FERTILIZER CONSUMPTION AND FERTILIZER USE BY CROP (FUBC) IN KENYA

Study Conducted For Africafertilizer.Org

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ACRONYMS AND ABBREVIATIONS

AFO	African Fertilizer Organization
ASAL	Arid and Semi-arid Land
ARM	Athi River Mining Company
BAT	British American Tobacco
CRF	Coffee Research Foundation
DAP	Di-ammonium Phosphate
EAC	East Africa Community
EAGC	Eastern Africa Grain Council
IFDC	International Fertilizer Development Centre
IDF	Import Declaration Fees
CAN	Calcium Ammonium Nitrate
CIF	Cost, Insurance and Freight
FTWG	Fertilizer Technical Working Group
FUBC	Fertilizer Use By Crop
GDP	Gross Domestic Product
KALRO	Kenya Agricultural and Livestock Research Organization
KEBS	Kenya Bureau of Standards
KEPHIS	Kenya Plant Health Inspectorate Services
KIPPRA	Kenya Institute of Public Policy and Research Analysis
KTDA	Kenya Tea Development Agency
MALF	Ministry of Agriculture, Livestock and Fisheries
MDG	Millennium Development Goal
M&E	Monitoring and Evaluation
MIS	Market Information Systems
MT	Metric Ton
NAAIAP	National Accelerated Agricultural Input Access Programme
NCPB	National Cereals and Produce Board
NPK	Nitrogen Phosphate Potassium
SSP	Single Supper Phosphate
TSP	Triple Super Phosphate
VAT	Value Added Tax
ToR	Terms of Reference

CHAPTER ONE: BACKGROUND INFORMATION

1.1 Introduction

The Kenyan economy is largely agriculture based with the sector accounting for 26% of the Gross Domestic Product (GDP) and 65% of the export earnings. The sector indirectly contributes 25% of the country's GDP through agro-processing, marketing, and other related services. Agriculture provides approximately 70% of informal and 18% formal employment. The agricultural sector is not only important for economic development in the country but is also expected to deliver other regional and global commitments. One such commitment is the achievement of the first Millennium Development Goal (MDG1) on poverty and hunger. Indeed, Kenya Vision 2030 has identified the agricultural sector as one of the key sectors to deliver the 10% annual growth rate envisaged under the economic pillar (GoK, 2008, Kenya Vision 2030). To achieve this growth, transforming smallholder agriculture from subsistence to an innovative commercially oriented and modern agriculture is critical.

Fertilizer policy in Kenya

In an effort to boost food security status, Kenya targets to increase fertilizer consumption to 50kg/ha from the current 31kg/ha by the year 2015. This is envisaged to increase production and crop productivity to ensure food security and income at farm level for the small scale farmers (who make over 80% of the farming community in the country).The increased use of fertilizers is a key factor and this is in line with the Abuja Declaration of 2006 which acknowledges that; *"Fertilizer is crucial for achieving an African Green Revolution in the face of a rapidly rising population and declining soil fertility"*.

Kenya has developed a draft fertilizer policy which is at advanced stage of conclusion. The draft policy sets guidelines for institutionalization of soil fertility management in agriculture and related sectors to arrest the declining trend in soil fertility and ensure increased land productivity. The specific objectives of the policy include promotion of efficient and sustainable use of natural resources (soil and water), provision of framework for developing and applying appropriate soil fertility management techniques, and facilitation of prioritization of soil fertility improvement in national programs.

The Draft policy proposes a fertilizer regulatory directorate to be based at the Ministry of Agriculture and Fisheries headquarters. Moreover, institutions such as Kenya Agricultural Research Organization (KALRO), Kenya Plants Health Inspectorate Services (KEPHIS), and Government Chemist, commissioner of Mines, Ministry of Trade and Kenya Bureau of Standards (KEBS) will be closely involved in fertilizer matters.

Kenya is also involved in the drafting of the East African Community (EAC) Fertilizer Policy which will eventually lead to the EAC Fertilizer Act and Regulations. The team working on drafting of the EAC Fertilizer Policy has come up with priority areas which need regional harmonization and is now working on the draft fertilizer policy. The proposed areas of policy harmonization address the inefficiencies in fertilizer access, price setting, marketing and regulations. The main themes are:

a) Taxation: Ensuring that agricultural inputs are tax free, harmonizing other taxes such as Withholding Tax (WHT) and Value Added Tax (VAT) in all the Partner States.

b) Targeted subsidies to support to Resource Poor Farmers: EAC Partner States have agreed to put in place the following mechanisms to address the challenges associated with subsidies:

c) Each Partner State to design a harmonized food insecure household inputs support facility;

d) Each State to develop a harmonized tool for identifying food insecure households to benefit from the scheme.

e) To ensure accessibility to the inputs, the support system must be farmer centered

f) Privatization / Liberalization: All Partner States to embrace full liberalization to support private sector participation.

g) Importation and infrastructure: To minimize fertilizer prices, there is need for policies in the EAC to facilitate the importation and storage of large quantities of fertilizers. There should also be appropriate financing mechanisms available for the establishment of fertilizer storage facilities especially in member states where these are lacking. These facilities have the advantage of reducing retail prices for the smallholder farmers.

h) Policies to improve and increase fertilizer use: In particular, smallholder farmers should have credit access to purchase agricultural inputs and crop insurance to protect their investments in the event of crop failure.

i) Registration of fertilizers, importers and distributers: In order to reduce trade and access related barriers, procedures for registration of fertilizers, importers and distributers need to be harmonized. This would make it possible for a fertilizer entity that has been registered in one partner State to be exempted from the same registration procedures in the rest of the Partner States.

j) Institutional structure, mandate and roles: Need for Partner State to establish Fertilizer Management Authority to facilitate coordination, regulations, fair play and fertilizer quality controls.

k) Acts/Laws: Need to harmonize all legal instruments related to fertilizer marketing, distribution, storage, pricing, etc.

l) Fertilizer standards: Fertilizer grades, mark labelling, fertilizer classification, packaging, fertilizer contents (Formulation) i.e., ratios, fertilizer quality including moisture content, heavy metal; handling and storage.

m) Procedures: Fertilize sampling and testing, importation and exportation, manufacture, registration of new fertilizers.

1.2 Objectives of the Study

- To provide best estimates of the real fertilizer consumption and Fertilizer Use By Crop (FUBC) statistics for Kenya.
- To assist in designing a cost-effective framework for estimating consumption and FUBC.

1.3 Study Methodology

1.3.1 Approach and conceptual framework

The methodological approach adopted was guided by the Terms of Reference (TORS) for the study that required estimation of actual fertilizer nutrients used by type and by crop type.

Table 1 summarizes the broad items that were used in developing the study concept, the reason for choice of the items as well as the key variables considered under each item. Figure 1 shows the conceptual framework used in the study.

Table 1: Items considered for development of Conceptual Framework

Concept development item	Reasons	Key variables
Fertilizer Supply	Knowledge of quantities of available fertilizer	Import, local manufacturing and blending
Apparent consumption fertilizer	Knowledge of broad trends of fertilizer utilization	Local distribution, exports
Fertilizer use by regions (counties)	To determine spread of fertilizer demand and application; to generate average fertilizer application rates (based on local practices)	County estimated fertilizer use data; regional/localized fertilizer application rates
Fertilizer utilization by crops	To establish actual fertilizer quantities by type used by specific crops	Crop area planted; area applied with fertilizer, average fertilizer application rates by crop types and by region
Fertilizer nutrients utilization	To establish fertilizer nutrients annual uptake by each crop	Fertilizer types used by each crop annually

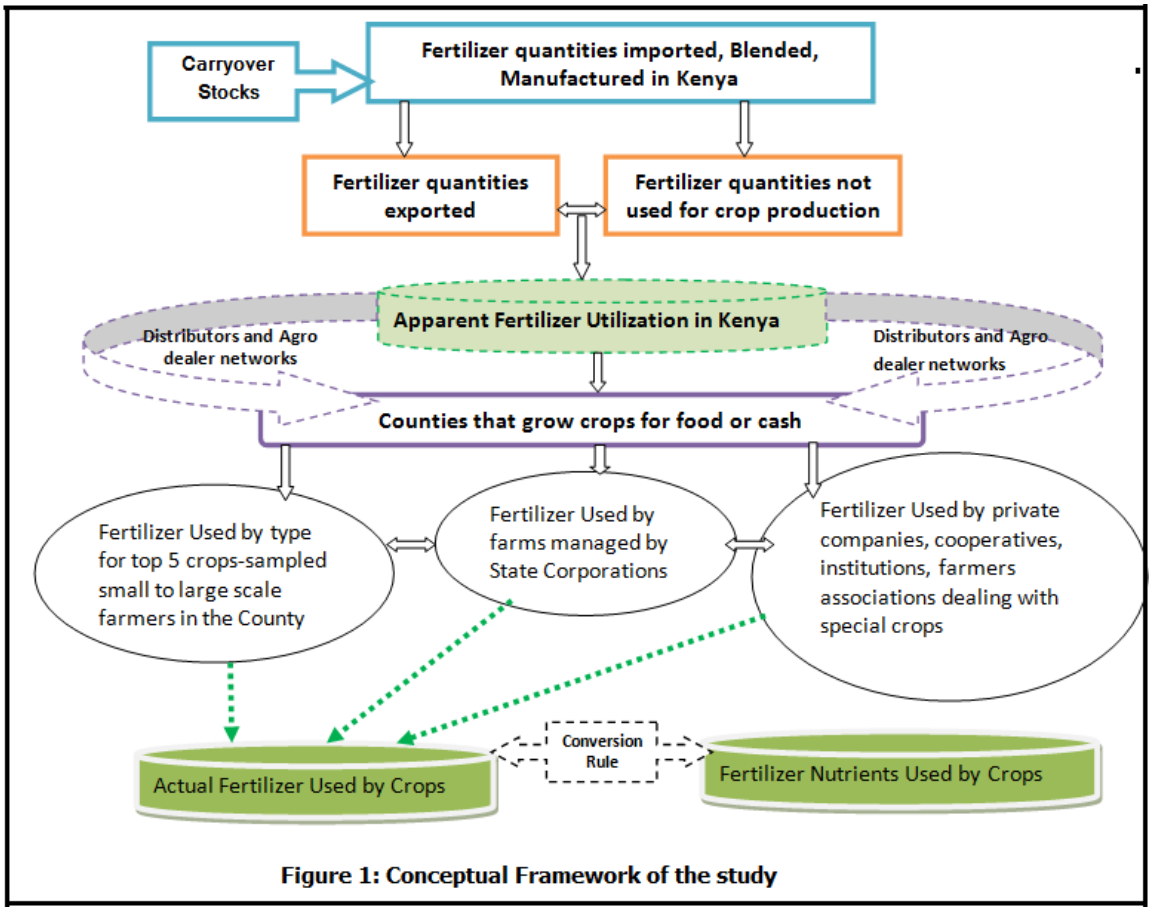

Figure 1: Conceptual Framework for developing the Fertilizer Consumption study for Kenya

1.3.2 Development of Study Tools

The main tools that were used in this study included the following

a) Official introductory letters and official notes for request of data from public and private institutions as well as large scale, commercial farms.

b) Data collection Checklist. These were simple forms with list of data items required. The forms were mainly prepared to be filled in by county field extension officers. Key informant checklist was developed to generate data from key informants.

c) Data collection questionnaires. The questionnaires were developed both for administration and filling in by enumerators as well as for institutions' and individuals' own filling to provide information.

1.3.3 Indicators selection

Fertilizer Imports and Production indicators

Data under this category looked at quantities of fertilizers by type annually imported, manufactured or blended in Kenya by the major players in the fertilizer industry.

Distribution level indicators

The indicators included fertilizer quantities by type distributed to farmers by state corporations that support farmers (e.g. Kenya Tea Development Agency (KTDA), private companies dealing with contract farming involving fertilizer supplies (e.g. BAT), and fertilizer given to farmers through government subsidy programme and other projects.

Regional and Farm level fertilizer use indicators.

