Innovation for Food Security and Nutrition in Kenya Towards Attainment of The Big Four: A Review of Chelelang' the Wonder Bean Technology

Njoka E. Mbaka
Mt Kenya Royal College, P.O Box 74 Chuka, Kenya.

**Corresponding email: Njokambaka@gmail.com*

Abstract

Various genetic and environmental factors adversely affect the yield of beans in east and southern Africa. These include climate change variables such as temperature, moisture, also included are: pest, diseases and soils. This paper reviews genetically superior genotypes with reference to yields of various bean lines and varieties in east and South Africa. Also considered, were two climatic variables including: temperatures and moisture. A series of on-farm and station trials were carried out to screen lines and varieties from five international nurseries in Kenya, Uganda, Tanzania, Rwanda and Burundi. Sixty four (64) genotypes were screened in Nakuru, Bomet and Meru districts. Using farmer field schools and on station trials in Kaguru- Meru, Egerton- Nakuru and Bomet. The trial yielded superior bean genotypes such as Ciankui, Tasha and the EU a word winning Chelelang "the wonder bean". These germ plasms had been inspected by KEPHIS, and were recommended for commercial growing in cool highlands and warm humid arid- lands. These were the areas with temperatures in the range of 22-30^{oc} and moisture levels of about 400mm per year. It was also observed that Chelelang yielded 1750 Kg/ha (19.5bags) as compared to an average of 550kf/ha (6.0 bags) (i.e 3.19 times better) than Rose coco the control. The new technology (Chelalang) was a bean of choice to replace low yielding environmentally vulnerable commercial varieties and temperatures of 30^{0C} *and moistures of about 400mm.* The current technology average yield =550kg/ha= 6.11 bags/ha. Average yield of new technology (Chelalang) = 1750kg/ha=19,4bags/ha. bags/ha/season=38.9 bags/year. Kenya has a potential of 800,000ha for growing beans. This results to 800,000 x 38.9 bags = 31,120,000 bags. Average bean consumption in the country is estimated at 26,666,666 bags giving a surplus of = 4,453,333 bags. /year. At a price of ksh. 4000/bag would translate to an additional revenue of Ksh.4, 453,333 x 4000 =17,613,333,333/year. The technology contributed to reduction of hunger and provision of proteins bean. Adoption of this new technology would save the nation a lot of revenue which is appropriate for VISION 2030.

Key words: *Bean, Chelalang, yields, hectarage, technology, nutrition, food security*

Introduction

Today there are 821 million undernourished people in the world, of these 257 million are in Africa, of whom 237 million are in sub-Saharan Africa and 20 million in Northern Africa. Nearly half of this increase is due to the rise in undernourished people in Western Africa, while another third is from Eastern Africa. This is a result of low cop productivity due to climate variability, high food commodity prices coupled with low prices of agricultural produce.

Kenya is the largest food and agricultural products importer in Eastern Africa. At present the Government of Kenya is trying to reduce poverty. The country has been developing food security and nutrition measures since the last decade. To be considered as a medium developing economy, the government of the day should stress on food security and poverty reduction measures. To achieve this, emphasis should be placed on transformation of agriculture from survival to commercial farming, agribusiness, markets and efficient use of agricultural products. In the dry lands (83% of the country) the nation should embrace climate smart technologies. Hence the objective of this review was to document some of the variables that enhance the productivity of chelalang bean and its contribution towards increased food production in Kenya and consequently reduction of food insecurity and malnutrition. An attempt has been taken here to discuss the food and nutrition situation of Kenya.

Considered also was the most superior varieties of bean and their ideal environment for increased productivity.Kenya continues to face severe food insecurity challenges with about 3.4 million of Kenyans facing food insecurity problems. In 2017, many Kenyans suffered from acute food insecurity (USAID 2017a). Drought, low purchasing power, high costs of food production, high global food prices, vastly contribute to food insecurity in the nation (USAID 2017b). However, low productivity of major crops including beans contribute a great deal to both issues of food insecurity and nutrition.

In eastern and southern Africa, beans are the most important source of dietary plant protein and calories. Annual consumption exceeds 50 kg per person (Broughton et al. 2003). Beans are produced in over 20 countries in eastern and southern Africa covering over four million hectares. Cultivation areas are concentrated in cooler highlands and warmer mid-elevation areas with altitudes greater than 1000 m above sea level. However, due to population pressure, the cropping area is being extended to lower elevations (Katungi, Farrow, Chianu, Sperling, & Beebe, 2009). Schlenker and Roberts (2009) conducted a study on the effect of temperature on soybean production and reported a threshold of 30°C. Eighty percent of this region experiences a mean annual temperature of 15–23°C, which is below the threshold temperature. Bean yields are also affected by precipitation. Yields are severely impacted by moisture deficit. When precipitation falls below 300 mm during the growing season, yield decline in beans is estimated to be 1000 kg/ha. Hence, in eastern and southern Africa, rainfall variability and soil moisture content, rather than rising temperature, are the crucial factors in determining the effect of climate change on bean production.

