Farm conservation and utilisation of coconut diversity

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Coconut, cocos nucifera L., is a mono-typic genus and an important crop of tropical world. Evolved and adapted along the coastal ecosystem in tropical world, coconut spread to other regions subsequently with human assistance and became part of human culture. Various uses of coconut to mankind and the long history of cultivation obliterate the marks of its origin and diversification. Dispersal of coconut has been aided by both nature and man, through ocean currents and human movements in prehistoric times. Its spread in coastal regions and islands can be attributed to ocean currents while the dissemination hinterland definitely required human interventions. Along its spread to various geographical situations and adaptation to the conditions, there was a gradual accumulation of phenotypic diversity. Origin of coconut is still a debated matter. It is generally accepted that coconut originated either in Central American region or in islands of Indian or Pacific Ocean.

Two major forms of coconut developed during the evolutionary process are tall types and dwarf types based on the plant height (Narayana and John 1949, Menon and Pandalai 1958). Tall is the commonly cultivated type for copra and oil. Dwarf types are generally used for tender nut water, avenue planting or ornamental purposes. Other two major types identified in coconut are the niu vai and niu kafa types based on fruit morphology. Niu kafa type, considered as wild, has triangular fruit with high husk content and small nut inside. Niu vai types, with round fruits with low husk content and large nut inside containing large quantity of liquid endosperm are considered as advanced cultivars developed under human selection (Harries 1978; Samsudeen et al 2006). Both niu vai and niu kafa types are identified in tall population. Dwarf types are known to produce niu vai type fruits but not niu kafa type fruits.

Major products of coconut, beside copra and oil, are desiccated coconut, tender nut water and coir. Other

products include copra meal, shell charcoal, activated carbon, cocochemicals (fatty acids, fatty alcohol, methyl ether), coconut wood, fibre products, coconut cream, coconut milk, coconut powder, coconut chips and nata de coco. The inflorescence sap, known popularly as 'neera', has been creating a lot of interest among farmers and consumers recently and emerging as a health cum sports drink of natural origin. Coconut today is being positioned as a food, nutraceutical and industrial crop rather than oil crop.

Today, coconut is cultivated in 12.3 million hectares in 94 countries producing 62.5 million tons of nuts equivalent of 10 million tons in copra or six million tons in oil (FAOSTAT 2014). Approximately 96% of coconut area is cultivated by 10 million smallholder farmers with farm holdings less than four hectare and more than 80 million people depend on coconut for their livelihood (FAO 2001). In India, coconut is cultivated in 18 states and three Union Territories under 2.16 million ha for the production of 15.08 million tons (Indiastat database 2015). The four southern states of Kerala, Karnataka, Tamil Nadu and Andhra Pradesh account for 90% of area under coconut and 93% of production. Rest of the production comes from Maharashtra, Orissa, Pondicherry, Andaman & Nicobar, Lakshadweep, Gujarat, Goa, West Bengal and non-traditional states like Bihar, Assam, Tripura, Nagaland, Manipur, Meghalaya, Arunachal Pradesh and Chhattisgarh.

Evidences suggest that coconut reached the Indian subcontinent early in history. Recent discovery of 65 million year old fossil fruit resembling coconut (world's oldest fossil record of coconut) from Ghansor in Seoni district of Madhya Pradesh suggests origin of coconut in the Indian subcontinent (Srivastava and Srivastava 2014). Diversity in tall as well as dwarf populations found in India along the west and east coast supports the theory of coconut origin from India. Andaman Nicobar Islands and Lakshadweep Islands are rich resources of coconut genetic diversity. Kerala is the traditional coconut growing state where coconut is closely associated with social and religious life. Diverse ecological conditions prevailing in Kerala resulted in adaptation of suitable coconut population in those conditions. Ecologically adapted coconut populations (ecotypes) are found throughout Kerala, many of which have been documented. However, the ecotype diversity has been obscured by the human interference (movement of genetic material in and out of ecological niches) and delineating these ecotypes has become extremely difficult.

The ecotypes described from Kerala include both tall and dwarf types. Generally, ecotypes are named based on the geographical locations where they are located. Major tall forms reported from Kerala are Bedakam, Annur, Kuttiyadi, Jappanam, Komadan, Neduvarayan and Kappadam. Major dwarf forms reported from Kerala includes Chowghat Orange Dwarf, Chowghat Green Dwarf and Chowghat Yellow Dwarf. These ecotypes are developed as a result of continuous farming activity and selection by man and nature. Coconut is found only as a cultivated form and has no wild relatives. Long juvenile period and long productive life makes coconut genetic resource management unique. Generation time (average time between two consecutive generations in the lineages

of a population) in coconut is 15 – 20 years. It takes many years for a coconut population adapt to a particular geographical location. Many generations of farmers are involved in one coconut population getting adapted to a location. Conservation of coconut genetic diversity is farmer driven. Most of the ecotypes are identified and named by farmers. In situ characterization, cataloguing and on farm conservation with farmer participation is most appropriate model for management of coconut genetic resources. Inventories of coconut ecotypes are the prerequisite in this model. A few ecotypes from Kerala are described here.

