analytical analysis is conducted by the SGS laboratories for quality and quantity; availability of major and trace elemental; and chemical and physical properties of fertilizers. SGS’s laboratory analyses are performed in accordance with the Association of Fertilizer & Phosphate Chemists (AFRC), the Association of Analytical Chemists (AOAC), The Fertilizer Institute (TFI), ISO, CEN and / or other international or national methods prescribed by any corporate guidelines before shipment from the country of origin. The bulk imported fertilizer is bagged at Dar es Salaam port under the supervision of TFRA and TBS for quality assurance of supplying, processing and packaging system that are resource efficient and reduce waste and emissions along the value chain and reduces the environmental footprint of the customer product.

4.4.1 Research & Extension

(a) Research and Development

Agriculture research is an important support service to the agricultural sector in any country. In Tanzania agricultural research is governed by the research policy with the main objective of developing, testing, disseminating and promoting appropriate crop and livestock production technologies to the farming communities. The policy requires development of demand – driven, cost – effective technologies which can be disseminated to farmers for development of the agricultural sector. The development of these technologies has taken into consideration the existing agro-ecological zones and social – economic variations, needs and opportunities of the farming communities.

Agricultural research needs highly specialised staff: who are meticulous, honest, able to take initiative, scientifically well trained, and able to keep up with the latest thinking, and to defend their work in international gatherings. There is an approaching crisis in human resources especially in the Zonal Research Institutes in Tanzania. The situation is most extreme in some research stations where for most of the posts for senior research officers are vacant. Currently there are about 334 scientific officers out

the ideal number of 585 in different stations of whom most were recruited and trained in the 1970s. Many of these are now or nearly retiring while several (the retired ones) are working on contract basis and keeping the service alive. Tanzania needs to give urgent thought as to how it can replace the generation of agricultural research scientists who were trained in the 1970s.

(b) Extension Services

Agricultural extension service plays a critical role in the introduction and popularization of fertilizer use to the farming communities. The promotion efforts for increased fertilizer use by the government and private sector endeavour to achieve environmentally sound, cost-effective, balanced fertilizer usage and other recommended farm practices. The government has to ensure that fertilizer programs are systematically organized and integrated in the extension programs.

In Tanzania the agricultural extension services have been decentralized with 9,558 extension staff out of the required 15,802 by June 2015 in order to have them well nested at the lowest level of government machinery (MAFC, 2015). This was expected to make the services cost-effective and responsive to farmers' needs, while demanding accountability from extension staff and other collaborators. In order to improve the extension service delivery, the Tanzania National Agriculture Policy (NAP, 2013) stipulates the need for the Government and Private sector to deliver extension services to (primarily small scale) farmers at the village level. The aim is to ensure that the farmers are equipped with agricultural knowledge and skills to improve their farming practices and eventually productivity. The implementation of NAP has resulted in an increase in the number of extension workers in the Districts from 3,749 in 2007.

Public-funded extension service generally are still facing some challenges including: not all villages in the districts have access to extension services yet; low budget allocated for extension services and the late disbursement of funds irrespective of the growing season; poor working environments involving lack of reliable means of transport to reach the farmers; limited financial support to carrying out demonstrations and field experiments on new technologies; sub-optimal housing; and inadequate working facilities. As a result, extension officers are not motivated to perform their duties well.

Access to Information and Communications Technology - ICT provides information on prices, markets, technology, and weather. Community-based tele-centres have the potential to empower rural communities and facilitate socio-economic developments in agriculture. It uses selected ICT such as e-mail, internet, phone, radio, television and other printed materials to accelerate the wider delivery of appropriately packaged agricultural information. Mobile phones, mushrooming in Tanzania are increasingly becoming affordable, and they help to overcome rural isolation and make communication easier.

Although farmers recognize the role and importance of having an extension officer in their areas, poverty is found to be the major obstacle hindering farmers from investing in agriculture. Other challenges are that many farmers have: not yet adopted new agricultural technologies disseminated; inadequate knowledge on farm management skills; and no farm records.

4.4.2 Regulation of fertilizers

Fertilizer business in Tanzania is governed by the Fertilizer Act No.9 of 2009 and the Fertilizers Regulations of 2011 for quality control at the levels of manufacturing, importation, distribution and utilization. The Act requires that all fertilizer manufactured, imported, and sold in Tanzania need be registered, packed, and labelled in accordance with the Act. It also requires that all fertilizer dealers must be registered, with a minimum level of knowledge concerning the product in which they deal with. It ensures that all premises

used for activities related to fertilizer must be registered including the importation of fertilizer in Tanzania, as well as export from the country that requires a permit.

These core functions are carried out by the Tanzania Fertilizer Regulatory Authority (TFRA). Among the day today responsibilities of TFRA are to:

- (a) register and maintain a register all fertilizer supplements and sterilizing plants;
- (b) license fertilizer dealers;
- (c) issue permits for importation and exportation of fertilizer and fertilizers supplements;
- (d) maintain and publish periodically a register of fertilizer dealers;
- (e) implement ratified international conventions relating to fertilizers; regulate and control the import, production, transportation, dealing, storage, and disposal of fertilizer or fertilizer supplements;
- (f) collect, maintain and publish information related to fertilizers and fertilizer supplement; make guidelines on the sound management and effective control of fertilizers and fertilizer supplements;
- (g) conduct regular training of stakeholders on fertilizer matters;
- (h) register inspectors and analysts; inspect or cause to be inspected fertilizer or fertilizer supplements for quality assurance; implement policies, strategies and programs relating to fertilizer industry development;
- (i) provide technical advice to the government and other institutions on all matters relating to the fertilizer and fertilizer supplements management and control;
- (j) collaborate with the national and international organizations on all matters relating to the fertilizer and fertilizer supplement; and
- (k) Adhere with the Environmental Management Act.

