INTEGRATED NUTRIENT MANAGEMENT TO ATTAIN SUSTAINABLE PRODUCTIVITY INCREASES IN EAST AFRICAN FARMING SYSTEMS (INMASP)

AGRICULTURAL PRODUCTION AND ITS CONSTRAINTS IN CENTRAL KENYA: A CASE STUDY OF KIAMBU DISTRICT


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<tr>
<td>AEZ</td>
<td>Agro-ecological zone</td>
</tr>
<tr>
<td>CRF</td>
<td>Coffee Research Formation</td>
</tr>
<tr>
<td>GoK</td>
<td>Government of Kenya</td>
</tr>
<tr>
<td>KCC</td>
<td>Kenya Cooperative Creameries</td>
</tr>
<tr>
<td>KSH</td>
<td>Kenya Shillings</td>
</tr>
<tr>
<td>MoA</td>
<td>Ministry of Agriculture</td>
</tr>
<tr>
<td>MoLD</td>
<td>Ministry of Livestock Development</td>
</tr>
<tr>
<td>NCD</td>
<td>New castle Disease</td>
</tr>
<tr>
<td>PBK</td>
<td>Pyrethrum Board of Kenya</td>
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1.0 Introduction

Kiambu District lies in the high potential area of Kenya, which constitutes 20% of total arable land. The rest of the land is either marginal or arid. These areas have been the focus for many research and extension processes and are deemed to have benefited enough to optimise agricultural production. However, the agricultural sector in Kenya, just like any other SSA countries continues to face major challenges as the engine of development especially in the face of declining per capita food production, rising levels of malnutrition and increased food insecurity over nearly three decades (Lynam et al., 1998). While the causes of this negative trend are complex, emerging evidence point to the fact that declining soil fertility, lack of robustness in addressing agricultural policy concerns and farmers’ socio-economic and biophysical environment are some of the prime underlying causes for this trend (Sanchez et al., 1997; Muriuki and Qureshi, 2001; Deugd et al., 1998; Hilhorst et al 2000; DALEO, 2000). Reversing this trend calls for new approaches in agricultural technology development and diffusion, which take into account farmers’ knowledge and biophysical and socio-economic circumstances.

It is, thus apparent that there is need for new approaches to increase farmers’ capacity to test new technologies in their fields, assess results and relevance of technologies to their particular circumstances and to interact with researchers and extensionists on a demand driven basis (GoK and UNDP, 2001). This calls for shift from the current top down approaches to participatory approaches for enhanced soil and farm productivity. Farmer field school is seen as one approach that can contribute substantially to bridging this gap (Braun et al., 2000). The drive towards farmer field schools has been due to the search for robust approaches to arrest declining agricultural productivity and to increase opportunities for facilitating learning at farm level. Farmer field schools are deemed important in addressing the existing cobwebs in agricultural technology development and adoption, weaknesses in research and extension linkages, low rating of farmers expert knowledge, communication gaps between scientist and farmers’ and in strengthening community-based institutions.

This report presents a review of literature on agricultural production and its constraints in central Kenya with a focus on Kiambu District. It details agricultural production levels of various crops or livestock enterprises and problems facing the existing systems.

2.0 BIOPHYSICAL AND SOCIAL ECONOMIC ENVIRONMENT OF KIAMBU DISTRICT

2.1 Biophysical environment

Kiambu District is situated in Central Province. It borders Nairobi Province and situated between latitude 0°75” and 1°20” south of the equator and longitudes 36°54” and 36°85” East and an altitude of between 1800 and 2550 m a.s.l as shown in the District map of Kenya (Figure 1).
Figure 1: Location of Kiambu District in Kenya

101 - 105 Central Province
201 - 205 Coast Province
301 - 306 Eastern Province
401 Nairobi
501 - 503 North Eastern Province
601 - 604 Nyanza Province
701 - 712 Rift Valley Province
801 - 803 Western Province
It has an area of 1460 km² of which 1422 km² (97.5%) is available for agricultural production. (DALEO, 2000). Administratively, the district has undergone various changes in terms of size and number of divisions. Currently, there are 7 divisions, Kikuyu, Githunguri, Kiambaa, Lari, Limuru, Municipality, and Ndeiya Divisions created in 2000. The rainfall regime is bimodal and rainy seasons are distinctly separated. First rains start mid- to end of March, with their peaks in April-May followed by a cold season during July-August and second rains start mid to end of October with their peak in November. Average annual rainfall is 1,100mm per year. Rainfall steadily increases from east to west but decreases, however, in the rain-shadow of the Nyandarua range within highland zones (LH₃-LH₅) (FURP 1987). Generally the District has two growing periods per year. The mean annual temperatures range from 11°C in the upper highlands to 27°C in lower midlands of Karai in Kikuyu Division. The years 1983-84, 1996 and 2000 recorded the lowest annual rainfall received in the district of (less than 700mm) per annum (Fig. 2). This was accompanied by a decrease in production with some crops having total failure.

According to Jaetzold and Schmidt (1983), Kiambu District has 3 main agro-ecological zones namely:

**Upper highlands (UH₀-UH₂) - Tea/Sheep/Dairy Zone**: The area forms the main catchments area for natural channels with well-drained soils. It is mainly in Lari and parts of Githunguri and Limuru Divisions.

**Upper midlands (UM₁-UM₃) - Coffee/Dairy zone**: Characterised by wide spaced parallel ridges with fairly good drainage. Mainly in Kiambaa municipality, Githunguri and parts of Kikuyu Divisions.