The regional indicators looked at the quantities of fertilizer by type used for planting of top five most important crops in the Counties known for crop production as well as average (typical) localized fertilizer application rates for various crops. The farm level indicators looked at crops types that use most of the fertilizers according to average local application rates. This targeted data provided by local extension staff, farmer groups/associations and data from state corporations.

1.3.4 Areas covered under the Study

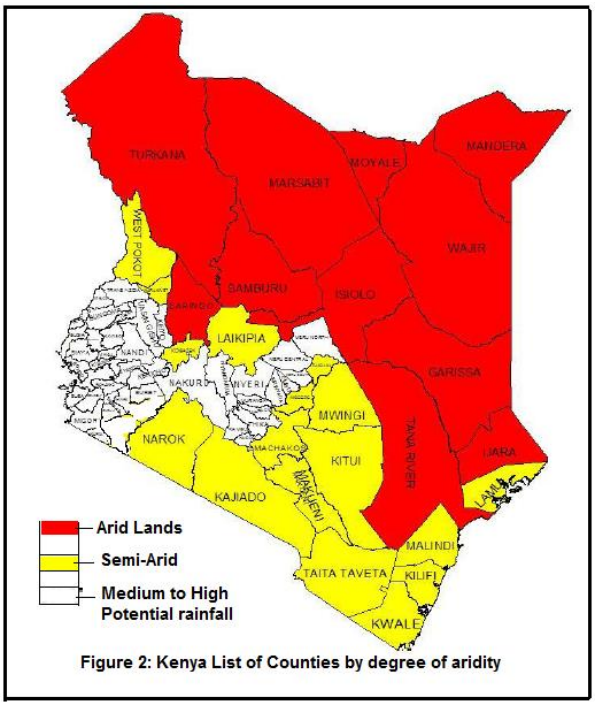

Figure 2: Kenya List of Counties by degree of aridity

The data was obtained from farmers in the major crop production agro-ecological zones. To get the data, the Counties were categorized into Arid and Semi Arid Lands (ASAL) as well at the high and medium rainfall areas (see figure 2). In Kenya, there are 7 Counties that are 10% arid; namely Turkana, Moyale, Marsabit, Isiolo, Wajir, Mandera, and Garissa. No substantial fertilizer-dependent crop production takes place in these Counties and thus were not included in the study. In terms of area size, the 100% arid Counties occupies 56% of the total land mass. The next category is the Counties with 85-100% aridity. These Counties, which constitute 21% of total land mass, include Kitui, Makueni, Tana River, Taita Taveta, Kajiado, and Samburu. In these Counties, fertilizer-dependent crop production is mainly carried out in the irrigation schemes, which are mostly managed by the National Irrigation Board as well as government State Corporations. In this category of Counties, data was mainly obtained from the major irrigation schemes. Within ASAL, the last category is those that are 50-85% arid, representing 8% of the total land mass. In these Counties, some portions or Sub-counties (Districts) may be arid while other portions are not arid. The Counties in this category include Machakos, Mwingi, Tharaka Nithi, Laikipia, West Pokot, Baringo, Kwale and Kilifi. In these Counties, the survey process involved delineating and separating the arid portions at administrative level. These arid portions or Sub-counties were left out of the study due to lack of substantial fertilizer-depended crops. Data for the study in these counties were therefore collected only in the Sub-counties with medium to high rainfall. For the remaining

Counties that are classified as medium to high rainfall areas, data was collected through survey reports. The Counties include Kisumu, Siaya, Homa Bay, Kisii, Nyamira, Migori, Busia, Kakamega, Bungoma, Uasin Gishu, Trans-Nzoia, Bomet, Nandi, Narok, Kericho, Nakuru, Elgeyo Marakwet, Nyandarua, Kiambu, Murang'a, Kirinyaga, Nyeri, Meru, Embu, Mombasa and Lamu.

1.3.5 Data Collection Methods

The following are the data/information sources and collection methods used in the study:

Review of documentary evidence- This considered research publications on agro-ecological zones; crops grown in various zones; soil and weather patterns of the zones; and recommended fertilizers and application rates for each zone and by crop variety based on national field extension guide book[i].

Collection of secondary data- These data were obtained from existing crop production as well as fertilizer supplies and distribution reports available at the headquarter office of the State Department of Agriculture, County Agricultural Offices, private farms, farmers associations, among others. Other secondary data were obtained from fertilizer study reports from multilateral organizations (FAO statistics), and research institutes like Tegemeo (2009, 2006[ii])[iii] and KALRO (20006) [iv]as well as data from regulatory bodies such as KRA and KEPHIS[v]. Substantial data was obtained from reports of State Corporations (details in appendix 1) as well as private companies that deal with crops production in Kenya.

Collection of primary data- This involved receiving data from different fertilizer stakeholders.

Farm level crop production data: For farmers operating privately, data covered top 5 crops grown in each County that use fertilizer, planted crop area in 2011, 2012 and 2013; average estimated Ha planted by small and large scale farmers; types of fertilizers used as basal as well top dressing material; average fertilizer application rates in Kg per Ha, and average quantities of fertilizer type applied per Ha per crop based on long-term application rates provided by local field extension officers. Appendix 2 shows example of Meru County and the excel sheet used to estimate the fertilizer consumption by crop.

Agro-dealer survey: a structured questionnaire was administered by enumerators through mailing as well as face to face interview.

Key informant interviews: in the fertilizer industry: semi-structured questionnaire was used to obtain data either through email or telephone interviews. The questionnaires were also posted to some of the key informants.

1.3.6 Data Management and Analysis

Primary data collected from households and agro-dealers were entered, cleaned, analyzed and stored using excels spreadsheet. Descriptive methods of analysis were used showing the frequencies, proportions, means and where necessary the mode and the spread. Statistics were generated for each fertilizer type used for each crop by County and conversion of fertilizer types into fertilizer nutrients used by each type for each type of key crop per county.

1.3.7 Limitation of study

Despite the great success in implementing this, a few limitations/obstacles were observed and should be reported to allow the results of this study to be interpreted within these confines. The main limitations of this study stem from the low response rate from the industry. There were many cases of unwillingness to participate, non-response or delayed response to requests for information by players in fertilizer and output markets. Due to lack of actual field surveys (data captured past years), it was not easy to establish actual sampling sizes, thus the study had to rely on proxy sample sizes reported by those who collected data. Due to time and financial constraints, the study team could not interview sufficient numbers of key informants. Following devolution process, challenges in getting corporation and support was not amongst some County officials leading to many cases of incomplete or missing information.

CHAPTER TWO: FERTILIZER MARKET IN KENYA

2.1 The Fertilizer Market

Most of the fertilizer used in Kenya is imported from various countries in Europe, United States of America, South Africa and North African countries. Only 10,000 MT of Single Super Phosphate (SSP) are manufactured in the country by KEL Chemicals Company based in Thika town. In 2013, it was estimated that the apparent fertilizer consumption in the country was 665,373 MT comprising about 37 fertilizer types. Over 95 percent of these fertilizers was used for crop production, with about 5% used for fodder and pasture production.

2.2 Fertilizer Trade in Kenya

2.2.1. Major Fertilizer importers

There are about 64 importers of fertilizers to Kenya but the most active are 18. The 18 importers supply supply fertilizer to both the large scale and small scale farmers. Most of the imported fertilizer (70%) arrives arrives as bulk cargo (not bagged), the greatest challenge is therefore in adulteration and sale of underweight fertilizer which mainly occurs during bagging and re-bagging. Some 20 – 25% of fertilizer that fertilizer that leaves the port is re-bagged mainly at the retailer level due to the high demand of fertilizer fertilizer in smaller units.

Table 2 shows list of main fertilizer importing companies in 2013.

Table 2: Main fertilizer importing companies in Kenya in year 2013

IMPORTER	QUANTITY (MT)	%SHARE
Yara East Africa	169,416.0	24.7
Mea Ltd	120,032.0	17.5
Export Trading Limited	92,393.0	13.5
Kenya Tea Development Agency(KTDA)	64,697.0	9.4
Turbo Highways	62,390.0	9.1
Louis Dreyfus Commodities Ltd	34,284.0	5.0
Ministry Of Agriculture	27,493.0	4.0
National Cereals and Produce Board(NCPB)	23,954.0	3.5
Devji Meghji Bros Ltd (DMBL)	23,355.0	3.4
Elgon Kenya Limited	17,644.0	2.6
Supplies And Services Limited	16,026.0	2.3
Afriventures	12,564.0	1.8
Amiran Kenya Limited	2,793.0	0.4
Athi River Mining(ARM)	2,542.0	0.4
Agroexim Agencies	2,375.0	0.3
British American Tobacco(BAT)Limited	1,275.0	0.2
Others	13,194.0	1.9
TOTAL	**686,427.0**	**100.0**

Source: KRA

2.2.2. Fertilizer production

Local fertilizer blending in Kenya is done by MEA Limited and Athi River Mining (ARM) Company. These companies have a capacity to blend up to 100,000 and 30,000 Metric tons of fertilizer per year respectively. The blends from these companies are either soil or crop specific. For example blends from ARM, popularly known as Mavuno fertilizers, contain eleven elements including trace elements. The feedstock for fertilizer blending is imported while other materials are found locally. The imported materials include Diammonium Phosphate (DAP), Murate of Potash (MOP), Urea as well as trace elements such as Zinc, Manganese, Copper, Boron and Molybdenum. The locally available materials used in blending include Gypsum and limestone. In order to enhance quality of blended fertilizers, the Kenya Bureau of Standards (KEBS) has developed a code of conduct for fertilizer blenders that should be followed strictly by all blenders.

2.2.3. Major Distributors

There are three main types of fertilizer distribution channels serving the farming community in Kenya. The first is the commodity-based interlinked input-credit-output marketing systems typified by the Kenya Tea Development Agency (KTDA) fertilizer distribution model. In this system, farmers, especially smallholders, are given credit in form of physical farm inputs purchased in bulk by supporting agency that also distributes the fertilizer to supported farmers. The other fertilizer distribution system involves network of private, independent importers, wholesalers, and retailers operating on a demand and supply basis. Distributors in this system are estimated to be 8,000 agro-dealers working with about 3,000 wholesalers and retailers. The third distribution category involves Government procurement of fertilizer, distribution and sale of fertilizer to targeted needy farmers at subsidized prices under the fertilizer price stabilization plan. Under this arrangement, governments distribute fertilizers to farmers through NCPB which has 180 NCPB depots countrywide. Table 3 details the quantities of fertilizer procured and supplied to farmers under the fertilizer subsidy programme while Figure 2 gives a summary of fertilizer imports and distribution channels in Kenya.