5 FERTILIZATION AND FERTILIZER USE IN MAJOR CROPS

5.1 Crop Sector Information

In Tanzania there are crops are categorized as cereals, roots and tubers, pulses and legumes, fruits and vegetables, oil seeds and nut crops, and traditional industrial crops. Some crops (two or three) are produced by one farmer.

5.1.1 *The sector and its main actors*

The main actors for these main crops (might be producing more than one crop) as per 2016/2017 AASS are summarized in the **Table 5** below:

Table 5: Main Crops and Main Actors (Operators)

Main Crop	List of Main Actors
Maize	7,406,070 operators; fertilizer companies; agro–dealers; LGAs for advisory services and MA for policy matters on agriculture.
Paddy	1,597,123 farmers; fertilizer and seed companies; agro – dealers; LGAs for crop production advisory services and MA for policy matters on agriculture.
Other cereals	1,108,752 operators in sorghum production; 30,254 operators in wheat; 257,351 in bulrush millet; and Finger millet was produced by 74,086 smallholder farmers; fertilizer and seed supplying company; MA and LGAs; crop buyers.
Roots and Tubers	These include cassava, sweet potatoes, round potatoes, yams and cocoyam produced by 3,202,615 operators; procurement companies for the crops, especially cassava.
Pulses & Legumes	Produced by 2,970,496 farmers; and private crop buyers
Traditional Industrial Crops	Production of cotton was carried out by 381,021 farmers, for sisal (5,475), cashew nuts (666,848), banana (533,733), oil palm (27,698), coffee (183,343), tea (3,687), sugarcane (59,045), mangoes (183,602), coconuts (177,043), oranges (63,356) and cloves (462). Other actors were MA, LGAs and agricultural input companies as well as the Crop Boards for policy and regulatory functions in some particular crops.
Oil Seed and Oil nuts	The crops are groundnuts, sunflower and sesame engaged 2,071,014 smallholder farmers; Seeds and Fertilizer Company; LGAs for extension service, and oil mill operators for further processing
Fruits and Vegetables	Crops include cabbage, amaranths, pumpkin, cucumber, eggplant, watermelon, okra, onion and tomatoes engaged 373,355 farmers; the Tanzania Horticulture Association (TAHA), an apex private sector member for the growth and competitiveness of the horticultural industry.

5.1.2 Planted areas, production and yields

Approximately 85 percent of the cultivated land is dominated by small-scale farmers who operate between 0.9 and 3.0 hectares and traditional agro-pastoralists (MAFC, 2015). The cultivated land for each year changes in accordance to farmers’ crop preferences, price and availability of agricultural inputs (organic fertilizers and improved seeds) for investment, availability of moisture to support the intended crops as well as the marketing segment for the produces. During the 2016/2017 agricultural year, the total area of land in farms engaged in crop production were 14,888,738 hectares. Out of the total area cultivated, maize was cultivated in 3,787,000 ha in 2014, 3,583,000 ha in 2015 and 3,817,900 ha in 2016. Data for other crops from 2014 – 2016 on the acreage for the major crops, location to where crops were grown (growing system or regions), area planted (ha), production (tons) level to each crop and yields (tons / ha) is indicated in Agricultural Statistics form attached as **Appendix V**.

AGRICULTURAL STATISTICS										
Crop	Growing system/region	Year 2014			Year 2015			Year 2016		
		Planted Area (x1000 ha)	Production (x1000 tons)	Yield (Kg/ha)	Planted Area (x1000 ha)	Production (x1000 tons)	Yield (Kg/ha)	Planted Area (x1000 ha)	Production (x1000 tons)	Yield (kg/ha)
Maize	countrywide	3,788	5,903	1,558	3,584	6,149	1,716	3,818	6,681	1,750
Rice	countywide	1,154	2,980	2,581	1,122	3,429	3,057	1,097	2,452	2,234
Irish Potatoes	Southern highlands & Northern Zone	2,017	5,886	2,919	1,944	6,614	3,402	2,101	4,025	1,916
Beans	countrywide	1,125	1,202	1,070	1,181	1,307	1,106	1,120	1,428	1,280
Cowpeas	Countrywide	217	181	830	228	197	860	148	178	1,200
Flue-cured Tobacco	Western zone	62	70	1,132	43	49	1,119	38	66	1,721
Fire-cured Tobacco	Southern Highlands zone	16	18	1,132	12	12	1,001	10	16	1,725
Sugar cane	Eastern and Lake zone	44	3,133	71,206	42	2,839	67,312	44	3,061	69,909
Tea	Southern Highland, Lake and Eastern zone	23	36	1,588	23	33	1,450	23	27	1,187
Coffee		222	42	188	219	61	278	231	48	209
Grand Total		8,667	19,450		8,398	20,689		8,630	17,982	

Maize

45% of Tanzanian land is used for maize cultivation in which 4.5 million of households utilize their land for maize cultivation.[3] The contribution of smallholders is 85% of total national cultivation with the rest of contribution being from community farms, large farms (private and public)[1] Cultivation of maize is conducted in two different rainfall seasons of the year, which are:- Bimodal (vuli) October to December and Unimodal(masika) March to May.