**Lower Highlands (LH₃-LH₅) - Maize/Wheat zone**: It is generally level with fewer ranges characterised by poor drainage and few streams. This zone covers mainly Ndeiya Division and Karai in Kikuyu Division.
High rainfall experienced in some parts of the District have negative effects on crop production and marketing due to water-logging and destruction of communication network reducing accessibility to markets in some rural areas. Other problems in countered in the District include:

- Leaching of nutrients due to high rainfall
- Severe soil erosion in poorly conserved lands.
- Declining crop yields: The crop yields for annual crops are low despite the use of fertilizers, indicating decline in natural fertility in intensively cropped land.
- Declining soil fertility: The use of mineral fertilizers in the district is mainly confined to cash crop such as tea and to some extent, horticultural crops. Application of mineral fertilizers to coffee, especially among the small- scale sub-sector has declined in the recent past due to low prices of coffee. The use of organic inputs is generally low. However, soil and water conservation practices are practiced in the district e.g. terraces in coffee farms.
- Declining land sizes: Due to increased population pressure, land sub-division is becoming rampant and may soon be uneconomical to support a family.

The following has been identified as solution to inadequate rainfall:

- Construction of water pans to trap and store run-off rainwater during high rainfall seasons for use in times of dry periods;
- Use of irrigation methods that make effective and efficient use of the scarce water resource;
- Adoption of water harvesting technologies and fast maturing crops or drought escaping crops;
- Diversification of farm enterprises to spread risks; and
- Adoption of appropriate Integrated nutrient management technologies i.e. adoption of organic and Inorganic sources of plant nutrients.
2.2. Soil characteristics and farming systems

A greater part of the District has well-drained, extremely deep, dark reddish to brown, friable clay, with acid humic topsoil ando-humic Nitisols (popularly known as “red kikuyu loams”). The soils in the district are inherently fertile, but continuous cropping with limited management of organic and inorganic sources of fertility has resulted in declining soil fertility, especially in small-scale farms. Nitisols are found on volcanic footridges and high-level uplands, where major cash crops such as coffee, tea and pyrethrum are grown. Other minor soils include pellic vertisols, Andosols and Planosols. This is mainly in Ndeiya division and Karai area of Kikuyu division. They are variable in fertility and are either sandy or clay loam, which are poorly drained (Jaetzold and Schmidt 1983).

The main food crops grown in the district are maize, beans, floriculture with emphasis of cut flowers (Roses etc) and potatoes while the main cash crops grown are tea grown in estates and small scale farms, horticultural crops (kales, tomatoes, onions etc), coffee and pyrethrum mainly on smallholder farms. The staple food crops, maize and beans are planted roughly on 55% of the annual crop area, while the rest of the cropping area is dedicated to horticultural production. Horticultural activities are found in the wetter parts of the District. Land is cropped 1.4-1.7 times per year. Livestock kept are dairy and beef cattle, poultry, sheep and goats, pigs among others. Choice of livestock is determined by the AEZ characteristics, available market and economic returns of the enterprises. The stocking rate for dairy animals is extremely high (6TLU/ha) mainly due to livestock management systems practiced in the District.

2.3 socio-economic environment

2.3.1 Population and labour
The District has a population of approximately 799,164 persons with 189,706 households each (at least 6 persons/HH). This translates to approximately 562 persons/km². It is one of the most densely populated districts in Kenya (CBS, 2000). There are approximately 105,175 farm families occupying an average farm size of 0.8 hectares for small-scale farmers and 21.3 hectares for large-scale farmers (DALEO, 2001). The low average farm size among the rural poor (Table 1) is a result of the high land pressure in the district. Among the poor (approximately 28.7%) in the district, 21.3% do not own land. Due to the low land sizes, the production system adopted by the farming community in the District is intensive. Most farmers in the district rely on the small land holdings for their livelihood.
Table 1: Food and non-food share in total expenditure in Kiambu District (to 1997)

<table>
<thead>
<tr>
<th></th>
<th>Food</th>
<th>Non-food</th>
<th>Total</th>
<th>Food share (%)</th>
<th>Non-food share (%)</th>
<th>Mean HH size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor^1</td>
<td>3,677.9</td>
<td>988.2</td>
<td>4,666.1</td>
<td>78.8</td>
<td>21.2</td>
<td>5.9</td>
</tr>
<tr>
<td>Non-poor</td>
<td>6,646.4</td>
<td>4,897.5</td>
<td>11,543.9</td>
<td>57.6</td>
<td>42.4</td>
<td>4.3</td>
</tr>
</tbody>
</table>

Source: CBS, 2000
^1—see footnote next page

The District has got good network with most of the roads well maintained or under tarmac. The District is also situated within a reasonable distance from Nairobi, which provides jobs, additional income and market for smallholder farmers. The farmers in Kiambu District enjoy a greater comparative advantage over most farming regions in Kenya. The combination of suitable climate, well-developed infrastructure and proximity to the country’s main market makes Kiambu District the most economically vibrant in the country and puts the District on a competitive edge. Approximately 70% of the population in the district rely on the agricultural sector for their livelihood through direct or indirect employment. According to GoK (1999) agriculture is by far, the largest source of gainful employment.

3.0 TRENDS AND CONSTRAINTS TO CROP PRODUCTION

In the district, food crops occupy a total of 39,168 hectares while cash crops occupy 11,549 hectares. Due to proximity to major markets e.g. in Nairobi, farmers in the district specialise in cash crop farming. Consequently, it is not common to find a portion as large as 2 acres devoted to food crops only (FURP, 1987). Of importance is the dual-role played by most food crops which double as cash crops in times of surplus. For purposes of this report, crops in the district are classified as food crops (maize, beans, potatoes etc.), cash crops as horticultural and industrial crops (vegetables, coffee, tea, etc.)