West Coast Tall (WCT)

WCT is the coconut population adapted to west coast of India especially the Kerala coast. It is a very sturdy palm adapted well to the coastal ecosystem yielding beyond 100 years. The palms flowers in 6-7 years in open condition.

Kuttiyadi ecotype

This variety of coconut population is adapted to hilly region in Kozhikode district of Kerala. It is a very sturdy palm adapted well to the midland ecosystem yielding beyond 100 years. The palm flowers in 6-7 years in

open condition. Seeds of this cultivar germinate in 120 – 180 days. Kuttiyadi ecotype has longer inflorescences compared to WCT. Length and number of spikelets, number of female flowers and number of nuts/year are more in WCT compared to Kuttiyadi ecotype. Husk content and oil percentage in copra are higher in Kuttiyadi compared to WCT.

Bedakam ecotype

This ecotype is found on the eastern part of Kasaragod district. Bedakam ecotype can be described as intermediate in height having spherical crown, slender trunk, close leaf scars, less than 28 leaves on the crown, spaciously arranged leaflets, spaciously arranged spikelets, more than 46% husk, fruit length to breadth ratio 1.2, thick shell and thin endosperm.

Annur ecotype

This variety of coconut population is adapted to coastal area of Kannur district. It is adapted well to the coastal sandy soil yielding beyond 100 years. The palm flowers in 6-7 years in open condition. Seeds of this cultivar germinate in 120 – 180 days.

Jappanam ecotype

Jappanam ecotype is located in Alleppey district of Kerala state. The ecotype has large fruits, large nuts, thick shell and thick endosperm. Farmers are of the opinion that the palms are not susceptible to root (wilt).

Kappadam Tall

Kappadam Tall, an ecotype from coast of Kerala, is also known as 'Chappadan' in some parts of Kerala. Compared to the other varieties from west coast populations, this cultivar produces heavier larger fruits with thinner husk. The fruits of this selection are predominantly green, oblong to round in shape. The palms shows clear bole on the stem. The leaves are longer with broader and longer leaflets. The palm starts flowering between the 6th to 7th year after planting and produces large inflorescences. The average fruit weight is around 1200 g, with husked fruit weight of about 800 g. The kernel weight ranges from 400 to 550g with 215 to 280g of copra per nut.

Puvar ecotype

The Puvar ecotype is long fruited,with long fibre. They yield one and a half times more fibre than other types. The fibre is more than 30cm in length. The ecotype has large endosperm content. It gives 200 to 250 gram copra per nut. Oil percentage is about 70.

Chowghat Orange Dwarf

Chowghat Orange Dwarf is the most common dwarf coconut cultivated in India. Found sparsely cultivated throughout the west coast region of India, particularly in the Chavakkad area of Thrissur district of Kerala. The palm has a thin stem with closely arranged leaf scars, a small compact crown with characteristic orange colour on leaf petioles, inflorescences and fruits. This is an early

flowering cultivar and takes about 3-4 years for initial flowering. This is largely a self-pollinating cultivar. The palms of this variety are sensitive to moisture stress and also show alternate bearing habit. The fruits are small with an average weight of 634 g per fruit and average copra content of 128 g/nut and 66 % oil. The variety Chowghat Orange Dwarf was found to have the highest total sugar content in tender nut water. The tender nut water of fruit of 7th month is sweet with a total sugar content of 7.0 g/100 ml and sodium and potassium contents of 20 ppm and 2000 ppm, respectively and organoleptically graded as 'very good'.

Chowghat Green Dwarf

Chowghat Green Dwarf gets its name from the green coloured fruit and it was first identified from Chavakkad

region in Kerala. The palms are early flowering and take about 2.5 to 3 years for flowering. The leaf petioles, leaves and nuts are dark green in colour. The fruits are oblong in shape and have a characteristic 'beak' when fully mature. The palm attains a height of around 4 m at 20 years of age. It is generally grown for tender nut purpose as it contains very sweet nut water. The tender nut water has total sugars about 4.80 g/ml, average potassium content of 2150 ppm and average sodium content of 22.40 ppm. The palms are very sensitive to biotic stress and need plant protection measures against major pests particularly red palm weevil when large scale commercial plantings are adopted.

Chowghat Yellow Dwarf

Chowghat Yellow Dwarf is another variant of dwarf coconut from Chavakkad area in Kerala. The palms are scarcely distributed among the coconut populations in the area. The Chowghat Yellow Dwarf has erect leaves, large sized nuts with higher tender nut water and higher nut yields. The number of fruits per bunch range from 12 to 20. The palms are characterized by stem girth of 55 cm at 1 m from ground and an average leaf length of 3.45 m at the age of 30. The bunch production is regular and ranges from 9 to 13 bunch per year. The colour of the fruit is yellow, oval shape with an average fruit length of 37 cm and average fruit breadth of 16.5 cm. Tender nuts of this cultivar contain more sweet water ranging from 250 to 340 ml per nut with average TSS of about 6.7o Brix.