About 47% of maize grown on vuli season and 41% grown in masika season

Land area, production and Yield of maize for the period 2014-2016

Date	Land area x1000 ha	Production x 1000 mt	Average Yield (t/ha)
2014	1,154	2,980	2,581
2015	1,122	3,429	3,057
2016	1,097	2,452	2,234

Rice

Rice is grown in most regions of the country: with the Coast, Morogoro, Tabora, Mbeya, Mwanza, Shinyanga and Arusha Regions each produce in excess of 100 000 tonnes. Almost 20 percent of farmers are involved in rice production. Most rice is grown by smallholders under rainfed conditions but some farmers grow and irrigate 2 – 2.5 hectares under schemes that are often initiated and controlled by government. Larger farms have larger areas under irrigated cultivation but large-scale commercial rice farming is limited to a few private firms who bought their land when the large-scale National Agricultural and Food Corporation (NAFCO) schemes were privatized. Consumption is expected to decrease due to decrease in milled production.

Land area, production and Yield of maize for the period 2014-2016

Date	Land area x1000 ha	Production x 1000 mt	Average Yield (t/ha)
2014	3,788	5,903	1,588
2015	3,584	6,149	1,716
2016	3,818	6,681	1,750

Wheat

Wheat in Tanzania is grown almost exclusively as a commercial crop, on a large-scale basis in the northern highlands and by small and medium scale farmers in the southern highlands. Although less than 1% of farmers in Tanzania grow wheat, 32% of wheat production is exported, while 91% of wheat consumed is imported.

5.1.3 Fertilization Recommended Rates and Farmer Practices

Application of fertilizer by smallholder farmers of many crops are far below the recommended application rates. **Appendix VI** gives the detailed information on crops, area planted, RAR, AAR and total fertilizer consumption for every crop. The study has revealed that Sugarcane and Tea are the leading crops in terms of fertilizer nutrient application by farmers. The actual application rates of 100 N kg/ha and 52 P₂O₅ kg for sugarcane; and the 100 N kg/ha and 10 P₂O₅ kg/ha for tea are almost the same as the recommended application rates from R & D. These are followed by fire – cured tobacco and coffee. This has been possible for farmer practices to approach the quantity recommended due to contract farming and out growers' arrangement where most of fertilizers are supplied by the recognized Crop Boards' Affiliated Firms or the crop procurement that are entities for specific crop processing.

5.1.4 Fertilizer supply chain

All traditional cash crops are directly managed by Crop Boards and some affiliated associates. Crop Boards in Tanzania carry out regulatory functions and other activities necessary, advantageous or proper for the benefit of the industrial crops. The Boards advise the Government on policy issues and strategies for the development of crops in order to improve the quality and increase in production competitiveness in local and international market; regulate and control the quality of the crops; collect, refine, maintain, use or disseminate information or data concerning the crops; and enforce the implementation of regulations in respect of farming, marketing, processing, transporting and storage of crops among the few functions. Crop Boards are allowed to appoint and employ agents or contractors (private sector) for the better carrying out of the fertilizer through open and competitive tenders for acquisition of enough quantities and quality fertilizer.

For crops such as cereal, legumes and pulse, oil crops and roots and tubers that are not regulated by crop boards, input supply is purely left to private companies for importation, distribution and sells to farmers after consultation with other stakeholders, in particular MAFC for potential demand, distribution plans, and levels of consumption by farmers through open markets.

5.1.5 Fertilizer consumption

There have been different levels of fertilizer consumption for the major crops in Tanzania in the duration of 2014 – 2016. A summary for crops and quantity of consumed fertilizer in each year is observed in **Figure 7**.