Table 3: Quantities of Fertilizer Procured by Government of Kenya

Financial Year	Quantity Procured (MT)	Treasury allocation for Fertilizer Procurement (Kshs. M)
2009/2010	16,624	758
2010/2011	96,000	2,995
2011/2012	94,155	3,320
2012/2013	66,276	3,150
2013/2014	171,750	3,900
Total	**444,805**	**14,123**

Source: State Department of Agriculture; Agribusiness Directorate

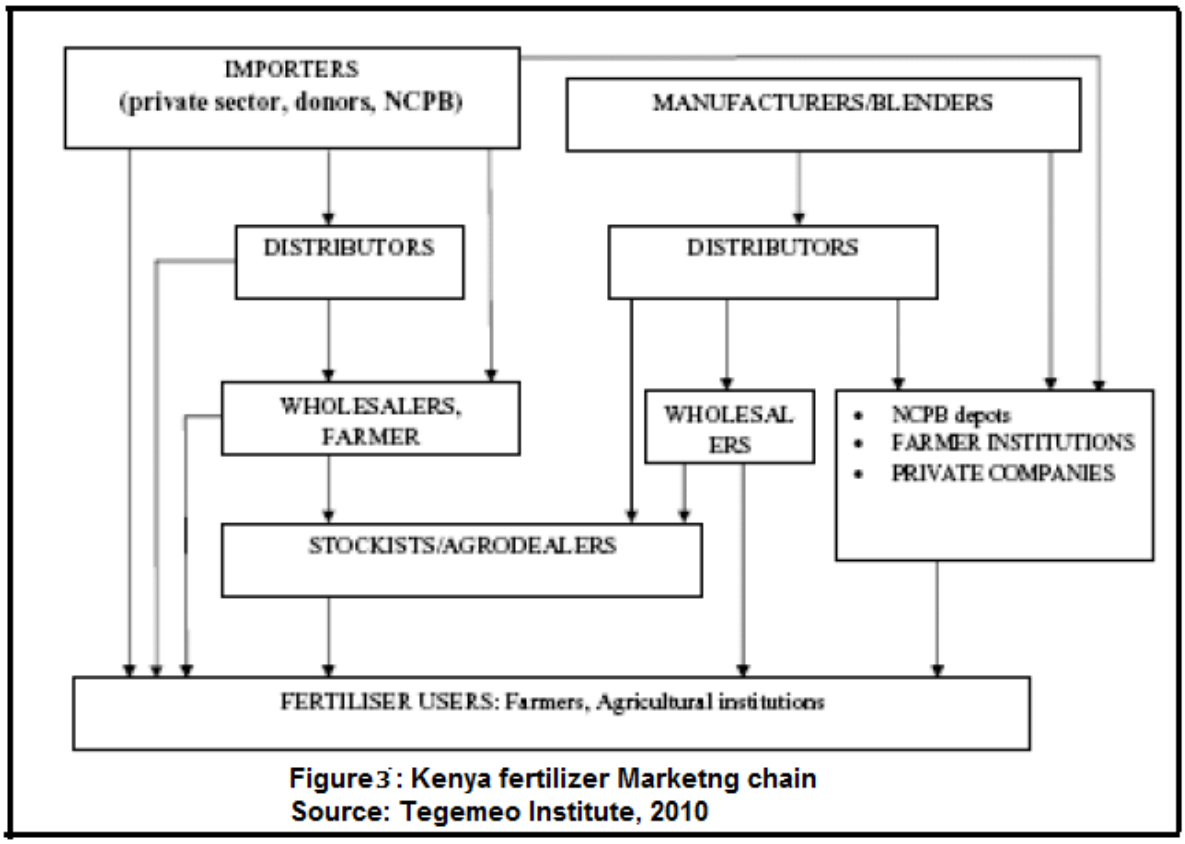

Figure 2: Fertilizer value chain for Kenya

2.2.4. Wholesale and Retailers

There are about 800 agro-dealers (farm inputs stockists) in major cities, towns and market centers that sell fertilizer on wholesale and retail basis. The stockists keep up to 500 bags of various types of fertilizers, with large volumes stored mainly during the planting seasons. These type of traders play a very crucial role in the fertilizer value chain by ensuring that fertilizers are accessible to the farmers. Some stockists have been trained by various projects on fertilizer storage and management, as well as farmers' education on fertilizer use (Okello *et al,* 2010[vi]).

2.2.5 Other important stakeholders in the fertilizer industry

To ensure fertilizer quality, fertilizer analysis is undertaken largely by government institutions and to a smaller extent, private laboratories. Those in the public category include:

- National Agricultural Research Laboratories (NARL) at Kabete, Nairobi
- Kenya Plant Health Inspectorate Services (KEPHIS) laboratory at Nairobi
- Mines and Geological Department laboratory
- Kenya Bureau of Standards Analytical Laboratory
- The Government Chemist

The private laboratories include:

- SGS LABS (K), Nairobi
- GMP/ACCL LABS, Nairobi

- INTERTEK, Nairobi
- Crop Nutrition Laboratory Services Ltd, Nairobi
- Polucon Services (K) Ltd, Laboratory Department, Mombasa
- MEA Ltd Nakuru

2.3. Fertilizer Prices

Fertilizer utilization is highly dependent on prevailing fertilizer prices. In Kenya, fertilizer prices witnessed period of general increasing prices between 2007 to 2011. According to Future agricultures (2008[vii]), the price increases were influenced by several global factors including increased fertilizer demand due to higher food prices and increased use in biofuel production. Moreover, supply was affected by increasing energy costs (which are particularly important in producing nitrogenous fertilizers), the introduction of export tariffs on some fertilizers (for example by China in April 2008), and capacity limits in expanding production to meet rising demand – particularly for phosphate rock.

Figures 3, 4 and 5 show the fertilizer retail cost trend in Kenya in 2011, 2012 and 2013, respectively.

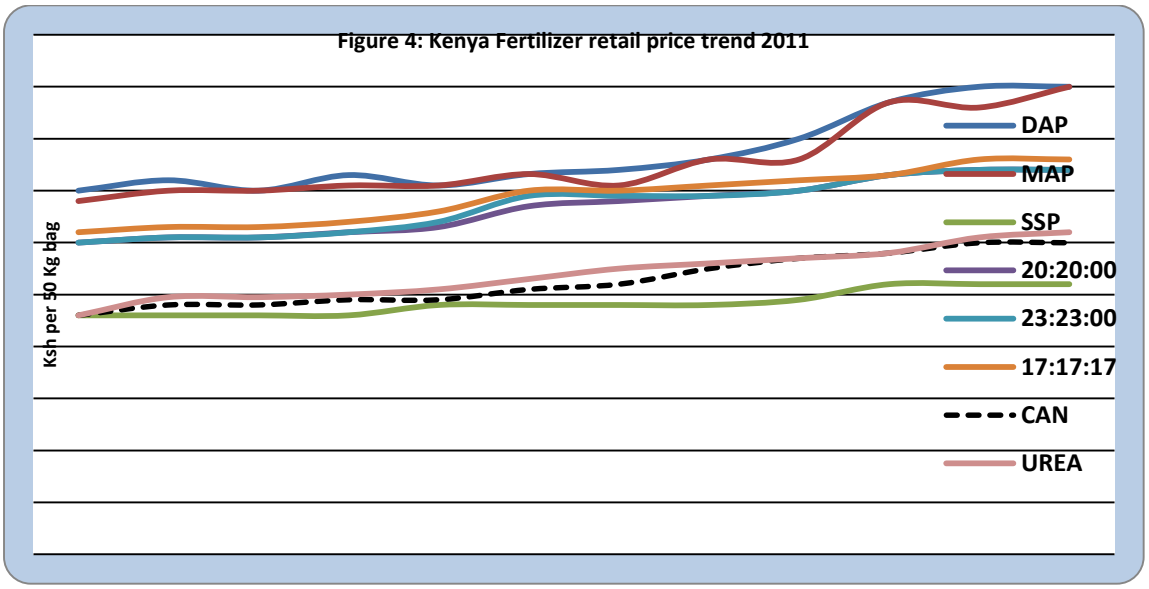

Figure 3: Fertilizer retail price trends in 2011

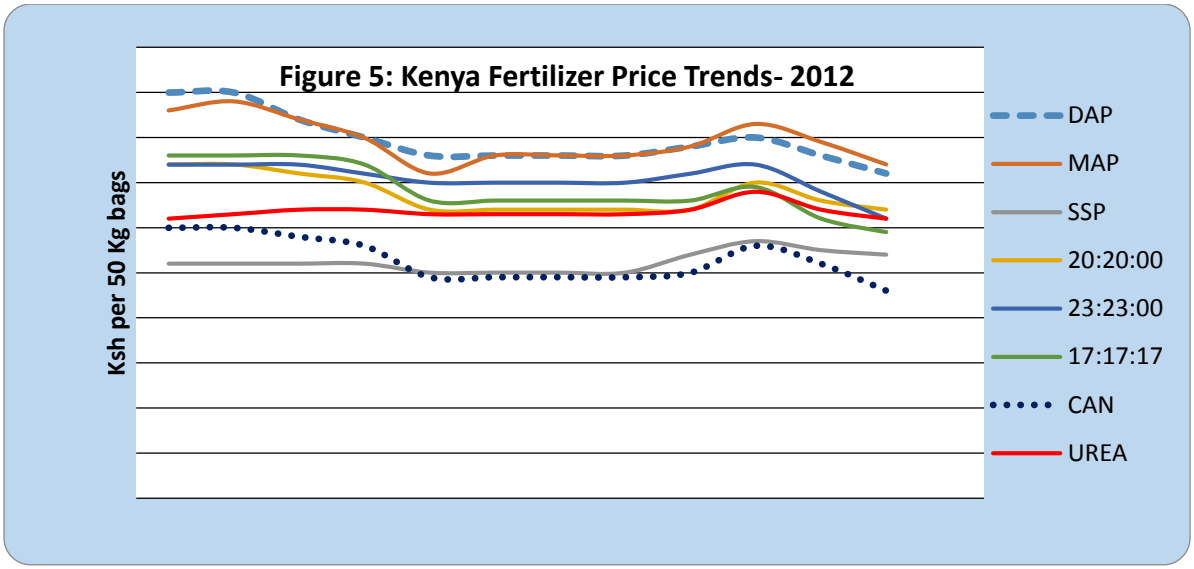

Figure 4: Fertilizer retail price trends in 2012

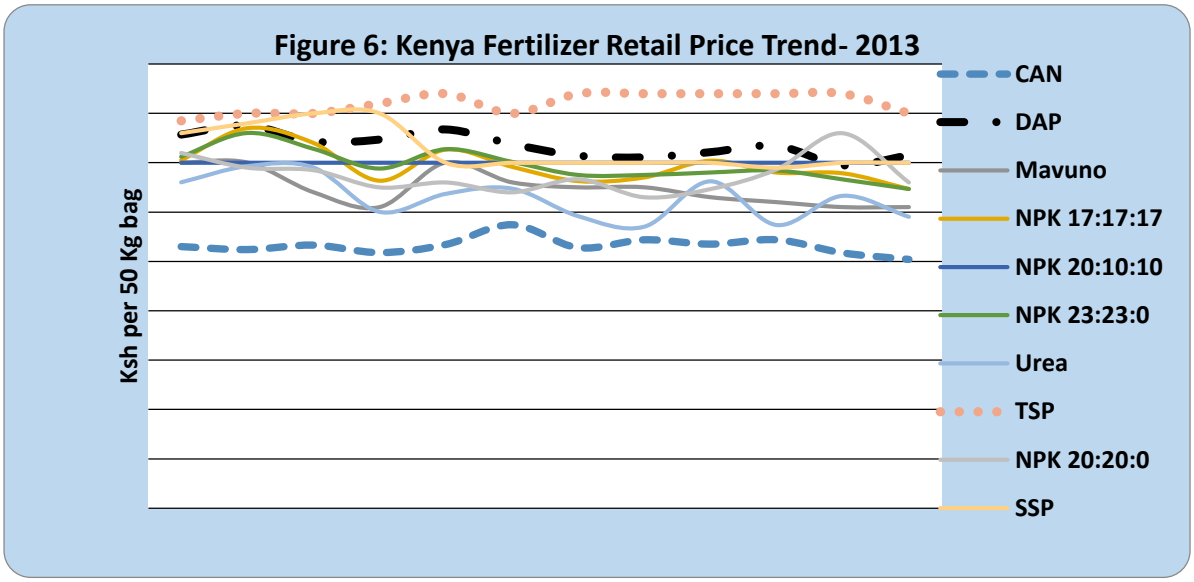

Figure 5: Fertilizer retail price trends in 2013

CHAPTER THREE: SWOT ANALYSIS OF METHODOLOGIES USED IN KENYA TO COLLECT FERTILIZER UTILIZATION DATA

3.1 The main data sources

Data type	Main data source	SWOT elements	
1. Data on Imported and exported fertilizers	Kenya Revenue Authority (KRA), Kenya Bureau of Statistics, Kenya Bureau of Standards	Strength	i) Have legal authority to access data; ii) Have good records of inputs inflows and outflows; iii) Easy means of getting data
		Weaknesses	i) KRA: mix up of various fertilizers with non-fertilizers ii) Importers evading taxes change inputs codes and names iii) Data not given frequently; delays lead to difficulties of sorting out mixed fertilizer codes
		Opportunities	i) Training of officials on identification of none fertilizer inputs; ii) Timely data access to ease sorting of mixed fertilizers; iii) Attaching a trained agricultural statistician to work with institutions such as KRA to handle agricultural inputs statistics; iv) Use of relevant computer software to help in automating data analysis and validation
		Threats	i) Few staff availability to undertake extra duties of data management; ii) Lack of fertilizer quality control and imports/exports regulatory framework
2. Data on blended fertilizers	Private companies undertaking fertilizer blending and sales	Strength	i) Data fairly accurate;
		Weaknesses	i) Difficulties of getting data from some companies due to fear of competition ii) Some blends have complex nutrient mixtures hence difficult to classify;
		Opportunities	i) Almost all companies are in Nairobi, hence easy to access; ii) Liaison with association members to enhance data collection;
		Threats	i) Lack of legal framework controlling data provision to government; ii) Low awareness by managers of some companies on the value of data provision to the government.