According to CBS, (2000), in terms of expenditure on agricultural inputs for crop and livestock production, family labour is the major source of labour among the poor while non-poor hire labour as shown on the Table 2 below:
Table 2: Mean annual expenditure of poor and non-poor on agricultural inputs in Kiambu district:

<table>
<thead>
<tr>
<th></th>
<th>Poor</th>
<th>Non-poor</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>equipment last 1 year</td>
<td>land last one year</td>
<td>other agricultural investment</td>
</tr>
<tr>
<td>Poor</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Non-poor</td>
<td>50.2</td>
<td>0.0</td>
<td>2.2</td>
</tr>
</tbody>
</table>

Source: CBS, 2000

The major cereals planted in the district are maize and beans. Wheat has been gaining popularity in the last decade due to the weather patterns, which are favourable for wheat. The greatest constraint to its production has been birds. Low hectarage of security crops (like sweet potatoes, arrowroots, cassava etc.) and over-dependence on maize as the main staple food crop in the semi-arid areas of the district has had negative effects on food security.

3.1 Maize production

3.1.1 Trends in maize production: 1979 - 2001

Maize (*Zea mays* L.) is the staple food for over 90% of Kenya’s population and provides a cheap source of calories. The crop is subject to a number of biotic and abiotic stresses, which reduce yield (*Ransom, et al 1997*). Biotic factors include pests and diseases while abiotic factors include endaphic and moisture factors (*Carlson, 1990*). Demand for maize in the country has outstripped production. This has necessitated importation to meet surplus demand (*GoK, 2001*). Average maize yield is approximately 3.5 t/ha while mean yield in the National Performance Trials conducted range from 6.0 to 8.0 t/ha (*Ligeyo, 2000*).

Maize is also the most important cereal food crop in Kiambu District grown both in the long and short rains (*MoA, 1982*). The crop is harvested either when green or dry. The yields and hectarage under maize in the district since 1979 are as shown in Figure 3.

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2 Overall poverty line is estimated at KES.1,239 and KES.2,648 per month per adult person in rural areas and urban areas respectively for food and non-food expenditure (*MoFP, 2000[a, c]*)
Figure 3: Trends in maize yield and hectarage in Kiambu District (1979-2001)

On average, hectarage and productivity were higher for the period 1979-1989 as compared to 1994-2001 (Figure 3). Whereas average hectarage reduced by 17.5% from 21,516 to 17,743 hectares, production per hectare reduced by 50% from 28 bags/ha to 14 bags/ha. Hectarage under the crop is declining because of stiff competition from horticultural crops, which find a ready and profitable market in Nairobi City (DALEO 1999; GoK 2001). The changing weather patterns also influence production levels and input use levels of the crop. Production levels are often determined by productivity and rainfall patterns of previous seasons.
3.1.2 Constraints to maize production

Constraints that have led to low maize production are:

a) Poor market prices: Low producer prices offered to the farmers for their maize produce immediately after harvest is a major constraint that has resulted in low returns to capital invested. In turn, farmers’ ability to invest more in the production of the crop is limited. It is important to note that the poor prices at harvest time for maize are leading to supplementation of maize with horticultural crops as a means of cash earnings.

b) Input use: Due to poor prices, there is low input use (e.g. mineral or organic fertilisers) into the enterprise and gradual loss of soil fertility. This in turn results in low yields. In some years e.g. 1995, unavailability of seed at planting time was reported. Untimely availability of seed and poor seed quality result in late planting hence affecting yield levels. Use of poor planting materials due to successive crop failures is also on the increase. There is an increasing number of farmers going back to use of local seed (DALEO, 2001) and this has resulted in decreasing yields as well as high pest and disease incidences.

c) In some parts of the district, weather patterns have changed over the years. Periods of unpredicted drought have led to low or no yields hence affecting farmers decision making related to input use and amount of land to dedicate to particular enterprise. According to Fischer, et al., (1983), estimates reveal that drought may account for 15% or more of production loss in tropical areas, even where rainfall is reasonably high. However, in most cases high rainfall in one period may be followed by periods of very low rainfall or vice versa, hence affecting annual average crop yields.

d) Population increase in the district has resulted in diminishing land sizes hence increasing the pressure on land available for cultivation. This has resulted in nutrient mining from intensive farming and low input use. As a result of low economic returns farmers are unable/unwilling to replenish lost soil nutrients hence organic and/or inorganic fertilisers are not applied adequately.

e) Prevalence of pests and diseases: The maize streak virus is a perennial problem. Incidences of maize stalk borer have also been reported in the last ten years in some places. However, extension staff has followed up control of the incidences and levels have reduced over the years. Reduced incidence of maize streak virus and maize stalk borer were reported in the year 1997 (DALEO, 1997). However, since 1998, there is an increase of incidences of maize streak virus, maize smut, and maize stalk borer.

f) Low soil fertility: This can be attributed partly to farmers’ inability to replenish lost soil nutrients because of low economic returns from farming.
3.2 Bean production

3.2.1 Trends in bean production: 1979 - 2001

Food beans are grown widely in the district although production levels are usually low. They are the most common pulses and are intercropped with maize, other crops or planted as a pure stand. The most dominant varieties grown are rose-coco and Canadian wonder (DAO, 1989). Other pulses grown include Dolichos beans (Dolichos lablab), cowpeas, pigeon peas and soybeans. Beans form the leading source of plant protein (DAO, 1986). They require moderate well distributed rainfall (300-400 mm per cropping cycle), but dry weather during drying and harvest is essential (Maeseu et al, 1992).

Bean production in the district has been low due to various factors and prices have hence been high (Figure 4). After maize, beans occupy the largest area under production in the district since it is usually grown as maize bean intercrop. Although, there has been a general decline in productivity over the years, some years have exhibited increased production. In 1997, hectarage under beans decreased by 17% whereas productivity increased by 14%. This could be attributed to the high rainfall received in the year due to the el-nino phenomenon. Highest hectarage under beans was achieved in 1994 (20,979 hectares) that, however, had the lowest production reported (16,322 90-kg bags) and productivity (0.8 bags/hectare) as in the Figure 3 below.