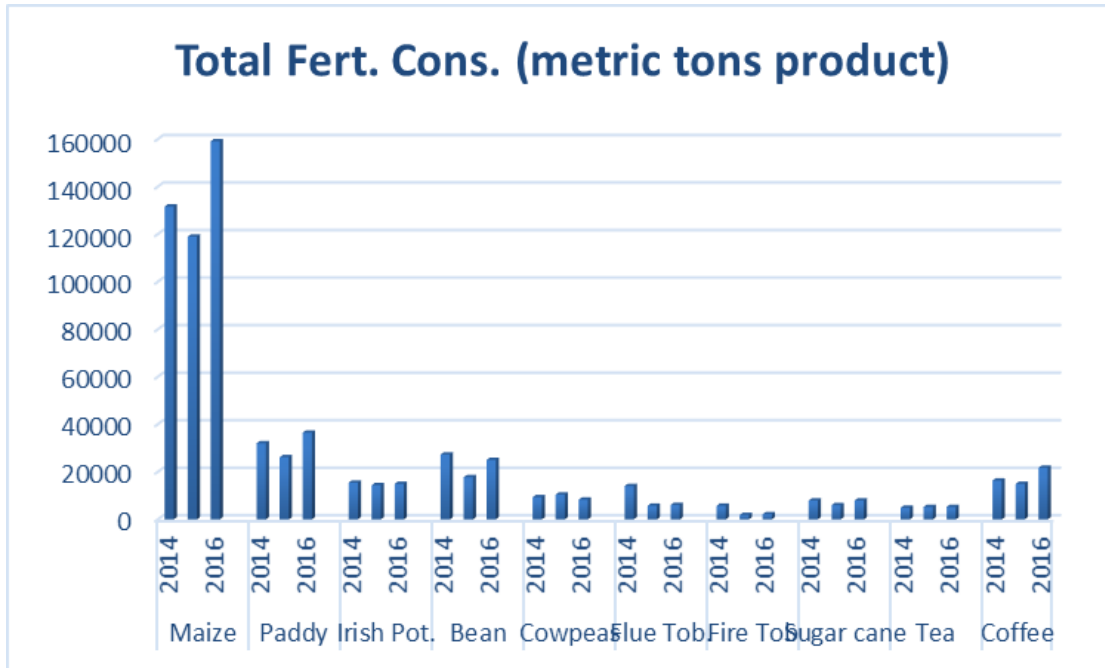


Figure 7: Fertilizer Consumption by Major Crops 2014 -2016

The study has revealed that the apparent fertilizer consumption is not necessarily equivalent to the real fertilizer consumption in any specific year. This is due to the reason that each year there are carry-over stocks to the next year as is indicated in **Figure 8**.

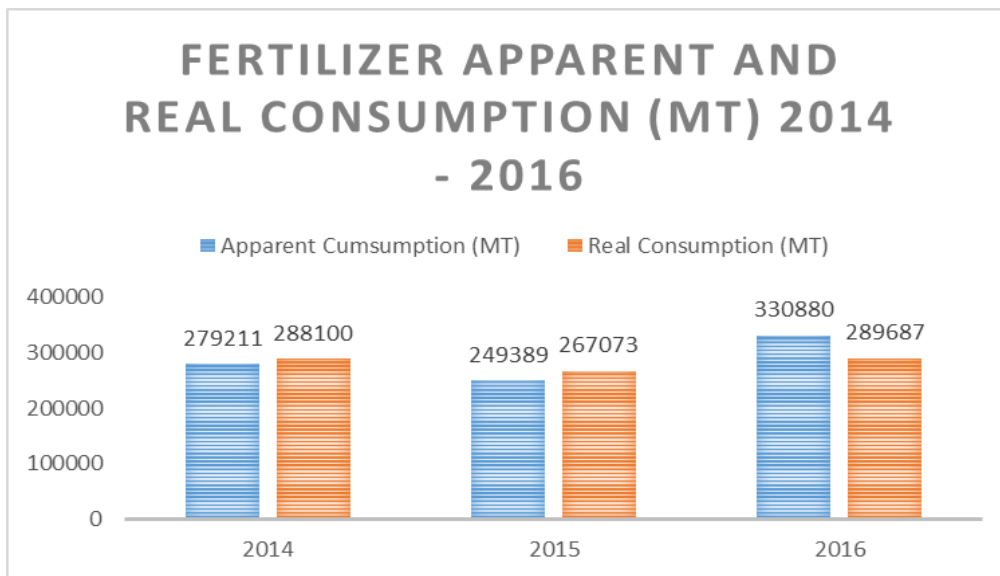


Figure 8: Fertilizer Apparent and Real Consumption (MT) 2014 - 2016

5.1.6 Comments on the quality of the data

Data were collected from different sources such as the Government institutions (MA, MIT, LGAs, R&D – MA, Crop Boards and affiliated associates, private sector dealing with agriculture crop production and processing. All data are reliable, accurate and represent what was collected from the stakeholders.

6 TYPE AND CONSUMPTION OF FERTILIZER IN TANZANIA

Farmers in Tanzania grow a wide range of crops. Fertilizer application to some crops is not recorded due to their small volume consumed. Type of fertilizers used for major crops in the country are specified in the **Table 6**.

Table 6: Type of Fertilizer Used and Crops

Type of Fertilizer	Preferred Crops
SA	Maize, Paddy, Sorghum and Barley
CAN	Tobacco, Maize, Paddy, Sorghum, Coffee
Calcium Nitrate	Tea, Barley
Yara Milla Java	Coffee, Tea, Cloves
NPK 20-10-10	Tobacco, Maize, Sorghum
NPK 10-18-24	Tobacco
NPK 23-21-0+S	Maize, Paddy, Sorghum, Millets
NPK 15-9-20	Vegetables, Fruits
NPK 25-5-5	Coffee
NPK 17-17-17	Tea, Barley
TSP	Maize
Urea	Maize, Paddy, Sugarcane, Tobacco
DAP	Maize, Paddy, Sugarcane
Minjingu Mazao	Cereals, Legumes and Root crops
Minjingu Nafaka	Cereals, Legumes, Fruits and Root crops

6.1 Recommendations for fertilizer use by crop type (summary)

All major crops have recommended fertilizer application rates by the Research & Development Department of the Ministry of Agriculture. The recommended fertilizer use by crop and date of release are referred in **Appendix VI**.

