KENYA POLICY BRIEFS
Towards Realisation of Vision 2030
JULY 2021
Volume 2 No. 2

Series 1 – Economic Pillar: Agriculture and Livestock

Improvement of Coconut Production in Kenyan Coast for Income Generation

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Key Messages

Kenya has lagged behind in technology development for coconut production, product diversification and product utilization.

Morphological variation exists. This variation cannot be exploited reliably because it's uncertain how it will impact on nut production.

There is narrow genetic variation among coconut trees at the Kenyan coast. This hinders meaningful crop improvement.

Research on coconut is hindered by the long juvenile phase of palms and long-term of field evaluation.

Context

The coconut palm is mostly cultivated in Kwale, Kilifi, Mombasa, Tana River, Lamu and Taita-Taveta Counties. It is grown in different agro-ecological zones at the coast and plays an important role in the economy. The total number of plants in the Kenyan coast is approximately 4.4 million, with an average nut yield of 1.5 tonnes/ha, while that of copra is as low as 0.45 tonnes/ha. Over 80 percent of coastal farm households (about 2.4 million people) derive their livelihood directly or indirectly from coconut and its by-products.

Almost all coconut tree parts can be used in either making commercial products or meeting the food requirements of rural communities (Teulat et al., 2000), an indicator of its economic value. Coconut production contributes an estimated 1.5 percent to the agricultural Gross Domestic Product (GDP) and 0.4 per cent of Kenya's GDP. Compared to other African countries, Kenya has lagged behind in technology development for coconut product diversification and product utilization reducing the overall value of the crop to our economy.

The potential value of the coconut sub-sector is estimated at US$180.6 million. But the actual value is only 25 percent of that (US$44.5 million) annually and consists of nuts (mature and immature-madafu) accounting for about 24 percent, coconut wine (60 percent), *Makuti* roofing materials (12 percent), brooms (3.3 percent) and coconut wood (1 percent).

The low level of productivity is due to old and unproductive orchards – the East African Talls (EAT) with no designed improvement programme since they were introduced in Kenya, inadequate quality planting material, lack of fast means of generating clean planting materials, unavailability of improved varieties and a general lack of value addition (Muhammed et al., 2013). Slow growth and long pre-breeding period of palm is also a factor (Rajesh et al., 2008).

Additionally, there is no medium- to long-term coconut breeding programme in Kenya to breed varieties to replace the over-cultivated EAT, East African Dwarfs (EAD), and their incidental hybrids. This has prompted farmers to rely on their current crop to get seedlings. There are also some individual farmers' efforts including Gazi Farm Enterprises Ltd, which produce and sell unimproved coconut seedlings.

Coconut research in Kenya (and the rest of the world) is hindered by the long juvenile phase of palms, the high cost of conducting investigations, long-term of field evaluation, lack of research funding, and lack of use of robust DNA and tissue culture technology.

Approach and Results

Coconut trees were characterized in situ and leaf samples collected for DNA analysis at the coastal counties of Kilifi, Kwale, Lamu, and Tana River. The objective was to characterize the Kenyan coastal lowland coconut using morphological and DNA markers. Sampling was done at different agro-ecological zones. The focus was in areas where palms grown were morphologically different with a marked change in altitude or cropping systems, existence of a formidable barrier, or local people ethnically different (in terms of dialect) from previous collection sites. Sampling was done in both large and small scale farmers' fields.

Morphological characterization (qualitative and quantitative traits) was done according to the procedure as given in by International Plant Genetic Resources Institute (IPGRI) in 1995. For genetic analysis, DNA was extracted from leaf samples and used to assess how coconut trees were closely or distantly related based on their DNA profiles.

Several different morphological features were observed but generally, differences in morphology did not follow geographical areas from which coconut trees were grown (see Figure 1). This suggests that there is an exchange of planting materials among the coastal farmers across the region.

Narrow genetic differences were reported among and with the materials studied. Three DNA groups were realized. Groups were made of mixtures of materials from all the counties. There were also subgroups within the three groups. The presence of subpopulations in all the clusters and different levels of similarity between the localities showed overlapping of same materials at the coast region. This is because the materials have close genetic relationship among them and similar genetic materials are spread across Kenyan coast.

