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Reprinted from Conservation of Tropical Plant Resources, 1984, pp. 246-253  
3  
1 JUN 1984

KASARAGOD

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## CONSERVATION OF PLANTATION CROPS GENETIC RESOURCES

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There is no absolute definition for plantation crops. The expression first came into use during the American colonial days when servile labour was being used extensively to cultivate large areas under one crop, usually, cotton or sugarcane. Subsequently, the term was being used by the European colonialists in Africa and Asia to include generally perennial crops when they were grown in large stands. At present, plantation crops are taken to include coffee, coconut, rubber, cacao, tea, cashew, oil palm, black pepper, cardamom, nutmeg, cinnamon and clove. In this paper, these crops, plus, kola, pimento (allspice), betel nut, ginger and turmeric are also considered as plantation crops. Together, these 17 crops occupy approximately 36 million ha area covering almost 3% of the total arable land of the world. The areas of natural variability of all these crops are confined to the tropics, but certain crops like coconut, ginger and turmeric are being increasingly grown in the subtropics, and even in the temperate zones. These 17 crops belong to 11 families (Table 1). All except rubber, are used for edible purposes by man : coconut and oil palm for oil, coconut and cashew for the nut, and all the others as stimulants, beverages or flavourings. Almost all these plants possess recalcitrant seeds. Of course, turmeric and ginger bear seeds only shyly. All are perennial except ginger and turmeric. Several of these, like rubber, black pepper, turmeric and ginger are normally propagated asexually. Their economic parts may be ripe seeds or fruits (oil palm, black pepper, coffee, kola, cacao, cashew, nutmeg, betel nut, cardamom), underground stems (ginger, turmeric), flower buds (clove), unripe fruits (pimento), tender leaves (tea), bark (cinnamon), or exudates from special cells in the bark (rubber). In coconut, most plant parts find an active economic use.

Though plantation crops are thus a heterogeneous group of plants, some groupings can be made on the basis of their areas of natural variability and of cultivation. Rubber, cashew and cacao occur in natural stands mostly in the Amazon basin and also in other parts of northern South

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America and Central America; oil palm occurs widely in nature in tropical West Africa and coffee in tropical Africa, but all of them are grown most extensively elsewhere in other parts of the world—rubber in south and south east Asia, cashew in south Asia and east Africa, cacao in tropical west Africa and coffee in south America and south Asia. In contrast, plants which occur naturally in south and south east Asia are also most cultivated in the same area—black pepper, ginger, turmeric, cloves, nutmeg, cinnamon, tea, coconut and betel nut. Some of them are grown in certain other regions of the world also—as cloves in east Africa, ginger in several countries of the world, tea in east Africa and coconut throughout the tropics. Kola and allspice are also grown only in the regions which are their native habitats—kola in tropical west Africa and pimento in the West Indies, but they are cultivated to a limited extent only.

Of all the crops, ginger and coconut have perhaps the widest adaptability. Ginger is grown throughout the world in the tropics, subtropics, and even in the temperate region. Coconut is grown throughout the tropics of the world, its cultivation is now being successfully extended to the subtropics also. Crops like tea and cardamom, and to a lesser extent, coffee and black pepper, show definite ecological preferences for optimal growth and yield.

From the accounts of early travellers, it is known that crops like black pepper, ginger, cacao, cardamom and coconut have been used by man for more than 2000 years and also that some of them like the spices, formed a major component of international barter trade in early historical times. Many of the other crops like tea, oil palm, rubber and coffee have been in use since more than 700 years, even before the Europeans started their organised travels to the tropics of the world. The local people in west Africa have been using oil palm and those in south and central America, rubber. Many of these crops have been brought into cultivation only since the last 100 years. In fact, the history of the introduction and development of oil palm and rubber cultivation has been well documented.

An important characteristic of all plantation crops is that what are at present being cultivated by man are basically wild plants, and only slight or moderate levels of enoblement have been brought about in them upto now. The differences between the present day cultivated forms and the naturally occurring forms of all the plantation crops are only qualitative.