COUNTRY		Tanzania		RECOMMENDED APPLICATION RATE (RAR) FOR FERTILISER PER CROP																						
No.	Crops	Agro ecological zone	Administrative zone	Expected yield	Time of application	Fertilizer product	RAR per product (kg/ha)	N	P2O5	K2O	S	MgO	CaO	Zn	B	Mn	Cu	Fe	Mo	Cl	Source	Date Released				
C1	Maize	Countrywide		4.8 - 8.0 t/ha	at planting	DAP	87	0	40	0											R&D - MoA	2015				
					at planting	TSP	87	0	40	0													R&D - MoA	2015		
					top dressing	Urea	217	100	0	0														R&D - MoA	2015	
					top dressing	SA	476	100	0	0	23													R&D - MoA	2015	
C2	Rice	Countrywide		5.0 - 10.0 t/ha	at planting	DAP	43	0	20	0											R&D - MoA	2015				
					at planting	TSP	43	0	20	0													R&D - MoA	2015		
					top dressing	Urea	174	80	0	0	7.6													R&D - MoA	2015	
C3	Ipotaotes & Cassava	Southern Highlands		4.5 - 10 t/ha	at planting	NPK 17-17-17	335	57	57	57											R&D - MoA	2013				
					top dressing	Urea	435	200	0	0														R&D - MoA	2013	
C4	Beans & Peas	Countrywide			at planting	TSP	130	0	60	0												R&D - MoA	2013			
					top dressing	CAN	115	30	0	0														R&D - MoA	2013	
C5	Tobacco (flue)	Western and Central		0.72 - 1.12 t/ha	nursery development	TSP	261	0	120	0												R&D - MoA	2013			
					at planting	Urea	65	30	0															R&D - MoA	2008	
					crop development	NPK 10-18-24	375	30	120	90															R&D - MoA	2008
C6	Tobacco - flue	Southern Highlands		1.1 - 2.1 t/ha	nursery development	TSP	261	0	120	0												R&D - MoA	2008			
					at planting	Urea	65	30	0	0														R&D - MoA	2008	
					top dressing	NPK 20-10-10	900	180	90	90															R&D - MoA	2008
C7	Sugarcane	Eastern and Lake		55 - 100 t/ha	at planting	DAP	500	0	230	0												R&D - MoA	2010			
					crop development	SA	476	100	0	0														R&D - MoA	2010	
					crop development	Urea	535	246	0	0															R&D - MoA	2010
C8	Tea	Southern Highlands, Lake and Eastern		3.5 - 10 t/ha	at planting	TSP	43	0	20	0												R&D - MoA	2013			
					crop developmentg	NPK 25-5-5	435	200	40	40															R&D - MoA	2013
C9	Coffee	Lake, Southern Highlands, Western		0.4 - 0.5 t/ha	at planting	TSP	22	0	10	0													R&D - MoA	2013		
					top dressing	CAN	288	75	0	0															R&D - MoA	2013
					crop development	NPK 17-17-17	59	75	10	10															R&D - MoA	2013

6.2 Analysis of fertilizer consumption

Fertilizer consumption analysis is calculated by utilizing available information of type of crops, planted area for the crops (ha), recommended application rates by R&D, actual application rates by farmers and real fertilizer consumption per each crop per year (metric tons of nutrients and products). The summary is seen in IFA FUBC form in **Appendix III**.

6.2.1 Actual consumption by product and crop

Different crops grown requires different levels of nutrients for establishment, high productivity and production. Level of fertilizer (nutrients) applied for certain crops and area planted with crops will definitely provide the Actual Application Rate (AAR) of nutrients per year by farmers. In this case, AAR is calculated by division of Total Fertilizer Consumption (TFC) for the crop to Total Planted Area (TPA) in hectares per annum.

$$\text{Therefore AAR} = \text{TFC} / \text{TPA}$$

The final results for major crops' AAR are indicated in **Appendix V** of this document. Crops such as sugarcane, tea, coffee and tobacco are the leading crops in terms of fertilizer nutrient availability to crops. The amount available is approaching the recommended application rates to some of these crops. This is attributed by the regulatory responsibility of the Crop boards. In between 2014 – 2016, for tea, N and P₂O₅ availability ranged in 100 – 102 N kg/ha and 9 – 11 P₂O₅ kg/ha respectively. For sugarcane, it was 99 – 100 N kg/ha and 35 – 82 P₂O₅ kg/ha. The least crops in terms of fertilizer AAR were roots and tubers followed by pulses and legumes. However, such information on other traditional crops such as cashew nuts, cotton and pyrethrum were not included as data on fertilizer use by product were not readily available. The total area cultivated for those crops were 946,460 hectares in 2014; 881,750 hectares in 2015; and 1,179,900 hectares in 2016.

Tanzania has about 150 type of crops (AASS, 2018) and not all of them are fertilized. The only crops known to be fertilized are cereals mainly Maize, Paddy; Pulses and Legumes mainly common beans and cowpeas; traditional industrial crops including both fire and flue Tobacco, Tea, Sugarcane and Coffee. The list of crops, type of fertilizers and volume applied is verified in AFO FCBC as **Appendix IV** of this document.