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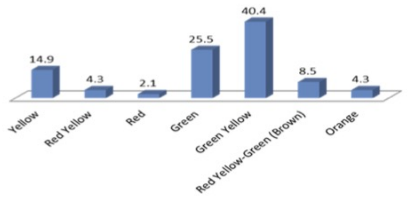
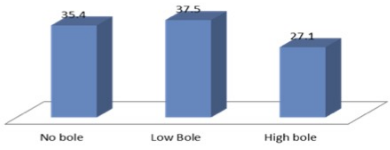
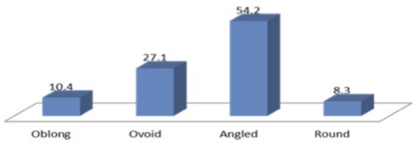


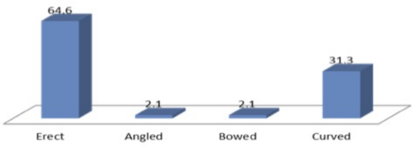
Colour of Stalk and Immature Nuts



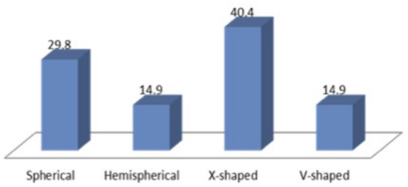
Bole Category



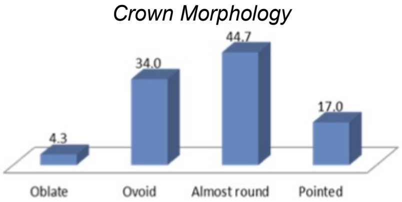
Fruit Morphology



Vertical Stem Descriptors



Crown Morphology



Fruit (without Husk) Appearance/Shape

Figure 1 – Quality Characteristics and their frequencies for the germ plasm studies.

Further analysis showed that there is a high genetic similarity (over 0.95) with a low genetic distance (0.011) of coconut in farmers' field across Kenyan coast (Figure 2). There is also a very narrow variation (2 percent) among coconut trees pointing to the fact that more variation exists within individual coconuts as opposed to among groups based on the areas where they are produced. These results clearly indicate that Kenyan coconut have a shared ancestry, making them close or distant relatives. As a result, they cannot be adequately and meaningfully exploited during plant improvement programmes through hybridization. This means that if a crossing programme was initiated, gene exchange between individuals would result in marginal crop improvement due to relatedness.

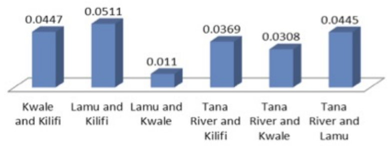


Figure 2a – Comparison of Genetic Distance Among Counties

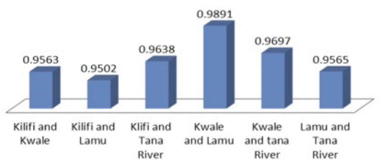


Figure 2b – Comparison of Genetic Similarities Within Counties

Policy Recommendations

Short-Term

- Deliberately introduce and evaluate materials with potential qualities form the International Coconut Gene Bank.
- A multidisciplinary team should monitor and document attributes of seed nuts brought into Kenya from India in 2018 and planted in a quarantine site at KALRO-Matuga, Kwale County. Their attributes, based on coconut descriptors, IPGRI 1995, should documented.
- Support individual farmers who produce and sell EAT and EAD coconut seedlings to multiply improved varieties once identified.
- Staff training in national research centres and universities on modern plant breeding and rapid multiplication techniques using molecular tools.
- Promoting conservation through use by establishing farmer community-managed coconut seedling nurseries and linking germ plasm conservation and use with research and development.

Medium-Term

- Establishing a coast region-based coconut breeding programme equipped with tissue culture facility for optimized and rapid regeneration of superior and clean parental materials for sale to farmers.
- There should be conservation strategy whose components should include conservation in a national field based in KALRO-Mtwapa or Matuga and in situ and on-farm conservation. In vitro embryo culture, somatic embryogenesis and cryopreservation should be considered.
- Establishment of a coconut value chain with emphasis on input-output structure.

Acknowledgements

The author is grateful to NACOSTI for funding. This brief is derived from 'The morphological and genetic characterization of coconut in Kenyan coast'. I thank Prof Mwangi Githiri (JKUAT), Dr. Muhammed Najya (Pwani University), Agriculture Food Authority and KALRO Mtwapa for assistance, and Dr Grace Kibue (Egerton).

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