Farmer participatory characterisation of coconut diversity

Genetic diversity is very important to sustain the productivity of a crop. In coconut, diversity provides characters for yield, adaptation, disease resistance, high value uses and characters. Rich diversity of coconut varieties is observed in farmers' fields, which have not been reached by the traditional research methods employed for crop improvement in coconut. Farmer participatory approaches are important to characterize and to utilize the coconut genetic diversity for the sustainable production of coconut and enhancing income of farmers.

An initiative for the participatory analysis of coconut situation by the local coconut growers conducted under COGENT/IPGRI sponsored project implemented by Central Plantation Crops Research Institute (CPCRI) on "Developing coconut based income generating technologies in poor rural communities" in Pallikkara village in Kasaragod District, Kerala State and Ariyankuppam village in Pondichery. Farmer participatory methods were employed to understand the coconut cultivation scenario and to analyse the coconut diversity in farmers' gardens. PRA tools such as transect walk, resource mapping and seasonal calendar were employed to analyse the land use, local agro-ecology, problems and opportunities in the coconut community. Through matrix ranking farmers were facilitated to characterize and evaluate the coconut varieties found in their community. Coconut Diversity Fair was organised in the communities to facilitate the coconut growers to gather together in a common place, exhibit the different varieties of coconut grown in their gardens, study their preferences for varieties and analyse various criteria for characterizing and evaluating the varieties.

Altogether 12 diverse coconut types, six in Pallikkara and six in Ariyankuppam coconut communities were identified and their significant characteristics were documented. 'Sevvelanir' was one special coconut ecotype documented in Ariyamkuppam coconut community. 'Sevvelanir' in Tamil language means red tender nut. This is a special ecotype present in the locality, the tender nut of which when cut open the husk at the top portion shows a unique pink colour and hence the local people call it sevvelanir. The tender nut water is very sweet and local people believe that the tender nut water has the medicinal property to cure jaundice and asthma. The palms are tall and produce medium sized light green nuts. Only very few palms of sevvelanir tall are present in the locality.

The farmer participatory characterisation of coconut varieties in two coconut communities, one in the west coast and the other in the east coast in India, revealed the genetic diversity of coconut present in farmers' gardens. Further, the analysis also yielded information on the preference of farmers about the desirable traits of coconut varieties. (Thamban et al 2007). In the farmer participatory survey and study of varietal diversity and profitability of coconut in Kerala by IPGRI/COGENT

funded by IFAD it was revealed that farmers value hybrids for the traits of early bearing and high production potential in terms of nuts when facilities for better management are available whereas under average and below average management level preference is for local tall variety (Thampan, 1999). It is important that coconut breeders take into account the performance of coconut varieties in farmers' field and also the varietal preference of coconut growers while formulating coconut breeding programmes.

Management and utilisation of coconut diversity

Conservation of biodiversity is essential to the sustainable development and human survival. Coconut (Cocos nucifera L.) is an integral part of agricultural biodiversity in its natural home for many centuries and has been closely associated with human culture as food, medicine, cosmetics, in construction, in rituals and in social life. Development activities and non-profitability of coconut cultivation are driving the coconut out of cultivation leading to erosion of coconut genetic resources and indigenous knowledge associated with it. It is imperative that such resources and knowledge associated with are documented and protected for the benefit of future generations.

As a result of many uses and preferences by local people, different ecotypes have emerged through the selection both by man and nature. West coast of Kerala is a natural home to coconut. It is a narrow strip of land between the Western Ghats and the Arabian Sea and ranges from 50 to 100 km in width. The region with numerous rivers and backwaters inundating the land sustains unique ecosystems. Selection coupled with adaptation lead to the development of many local ecotypes in coconut along the region. Identification, characterization, documentation and conservation of this genetic diversity are crucial for future breeding programs.

Supporting the maintenance of diversity on farm is one strategy for crop genetic diversity conservation. On farm conservation is viewed as a complementary strategy to ex situ conservation strategies. Through on farm conservation not only the materials, but also the processes of evolution, adaptation of crops to their environment and traditional knowledge associated with the crop are conserved by studying traditional identification and nomenclature processes one can understand the way in which coconut diversity is perceived and understood by indigenous people. Documentation of diversity and its association with people is prerequisite to develop on farm conservation programs.

Ethno botanical approach aim to document, describe and explain complex relationships between cultures and uses of plants. This field of study analyzes the results of indigenous manipulations of plant material together with the cultural context in which plants are used. Coconut has a long history of human association. Man had used coconut in many ways resulting in a large number of products and knowledge associated with it. Most of these products and knowledge are location or region specific linked to the culture of the land. Documentation of these products and knowledge help in the sustainable use of coconut genetic diversity and promoting coconut as a food for nutrition, health care and environmental services to safeguard the interest of millions of people and their livelihoods.

Conclusion

There is tremendous scope for utilizing the genetic diversity of coconut available in farmers' fields for providing various options and opportunities while formulating strategies for solving the problems of coconut farmers. A thorough understanding about the coconut diversity available in farmers' gardens would enable the stakeholders to utilize the germplasm for sustainable production of coconut and enhancing income of farmers.

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