Figure 4: Trends in beans yield and hectarage in Kiambu District (1979-2001)

Bean production in the district is rainfed and this has often resulted in crop failure in case of insufficient rain or shorter than required season. In 1984, only short rain produce was realised. Production of beans in the district falls below demand hence the need to supplement with beans from other districts.
3.2.2 Constraints to bean production

Bean production is often much lower than targeted production in the district. This is attributed to various constraints facing its production. The most significant constraints are:

a) Pest infestation, which has been reported in different seasons. Pest infestation has been influenced by various factors e.g. weather patterns, soil conditions, management practices etc. The most common pests and diseases reported are:

(i) Aphids (in times of dry conditions),
(ii) Bean fly (in water logged areas). The problem is compounded by use of recycled seed from previous harvests that is not treated hence transmitting the pests.
(iii) Halo blight

b) Poor weather conditions:
(i) In seasons where rainfall was less or lasted for shorter period than normal, low yields were experienced and in some cases complete crop failure (e.g. long rain-season in 1984). This in turn results in low annual crop yield. The loss is more severe when there is lack of sufficient rainfall during critical growth periods. This also affects availability of seed for next planting season hence reducing area under the crop since most farmers use seed from previous harvest.
(ii) Too much rainfall is also harmful to the bean crop. High rainfall of 1988 reduced potential yield for the year in the long rain-season through water logging.

c) Low input use: Low fertiliser use in the district has led to declining soil fertility.

i) There is little or no fertiliser use in bean production in the district. Where used the rates are lower than recommended rates leading to declining soil fertility.
ii) Disease and pests control measures are not applied in bean production in the district. This results in low yields due to destruction by the pests.
iii) Most farmers use seed from previous harvest instead of certified seeds. A large number of stockists do not stock certified bean seed due to lack of market. Use of own seed has also led to declining yields due to disease and pest infestation being carried from one season to the next.
3.4. Irish potato production


Being a popular food within the community, potatoes are widely grown in the district mainly for home consumption and surplus for sale to the nearby Nairobi market. With high production achieved through growing of improved potato varieties and better management of the crop, more of the crop is finding its way to the market. The area under Irish potatoes has been on the increase over the years (Figure 5). On average, production and productivity of the potatoes has increased by 74%, 99% and 19% respectively from 1980 to 2001. Wide ranges of varieties are grown including Desiree B53, Roselyn Tana, Nyayo (most popular) among others (DALEO, 1998). The improved varieties i.e. Tigoni and Asante are also gaining importance in high rainfall and high altitude areas. Kerr’s Pink is a preferred variety in marginal low altitude areas (DALEO, 2001).

Figure 5: Trends in Irish potato production in Kiambu District (1979-2001)

![Graph showing trends in Irish potato production](image)

NB: Av. 80s = Average production/ha 1979-1989
Av. 90s = Average production/ha 1994-2001

There was a rise in hectarage of other root crops like arrowroots, sweet potatoes, yams and cassava indicating that farmers continue to realise their importance as “security crops”. This is because they tolerate drought. However, their acreage remains generally low in the last decade due to changing eating habits in the district. The crops are mainly popular amongst the old farmers and are susceptible to rodent menace than other crops. However, sweet potatoes are gaining popularity due to their high market value.
3.4.2 Constraints to potato production

a) Poor storage of seed potato: Lack of knowledge on appropriate seed storage methods leads to low quality planting materials hence low yields.

b) Use of non-certified seed: Certified seeds are not readily available to most farmers. Some of the small-scale farmers perceive the certified seed as expensive to purchase.

c) Attack by early or late blights and bacterial wilt virus: Incidence of bacterial wilt usually results from non-use of clean planting materials and lack of rotation due to diminishing land sizes amongst farmers (DALEO, 1998). High fungicide costs also inhibits use of the same by some farmers.

d) Low soil fertility arising from little or no use of fertilisers and manure amongst potato farmers: This is often a result of low prices offered for potatoes at harvest coupled with high perishability of the same.

e) Low prices for the produce since farmers’ are not organised in marketing groups. This low prices inhibits inputs due to low returns to the same.

4.0. CASH CROP PRODUCTION

The most important cash crops grown in Kiambu District are tea, coffee, and various horticultural crops. The proximity of the district to major markets like Nairobi and hence facilities like the airport, enhances the capacity of the district as a commercial one.

4.1. Tea production

Tea is the leading export commodity in terms of foreign exchange generation. It accounts for approximately 20% of total export earnings (GoK, 2001). Tea marketing in the country has undergone change with private factories coming up to process and market tea, which was once the sole responsibility of the Kenya Tea Development Authority (KTDA). Currently the market is more organised as compared to the coffee market and farmers’ payments more stabilised.

4.1.1 Trends in tea production: 1979-2001

Tea is the main cash crop in the higher zones of Kiambu District, which are to the East of the Rift Valley. Figure 6 shows tea production trends from 1979 to 2001.
4.1.2 Constraints to tea production

The main constraints faced by tea producers are pests and diseases. Pests and disease levels are highly influenced by management of the crop in the field. The main problems include occurrence of armillaria root rot, red crevice mites and purple mites. However, presence of mites is usually observed in the dry season and clears with onset of rains and pruning. Main disease in tea production was Armillaria mellea.

4.2 Coffee production

The major botanical species grown are Arabica (99.99%) and Robusta (0.01%) with the following botanical varieties: K7, SL28, SL34, Ruiru 11 (a hybrid) and Blue Mountain. (DALEO, 2001). There are two coffee flowering periods: March and April (during long rains); October and November (short rains). The short rains harvest comprises 60% of the crop harvested.