Crop	Types of Fertilizer Applied	Volumes of Fertilizer Applied (tons)		
		2014	2015	2016
Crop 1: Maize	DAP	20,962	23,275	21,760
	NPK 23 10 05	2,381	4,147	7,860
	CAN	500	5,906	10,239
	TSP	-	108	153
	Urea	93,083	73,662	93,552
	SA	14,724	-	13,482
Crop 2: Rice	DAP	8,455	7,305	8,837
	NPK 23 21 0 + S	8,487	-	-
	TSP	-	109	149
	Urea	15,104	18,756	24,493
Crop 3: Roots & Tubers (Irish potatoes)	TSP	-	1,450	721
	NPK 17 17 17	5,923	5,929	5,393
	SA	2,089	-	2,397
	CAN	7,456	7,002	6,435
Crop 4: Beans	DAP	-	-	2,252
	SSP	1,238	-	-
	SA	611	-	8,174
	NPKs (Others) + NP + PK	17,238	13,603	2,667
	CAN	10,226	8,938	13,600
	DAP	-	-	563
Crop 5: Cowpeas	SSP	310	-	-
	SA	153	-	2,044
	NPKs (Others) + NP + PK	4,310	3,401	667
	CAN	2,557	2,235	3,400
	TSP	-	200	200
	Urea	200	-	-
Crop 6: Flue -cured Tobacco	NPK 10 18 24	13,833	10,020	8,875
	TSP	-	-	-
	Urea	350	350	200
Crop 7: Fire - cured Tobacco	NPK 20 10 10	5,396	3,830	2,982
	DAP	4,531	5,943	3,539
	Urea	-	1,596	-
Crop 8: Sugar cane	SA	14,919	11,811	13,248
	TSP	-	250	230
	NPK 25:5:5	4,710	4,500	4,540
Crop 9: Tea	TSP	-	50	75
	CAN	1,065	3,970	16,704
	NPK (Others)	-	-	3,447
	NPK 17 17 17	3,746	10,953	1,507
	Calcium Nitrate	6,593	512	725
Crop 10: Coffee	MOP	49	3,210	1,078
	SOP	457	-	54
	MAP	848	10	50
	NPK (others)	-	10,191	-
	Calcium Nitrate	12,740	2,000	-
	MOP	326	3,000	966
Crop 11: Other Cereals (millets, sorghum, wheat and barley) & Oil Seeds (Simsim, sunflower and oil palm)	SOP	1,511	163	-
	MAP	1,019	153	108
	NPK (others)	-	18,535	2,321
	MRP Mazao	-	-	-
	Calcium Nitrate	12,740	2,000	-
	MOP	326	3,000	966
Crop 12: Vegetables and Horticulture (Carrots, Cabbages, Tomatoes, Spinach, Melon, Bulb Onion and Pineapple)	SOP	1,511	163	-
	MAP	1,019	153	108
	NPK (others)	-	18,535	2,321
	MRP Mazao	-	-	-
	Calcium Nitrate	12,740	2,000	-
	MOP	326	3,000	966
Grand Total		288,100	267,073	289,687

6.2.2 *Distribution of fertilizer consumption by crop (FUBC)*

The real fertilizer consumption for the whole country were distributed for various major crops in different farming system and agro-ecological zone. The quantity of fertilizer used for crops from 2014 – 2016 are shown in **Appendix IV** as were validated by the FTWGs.

6.2.3 *Quantities of fertilizers consumed by type and nutrients*

Despite the low volumes of fertilizer used by product for the main crops as referred to **Appendix II** for years 2014 - 2016, Tanzania still produced surplus crops of cereals (maize and rice), pulses (common beans), roots and tubers (round potatoes and cassava) and vegetables (onions and tomato). All these surpluses did not find adequate markets ending up farmers getting low prices which frustrates them to get more involved in agriculture. Strengthening agricultural output markets for both internal and external markets is as important to sustain by increasing uptake of fertilizer by farmers at all levels.

6.3 **Analysis of nutrient consumption by nutrients**

The area cultivated and availability of fertilizer for agriculture use for 2014/2015 to 2016/2017 has determined the percentage for fertilized planted area of various crops. The percentage of area cultivated that is fertilized is shown in **Figure 9**. The study observed that 54% of the cultivated land with maize was fertilized. This was followed by paddy of which 19% of the cultivated area was fertilized and then beans (11%). Other crops and their percentage of fertilized area cultivated are referred in **Figure 9**.

For other crops with very low levels approaching zero (0%), their production might be recognized by the availability of natural fertility of the areas under cultivation and availability of some few nutrients from other fertilizers.

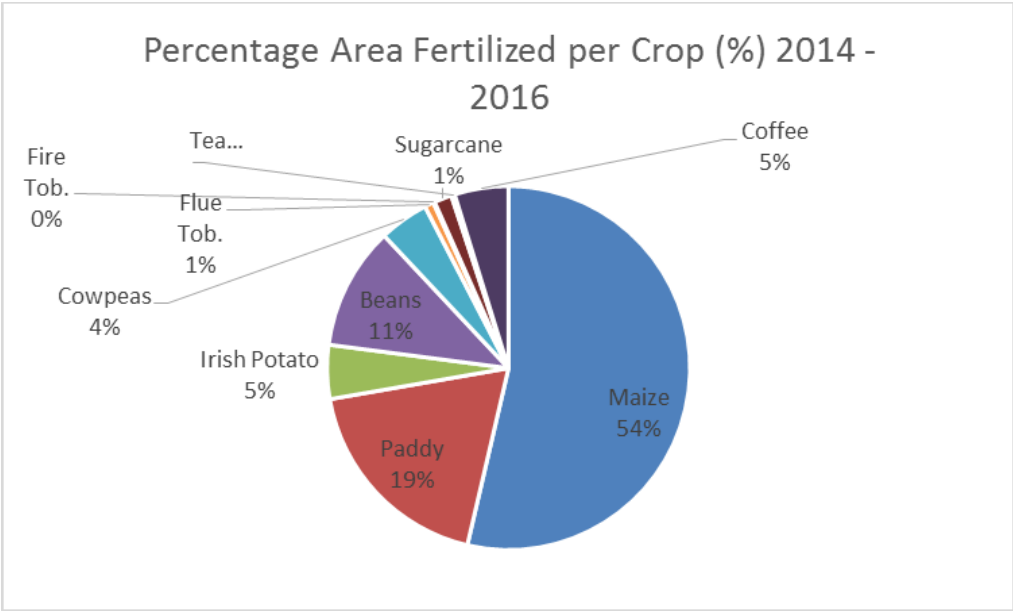


Figure 9: Percentage Area Fertilized per Crop 2014 - 2016

For three consecutive years (2014– 2016), maize crop recorded the lead in the average percentage share of fertilizer consumption (MT product) of 48.39%. Next to maize was cowpeas (14.84%) and paddy (11.17%). Other crops and their share are depicted in **Figure 10**