Ramirez and Thornton (2015) model on bean production in East Africa estimated that up to 13% bean cultivation area by 2030 and 56% of area by 2050 will experience greater than 20% yield reduction. Thornton projected mixed effects with minor variations in 2030 and up to 20% yield decline in 2050 in rain fed humid-and sub-humid regions. Arid and semiarid regions of Tanzania and Uganda were predicted to gain yields in the 2030s and decline in the 2050s.

Beans are the most important legume staple food crop in Kenya and rank second after maize. World hectarage is 28 million hectares producing 40 million tons of beans (FAO, 2005). Kenya's hectarage approximates 800,000 hectares with production ranging between 90,000- 150,000 tons per year. The national average yield is very low at 350-750 kg/ha (mean 550kg/ha).

Beans are grown in almost all areas in Kenya but the major provinces are Eastern, Central, Rift valley, Nyanza and Western. It is mainly grown by small-scale farmers in intercropping systems. Kenya is presently a net importer of beans from the neighboring countries of Uganda and Tanzania.

The main biotic constraints affecting bean production in Kenya are mainly diseases and pests. Other factors includes: climatic factors such as temperatures, moisture and humidity. Genetic potential of commercial germplasm was considered an important variable to consider in the quest for high bean productivity in Kenya.

Kenyan farmers have not been exposed to high yielding bean varieties. Average commercial varieties yield about 550kg/acre which is way below global averages. The last release of four varieties was by the National Dryland Farming Research Center (NDFRC), Katumani who between 1987-1998 released varieties such as Kat Bl, Kat B9, Kat X56 and Kat 69. Since then no other varieties had been released. As a result, Kenyan farmers have not been benefiting from the high yielding disease and pest tolerant varieties developed by International organizations like International Centre for Tropical Agriculture (CIAT) which works on beans and other regional bodies like ASARECA. Hence with the declining in the yield of Kenyan beans e.g. Common bean (*Phaseolus vulgaris L.)* (Wagara, Mwang'ombe, Kimenju, Buruchara, & Kimani, 2011).

Methodology

A collaborative project was therefore initiated resulting in a series of on-farm and on-station trials to identify and disseminate improved bean varieties in all major bean growing areas in Kenya.

A regional breeding program was therefore initiated with 5 international nurseries in 5 countries (Kenya, Uganda, Tanzania, Rwanda and Burundi). The project was supported by East and Central Africa Bean Network (ECABREN) a project of ASARECA. Sixty four genotypes of determinate bush habit beans from germplasm bank and breeding nurseries at (CIAT) and four commercial varieties as checks (GLP2, GLP24, GLP585 and GLPx92-Rosecoco) were screened in Nakuru (on-sation) and Nakuru , Meru and Bomet districts as field trials from 2003-2007. KEPHIS played regulatory role while CIAT provided Standard characteristic procedures for diseases and pest rating.

Results

Three lines were found to be superior and sent to KEPHIS for NPT and DUS in 2006. The three lines included ECAB 00081, AFR708, LYAMUNGU- 85 and were amongst the highest yielding as compared to other lines from other institutions like University of Nairobi, KARl and Simlaw seeds. They were also better than 3 commercial checks (GLP2, GLP9, and GLPl127) evaluated together in 8 sites (Eldoret, Embu, Kabete, Katumani, Kisii, Njoro, Meru and Thika) for 2 seasons. Other special attributes of these lines were; diseases tolerance (bean anthracnose, leaf spots, BMCV, halo blight and mildews) ranged 1.2-2.8 of scale of 1-5 for most genotypes and pest susceptible cultivars.

The project achieved its objective by recommending three superior varieties for farmers. The study demonstrated that in high lands the temperatures and rainfall were suitable for bean growing except that the area was limited yet Kenya is about 17% arable. It is against this background information that it can be concluded that with irrigation, the dry lands of Kenya can produce beans not only for subsistence but for market. The temperature thresh holds for of beans is 30^{oc} while the optimum moisture is within the range of 400 mm. From the results of Chelalang, it can be estimated that if the existing land potential for bean grown with Chelelang the following could be realized:

Current technology average yield = 550kg/ha= 6.11 bags/ha. Average yield of new technology (Chelalang) = 1750kg/ha= 19,4bags/ha bags/ha/season = 38.9 bags/year. Kenya has a potential of 800,000ha for growing beans. This results to 800,000 x 38.9 bags = 31,120,000 bags. Average bean consumption in the country is estimated at 26,666,666 bags giving a surplus of = 4,453,333 bags. /year. At a price of Ksh. 4000/bag would translate to an additional revenue of Ksh.4, 453,333 x 4000=17,613,333,333/year. Adoption of the new technology would save the nation a lot of revenue which is appropriate for VISION 2030.

Discussion and conclusion:

The main objective was to screen, compare and analyze superior bean lines and varieties to replace low yielding, disease and pest susceptible commercial cultivars. The three lines were found to perform much better in areas with about 24 ^{0}C and moisture content of about 400mm. This area is below the potential for bean growing in Kenya and if run-off rain water can be harvested and stored the dry lands of Kenya can supply their protein and calorie need to solve the problem of perennial food insecurity in these lands. Adoption of the new technology would earn the nation a lot of revenue which is in accordance to VISION 2030.

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