Coffee production in Kenya has declined significantly over the years from a peak of 129,000 metric tonnes (1987) to 95,000 tonnes (2000). The major causes are the declining world coffee prices, high input costs, erratic weather, pest and disease upsurge, inefficient management of coffee co-operative societies, poor marketing, disharmony between current policy and legal framework amongst others (GoK, 2001).
4.2.1 Trends in coffee production: 1979-2001

In Kiambu District, coffee is planted in the Upper midland zones in Kiambaa, Municipality, and parts of Githunguri and Kikuyu Divisions. Production is by both large and small-scale farmers. The large-scale planters use irrigation for their production and generally have easier access to markets. The small-scale farmers on the other hand rely on rainfed coffee production and hence their production levels are highly influenced by weather patterns. Input use is also higher among the large-scale planters compared to the small scale. The small-scale farmers market their coffee through co-operative societies while the large-scale farmers mainly form the estate sector with direct marketing of their produce. Most of these estates have their own coffee processing companies. Payment is mainly determined by the quality of the coffee as received in various factories. Through the years cherry production has been below potential in Kiambu District (DALEO, 2000).

The Coffee Research Foundation (CRF) helps in the technical aspects of coffee production including training on proper management, research in aspects affecting coffee production, conducting soil analysis and giving appropriate input recommendations to farmers among others.

4.2.2 Constraints to coffee production

The coffee sub-sector has faced diverse challenges over the years especially due to market organisation. This in turn has affected coffee production levels negatively with a decline in production experienced through the years. Hence to increase farmer’s willingness to increase production of coffee, better prices should be offered.

The major constraints facing the sub-sector are:

a) Intercropping of coffee with beans and other crops practised by small-scale farmers results in poor returns due to quality and quantity of coffee produced. The practice was high in early 1980s but declined towards mid-80s. However, with current poor payment the coffee bushes are again neglected and intercropped with other crops.

b) Poor weather conditions – especially for small-scale production.

c) Poor management of coffee marketing co-operatives has resulted in poor payment of dues to farmers and in turn coffee production has reduced greatly.

d) Lack of affordable and favourable credit facilities from co-operative societies.

e) Poor practices such as improper pruning, weed control and soil conservation practices have resulted in low yields.. It is important to note that poor practices have come about due to poor payment hence no reward to effort.
f) Reduced acreage: Change of land use from coffee farms to residential plots/areas coupled by inadequate input use especially fertiliser and fungicides caused by low coffee prices.

g) Botanical problems including presence of coffee berry disease and leaf rust

4.3. Pyrethrum production

Kenya produces approximately 70% of the world’s supply of pyrethrum. This in turn earns the producers approximately Ksh.1.52 billion per year. Pyrethrum supports close to 2 million people through co-operative societies, 780 self help groups and 5,000 individual farmers (GoK, 2001).

One hectare of pyrethrum accommodates 52,000 pyrethrum plants. Picking continues for nearly a whole year; from July to April the following year. About 1,000 kg of dried pyrethrum flowers are obtained in one year from one hectare. Although pyrethrum is a perennial crop, a typical plantation will last for three to four years. The farmer will then transfer the plants to another crop (DALEO, 2002).


Pyrethrum is a cash crop grown in the cool parts of Kiambu district i.e. Lari, Kikuyu and Limuru divisions. Production levels are mainly influenced by the market prices of produce. Pyrethrum is mainly grown by small-scale farmers in the district with similar management levels and has an average pyrethrin content of 1.4%. Management problems that rocked the sub-sector led to reduction in production levels due to low input use and preference of other crops, which fetched better prices in the market. However, with improved prices in 2000-2001 offered by the Pyrethrum Board of Kenya (PBK), production is on the increase with a 100% increase in the year 2001 (Figure 6). More farmers are now making a comeback to pyrethrum growing since earnings have more than doubled (DALEO, 2001).

Production since the early 1980s has been on the decline. The average production from 1979 to 1989 was 639MT per year, which declined to 3 MT between the period 1994 to 2001 (Fig. 7). This can be attributed to poor crop husbandry and low returns as a result of low prices.
4.3.2 Constraints to pyrethrum production

a) From 1982 to 1985 pyrethrum suffered a downward production trend due to lack of market resulting in most farmers uprooting the crop in favour of other crops (MoA, 1986).

b) Absence of crop rotation due to diminishing land sizes has led to reduced productivity. In early 1980s, low yield also meant poor pyrethrin content.

c) Poor management of the crop due to fluctuation of market prices

d) Competition with other crops e.g. tea, potatoes and vegetables, which fetch ready and better prices in local market.

e) Presence of phased out clones in some areas hence poor production levels.

f) Although heavy rains usually favour flowering of pyrethrum, it becomes a problem in times of drying.


g) Poor marketing due to the mismanagement of the co-operatives has led to the deterioration of the sub-sector. Most farmers sell their flowers to middlemen in Naivasha.

h) Due to the poor marketing there is now high labour costs occasioned by low returns to the labour requirement. Less attention is hence given to the crop (DALEO, 1997).
4.4 Horticulture production

Horticultural crops are the third most important foreign exchange earners in Kenya after Tea and tourism. Smallholder production constitutes 80% of all growers and produces 60% of horticultural exports (GoK, 2001). The key challenge to horticultural production is meeting the high quality and safety standards in the international market. The major horticultural products for both the export and local markets are flowers and vegetables.