This fact is very well exemplified in the case of black pepper and cardamom in India. They are both native to the evergreen forests of pensinsular India. They have been known as spices for more than 2700

years at least. Even today, cardamom and black pepper are being collected as Minor Forest Produce (MFP) from the forests of peninsular India and the Forest Departments earn some income from them annually by auctioning of the rights to collect them during the season. However, the income from this has come down sharply within the last 1-2 decades. During our field surveys for collection of black pepper germplasm, we used to see in many households set up in the peripheries of these forests plants growing in their backyards, that they said, they had collected from the forests because of their having certain economic attributes as higher yields, better pungency or flavour, longer spikes, or better fill of spikes. In many Pacific Ocean Islands, in India in Lakshadweep and Nicobar Islands, coconut still grows extensively in natural stands and local people are able to meet more than their requirements just by collecting the fallen nuts.

Extensive natural stands of oil palm still occur in many parts of tropical West Africa, though commercial plantations have also been established in the region, and the local people have been traditionally meeting all their requirements and also sustaining an active export trade in palm oil until quite recently by utilising the harvests from these natural stands.

In the case of betel nut, it is commercially grown at the present time in only India and Bangladesh. And in peninsular India particularly in the Canara and Konkan regions, its cultivation has been developed to a high level of specialisation. At the same time, in many parts of south and south east Asia, including several Pacific Ocean countries, it is typically, what we may call as "a protected plant", that is, a plant that comes up naturally from self-sown seeds or raised by planting one or few seeds in the backyard, or in the borders of the homesteads, which are then allowed to grow up by the homestead owner. The demands for its nuts are only at a low level and these few plants are able to meet this.

We can cite numerous instances of such plants from the tropics—plants whose produce are used by man, and whose few seedlings are protected or raised in the backyards to meet his immediate needs. The demand for their produce are usually too low to justify their commercial cultivation for sale in the market, and man has been meeting his needs by collecting their produce from the forests, or from his backyards, or by taking them gratis or at a small price from his neighbours. With increasingly more intensive land use, stands of such plants have been steadily getting decimated, and it has been becoming increasingly difficult to obtain their produce for even a price. We can cite examples of a number of such plants which are used particularly in local systems of medicine. There is an urgent need to conserve them.

Table 1. Plantation crops, some of their characteristics

Name and family	Area 000 ha	Plant part used & nature of use	Area of natural variability	Areas where most cultivated
Cashew : <i>Anacardium occidentale</i> (Anacardiaceae)	1,000	Nut (food)	Brazil	South Asia, East Africa
Coconut : <i>Cocos nucifera</i> (Aracaceae)	8,500	All parts (mainly food and oil)	South and South East Asia, Oceania	Throughout the tropics
Oil palm : <i>Elaeis guineensis</i> (Aracaceae)	1,500	Fruits (oil)	Tropical West Africa	South East Asia and West Africa
Betel nut : <i>Areca catechu</i> (Aracaceae)	300	Seeds (stimulant)	South and South East Asia	South and South East Asia
Tea <i>Camellia sinensis</i> (Camelliaceae)	1,800	Tender leaves (beverage)	Nepal, NE India, South China	South and South East Asia, East Africa
Rubber : <i>Hevea brasiliensis</i> (Euphorbiaceae)	7,000	Plant exudate (industry)	Amazon basin	South and South East Asia
Cinnamon : <i>Cinnamomum zeylanicum</i> (Lauraceae)	No data	Bark (flavour and essence)	South Asia	South and South East Asia
Nutmeg : <i>Myristica fragrans</i> (Myristicaceae)	30	Fruits (flavour)	Moluccas Indonesia	South and South East Asia
Pimento (allspice) : <i>Pimenta dioica</i> (Myrtaceae)	No data	Unripe fruits (flavour and essence)	West Indies, Central America	West Indies, Central America
Clove : <i>Eugenia caryophyllus</i> (Myrtaceae)	70	Flower bud (flavour and essence)	Moluccas, Indonesia	South and South East Asia, East Africa
Pepper : <i>Piper nigrum</i> (Piperaceae)	250	Seeds (flavour and essence)	South Asia	South and South East Asia, East Africa, Tropical South America
Coffee : <i>Coffea arabica</i> ( <i>C. conephora</i> ) (Rubiaceae)	9,250	Seeds (beverage)	Tropical Africa	Tropical South America
Kola : <i>Cola nitida</i> (Sterculiaceae)	No data	Nuts (stimulant)	Tropical West Africa	Tropical West Africa
Cacao : <i>Theobroma cacao</i> (Sterculiaceae)	5,000	Seeds (beverage)	Brazil to Mexico	Tropical West Africa
Ginger : <i>Zingiber officinale</i> (Zingiberaceae)	100	Rhizomes (flavour and essence)	South Asia	Throughout the tropics and some sub-tropics
Turmeric : <i>Curcuma longa</i> (Zingiberaceae)	100	Rhizomes (flavour)	South Asia	South and South East Asia
Cardamon : <i>Elettaria cardamomum</i> (Zingiberaceae)	120	Seed (flavour and essence)	South Asia	South Asia, Central America