3. Data on fertilizer distribution and uptake by farmers	i) State Corporations given mandate to promote development of a specific crop e.g. Tea, coffee; government of Kenya, private traders, wholesalers and retailers	Strength	i) Accessible and reliable data where the government or state corporation is directly involved in provision of fertilizers to farmers; ii) Easy way of getting data through published reports; iii) Ease of estimating fertilizer consumption by crops due to good farmer records, et tea and coffee
		Weaknesses	i) Many state corporations have poorly trained agricultural statistics officials; ii) Difficulties of accessing historical data due to poor data archiving practices
		Opportunities	i) Introduction of modern technology to enhance data collection and dissemination; ii) Mass training of officers on simple techniques of fertilizer data use estimation iii) Support by officials from Kenya Bureau of Statistics with relevant experiences;
		Threats	i) Recent merger of some state corporations leading to lack of clarity of data sources; ii) Government changes of fertilizer subsidy system to avoid direct purchase and supply may lead to limited access to data.
4. Data on actual fertilizer used by crop and by regions	i) County Extension offices, national government offices	Strength	i) Large number of extension officers responsible for data collection at grassroots; ii) Ease of getting some accurate data from farmers' or cooperatives' records; iii) Cheap way of data collection and management
		Weaknesses	i) Field officers heavy work load ii) Inadequate funds to support elaborate field mobility; iii) Lack of skills on fertilizer use data collection methods iv) Lack of proper sampling and survey methods v) Officers at HQ office handling revenant statistics are few and very busy
		Opportunities	i) Experienced crops and agribusiness officers deployed at County and Sub-county level assisting with data validation ii) Introduction of modern technology to enhance data collection and dissemination; iii) Mass training of field officers on simple techniques of fertilizer data use estimation

			iv) Support by officials from Kenya Bureau of Statistics with relevant experiences;
		Threats	i) Poor cooperation by field officers in the devolved Counties; ii) Aging field extension staff iii) Inadequate staff deployed to handle statistics at HQ office
5. Data on fertilizer consumption rates, fertilizer use by soil types and other secondary data	Research institutions such as KALRO, Agricultural Universities such as Tegemeo Institute	Strength	i) Data tends to be accurate ii) Data sources fairly accessible
		Weaknesses	i) Lack of consistency in data supply ii) Difficulties of accessing soft data
		Opportunities	i) Enhanced stakeholders' collaboration ii)
		Threats	i) Inadequate stakeholders' collaboration ii) Few institutions dedicated to data collection and dissemination

3.2 Methodologies and tools used for data collection

Type of data collection	**Brief description of Methodology and tools used**	**SWOT elements**	
1. Estimation of apparent fertilizer consumption data	i) Raw data on imported, manufactured, blended or exported fertilizer is obtained annually through regulatory bodies such as KRA or from published reports prepared by agencies involved. ii) Raw data is cleaned to remove non-fertilizer data. iii) Apparent consumption is calculated by deducting amount exported from amount imported or manufactured.	Strength	i) Easy method of calculating fertilizer use; ii) Ease of getting data from government established institutions; iii) All key players captured, no sampling required
		Weaknesses	i) Need for detailed cleaning and validation of the data from array of experienced stakeholders ii) Data does not include carryover stocks; iii) Statistics does not reveal fertilizer used by crop type
		Opportunities	i) Identifying persons dealing with such data in the institutions involved and training them on how to record fertilizer data to minimize wrong entries;

			ii) Improving definitions of fertilizers to help differentiate non-fertilizers; iii) Attaching a trained agricultural statistician to work with institutions such as KRA to handle agricultural inputs statistics; iv) Use of relevant computer software to help in automating data analysis and validation
		Threats	i) As economy grows and use of fertilizer increases, more cleaning and validation required; ii) Challenges of getting experts who know all types of fertilizer to assist in data cleaning
2. Data on fertilizer imports and exports	i) Letter written to private companies involved together with NCPB, KTDA, BAT, etc. ii) Questionnaires given to be filled in by the concerned agencies iii) Enumerators hired to take up the letters and questionnaires to the companies and get back results	Strength	i) Tools easy to develop; ii) Accurate data where response is given
		Weaknesses	i) Not all companies giving ready data leading to need for several visits; ii) High cost of hiring data collectors; iii) Data collection can be affected by timing of event, eg in this case, data was being collected near December holidays when many firms where not in full operations
		Opportunities	i) Enhanced stakeholders collaboration; ii) Data can be obtained better if more time and prior notice is given; iii) Application of modern technology to enhance data collection and management iv) Explaining purpose of survey to enhance good understanding
		Threats	i) Lack of legal framework to support data provision;
3. Fertilizer use by crop data estimation through public	i) Letter written to county offices requesting for data; simple form given to be filled in by counties to provide data.	Strength	i) Large number of extension officers responsible for data collection at grassroots; ii) Easiest way to get data from farmers' records;

agricultural extension staff	ii) Field officers given time to collect data and ask for any clarification. iii) Data from counties submitted to national office through emails.		iii) Cheap way of getting data
		Weaknesses	i) Many field officers not understanding work details due to lack of training ii) Low response rates due to lack of motivation; iii) Lack of good office records on farm inputs in general;
		Opportunities	i) Introduction of modern technology to enhance data collection and dissemination; iii) Training of field officers on simple techniques of fertilizer data use estimation iv) Support by officials from Kenya Bureau of Statistics with relevant experiences;
		Threats	i) Cooperation by field officers in the devolved Counties; ii) Officers demanding for large amounts of money due to difficulties of accessing data iii) Risks of paying field officers but no work done
4. Fertilizer use by crop data estimation through private institutions and state corporations giving fertilizers to farmers	i) Letter written to Managers of private companies or state corporation requesting for data; simple form given to be filled in by farm managers to provide data. ii) Farm/operations managers given time to collect data and ask for any clarification. iii) Data submitted to national office through hired enumerators or emails	Strength	i) Private companies have accurate data; ii) There are relatively few companies; are concentrated in Nairobi hence easy access; iii) Cheap way of getting data
		Weaknesses	i) Some private companies not willing to cooperate ii) Low response rates leads to more time needed for follow up hence; iii) Data collection approach should consider timing, ie not close to Charismas Holidays when most office managers are out in holiday
		Opportunities	i) Awareness creation on importance of sharing data with government; ii) Data can be obtained if request is made in time;

		Threats	i) Lack of legal framework to enforce provision of data by private sector; ii) Limited budget to support elaborate survey

CHAPTER FOUR: STUDY RESULTS AND MAIN FINDINGS

4.1 Crop Production in Kenya

Kenya produces a wide range of crops that use various types of fertilizers. The main food crops are categorized into cereals and pulse crops (maize, wheat, rice, sorghum, millet; beans, chick pea, beans, cow pea and green gram), roots and tuber crops (potatoes, cassava, yams, sweet potato) and oil crops (ground nuts, sunflower, sesame). The main cash crops include tea, coffee, sugarcane, tobacco, pyrethrum, and sisal. Kenya also produces several horticultural crops as well as flowers, both for consumption and also for export. Besides commodity crops, Kenya also produces a wide variety of seeds. The national area, production and average yields of specific crops in the country from 2011 to 2013 is summarized in Table 4.

Table 4: National Area, Crop Production and Yield for 2011- 2013

Crop	Year 2011			Year 2012			Year 2013		
	Ha	Production-MT	Yield MT/Ha	Ha	Production-MT	Yield MT/Ha	Ha	Production-MT	Yield MT/Ha
Maize	2,131,887	3,376,862	1.6	2,159,321	3,749,880	1.7	2,123,138	3,592,688	1.7
Wheat	131,509	268,482	2.0	148,703	444,374	3.0	131,309	485,847	3.7
Beans	1,048,435	551,406	0.5	1,058,941	644,597	0.6	1,083,885	813,259	0.8
Rice	22,966	91,055	4.0	30,206	140,565	4.7	36,949	154,010	4.2
Sorghum	254,125	159,877	0.6	223,800	166,627	0.7	222,015	1,592,337	7.2
Millet	111,304	76,118	0.7	118,378	74,888	0.6	88,049	641,024	7.3
Cowpeas	197,980	81,534	0.4	214,492	113,803	0.5	192,345	1,226,822	6.4
Green Grams	159,910	70,225	0.4	376,831	183,649	0.5	174,320	796,750	4.6
Pigeon peas	138,708	7,588	0.1	286,423	178,780	0.6	144,218	731,831	5.1
Sweet Potatoes	66,971	859,549	12.8	66,971	859,549	12.8	63,598	1,150,359	18.1
Cassava	69,169	893,122	12.9	69,169	893,122	12.9	72,482	1,111,951	15.3
Irish Potato	119,598	1,470,562	12.3	119,598	1,470,562	12.3	126,243	1,565,054	12.4
Cocoa Yam	9,644	117,113	12.1	9,644	117,113	12.1	11,148	114,540	10.3
Tomatoes	20,339	434,161	21.3	21,874	444,860	20.3	23,866	494,037	20.7
French Beans	3,755	30,649	8.2	4,227	33,519	7.9	4,528	38,398	8.5
Snow peas	1,979	11,566	5.8	2,014	11,772	5.8	2,470	16,538	6.7
Garden Peas	9,456	44,326	4.7	10,704	46,112	4.3	13,782	60,855	4.4
Spinach	4,651	46,767	10.1	4,651	46,767	10.1	4,784	74,782	15.6
Cabbage	17,950	490,020	27.3	19,251	503,357	26.1	25,334	762,263	30.1
Kales	27,681	332,188	12.0	28,735	366,770	12.8	28,564	398,535	14.0
Carrots	4,090	76,945	18.8	3,690	169,424	45.9	5,052	235,056	46.5
Onions	6,750	96,908	14.4	7,043	96,922	13.8	7,730	123,331	16.0
Banana	54,266	1,140,201	21.0	58,003	1,207,841	20.8	60,154	1,375,516	22.9
Mango	51,653	543,662	10.5	43,777	520,032	11.9	46,980	581,290	12.4
Passion Fruits	3,687	39,567	10.7	3,743	39,567	10.6	4,377	62,207	14.2
Oranges	5,941	61,030	10.3	5,941	61,030	10.3	7,494	99,432	13.3

Lemons	1,015	10,658	10.5	965	9,132	9.5	1,135	16,381	14.4
Pineapples	6,290	120,972	19.2	3,743	39,567	10.6	6,290	120,876	19.2
Melons	4,707	107,347	22.8	2,121	36,075	17.0	2,006	35,082	17.5
Flowers	12,880	102,360	7.9	13,112	108,306	8.3	12,165	103,770	8.5
Seeds	14,350	46,793	3.3	15,849	52,984	3.3	12,133	29,160	2.4
Coffee	109,795	65,446	0.6	108,716	47,233	0.4	108,220	68,978	0.6
Tea	124,145	112,239	0.9	190,600	169,400	0.9	198,657	98,138	0.5
Sugar Cane	213,610	5,822,633	27.3	213,710	5,822,633	27.2	213,780	5,822,633	27.2
Tobacco	14,828	22,539	1.5	14,380	20,707	1.4	15,025	15,927	1.1

Source: State Department of Agriculture; Crops Directorate

4.2 Types of Fertilizers Used in Kenya

Kenya farmers use a wide variety of inorganic fertilizers for production of different crops. The fertilizers used in large volumes are those applied to food crops, horticulture and industrial crops. Table 5 shows the top ten most important fertilizers used in Kenya as well as the group of crops on which the fertilizers are applied.