In Kiambu horticultural production is both rainfed and irrigated. However, poor rainfall patterns negatively affect irrigation due to low water levels as experienced in 2000 (DALEO, 2000). The major horticultural crops in the district are:

i) Flowers (Rose, carnation, alastomeria, lilies, tuberose, etc.)
ii) Vegetables (Cabbages, kale, spinach, lettuce, tomatoes, carrots, broccoli etc)
iii) Fruits (Citrus, passion, tree tomato, bananas, mangoes, apples, avocados etc)
iv) Herbs and Spices (chillies, capsicum, celery, coriander, mint etc)

The common vegetables produced in Kiambu District are discussed here below.

4.4.1 Trends in vegetable production: 1979-2001
(Tomatoes, Kale, Cabbages)

Tomatoes, kale and cabbages are the most commonly consumed vegetables in the district. They are grown in most parts of the District. Other vegetables in the district include spinach, lettuce, Brussels sprouts, red cabbage, carrots, broccolic and cucumber among others. Weather conditions dictate available amounts of vegetable produce in the market and prices rise and fall respectively (DALEO, 1997).

Kale is the most important, popular and preferred vegetable in Kiambu district. The produce finds ready market in Nairobi and Rift Valley (DAO, 1986). Cabbages are second in importance and popularity to kale. Tomato demand is high throughout the year hence providing ready market. However, continuous production on the same plot reduces the yields due to increase in disease and pest incidences. Farmers are keen on tomato production considering that the crop does not require so much rainfall. However, in the last few years, increase in viral infections on tomatoes, courgettes and capsicum has reduced production of the same. Shortage of land hinders balanced rotation that could reduce disease occurrence in tomatoes. Production of the vegetables dominates the riverbeds and former forestlands.
Area under kale production has steadily been on the increase (136%) since the early 1980s from an average of 2,597 to 6,138 hectares per year in the 1990s (Fig. 8) while production increased (58%) from 8 to 12 metric tonnes per hectare. A 36% drop in area under tomato production in the 1990s compared to the 1980s was accompanied by a 9% decline in productivity from 21 to 19 mt per year. Cabbage production also depicted a 28% increase per hectare per annum with a 40% increase in area (Fig 8, 9).

Figure 8: Trends in area under common vegetable production in Kiambu District

Figure 9: Trends in Yields under common vegetable production in Kiambu District
4.4.2 Constraints to vegetable production

In the 1980s no major diseases were reported in the kale and cabbages. However,
a) Poor seed germination was a great constraint in production;
b) In tomatoes, blight remains a big problem though most farmers can now control it adequately (DAO, 1986). Diseases include Late Blight (controlled by fungicides, crop rotation and destruction of affected materials) and Blossom-end rot (the application of calcium ammonium nitrate or the correction of the aforementioned problems may control this disease). Other pests include the American bollworm and tobacco white fly.
c) Diminishing land sizes hinder the farmers’ ability to rotate crops like tomatoes. Constant production of tomatoes on the same plot reduces yields due to recurrence of disease and pests.
d) The 1997 clashes in Mombasa highly interfered with tourism and hence with vegetable market in Mombasa for Kiambu produce. Alternative local markets were hence flooded with the commodities hence decreasing prices considerably.

5.0 LIVESTOCK PRODUCTION

In Kenya, livestock production accounts for 10% of GDP. This is exclusive of home consumption and other unrecorded values (GoK, 2001). With declining land sizes in the medium to high rainfall areas, land is turned to growing crops and consequently alternative livestock management systems have to be adopted.
The most commonly kept livestock are cattle, pigs and poultry. Improved cattle (Friesian, Ayrshire, Guernsey and Jersey) are the main cattle breeds kept. Sheep and goats are also kept. Just as in crop production, the proximity to Nairobi and the commercial nature of the farmers highly favours the livestock sub-sector.

Fodder crops are usually grown by the farmers to feed to the shoats and cattle. These include Napier grass, sweet potato vines, various other grasses and fodder trees like Sesbania, calliandra amongst others. Most fodder crops are rainfed and hence performance depends on weather patterns. Not many farmers in the district preserve fodder in times of plenty hence in times of drought, there is shortage and where available e.g. hay becomes very expensive. Feed conservation measures should hence be intensified and taught to farmers.

Artificial insemination services (AI) are widely known amongst the farmers in the district. Most dairy co-operatives in the district offer AI services to the members as well as non-members. Privatisation of the AI services however, has led to increased costs of AI services hence hampering the exploitation of the dairy industry to maximum potential. However, use of pedigree bulls is not common except for a few large-scale farms while the use of communal bulls is only found in a few pockets in Lari, Githunguri and Kikuyu.

Pig and poultry production levels are determined by market availability. Cases of poor prices due to over flooded markets lead to low production in subsequent periods hence market regulates itself freely. The main markets for pig produce are Farmers Choice and Chefs Choice companies in Nairobi.

5.1 Cattle production in Kiambu district

5.1.1. Trends in cattle production

The main objective of the livestock department of the Ministry of Livestock Development (MoLD) is to have farmers produce enough livestock products for home consumption and have surplus for sale. However, the success of this is greatly affected by various constraints faced at farm level.

- Poor infrastructure especially in relation to processing of products.
- High cost of inputs. This greatly affects use of commercial concentrates in animal production since the prices are not encouraging.
- Inaccessibility to affordable credit facilities.
- Lack of organised market for livestock products especially eggs and milk.

a) Dairy cattle
Of the milk produced in Kenya, 63% is marketed, 30% is consumed at home and 7% given to calves. Since liberalisation of milk marketing in 1992, there has been an upsurge of new milk processors. However, informal milk marketing accounts for 60% of milk marketed (GOK, 2001).

i. Breeding

As shown below (Fig. 10) dairy cattle population in the district is much higher than beef/zebu cattle figures. The dairy cows are served mainly through artificial insemination with exception of some large-scale farms e.g. Gitata farm, Greens farm, Limuru mission farm etc., where superior breeding bulls are used. In areas like Kinale, Karai and Ndeiya however, bull service is the only means of cattle breeding where communal free-range grazing is the most common production system. Zebu cattle are widely kept in the drier areas of the district. Previously, AI services were government supported. Following privatisation and subsequent withdraw of GOK run services, the services are available from dairy co-operatives in the district and also from private practitioners. The increase in charges is hence too expensive for ordinary farmers and may result in more farmers using the cheaper natural service (bulls) method. This is shown by the general decline in number of inseminations (Table 6).