Even as we have several plantation crops in which there are hardly any differences between forms that are cultivated today and those that occur in natural stands, in a few of them a considerable degree of improvement or ennoblement has been brought about by man; in some like ginger and turmeric this has been brought about during hundreds of years of cultivation employing vegetative propagation; in others like the oil palm and rubber, in fewer than 10 generations.

The case of cashew is quite different from the others. Cashew is the most widely consumed nut by man today. Almost 70,000 tonnes of processed nuts enter the international trade every year, and there is still much unfilled demand.

Cashew is native to tropical South America, and extensive natural stands of cashew exist in Brazil. It was introduced into India more than 400 years ago by the Portuguese and it has got itself established there. It now grows or is grown in about 4,00,000 ha in India. It was initially being used primarily for soil conservation purposes. From India, it was introduced into east Africa, mostly to Kenya, Mozambique and Tanzania. Cashew has got itself 'naturalized' in those countries, and extensive self-propagating stands occur there. In recent years, there has been much interest in taking up cashew cultivation in several countries of tropical America, tropical Africa, south and south east Asia and even Australia mainly because of the good edible quality of the nuts, its unfilled demand in the international market, and its ability to grow well in poor soils and other adverse conditions. In south Asia and east Africa, it does not appear to have undergone differentiation to any significant extent. At the same time, we are aware that its present yield levels are low, that much variability exists in cashew in tropical America and that much of this variability is getting rapidly eroded, particularly in Brazil, because of aggressive land development projects. Cashew in natural state is stated to be present just outside Brasilia, and one can observe the rapid decimation of these stands taking place. The International Cashew Symposium (1979) took note of this and has called for immediate international action to collect and conserve the available resources. Our efforts to interest the IBPGR in this direction are still continuing.

No uniform strategy can be proposed for the conservation of plantation crops genetic resources. This is because they are a heterogeneous groups of plants having different periods of longevity, different modes of propagation, different breeding systems, and different intensities of usages. Since several of them are used as beverages and flavourings, quality characteristics assume greater importance in them than even perhaps yield. Most importantly, since these crops are of commercial importance, several

countries, where these are grown or occur naturally, have put various kinds of restrictions on the movement and exchange of their planting materials.

The crops, in which reasonably free exchange of germplasm is at present taking place, are rubber, cacao and coconut. Thanks to the activities of the Association of National Rubber Producing countries, inter-country exchange and trials with improved clones are being carried out in all the major natural rubber producing countries. They have also begun organising joint expeditions to the Amazon region for collecting germplasm.

In cacao, a number of collection expeditions have been organised to various parts of tropical south and central America—but chiefly to the Amazon region—in the last seven decades to collect cacao germplasm. And several reasonably good collections are available in Nigeria, Ghana, Cameroon, UK (Kew), USA (Puerto Rico), Trinidad, Brazil and Costa Rica. But cacao shows such a tremendous range of variability and the crop is beset with several important problems that these collections cannot be considered as adequate.

In coconut, collections have been carried out earlier in a different manner and with different objectives. As already stated, coconut has probably the widest pantropical distribution for any plant. It is also affected by the maximum number of diseases of uncertain aetiology. More than 25 such diseases have been reported. About 30 years, coconut industry in the West Indies was affected by one such disease, the lethal yellowing, and very soon, it threatened to decimate the coconut industry of West Indies. Then, with the assistance of the UK Government a collection mission was organised under the leadership of Dr R. A. Whitehead in the mid-sixties to the Pacific Ocean Islands. These collections were then planted in the West Indies to study their response to the disease, and one form, the Malayan Dwarf was found to be resistant to the disease. Now, this cultivar, or hybrids involving this cultivar as one of the parents, are being planted in West Indies.