Table 5: Top ten most utilized fertilizers in Kenya

Fertilizer type	**Estimated apparent consumption in MT**	**Main crops fertilizer used on**
1. Di-Ammonium phosphate (DAP)	267,988	Cereals, horticulture
2. Urea	111,123	Cereals, sugarcane
3. CAN	99,898	Cereals, horticulture, coffee
4. NPK 26:5:5	63,966	Tea
5. NPK 25:5:5:5S	25,185	Tea
6. NPK 23:23:0	20,819	Cereals
7. Calcium Nitrate	16,056	Flowers and vegetables
8. Ammonium Sulphate	15,930	Rice
9. NPK 17:17:17	13,288	Coffee and fruits
10. Muriate of Potash (MOP)	6,014	Fruits and sugarcane
TOTAL	640,267	

Source: Kenya FUBC Study Results, 2015

4.3 Fertilizer apparent Consumption

The apparent fertilizer consumption is deduced from quantities of annual imported fertilizers compared to annual fertilizer exports. Table 6 shows Kenya's apparent consumption of major fertilizers by type in Metric Tons between 2011 and 2013. Di-Ammonium Phosphate (DAP), Urea and CAN are the most apparently consumed fertilizers followed by various blends of NPK, Calcium Nitrate and Ammonium Sulphate.

Table 6: Apparent Consumption of Fertilizer in Metric tons

Fertilizer Type	**2011**	**2012**	**2013**
Phosphate rock	6,550	2,241	4,578
Ammonia, anhydrous	26	21	56
Ammonium Hydroxide	179	64	136
Magnesium Nitrate	53	50	692
Magnesium Sulphate	1	352	108
Potassium nitrate	1,646	1,685	995
Organic material, total	..	104	346
Urea	27,295	63,480	111,123
Ammonium sulphate	9,294	13,181	15,930
Ammonium nitrate	395	96	23
Calcium ammonium nitrate	131,363	53,000	99,898
Sodium nitrate	24	16	9
Calcium nitrate	10,371	7,843	16,056
Calcium Cyanamid		21	
Urea and ammonium nitrate solutions	..	..	
Other straight nitrogen	491	215	85
Superphosphate	754	749	596
Superphosphate above 35%	486	3,825	552
Potassium chloride (Muriate of potash)	1,887	4,410	6,014
Potassium sulphate	718	1,134	1,202
Other Straight Potash	..	..	
NPK complex >10kg			
NPK 26 5 5	70,372	64,215	63,966
NPK 25 5 5 + 5S	6,499	21,605	25,185
NPK 17 17 17	4,406	10,217	13,228
NPK 25 5 10	5,000	..	5,000
NPK 27 6 6 + 2S	2,055		4,980
NPK 14 14 20 + 1.5MgO + TE	3,737	4,072	2,975
NPK 20 10 10		18	2,140
Other NPK	6,432	23,334	1,809
Other NPK Unknown grades	3,607	4,411	..
Diammonium phosphate (DAP)	176,531	125,344	267,988
Monoammonium phosphate (MAP)	..	677	878
Other nitrogen & phosphates compounds(NPK 23:23:0 &NPK 20:20:0)	19,458	11,954	20,813
Other nitrogen & phosphorus compounds	..	..	16
PK compounds	159	121	22
NK compounds other than Potassium nitrate	3	21	466
TOTALS	**493,572**	**424,794**	**665,373**

Source: Kenya FUBC Study Results, 2015

4.4 Fertilizer application Rates

Study results from extension officers and other stakeholders showed that in Kenya, fertilizer application rates is highly influenced by farmers' level of education, levels of crop profitability, historical practices (such as introduction of fertilizer use in the region by colonial governments), soil types and farmers' adoption of modern farming practices. According to Tegemeo Institute (2009), fertilizer dosage rates is widely affected by Agro-regional positioning of the farmers. Table 7 shows average farm households' fertilizer dosage or fertilizer application rate established per Agro-Regional Zones through panel study of sampled farmers by Tegemeo Institute.

Table 7: Tegemeo Panel Study Fertilizer application rates

Fertilizer Doze Rates (Kgs/acre)					
Year		1997	2000	2004	2007
Marginal Rain Shadow		26.1	31.7	33.4	28.6
Central Highlands		105.9	121.4	103.2	96.1
Western Highlands		30.4	44.5	51.1	46.7
High Potential Maize zone		63.4	62.8	66.9	70.9
Western Transitional		37.4	69.8	51.6	54.4
Western Lowlands		59.3	42.5	9.8	18.7
Eastern Lowlands		27.5	13.8	11	16.5
Coastal Lowlands		18.1	2.3	4.5	5.6
Overall Sample		64.8	72.1	64.8	63.2

Source: Tegemeo (2009)[viii]

The fertilizer use recommendations were last developed in the 1980's under the Fertilizer Use Recommendation Project (FURP). Since then occasional recommendations are provided through the Kenya Agricultural and Livestock Research Organization (KALRO). A follow up verification exercise was done under the Fertilizer Extension Project (FEP) in early 1990's. More recently in 2014 through the NAAIAP project, recommendations were made for maize and other food crops such as potatoes, beans and peas in 164 sub counties.

Within the Ministry of Agriculture, field extension officers follow Field Extension manual that indicates recommended rates of fertilizer for various crops in Kenya. The fertilizer rates Table 8 shows recommended application rates of most fertilizers by crops based on the Field Extension Handbook published in 2012.

Table 8: Kenya Recommended Fertilizer Application Rates

CROP TYPES	**Planting Recommended Rates Kgs/Ha**	**Top Dressing Recommended Rates Kgs/Ha**	**Others Recommended Rates Kgs/Ha**	
BARLEY- Normal	DAP- 90	CAN- 300		
		ASN- 90		
BARLEY- Malting	DAP- 90	CAN- 180		
	MAP: 100	ASN- 90		

MAIZE	DAP: 150-200	CAN: 250		
	TSP: 150	UREA: 150		
	Mavuno: 150			
	NPK: 23:23:0- 200			
WHEAT	New land (virgin)	NPK 11:52:0 -130		
	2nd year crop	D.A.P 130		
	3rd year crop	D.A.P 109		
	4th year crop	D.A.P 87		
	Over 4 years	NPK 20:20:0 200		
RICE	DAP: 100	SA: 180	Nursery: DAP: 160	
	NPK 17:17:17 -100	CAN: 100		
	NPK 23:23:0 100			
MILLET	DAP: 120	CAN: 125		
	MAP: 180			
SORGHUM	DAP: 120	CAN: 100		
	MAP: 180			
	NPK 23:23:0 100			
BEANS	DAP : 200			
	NPK 23:23:0: 200			
	NPK 17:17:17: 200			
COW PEAS	DSP: 100	CAN: 150		
	TSP: 80	UREA: 100		
	NPK 20:20:20: 150			
IRISH POTATO	DAP: 500			
BEET ROOT	DAP: 300			
BRINJALS /EGG	NPK 23:23:0: 120			
BROCCOLI	DAP: 500			
CABBAGE	DAP: 250	CAN: 250		
CARROTS	DAP: 200	CAN: 200		
	DSP: 220			
CUCUMBER	DSP: 200			
FRENCH BEANS	DAP: 200	CAN: 100		
GARDEN PEAS	TSP: 200	CAN: 150		
KALES	DSP: 500	CAN: 200		
	TSP: 250			
LEEKS	DAP: 250	CAN: 125		
LETTUCE	TSP: 200	CAN: 125		
	DSP: 400			
ONIONS	DSP: 400	CAN: 300		
	TSP: 200			
	DAP: 150			
SNOW PEAS	DAP: 250	CAN: 200		
TOMATO	DSP: 200			
	TSP: 100			
	DAP: 100			

AVOCADO	Age of tree CAN (g/tree) TSP(g/tree) 1-3yrs 120 120 4-5yrs 220 450 6-7yrs 450 650 Over 8yrs 650 650	
BANANA	DAP: 200 CAN: 300 NPK 23:23:0: 150	
CITRUS	Age of tree CAN (g/tree) TSP(g/tree) 1-3yrs 200 300 4-5yrs 400 450 Over 6-7yrs 600 750	
MANGO	Age of tree CAN (g/tree) TSP/DAP(g/tree) 1-3yrs 240 150 4-5yrs 400 500 Over 6-7yrs 400 1000	
PASSION FRUITS	TSP: 200 CAN: 300 DAP: 200	
PINEAPPLES	DAP: 500 UREA: 200 NPK: 23: 23: 0- 250 SA: 200	
MELON	TSP: 200 CAN: 250 DAP: 200	

COFFEE (*Coffee Research Foundation*)				
Recommended types of nitrogen fertilizers based on soil reaction				
Soil Reaction	Acid Soil	Moderately Acid soil	Mildly Acid Soil	
PH	Under 4.4	4.4 – 5.4	Over 5.4	
Form of Nitrogen Fertilizer	For each three applications use CAN twice, ASN or Urea* once	Alternate between Calcium Ammonium Nitrate (CAN) and Ammonium Sulphate Nitrates (ASN) or Urea	Use Ammonium Sulphate (AS) or Ammonium Sulphate Nitrate (ASN)	
Note: for Urea (46% N) multiply rate by 0.55.				

Recommended rate of application for Nitrogen					
Amount of crop estimated in the current season	Kg Nitrogen/ha per year	gm per tree		kg of fertilizer/ha	
		21% N	26% N	21% N	26% N
Less than 1000 kg clean coffee per hectare (5 kg of cherry per tree)	80	330	260	390	310
1000 - 1500kg clean coffee per hectare (5 – 7 kg of cherry/tree	100	358	290	476	385
1500 – 2000 kg clean coffee per hectare (7 – 10 kg) of cherry/tree	100 – 150	358 to 538	290 to 434	476 to 715	385 to 577
Over 2000kg clean coffee per hectare (0ver 10 kg of cherry /tree	Up to 200	716	578	952	769

Note: The above fertilizer rates are based on coffee density of 1330 trees/ha or 2.74 m x 2.74 m spacing.			
Apply Nitrogen fertilizer only when the soil is wet			
Phosphate (P) fertilizers			
Recommended types of application for Phosphate fertilizers			
Soil reaction	Acid soil	Moderate acid soil	Mildly acid soil
PH	under 4.4	4.4 – 5.4	over 5.4
Types of Phosphate fertilizers	Single or Triple Super phosphate	SSP	DAP
		TSP	
Recommended rate of application for Phosphate fertilizers			
Types	**Quantity (g/tree)**		
SSP	350	350	-
TSP	150	150	-
DAP	-	-	150
Phosphoric acid *	40ml in 20l water (30 trees)	40ml in 20l water (30 trees)	40 ml in 20l water
(3 – 4 sprays per year)			
TEA *(Tea Research Foundation)*			
Fertilizer: Use compound fertilizers (NPK 26:5:5 or 20:10:10)			
1st year: apply 180kg/ha (6g per plant) 6 weeks after transplanting and thereafter at 8 weeks intervals up to end of the first year			
2nd year: apply 160kg/ha (15g/bush) every 3 months			
3rd year: Apply 720kg/ha (67g/bush) once			
4th year: Apply 920kg/ha (86g/bush) once			
5th year: Prune and then apply 600kg/ha (56 g/bush) at tipping			
SUGARCANE *(Sugar Research Centre)*			
Fertilizer: Plant with 2-3.5 bags/ha DAP or 6-9 bags/ha SSP, Top dress with 4-5 bags/ha urea or 8-9 bags/ha CAN depending on zone and crop cycle			

Source: MOALF Extension Handbook (2012)[ix]

4.5 Fertilizer Use By Crop (FUBC)

Study results indicate that in Kenya, fertilizer use by crops varies depending on value of crop, soil types, reliability of rainfall and farmers' agronomic practices (see details in Table 9). For most crops, fertilizer is applied in two common regimes: planting fertilizer applied during crop sowing and top-dressing fertilizer applied later during plants' vegetative growth. While this split application of fertilizer is recommended to enhance crop's nutrients uptakes, farmers do not necessarily apply same volumes of planting and top-dressing fertilizer on one crop. Results of this study show that overall, farmers tend to use more volumes of planting fertilizers compared to top-dressing fertilizers.