Figure 10: Cattle trends in Kiambu District
Table 6: Comparative insemination figures
(Figures from registered practitioners only)

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<tbody>
<tr>
<td>Number of inseminations</td>
<td>40,458</td>
<td>26,352</td>
<td>33,178</td>
<td>37,909</td>
<td>28,955</td>
<td>30,101</td>
<td>27,914</td>
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ii. Feeding

Most farmers favour Napier grass as a fodder crop over others. Nevertheless some large-scale farms in Kiambaa, Limuru and Kikuyu Division have established pastures of Rhodes grass, Kikuyu grass and graze their animals in paddocks as opposed to small-scale farmers who use the zero-grazing system due to diminishing land sizes. The use of manufactured feed supplements for feeding livestock is common in the district. Farmers access the seed from dairy societies land Feeds Limited, various stockists in the town.

iii. Milk production

Milk production and number of mature dairy cattle are shown in figure 10 and 11 respectively. Production is approximated at 5kg/cow/day with a lactation length of 305 days and 60% of mature cows are in-milk.

Figure 11: Milk production trends in Kiambu District

Due to liberalisation and frustration of farmers by the Kenya Co-operative Creameries (KCC) due to non-payment/delayed payment for milk produced, other processors have come up to save the situation. Most of milk produced is disposed through milk bars.
upcoming milk processors, neighbours and hotels. Preference for dairy societies is mainly due to benefits associated with the same like credit and cheaper AI services. Other farmers sell milk directly to neighbouring households and hotels while others still deliver milk to the more established KCC. Dairy societies collect most of the milk and channel it to consumers in Nairobi and other towns within the District. Milk societies are preferred regardless of their prices in anticipation of other benefits like credit acquisition, AI services amongst others (DALEO, 1999). Milk supply has a positive correlation to fodder availability, which in turn is determined by the prevailing weather situation.

b) Beef industry

The beef industry comprises zebu cattle, dairy cows and bull calves. Most beef animals are slaughtered in Dagoretti slaughterhouse and are brought in from other districts in Rift Valley, Eastern and North Eastern provinces. Chicken are slaughtered at Tigoni Kenchic slaughterhouse and other local slaughterhouses, while pigs are mainly slaughtered in Farmers Choice, Chef’s Choice, Local butcheries, Kenyatta market and Kenya Cold Storage in Nairobi. Beef production is a major activity in the semi-arid areas of Kiambu District. Hence in Kiambu district apart from dairy culls, beef production can only be found there on transit to Nairobi or from the drier areas of the district i.e. Ndeiya and Karai area of Kikuyu Division.

From beef cattle, the main outputs are meat and by-products (hides and skins, meals and fertiliser, rural use of offal in home-made rations, bone and blood meal and ruminal contents) (Ouda et al, 2001).

5.1.2 Constraints to cattle production

Cattle production is faced with constraints, which inhibit ability of the industry from exploiting maximum potential.

i) Disease incidences like occurrence of Foot and Mouth disease (FMD) and tick borne diseases have over time been a menace to livestock production.

ii) Fodder production in most instances is rainfed in the district. With the changing weather patterns, decline in production has been experienced and instances of complete failure of fodder crops on some farms were reported by the extension staff. Rain fed fodder production has often resulted in high milk production during rainy season and low production in the dry season. This in turn leaves a deficit supply during dry season and hence high prices.

iii) Use of commercial concentrates is limited among small-scale farmers who mainly use the same at the time of milking. This is due to the high cost of the feeds compared to the low returns in terms of payment for milk produced.
iv) Poor payment for milk delivered has discouraged most farmers from investing much in the dairy sector. This is because the farmers do not break-even.

v) Most small-scale farmers do not know about manure quality. They apply manure but often the quality is not determined. Lack of knowledge on manure handling and storage has led to use of poor quality manure.

5.2 Sheep and goat production

5.2.1 Trends in sheep and goats production

These are kept mainly for subsistence. The breeds kept are indigenous and a few exotic breeds (DALEO, 2001). They are mainly zero-grazed due to land limitation. Most of the goats are fed on sweet potato vines, banana leaves, napier grass, bran supplement and other fodder plants including some weeds.

Demand for dairy goat is increasing in the district. Toggenburgs and German alpine are used for crossing with local breeds for better performance and adaptation to climatic conditions. Most households in the district keep meat goats. They occupy less space and are less demanding in terms of feeding compared to cattle. The goats are also easily exchanged for money in case of urgent needs. Goat manure is used in crop production.

Sheep are kept mainly in the higher potential areas of Lari and Limuru Divisions but are also kept in few numbers in other areas. The numbers of wool sheep kept have not changed significantly over the years whereas hair sheep production has been on the decline (Fig. 12).

Figure 12: Trends in sheep and goat production in Kiambu District
5.3 Poultry production

Poultry kept are chicken, geese, turkeys and ducks (Figure 13). However, chicken are the most widely kept with few farmers keeping other poultry for ornamental and commercial purpose. Chickens kept are both exotic and indigenous. Exotic layers and broilers are widely kept and get ready market in Nairobi. There is also growing demand for indigenous chicken for both meat and egg purposes. The exotic chickens are kept under intensive management and feed the chicken with commercial concentrates while the indigenous chicken are mainly kept in free-range system. However, when commercial concentrates become too expensive, some farmers undertake on-farm feed saving technologies.