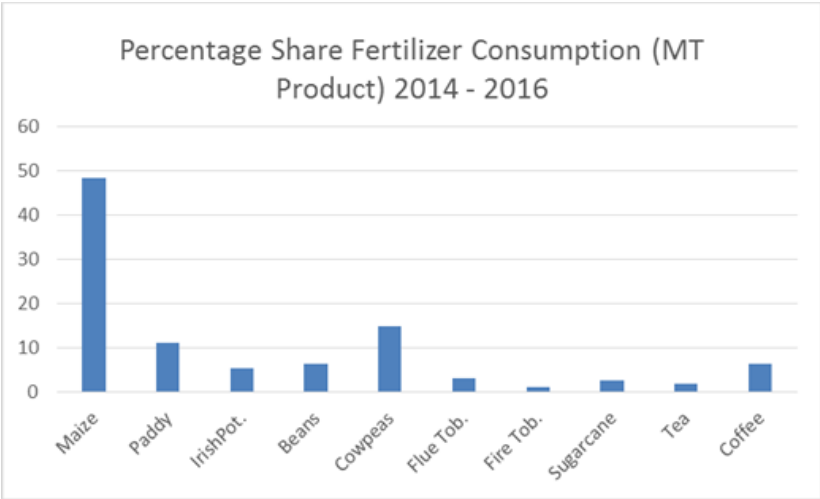


Figure 10: Percentage Share of Fertilize Consumption (MT Product) 2014 - 2016

The crops, percentage of the landarea that was fertilized (**Figure 10**), the recommended application rates, actual application rate and total fertilizer consumption has been derived. It was further observed that the Fertilized Cultivated Area (FCA) is determined by calculation for the Total Fertilizer Requirement (TFR) divided by the real consumed fertilizer which is multiplied by 100 as is shown in **Appendix III**.

The IFA FUBC for Tanzania shows that many crops differ in requirement and uptake of major fertilizer nutrients. Total fertilizer consumption (MT N nutrients/ha) was high in tea crop (98%) followed by maize

(82%) and beans (78%). P₂O₅ nutrients was highly consumed by sugar cane (80%), followed by cowpeas (50%) and round potatoes. K₂O nutrients/ha were highly consumed by flue – cured tobacco (55%), followed by fire – cured tobacco (50%) and coffee (20%). Other crop and their levels of N, P₂O₅ and K₂O nutrients/ha is indicated in Error! Reference source not found..

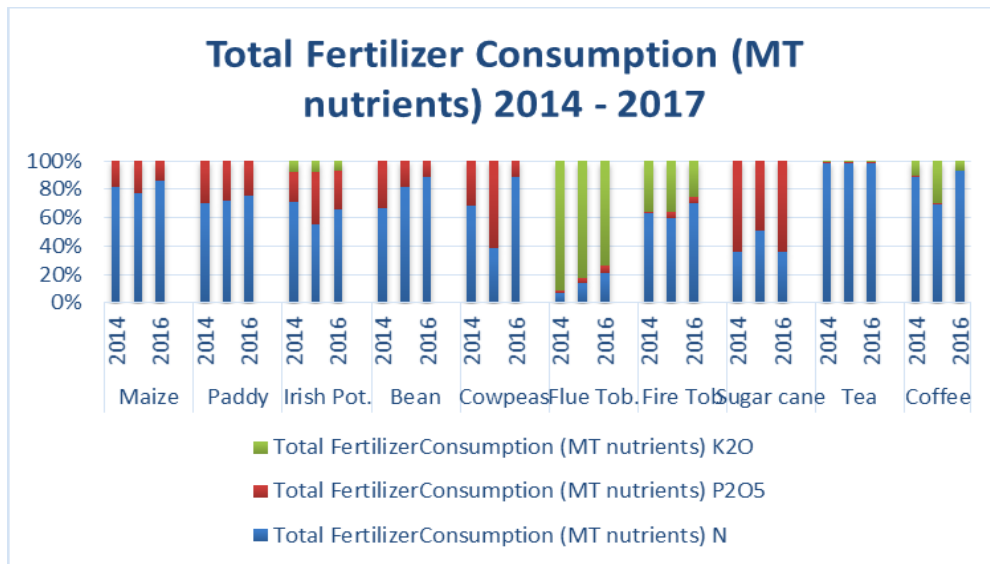


Figure 11: Total fertilizer consumption (metric tons nutrients)

6.4 Limitations of the study

Prior to finalizing this report, the Consultant had an opportunity to hold discussions with the main data source of the National Bureau of Statistics (NBS), Tanzania Ports Authority (TPA) and the Ministry of Agriculture (MA) respective departments and Policy and Planning – Statistics Section and Crop Development and Assistant Director-Agricultural Inputs. Other dignitaries consulted were the Tanzania Fertilizer Company (TFC) as a member of Fertilizer Society of Tanzania (FST). The major limitations of the study were: (i) variation of data, especially on fertilizers and non – fertilizers use as declared by importers and manufacturers. (ii) Recommended Application Rates (RAR) by the R&D Department for cassava, chickpeas, pigeon peas, garden peas, green gram, soya beans, cashew nut and pyrethrum crops in Tanzania are no in place. (iii) Information on fertilizer use by cotton and sisal were not readily available despite having in place the Recommended Fertilizer Application Rate for cotton of 40 N kg/ha and 40 P₂O₅ kg/ha; and 50 N kg/ha for sisal production respectively. (iv) lack of area specific recommendations for fertilizer use that are socially acceptable by stakeholders.