One-fourth of the area under coconut in India—which is more than 1.1 million ha—is affected by a disease of uncertain aetiology. It was first described 98 years ago and the present annual loss is estimated at 340 million nuts, almost 10% of the total production in India. The CPCRI has tested nearly 125 hybrids types and all of them have been found to be susceptible to the malady. With a grant obtained from the IBPGR, the Institute sent a team of two Scientists to nine important Pacific Ocean countries just recently, and the team collected 2500 seed nuts

comprising 25 collections. They have now been sown in Andamans to form the nucleus of a World Coconut Germplasm Centre which the Institute is planning to set up in an uninhabited island. Bilateral negotiations are being concluded with the Philippines, Indonesia, Malaysia and Sri Lanka for collection and exchange of coconut genetic material and this is expected to add another 60 collections within the next one year. Simultaneously, systematic collection and conservation programmes have been taken up in India, where at least 20 distinct forms are known to be available. This, should add another 50 collections.

India already possesses the largest collection of coconut germplasm but the sample size has been very low in most cases. The IRHO in Paris is maintaining duplicate sets of about 50 accessions both with good size of populations, in Ivory Coast and French Polynesia. Small to medium sized national collections exist in the Philippines, Indonesia, Malaysia, Sri Lanka and Nigeria. The IBPGR is also financing the establishment of a Regional Coconut Germplasm Centre in the Philippines. But for all the problems that the coconut is faced with, and its complete usefulness to man, the wide variability present in the species and with the coconut being a monotypic species, the presently available collections cannot be considered to be adequate.

The Institute has taken up systematic national collection programmes in the other agricultural plantation crops. Cardamom, black pepper, ginger and turmeric occur extensively in the forests of peninsular India. But an unfortunate aspect of the conservation programme has been the prevalence of diseases in black pepper and rhizome rot in ginger, which have made it difficult to maintain their living collections. In fact, further collection and conservation programme in these two crops have been suspended until effective control measures are developed against these diseases.

In oil plam, mainly due to the interests of big multinational firms like Unilever, the available collections are being enlarged in Malaysia, Nigeria, Ivory Coast and Zaire. In cashew, India is the only country where at least the locally available genetic material has been collected. Brazil has of late started the collections in a modest manner. Following the recommendations of the First International Cashew Symposium, an international committee has been formed for collecting and conserving cashew genetic material, but funds for carrying out even a reconnaissance survey have been a limitation. The IBPGR does not yet appear to have set up priorities for this group of plants. Brazil is agreeable to permit such a survey in its area.

In other countries, hardly any organised attempt to collect genetic resources of the plantation crops has been initiated anywhere. But, from the Newsletters brought out by the SE Asia Regional Committee of the IBPGR, it is noticed that some efforts at collecting ginger and other rhizomatous and tuberous plants have been initiated in Indonesia.

As already stated, no uniform strategy can be followed for this group of crop plants. Some plants like cacao, cinnamon, and black pepper show tremendous variability in natural stands. Many of them are affected by very serious diseases. Certain crops like clove and nutmeg hardly show any variation. Oil palm has been uniquely fortunate in that it is not effected by any serious malady yet. Fortunately, extensive natural stands of almost all the plantation crops still occur in their respective regions of natural variability, but this situation is bound to change drastically for the worst before the turn of the century because of population pressures and aggressive land development programmes. It is necessary to fix up immediately priorities by arranging regional meetings for various groups of plants, and to arrange systematic national and international collection programmes urgently as is being done in rubber. Possibly, the IBPGR can take the initiative and provide funds for organising these consultation meetings and also some seed money for arranging the collection programmes, which, I feel, could be taken up on the TCDC principle, or by making bilateral arrangements.

But, before these can be done, it will be necessary to arrive at a proper understanding to ensure free and unrestricted access and exchange of germplasm. This aspect requires to be settled with utmost urgency.

I feel that in most countries of south and south east Asia it is not primarily the lack of financial resources that have restricted organised conservation programmes, as the nonavailability of qualified personnel in adequate numbers and the non-realisation of the urgency of the situation by the policy makers. This appears to be so at least with plantation crops. This is inspite of the fact that they contribute so much to the GNPs of most of these countries in the region.

Alongwith fixing of priorities, definite time schedules have also to be prepared. Even within the last 10 years, we have witnessed large scale decimation of extensive natural stands of black pepper and cardamom in India, of rubber, cashew and cacao in Brazil and of oil palm and coffee in tropical Africa. I hope that this Workshop will pave the way for reversing this process or at least to neutralize the adverse effects of this process.