Various factors influence preference of poultry to other livestock. These factors include:

- The fact that they require little space;
- Proximity to ready market outlet;
- Availability of feeds from main manufacturers; and
- Proximity to source of day old chicks.
5.3.1 Constraints to poultry production

However, various constraints hinder exploitation of the poultry to its potential. These include:

- The eggs and broilers market are not organised into co-operatives;
- High diseases incidences (Coccidiosis, New Castle Disease, Gumboro, fowlpox, fowl typhoid);
- High cost of medication and packaging in large quantities which is unfavourable for farmers with small number of birds e.g. the New Castle Disease (NCD) vaccine is in packages of 50 and cannot be stored once opened;
- Presence of low quality feeds compared to the corresponding high cost of the same; and
- Deaths of poultry due to cannibalism.
6.0 SOIL AND WATER MANAGEMENT

Soil and water are the basic resources necessary for agriculture. It is hence important to maintain their quality to ensure that production and productivity are sustained and/or improved. Good quality soils, which provide nutrients, water and foothold for plants are vital. With decreasing land sizes, the option is to increase productivity from the available land and this calls for adopting appropriate soil and water conservation techniques. Dwindling soil fertility has become an increasingly urgent problem in tropical agriculture (Bindraban, et al, 2000). The main problem in Kenya and in Africa is inadequate return of nutrients to compensate losses through harvest and leaching/erosion.

6.1 Trends in soil and water management

In Kiambu district soil erosion has continued to affect soil fertility in the district resulting in low crop yields. Nutrient depletion from the soils has also led to deteriorating soil conditions. Small land units, increase in population and low incomes have led to encroachment in catchments areas and forests; thus interfering with water volumes and soil fertility aspects. According to various Ministry of Agriculture (MoA) reports, the major constraints to soil and water management observed in Kiambu district are:

- Interference of natural catchments resulting in low river flows and disappearance of streams. This adversely affects water for irrigation and domestic use;
- Extensive tree cutting has caused soil erosion and also reduced rainfall;
- Cultivation along riverbanks has led to riverbank erosion and consequently heavy soil erosion, pollution and loss of flow volumes;
- On-farm and roadside gullies have resulted from runoff erosion caused by water concentration when it rains; and
- Intensive agriculture due to diminishing land sizes coupled with increasing population leading to over mining of available nutrients. This is made worse by low soil nutrient replenishment brought about mainly by poor market infrastructure.

When there is insufficient soil nutrient replacement of those exported out in crop products or lost from the system during cultivation, levels of soil organic matter and chemical soil fertility will decline (Gachimbi et al, 2002). The soil physical characteristics e.g. infiltration and water holding capacities also deteriorate further increasing the risk of losses through process such as erosion and leaching.

Over the years, with the help of the district extension staff, various soil conservation techniques have been employed to reduce loss of soil nutrients through erosion. Training has also been done on soil conservation, irrigation and drainage and farm mechanisation. However, apart from soil conservation, management of the resource is of vital importance. Dalzell et al, (1987) observed that improving soil fertility is aided by wide range of farming practices that help to maintain and increase the amount of organic matter in the soil. These practices help reduce erosion, increase moisture retention and maintain desirable level of soil temperature. Such measures include fallowing, rotation, green manuring and manure application.
However, in Kiambu district, practices, like fallowing, are not popular with farmers due to diminishing land sizes and limiting resources. Manure from zero-grazing units is highly used in crop production. In contrast, Dalzell et al (1987) indicate that manure is more profitable when used in composting as it helps balance the high C/N ratio of very coarse wastes used in composts hence making them easily available to crops on application.

Most farmers in Kiambu district are aware of the benefits of applying mineral fertilisers to their farms. Application of the mineral fertilisers is widely practised in the district though below the recommended rates in most cases. Whereas the fertilisers are widely used in commercial farming (especially horticulture farming), food crops do not receive much attention in terms of fertiliser application. This agrees with the observation that with the little financial return on their crops and the added risks caused by the recent low and erratic rainfall patterns, farmers are now shying off from investing in inputs like mineral fertilisers (Gachimbi et al, 2002). Agro forestry practices have been on the increase in the district with most farmers realising the benefits. The trees used are also integrated into the livestock-feeding program on the farms.
7.0. DISCUSSIONS

From the review of Kiambu District, it is evident that rainfall patterns and land holdings per family have, respectively, declined over the last decade due to global weather phenomenon and population increase. This in turn has led to reduced productivity of crops and livestock in the district. Focus should hence be on use of effective irrigation methods like drip irrigation coupled with other farm practices to increase moisture retention capacity of the soil hence maximise on use of the scarce water available coupled with diversification of the farm enterprises and intensification.

In the district the major hindrance to optimising crop production is declining soil fertility coupled with poor marketing infrastructure. Poor prices for different crops limits farmers willingness to use advanced technologies available due to low returns to investment. Focus should hence be on cost-effective ways of increasing productivity on farmers’ fields to help maximise profits in the short-run.

Livestock production has also been slowed down by the poor market infrastructure. However, better use can be made of the manure from livestock production in the district. Most farmers appreciate the importance of the manure and hence increasing and diversifying its use to improve crop production is vital.

On soil fertility, farmers’ use of mineral fertiliser has been on the decrease due to low returns. Knowledge of proper manure application is not available to most farmers and quality of the manure is of crucial importance. As earlier said, reduced land sizes can only be compensated through increasing output from the land. Various cost-effective soil fertility management techniques should henceforth be taught to farmers. It is also important to have a wide range of soil management techniques disseminated and practised by the farmers for increased organic matter and hence increased production.
8.0. REFERENCES