6.4.1 Access to Missing Data - Quantity and Quality

One of the major challenge in dealing with data is non - availability of accurate and reliable data in terms of quantity and quality. For the purpose of this work of agriculture in nature of reviewing the fertilizer use by crop and by product, all data used were collected from reliable sources including the FTGWs, TFRA the Statistics Section of MA. Availability of these instruments had an advantage of hastening the implementation of the assignment. Indeed, no missing data came as a challenge on this.

6.4.2 Recommendations

- (a) The R&D Department of MA should be contacted to develop the Fertilizer Recommended Application Rates for cashew nuts, pyrethrum and other crops.
- (b) The R&D Department of MA should develop site specific fertilizer recommendations to benefit the farming community so as to use fertilizers when there is a convincing profitability to be attained.
- (c) There is a need of conducting a comprehensive study to address the availability, quality and quantity of manure that is used for different crops in the country. This will change the outlook of fertilizer use by crop and fertilizer nutrients availability to other crops.
- (d) Every entity is supposed to respond to provision of data that is required in order to access the type, quantity and quality of fertilizer in the market.

7 CONCLUSIONS

The main objective of this study was to review fertilizer use by crop and by product as a matter of comparing with data on fertilizer provided in the study conducted in 2013 on **real consumption** (as opposed to apparent consumption) and **fertilizer use by crop data** (FUBC). From this review, many gaps have been identified on the previous work on the actual application rates of fertilizer to crops.

From the study conducted, it was observed that maize crop is still leading in shares of fertilizer use for a period under the study when compared with the results from the Real Consumption of Fertilizer and Fertilizer Use by Crop study in Tanzania in 2013 (Kamhabwa, 2014). Maize has a large share in fertilizer marketing in the country, the level of fertilizer consumption was 131,650 MT in 2014 and went down to about 118,991 Metric Tons in 2015 due to abrupt changes made by the Government on the model of implementing the subsidies in fertilizer. However, it rose to 159,097 MT in 2016. By average, the percentage fertilizer consumption for 2014 – 2016 was dominated by maize (53%) compared to an

average of 67.04% of fertilizer used in 2009 – 2012 period. Next to maize on fertilizer consumption was paddy (12%) and beans (9%).

In 2014 – 2016 the quantity of fertilizer use by some industrial crops were at low level when compared to others. This was mainly contributed by the small area cultivated when compared to large land cultivated for other crops. Furthermore, the study has exposed that actual application rates of fertilizer on traditional cash crops namely as sugarcane, tea and flue and fire - cured tobacco production were almost the same as the recommended application rates. The main reason is that the Crop Boards have direct intervention on policy issues and strategies for the development of crops in order to improve the quality and increase in production through contract and or out - growers schemes with farmers; regulate and control the quality of the crops; collect, refine, maintain, use or disseminate information and data concerning the crops; and enforce the implementation of regulations in respect of farming, marketing, processing, transporting and storage of crops.

The quantity of fertilizer use is still very low despite the fact that the Government has been introducing different initiatives that are aiming to encourage farmers in fertilizer use. The country has a long way to go because of the truth that most croplands of the country have low fertility, and nitrogen is the most limiting nutrient and also phosphorous availability is commonly low. The study revealed that in 2014 – 2017 the average fertilizer use was around 300,000 MT, approximately 10% of fertilizer needed per annum. From the work done, Tanzania need between 2.5 million and 2.7 million tons of organic fertilizer if all cultivated crops are fertilized as per fertilizer recommended application rates.

According to the National Population Projection for 2013 – 2015, Tanzania's population is projected to reach 59.4 million in 2021 and 77.5 million in 2030 when at least 50% of the population will be under 18 years of age (MFP, 2018). From this projection, and from what is being harvested currently to meet food sufficient ratio for the present population, it is highly recommended to the Government of Tanzania to comprehensively address the constraints affecting fertilizer supply and use by smallholder farmers, the macro policy, market development, and technical constraints. This will ultimately improve agricultural productivity for increased economic growth, reduce rural poverty, improve food security to the projected population and recognize the crucial role of improved fertilizer use by farmers in additional to other productivity enhancing inputs to meet national targets for the future.

8 APPENDICES

- 1.1 *Appendix I: Fertilizer Requirement for Crops – Area Cultivated 2014 - 2016*
- 1.2 *Appendix II: Fertilizer Imports, Exports and Apparent Consumption 2014 -2016*
- 1.3 *Appendix III: IFA FUBC Fertilizer Use By Crop Statistics in Tanzania 2014 – 2016*
- 1.4 *Appendix IV : AFO FCBC Tanzania 2014 – 2016*
- 1.5 *Appendix V: Agriculture Statistics in Tanzania 2014 – 2016*
- 1.6 *Appendix VI: Recommended Application Rates (RAR)*

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