Table 9: Factors influencing fertilizer use by crop

Factor	Details

Crop value	Crops with good economic returns and ready market
Soil type	Whether soil is acidic or alkaline
Rainfall reliability	Farming risks associated with rainfall in a rain-fed agriculture system; farmers willing to invest more in fertilizer when rainfall is reliable
Farmers' agronomic practices	Farmers who have adopted fertilizer application tend to use more fertilizer
Availability of fertilizer	Ease of access, e.g. through subsidy, affects utilization

The main crops that utilize fertilizer in Kenya are listed in

Table 10. The crops range from cereals to pulses, root crops, horticultural crops (vegetables, fruits, flowers), nuts and oil crops, and industrial crops (tea, Coffee, Sugar cane) and seeds. Not all the crops grown in Kenya are shown in the table, as it only reflects the crops that use fertilizers within measurable levels. Collectively, it is estimated that the total quantities of fertilizer used by crops increased from 512,363mt in 2011 to 533,276mt in 2012. In 2013 however, the total volumes of fertilizer used by crops is estimated at 528,425mt. The marginal decline in total volumes of used fertilizer is attributed to poor weather conditions that affected several parts of Kenya in 2013. Of the crops listed, maize uses the largest amount of fertilizers followed by tea, sugar cane, wheat, beans and flowers respectively.

Table 10: Total quantity of fertilizer used by Crop in 2011-2013

	TOTAL QUANTITY OF FERTILIZER USED PER CROP		
CROP	**2013**	**2012**	**2011**
Maize	268,605,229	273,496,424	268,695,741
Wheat	25,621,563	29,066,258	24,473,674
Barley	4,969,802	4,652,283	4,097,447
Beans	20,719,820	21,102,929	20,584,107
Rice	5,891,782	5,491,877	4,163,771
Sorghum	9,094,113	9,200,031	10,529,866
Millet	5,632,033	6,406,106	5,061,649
Cowpeas	2,045,941	2,338,328	2,262,254
Irish potato	13,411,529	12,384,799	11,089,817
Tomato	4,667,677	4,303,070	3,967,851
French beans	795,211	733,817	653,700
Snow peas	387,405	496,515	453,032
Sugar Snaps	383,686	611,194	473,246
Garden peas	1,100,388	840,296	743,193
spinach	509,831	497,690	440,714
Cabbage	1,853,420	1,407,935	1,307,121
kales	818,896	936,599	786,695
carrots	223,004	166,608	198,885
Bulb Onions	173,549	300,636	162,539
Banana	66,990	63,869	72,684
Mango	36,567	35,452	19,790

Purple passion	1,318,095	1,106,068	1,082,292
Oranges	33,280	1,756	1,756
Lemons	3,657	398	395
Grape fruit	4,189	779	373
Lime	55,328	11,396	11,260
Tree tomato	65,202	77,037	79,597
Pineapples	674,062	653,664	674,251
Melons	448,131	397,324	394,319
Flowers	17,123,485	17,058,712	17,715,880
Coffee	7,410,964	7,510,387	1,637,586
Sugarcane	28,103,519	29,193,854	29,175,193
Tobacco	2,311,221	1,706,000	2,053,400
Tea	101,036,570	99,083,200	98,983,935
Seeds	2,829,025	1,706,000	4,460,145
Total fertilizer type	528,425,162	533,276,490	512,363,225

4.5.1: Fertilizer Use By Crop by type of fertilizers for all crops in 2013

Crop Fertilizer Use (tons) 2013																	
Crop	**Area (Ha)**	**Area applied with fertilizer (Ha)**	**DAP**	**Mavuno-P**	**NPK 17:17:17**	**NPK 23:23:0**	**CAN**	**UREA**	**Mavuno-TD**	**MAP**	**SA**	**TSP**	**NPK 20:20:0**	**DSP**	**Calcium Nitrate**	**MOP**	**Fertilizer Totals**
Banana	60153	493	34	0	0	0	17	9	0	0	0	8	0	0	0	0	68
Barley	22670	21538	2076	0	0	0	1922	0	0	430	0	0	0	0	0	0	4428
Bean	1083886	318907	20140	1060	0	0	0	0	0	0	0	0	0	0	0	0	21200
Bulb Onion	7730	5176	139	0	0	0	0	0	0	0	0	35	0	0	0	0	174
Cabbages	50668	30065	1809	0	0	0	1503	0	0	0	0	394	0	0	0	0	3707
Carrots	10104	5739	266	24	0	0	0	0	0	0	0	155	0	0	0	0	446
Cowpeas	197028	22005	822	0	0	0	400	469	0	0	0	0	354	0	0	0	2046
French Bean	9056	5847	390	0	0	491	484	0	0	0	0	75	0	150	0	0	1590
Garden Peas	27564	12101	1020	158	0	0	1023	0	0	0	0	0	0	0	0	0	2201
Grape Fruit	175	58	4	0	0	0	0	0	0	0	0	1	0	0	0	0	5
Irish Potatoes	126243	98134	12995	0	0	0	0	0	0	0	0	0	0	0	0	0	12995
Kales	57128	15419	573	0	0	0	645	276	0	0	0	143	0	0	0	0	1638
Lemons	1200	49	3	0	0	0	0	0	0	0	0	1	0	0	0	0	4
Lime	645	23	1	0	54	0	0	0	0	0	0	0	0	0	0	0	55
Maize	1883289	1311582	121606	7600	0	13661	62810	13216	2033	0	0	0	0	0	0	0	220925
Mango	46980	301	20	5	0	0	12	5	0	0	0	0	0	0	0	0	42
Melons	7344	6617	300	100	0	0	397	0	0	0	0	100	0	0	0	0	896
Millet	88049	42731	2225	0	0	0	947	929	0	247	0	0	0	0	0	0	4349
Oranges	7494	427	27	0	0	0	0	0	0	0	0	6	0	0	0	0	33
Pineapples	12230	3546.5	125	0	161	42	0	0	0	0	225	42	0	0	0	753	1348
Purple Passion	4377	2174	100	1114	0	0	87	0	36	0	0	41	0	0	0	0	1376
Rice	34989	32562	1596	0	957	638	457	2439	0	0	152	0	0	0	0	0	6241
Snow Peas	2470	2062	139	0	223	0	170	0	0	0	0	26	0	53	0	0	611
Sorghum	222023	82189	5225	0	0	0	1336	1953	0	581	0	0	0	0	0	0	9094
Spinach	9569	3138	406	0	0	0	377	0	0	0	0	79	0	158	0	0	1020
Sugar Snaps	2524	2108	183	27	228	0	174	0	0	0	0	0	0	0	0	0	611
Tomato	47732	31377	2388	0	1908	0	2916	0	0	0	0	457	0	914	753	0	9335
Tree Tomato	789	216.8	13	3	13	0	13	0	0	0	0	0	0	0	0	0	42
Wheat	131309	126203	12181	0	0	0	12181	0	0	1262	0	0	0	0	0	0	25624
Totals	**4155418**	**2182789**	**186806**	**10090**	**3544**	**14832**	**87872**	**19297**	**2069**	**2520**	**377**	**1563**	**354**	**1274**	**753**	**753**	**332105**

4.5.1.1: Fertilizer Use By Crop by type of fertilizers for AFFA crops in 2013

AFFA Crops Fertilizer use (ton) 2013																
Flowers																
Crop	**Area (Ha)**	**Area applied with fert-HA**	**Calcium Nitrate**	**NPK: 14:14:20**	**NPK: 27:6:6 +s**	**Potasium Sulphate**	**Potasium Nitrate**	**Magnesium Nitrate**	**Superphosphate above 35%**	**Amonium Hydroxide**	**Rock Phosphate**	**Other NPKs**	**Amonium Hydroxide**	**Magnesium Sulphate**	**MOP**	**Fertilizer Totals**
ROSES	8,420	**8420**	4000	1389	1368	947	674	118	354	84	926	1474	34	51	1010	12,428
CARNATIONS	1634	**1634**	776	270	266	184	131	23	69	16	180	286	7	10	196	2,412
STATICE	430	**430**	204	71	70	48	34	6	18	4	47	75	2	3	52	635
ALSTROMERIA	611	**611**	290	101	99	69	49	9	26	6	67	107	2	4	73	902
ARABICUM	313	**313**	149	52	51	35	25	4	13	3	34	55	1	2	38	462
TUBEROSE	121	**121**	57	20	20	14	10	2	5	1	13	21	0	1	15	179
OTHERS	636	**636**	302	105	103	72	51	9	27	6	70	111	3	4	76	939
TOTAL	**12,165**	**12,165**	**5,778**	**2,007**	**1,977**	**1,369**	**973**	**170**	**511**	**122**	**1,338**	**2,129**	**49**	**73**	**1,460**	**17,956**
Coffee																
	Area (Ha)	**Area applied with Fert-Ha**	**NPK 18:4:12**	**NPK 20:10:10**	**NPK 16:16:16**	**NPK 17:17:17**	**Fertilizer Totals**									
Large Scale (Estates)	24330	16544	5	97	146	487	735									
Smallholders	83890	4195	17	210	151	503	881									
TOTALS	**108,220**	**20,739**	**22**	**307**	**297**	**990**	**1,616**									
Sugarcane																
	Area (Ha)	**Area applied with fert-(Ha)**	**DAP**	**MOP**	**NPK 23:23:0**	**NPK 17:17:17**	**Special 1**	**Special 2**	**UREA**	**CAN**	**AS**	**Fertilizer Totals**				
Sugarcane	**213780**	**89788**	8081	718	180	90	207	826	16162	1751	90	28104				
Total	**213780**	**89788**	8081	718	180	90	207	826	16162	1751	90	28104				
Tobacco																
	Area (Ha)	**Area applied with fert-Ha**	**NPK 14:20:20**	**CAN**	**Fertilizer Totals**											
Tobacco	15025	10518	1798	513	2311											
Total	15025	10518	1798	513	2311											
Tea																
	Area (Ha)	**Area applied with fert-(Ha)**	**NPK 26:5:5**	**NPK 25:5:5**	**Fertilizer Totals**											
Tea	198,657	177,425	64516	23365	87881											
Total	198,657	177,425	64516	23365	87881											

4.5.2: Fertilizer Use By Crop by type of fertilizers for all crops in 2012

Crop Fertilizer Use (tons) 2012																	
Crop	**Area (Ha)**	**Area applied with fertilizer (Ha)**	**DAP**	**MAVUNO-P**	**NPK 17:17:17**	**NPK 23:23:0**	**CAN**	**UREA**	**MAVUNO-TD**	**MAP**	**SA**	**TSP**	**NPK 20:20:0**	**DSP**	**Calcium Nitrate**	**MOP**	**Fertilizer Totals**
Banana	58003	474	32	0	0	0	16	9	0	0	0	8	0	0	0	0	64
Barley	21827	20736	1990	0	0	0	1851	0	0	414	0	0	0	0	0	0	4255
Bean	1058941	318452	20048	1055	0	0	0	0	0	0	0	0	0	0	0	0	21103
Bulb Onion	7043	4721	253	0	0	0	0	0	0	0	0	48	0	0	0	0	301
Cabbages	38502	22794	1355	0	0	0	1140	0	0	0	0	321	0	0	0	0	2816
Carrots	7380	4218	199	18	0	0	0	0	0	0	0	116	0	0	0	0	333
Cowpeas	219095	25025	945	0	0	0	454	532	0	0	0	0	407	0	0	0	2338
French Bean	8454	5392	359	0	453	0	448	0	0	0	0	69	0	139	0	0	1468
Garden Peas	16756	9230	780	120	0	0	781	0	0	0	0	0	0	0	0	0	1681
Grape Fruit	72	20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Irish Potatoes	119703	94405	12385	0	0	0	0	0	0	0	0	0	0	0	0	0	12385
Kales	57470	17679	650	0	0	0	758	4197	0	0	0	154	0	0	0	0	5760
Lemons	1021	41	2	0	0	0	0	0	0	0	0	0	1	0	0	0	3
Lime	524	21	1	0	5	0	0	0	0	0	0	0	0	0	0	0	6
Maize	2159321	1526507	147116	9195	0	17123	81591	16009	2463	0	0	0	0	0	0	0	273496
Mango	37320	298	19	4	0	0	12	5	0	0	0	0	0	0	0	0	40
Melons	6863	5840	267	89	0	0	350	0	0	0	0	89	0	0	0	0	795
Millet	118289	62447	3491	0	0	0	1188	1340	0	388	0	0	0	0	0	0	6406
Oranges	5942	382	23	0	0	0	0	0	0	0	0	5	0	0	0	0	28
Pineapples	12230	3548	125	0	162	42	0	0	0	0	225	42	0	0	0	754	1349
Purple Passion	3743	1853	84	923	0	0	75	0	31	0	0	34	0	0	0	0	1146
Rice	30206	28447	104791	0	836	557	404	2167	0	0	134	0	0	0	0	0	108889
Snow Peas	2014	1680	114	0	181	0	137	0	0	0	0	21	0	43	0	0	497
Sorghum	232864	87204	5692	0	0	0	1402	2044	0	629	0	0	0	0	0	0	9767
Spinach	9302	6129	396	0	0	0	368	0	0	0	0	77	0	155	0	0	995
Sugar Snaps	4994	4215	365	54	455	0	348	0	0	0	0	0	0	0	0	0	1222
Tomato	43748	28693	2176	0	1822	0	2667	0	0	0	0	417	0	835	689	0	8606
Tree Tomato	639	176	11	3	11	0	11	0	0	0	0	0	0	0	0	0	35
Wheat	148703	142897	13771	0	0	0	13869	0	0	1429	0	0	0	0	0	0	29068
Total	**4430970**	**2423525**	**317439**	**11460**	**3924**	**17722**	**107869**	**26302**	**2494**	**2860**	**358**	**1402**	**408**	**1171**	**689**	**754**	**494852**

4.5.2.1: Fertilizer Use By Crop by type of fertilizers for AFFA crops in 2012

AFFA Crops Fertilizer Use (ton)2012																
Flowers																
Crop	**Area (Ha)**	**Area applied with fertilizer (Ha)**	**Calcium Nitrate**	**NPK: 14:14:20**	**NPK: 27:6:6 +s**	**Potasium Sulphate**	**Potasium Nitrate**	**Magnesium Nitrate**	**Superphosphate above 35%**	**Amonium Hydroxide**	**Rock Phosphate**	**Other NPKs**	**Amonium Hydroxide**	**Magnesium Sulphate**	**MOP**	**Fertilizer Totals**
ROSES	8,820	**8820**	4190	1455	1433	992	706	123	370	88	970	1544	35	53	1058	13,018
CARNATIONS	1934	**1934**	919	319	314	218	155	27	81	19	213	338	8	12	232	2,855
STATICE	428	**428**	203	71	70	48	34	6	18	4	47	75	2	3	51	632
ALSTROMERIA	726	**726**	345	120	118	82	58	10	30	7	80	127	3	4	87	1,072
ARABICUM	306	**306**	145	50	50	34	24	4	13	3	34	54	1	2	37	452
TUBEROSE	108	**108**	51	18	18	12	9	2	5	1	12	19	0	1	13	159
OTHERS	790	**790**	375	130	128	89	63	11	33	8	87	138	3	5	95	1,166
TOTAL	**13,112**	**13112**	**6228**	**2163**	**2131**	**1475**	**1049**	**184**	**551**	**131**	**1442**	**2295**	**52**	**79**	**1573**	**19,353**
Coffee																
	Area Ha	**Area applied with fertilizer (Ha)**	**NPK 18:4:12**	**NPK 20:10:10**	**NPK 16:16:16**	**NPK 17:17:17**	**Fertilizer Totals**									
Large Scale (Estates)	24,606	15,994	4	88	132	440	16,658									
Smallholders	84,110	4,206	5	63	45	151	4,471									
TOTAL	**108,716**	**20,199**	**9**	**151**	**177**	**591**	21,128									
Sugarcane																
	Area (Ha)	**Area applied with fertilizer (Ha)**	**DAP**	**MOP**	**NPK 23:23:0**	**NPK 17:17:17**	**Special 1**	**Special 2**	**UREA**	**CAN**	**AS**	**Fertilizer Totals**				
Sugarcane	213,710	89,758	8078	718	180	90	206	826	16156	1750	90	28094				
Tobacco																
	Area (Ha)	**Area applied with Fertilizer**	**NPK 14:20:20**	**CAN**	**Fertilizer Totals**											
Tobacco	14,380	10,066	1268	513	1782											

4.5.3: Fertilizer Use By Crop by type of fertilizers for all crops in 2011

Crop Fertilizer Use (tons) 2011																	
Crop	**Area (Ha)**	**Area applied with fertilizer (Ha)**	**DAP**	**Mavuno-p**	**NPK 17:17:17**	**NPK 23:23:0**	**CAN**	**UREA**	**Mavuno-TD**	**MAP**	**SA**	**TSP**	**NPK 20:20:0**	**DSP**	**Calcium Nitrate**	**MOP**	**Fertilizer Totals**
Oranges	10300	638	31	0	0	0	0	0	0	0	0	8	0	0	0	0	39
Banana	54266	810	56	0	0	0	25	11	0	0	0	11	0	0	0	0	103
Barley	18827	17885	1711	0	0	0	1596	0	0	357	0	0	0	0	0	0	3664
Bean	698020	208118	12985	683	0	0	0	0	0	0	0	0	0	0	0	0	13668
Bulb Onions	3405	2026	119	0	0	0	0	0	0	0	0	30	0	0	0	0	149
Cabbage	33632	19828	1165	0	0	0	991	0	0	0	0	275	0	0	0	0	2432
Carrots	7518	4313	219	19	0	0	0	0	0	0	0	128	0	0	0	0	367
Cowpeas	177321	21651	820	0	0	0	389	465	0	0	0	0	351	0	0	0	2024
French Beans	5932	3852	260	0	324	0	313	0	0	0	0	49	0	99	0	0	1045
Garden peas	17556	7469	628	96	0	0	639	0	0	0	0	0	0	0	0	0	1364
Grape Fruit	71	20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Irish Potatoes	112600	85617	11090	0	0	0	0	0	0	0	0	0	0	0	0	0	11090
Kales	55362	16053	636	0	0	0	688	322	0	0	0	163	0	0	0	0	1809
Lemons	1015	41	3	0	0	0	0	0	0	0	0	1	0	0	0	0	3
Lime	517	21	1	0	43	0	0	0	0	0	0	0	0	0	0	0	44
Maize	2131888	1511376	144590	9037	0	16797	80049	15793	0	0	0	0	0	0	0	0	266266
Mango	51653	169	10	2	0	0	6	3	0	0	0	0	0	0	0	0	21
Melon	9414	5794	265	88	0	0	348	0	0	0	0	88	0	0	0	0	789
Millet	111304	48974	2496	0	0	0	1252	1027	0	287	0	0	0	0	0	0	5062
Pineapples	12233	4162	183	0	235	0	0	0	0	0	341	61	0	0	0	1098	1918
Purple Passion	3687	1820	83	938	0	0	73	0	31	0	0	35	0	0	0	0	1161
Rice	23061	21621	1059	0	635	424	307	1637	0	0	102	0	0	0	0	0	4164
Snow Peas	1840	1533	104	0	166	0	125	0	0	0	0	20	0	39	0	0	453
Sorghum	254126	94382	6068	0	0	0	1529	2259	0	674	0	0	0	0	0	0	10530
Spinach	8796	5436	350	0	0	0	326	0	0	0	0	68	0	137	0	0	881
Sugar snaps	3928	3269	286	42	353	0	265	0	0	0	0	0	0	0	0	0	946
Tomato	40678	26642	2029	0	1610	0	2489	0	0	0	0	390	0	779	639	0	7936
Tree Tomato	639	206	13	3	12	0	12	0	0	0	0	0	0	0	0	0	40
Wheat	105649	95549	9162	0	0	0	9555	0	0	955	0	0	0	0	0	0	19672
Totals	**3955238**	**2209275**	**196422**	**10910**	**3378**	**17220**	**100978**	**21516**	**31**	**2274**	**443**	**1326**	**351**	**1054**	**639**	**1098**	**357641**

4.5.3.1: Fertilizer Use By Crop by type of fertilizers for AFFA crops in 2012

AFFA Crops Fertilizer use (ton) 2011																
Flower	**Area (Ha)**	**Area applied with fertilizer (Ha)**	**Calcium Nitrate**	**NPK: 14:14:20**	**NPK: 27:6:6 +s**	**Potasium Sulphate**	**Potasium Nitrate**	**Magnesium Nitrate**	**Superphosphate above 35%**	**Amonium Hydroxide**	**Rock Phosphate**	**Other NPKs**	**Amonium Hydroxide**	**Magnesium Sulphate**	**MOP**	**Fertilizer Totals**
ROSES	8,820	8820	4,190	1,455	1,433	992	706	123	370	88	970	1,544	35	53	1,058	13,018
CARNATIONS	1990	1990	945	328	323	224	159	28	84	20	219	348	8	12	239	2,937
STATICE	407	407	193	67	66	46	33	6	17	4	45	71	2	2	49	601
ALSTROMERIA	715	715	340	118	116	80	57	10	30	7	79	125	3	4	86	1,055
ARABICUM	300	300	143	50	49	34	24	4	13	3	33	53	1	2	36	443
TUBEROSE	98	98	47	16	16	11	8	1	4	1	11	17	0	1	12	145
OTHERS	550	550	261	91	89	62	44	8	23	6	61	96	2	3	66	812
Total	**12,880**	**12880**	**6,118**	**2,125**	**2,093**	**1,449**	**1,030**	**180**	**541**	**129**	**1,417**	**2,254**	**52**	**77**	**1,546**	**19,011**
Coffee																
Coffee	**Area (Ha)**	**Area applied with Fertilizer (Ha)**	**NPK 18:4:12**	**NPK 20:10:10**	**NPK 16:16:16**	**NPK 17:17:17**	**Fertilizer Totals**									
Large Scale	24,606	14763.6	25	15	5	98	143									
Smallholders	85,189	3407.56	85	3	17	213	319									
Total	**109,795**	**18,171**	**110**	**18**	**22**	**311**	**461**									
Sugarcane																
	Area (Ha)	**Area applied with Fertilizer (Ha)**	**DAP**	**MOP**	**NPK 23:23:0**	**NPK 17:17:17**	**Special 1**	**Special 2**	**UREA**	**CAN**	**AS**	**Fertilizer Totals**				
Sugarcane	213,610	89716	8,074	359	179	90	206	825	16,149	3,499	90	29,472				
Tobacco																
	Area (Ha)	**Area applied with Fertilizer (Ha)**	**NPK 14:20:20**	**CAN**	**Fertilizer Totals**											
Tobacco	14,828	**10,380**	1,479	573	2,053											
Tea																
	Area (Ha)	**Area applied with Fertilizer (Ha)**	**NPK 26:5:5**	**NPK 25:5:5**	**Fertilizer Totals**											
Tea	187,855	174,227	69289	29695	98984											

4.6 Fertilizer application rates for all crops

2013		
Crop	**Average Fertilizer Use Rate on Total Arable Area (Kg/ha)**	**Average Fertilizer Use Rate on Fertilized Area (Kg/ha)**
Banana	1	137
Barley	195	206
Bean	20	66
Bulb Onion	22	34
Cabbages	73	123
Carrots	44	78
Cowpeas	10	93
French Bean	176	272
Garden Peas	80	182
Grape Fruit	26	79
Irish Potatoes	103	132
Kales	29	106
Lemons	3	76
Lime	86	2406
Maize	117	168
Mango	1	138
Melons	122	135
Millet	49	102
Oranges	4	78
Pineapples	110	380
Purple Passion	314	633
Rice	178	192
Snow Peas	247	296
Sorghum	41	111
Spinach	107	325
Sugar Snaps	242	290
Tomato	196	298
Tree Tomato	54	195
Wheat	195	203
Total	**80**	**152**

2012		
Crop	**Average Fertilizer Use Rate on Total Arable Area (Kg/ha)**	**Average Fertilizer Use Rate on Fertilized Area (Kg/ha)**
Banana	1	136
Barley	195	205
Bean	20	66
Bulb Onion	43	64
Cabbages	73	124
Carrots	45	79
Cowpeas	11	93
French Bean	174	272
Garden Peas	100	182
Grape Fruit	19	70
Irish Potatoes	103	131
Kales	100	326
Lemons	3	76
Lime	11	285
Maize	127	179
Mango	1	134
Melons	116	136
Millet	54	103
Oranges	5	72
Pineapples	110	380
Purple Passion	306	618
Rice	3605	3828
Snow Peas	247	296
Sorghum	42	112
Spinach	107	162
Sugar Snaps	245	290
Tomato	197	300
Tree Tomato	54	196
Wheat	195	203
Total	**112**	**204**

2011		
Crop	**Average Fertilizer Use Rate on Total Arable Area (Kg/ha)**	**Average Fertilizer Use Rate on Fertilized Area (Kg/ha)**
Oranges	4	61
Banana	2	127
Barley	195	205
Bean	20	66
Bulb Onions	44	73
Cabbage	72	123
Carrots	49	85
Cowpeas	11	93
French Beans	176	271
Garden peas	78	183
Grape Fruit	22	78
Irish Potatoes	98	130
Kales	33	113
Lemons	3	86
Lime	86	2159
Maize	125	176
Mango	0	124
Melon	84	136
Millet	45	103
Pineapples	157	461
Purple Passion	315	638
Rice	181	193
Snow Peas	246	296
Sorghum	41	112
Spinach	100	162
Sugar snaps	241	290
Tomato	195	298
Tree Tomato	63	196
Wheat	186	206
Total	**90**	**162**

4.7 Fertilizer application rates for AFFA crops

2013		
Crop	**Average Fertilizer Use Rate on Total Arable Area (Kg/ha)**	**Average Fertilizer Use Rate on Fertilized Area (Kg/ha)**
Flowers	1476	1476
Coffee	15	78
Sugarcane	131	313
Tobacco	154	220
Tea	442	495
Totals	252	444

2012		
Crop	**Average Fertilizer Use Rate on Total Arable Area (Kg/ha)**	**Average Fertilizer Use Rate on Fertilized Area (Kg/ha)**
Flower	1476	1476
Coffee	194	1046
Sugarcane	131	313
Tobacco	124	177
Tea	520	568
Total	**313**	**551**

2011		
Crop	**Average Fertilizer Use Rate on Total Arable Area (Kg/ha)**	**Average Fertilizer Use Rate on Fertilized Area (Kg/ha)**
Flowers	1476	1476
Coffee	15	90
Sugarcane	138	328
Tobacco	138	198
Tea	527	568
Total	280	495

4.8 Fertilizer Use By Nutrients FUBC

The amount of nutrients from mineral fertilizers used by various crops in Kenya depends on the area of crop planted, portions of planted area applied with fertilizer, and the rates of fertilizer application. For each crop and fertilizer type used, the total quantities of nutrients are calculated using the AFO/FAO fertilizer-nutrients calculation procedure, as shown in Table 11 below.

Table 11: Fertilizer use by crop per nutrient

Crop	Year 2011			Year 2012			Year 2013		
	Total Fertilizer Consumption ('000 metric tonnes nutrients)			Total Fertilizer Consumption ('000 metric tonnes nutrients)			Total Fertilizer Consumption ('000 metric tonnes nutrients)		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
Maize	3,242.60	1,964.75	0.00	3,454.92	1,990.03	0.00	2,703.69	2,256.41	0.00
Wheat	47.94	37.91	0.00	143.94	107.11	0.00	127.11	94.58	0.00
Barley	16.61	15.87	0.00	19.25	18.39	0.00	19.99	19.83	0.00
Beans	43.06	558.63	0.00	45.71	571.32	0.00	45.29	566.15	0.00
Rice	23.67	2.89	0.00	69.55	8.80	0.00	56.31	4.67	0.00
Sorghum	57.65	166.05	0.00	53.51	159.88	0.00	48.56	96.71	0.00
Millet	31.15	55.34	0.00	47.98	99.48	0.00	17.86	32.09	0.00
Cowpeas	35.94	50.41	0.00	41.04	57.92	0.00	33.24	46.16	0.00
Green grams	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pigeon peas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Irish potato	16.88	220.20	0.00	16.94	227.47	0.00	20.26	40.52	0.00
Tomato	54.61	162.51	0.00	14.50	42.64	0.00	10.34	38.72	0.00
French beans	2.58	8.11	0.00	2.92	9.13	0.00	1.57	5.75	0.00
Snowpeas	1.48	4.61	0.00	1.63	5.11	0.00	0.86	3.14	0.00
Sugar Snaps	1.26	3.80	0.23	1.61	4.90	0.30	0.71	2.28	0.00
Garden peas	4.20	10.15	0.00	4.64	11.33	0.00	5.97	14.59	0.00
Spinach	1.31	3.12	0.00	1.29	3.06	0.00	1.33	3.15	0.00
Cabbage	3.60	7.25	0.00	3.99	8.01	0.00	5.25	10.54	0.00
Kales	11.06	11.20	0.00	11.65	11.40	0.00	11.59	11.34	0.00
Carrots	0.30	3.47	0.00	0.24	2.71	0.00	0.33	3.71	0.00
Bulb Onions	0.15	0.94	0.00	0.14	0.90	0.00	0.15	0.87	0.00
Banana	15.27	16.58	0.00	16.66	19.72	0.00	16.66	19.72	0.00
Mango	32.92	24.11	0.08	29.59	23.60	0.12	31.75	25.32	0.79
purple passion	7.39	20.10	2.01	7.39	20.30	2.06	9.44	25.90	2.59
Oranges	0.18	0.88	0.00	0.17	0.88	0.00	0.27	1.20	0.00
Lemons	0.05	0.26	0.00	0.05	0.25	0.00	0.06	0.29	0.00
Grape fruit	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.44	0.00
Lime	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.17	0.15

Crop	Year 2011 Total Fertilizer Consumption ('000 metric tonnes nutrients)			Year 2012 Total Fertilizer Consumption ('000 metric tonnes nutrients)			Year 2013 Total Fertilizer Consumption ('000 metric tonnes nutrients)		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
Tree tomato	1.28	2.98	0.19	0.32	0.75	0.06	0.01	0.50	0.00
Pineapples	6.52	1.93	126.73	0.32	2.26	23.27	1.13	0.64	0.08
Melons	1.81	2.62	0.01	1.78	2.67	0.01	0.75	1.13	0.00
Flowers	86.80	15.48	17.36	86.19	124.37	331.86	126.52	202.45	288.47
Coffee	53.13	3.88	3.88	52.60	3.84	3.84	52.36	3.82	3.82
Sugarcane	1,644.80	146.96	0.05	1,645.57	147.02	0.05	1,646.11	147.07	0.05
Tobacco	5.88	1.92	2.78	6.39	2.65	3.77	6.39	2.65	3.77
Tea	1,669.07	6.24	6.24	2,198.89	8.33	8.33	2,228.46	8.44	8.44
TOTAL	7,121	3,531	160	7,981	3,696	374	7,231	3,691	308

CHAPTER FIVE: CONCLUSIONS

5.1. Dealing with missing data/ data gaps

It is assumed that in general, it is the overall responsibility of the government of Kenya to manage and provide relevant, accurate and timely agricultural data to meet the demands of policy makers as well as other data users. Overall, access to data on fertilizer production, importation, distribution, export and utilization by crops is constrained by several factors. The major ones include:

a) Staff Capacity

i. Inadequate Staff Capacity: few number of staff in some stations at the field level that should be dealing with agricultural data collection; aging field extension officers at the grassroots thus affecting mobility and application of modern technologies.
ii. Work overload: most field extension staff carry out several activities related to government extension and collaboration activities with other organizations and projects/programs.
iii. Limited technical knowledge owing to limited trainings on agriculture statistics and data management. This has led to, among others, generation of inaccurate data with non-probability based sampling methods, lack of the coefficient of variation, sampling errors as well as non-sampling errors.
iv. Lack of validated sampling frames. Partly, this is caused by lack of census of agriculture.
v. Lack of basic tools and equipment for data collection and analysis.
vi. Low application of modern technology including ITC tools and systems.

b) Institutional and Management challenges

i. There is a general low appreciation of the importance of data and quality statistics at various levels in the public sector.
ii. Limited networking and collaboration amongst relevant stakeholders and agencies.
iii. Poor planning leading to among others inadequate budgetary provision for data collection and management activities.
iv. Inadequate policy and regulatory framework for food and agricultural statistics management.
v. Lack of understanding, hence poor cooperation by private sector in providing data when required by the government.

c) Lack of master sampling frame

One of the major drawbacks to crops data management in Kenya is lack of validated farm sampling frame. Owing to lack of agriculture census, Kenya has not developed comprehensive agriculture master sampling frame. Lack of list of farmers has significantly effect on sampling of farmers, other studies as well as surveys conducted in the agricultural sector.

5.2 Proposed changes to support data collection and management

In order to improve on fertilizer data management in Kenya, the following suggestions should be considered:

i. Restructuring of agricultural statistics unit at the Ministry Headquarters; expanding its mandate and improve staffing.
ii. Review of agricultural statistics legal framework and policy to take care of emerging challenges and concerns.
iii. Refinement of field officers' job description to incorporate expected roles of data collection, analysis, dissemination and collaboration.

iv. Field officers' regular and expanded training on agriculture statistics, including data collection, surveys, census etc.
v. Mainstreaming stakeholders' approach to statistics and information management.
vi. Provision and use of basic tools, equipment and software for data collection, analysis and networking.
vii. Regular annual work planning and budget allocation for agricultural statistics management.
viii. Adoption of new technologies such as ICT-based systems to reduce time and paperwork in data management.
ix. Sensitization of stakeholders responsible for data provision.

The factors that have been stated in the previous chapters. In order to manage missing data, the following suggestions should be considered:

5.3 Cost-effective ways if collecting real consumption and FUBC data

Results from this study show that there are several variations of the data on the amount of fertilizer manufactured, imported, exported and utilized by each crop. There is therefore need to establish cost-effective way of collecting data based on consumption and fertilizer use by crops. In order to achieve this goal, the following suggestions should be considered:

a) To have competent staff on fertilizer subsector stationed at Kenya Revenue Authority (KRA) and Kenya Ports Authority (KPA) border points for easy identification and monitoring the importation and exportation of fertilizer and fertilizer supplements;
b) Deployment of agricultural officers at border points to monitor and collect data on informal fertilizers imports and exports;
c) Mass training of officers responsible for farm inputs data collection and management in the Ministry as well as other stakeholders in the agricultural sector;
d) To have location specific recommendations for fertilizer that are socially and economically acceptable to farmers so as ease follow ups and proper management of fertilizer distribution by types and amounts;
e) Use census and surveys methods to capture more data on fertilizer use at various levels;
f) Use of modern technologies such as cameras to help monitor inflows and outflows of fertilizers at the border points.
g) Establish an automated system that will connect the Counties and MALF for easy access of fertilizer availability and utilization at village levels;
h) Strengthen communication between MALF and KRA and KPA for improved fertilizer data collection, storage and utilization;
i) Establish site specific fertilizer use for easy traceability of types and amount of fertilizer use at farm levels according to existing Agro-ecological zone and the farming systems.

5.4. Concluding Remarks

Fertilizer consumption in Kenya in the last two decades has risen tremendously due to the liberalization of the fertilizer industry in 1991 leaving most of the activities to be done by the private sector. However fertilizer quality control measures as well as fertilizer standards, policies and distribution systems are not well developed leading to inefficiencies and thus high costs of fertilizer in the country. Moreover, fertilizer taxation regimes are yet to be harmonized in line with EAC integration process.

To improve on fertilizer use in general, there is need for new fertilizer policy, which is currently being done. To take care of regional interest and commitments, the new policy should be harmonized with other policies within the EAC and COMESA regions. There is also need for a functioning of a fertilizer quality control system which should also be harmonized with other systems in the EAC and COMESA region. The regional perspective of fertilizer trade also calls for harmonization of fertilizer standards and rules governing trade in fertilizers. Besides, stakeholder networks and associations will also be required to take the centre stage in handling national and regional issues on fertilizers.

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