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Current Status of Conservation and Utilization of Tropical Plant Genetic Resources for Food and Agriculture in Malaysia

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Introduction

Malaysia is regarded as one of twelve "mega-biodiversity" countries in the world. Its tropical rainforest has been endowed with exceedingly rich flora and fauna biological resources. The hot and humid tropical climate with the generally ample sunshine and the good availability of rains throughout the year is the key factor in influencing the survival of these biological resources over times. It has been estimated that not less than 15,000 species of vascular plants, 290 species of mammals, 150,000 species of invertebrates and an enormous number of microbial populations exists in the forests (Anon, 1997).

General Issues on Plant Genetic Resources

Local biologists agree that many of the plant genetic resources (PGR), particularly the rare and wild species of food crops have not been fully studied and very little is known on their actual distribution and potential use. Some species are near to extinction even before they are documented. Another similar situation also exists with the disappearance of many land races, traditional varieties, natural mutants and specific ecotypes. The process of urbanization, agricultural development and logging activities are inevitable factors that led to such a gradual loss of crop biodiversity.

Systematic effort to inventorize and document the range of crop biodiversity including

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old land races, traditional varieties, natural mutants and specific ecotypes is also lacking. There is also the question of securing and keeping the materials in safe condition in field or seeds genebank. Similarly the issues of inadequate characterization, evaluation and utilization of biological genetic resources have often been raised. It should be realized that only by taking advantage of the genetic diversity can scientists develop improved and adaptable varieties. There is a need for urgent action to mobilize efforts in mitigating such loss of genetic diversity and overcoming various issues through their judicious management and sustainable utilization of biological resources.

Agricultural Research and Research on PGR

Agricultural research in Malaysia is carried out by a number of public and private sector organizations. Each of these has differing scope of work and functions. Of particular importance the relevant research agencies include Malaysian Agricultural Research and Development Institute (MARDI) that conduct research on all crops (except oil palm, rubber, cocoa and forest trees) and livestock, Palm Oil Research Institute of Malaysia (PORIM) on oil palm, Malaysian Rubber Development Board (MRDB) on rubber, Malaysian Cocoa Board (MCB) on cocoa and Forests Research Institute of Malaysia (FRIM) on timber and forest trees. Besides, both Department of Agriculture in the state of Sabah and Sarawak have their own research division with specific focus to the needs of agriculture in their respective states. Similarly research activities on specific areas of crops and agriculture do also involve many local universities and non-governmental organization.

Being the lead agency in spearheading the agricultural technology development in the country, MARDI has been identified as the national focal point for research and management of agro-biodiversity since the year 1996. Since then, Management and Utilization of Biological Resource Programme under the Strategic Resource Research Centre of MARDI have been given the task to undertake the national responsibility in the conservation, characterization, evaluation and utilization of crop genetic resources. The main objective within the programme is to mitigate the loss of agro-biological resources in the country through their judicious management and utilization in support of sustainable national food and agriculture development. In addition, the other functions of the programme are to gather and disseminate information on the nation's agro-biodiversity; to conduct research and development in areas relevant to management and sustainable utilization of agro-biological resources and to position MARDI as the national reference center for agro-biodiversity.

Recognizing the importance of plant genetic resources for food and agriculture, MARDI have been actively engaged in the exploration, collection, conservation and utilization of crop genetic resources, thus contributing to the activities of Convention of Biological

Diversity (CBD), Global Plan of Action (GPA) for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture (PGRFA) as well as the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA).

Other agencies listed above also undertake research activities pertaining to the management and utilizations of PGR but confined to their respective mandated crops and scope of functions. The three crops namely oil palm, rubber and cocoa which contribute to the major agricultural export earnings from Malaysia represent introduced crop species. All PGR for these crops are basically introduced from outside the country. Thus it would not be that relevant to discuss it in this paper. In the context of CBD, ITPGRFA and GPA, activities carried out by MARDI as well as other agencies especially Dept. of Agriculture in Sabah and Sarawak affecting the conservation and utilizations of the indigenous crop biodiversity would be very appropriate and these would be elaborated in this paper.

In-situ Conservation

In-situ conservation appears to be a better option for the conservation of PGRFA. In the context of this paper "*in-situ* conservation" was taken to mean "*the conservation of ecosystem and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties*" (Anon, 1997). Implementing *in-situ* conservation plans on PRGFA would thus involve not only maintaining indigenous and wild species in their original habitat but may also include conservation of domesticated and semi-wild species at its eco-adapted sites where man's influence over many generations may have allowed it to evolve into its peculiar characteristics. In the latter, conservation could be pursued on the farmers land itself thus rendering it as an on-farm conservation but at the same time as an *ex-situ* approach as the species may have moved out of the original habitat (Wong, 2005).

- In-situ conservation of wild species

In-situ conservation of PGRFA involving wild relatives of crops in Malaysia is effectively carried out in the protected areas. However this requires large areas of undisturbed forests having, ideally, maximum species diversity and high intra-specific diversity for different species. Also, selecting large land mass as candidate genetic reserves is not easy due to a general lack of basic floristic data in the targeted areas. An overview of these legally protected areas has been given by Soepadmo (1995). The total protected areas was 5.8% (763,300 ha), 8.9% (658,824 ha) and 2.3% (288,806 ha) of the total land area respectively in Peninsular Malaysia, Sabah and Sarawak (Table 1). With respect to Sarawak, Soepadmo

also noted then that the state authorities have strong intention of expanding the protected areas to 1.14 million hectares representing about 8% of the total land area in the state.

The total protected areas of the forest habitats comprise of the gazetted National and State Parks, Virgin jungle reserves, Wildlife reserves and Bird sanctuaries as well as Protection forest (in the case of Sabah). Among the more important and larger areas where probably an extensive flora and fauna species diversity occurred include Taman Negara (434,000 ha), Endau-Rompin Park and Wildlife Reserves (90,000 ha) and Krau Wildlife Reserve (63,000 ha) in Peninsular Malaysia, Gunung Mulu Park (53,000 ha), Lanjak Entimau Wildlife Sanctuary (169,000 ha) and Batang Ai Park (24,000 ha) in Sarawak and Kinabalu Park (73,000 ha), Crocker Range Park (140,000 ha) and Tabin Wildlife Reserve (141,200 ha) in Sabah. Virgin Jungle Reserves (VJRs) are established to serve as permanent nature reserves and natural arboreta. In Peninsular Malaysia VJRs cover 19,000ha, representing various forest types while in Sabah there are over 88,000 ha.

Table1. Existing protected forest habitats in Malaysia

Type of habitat	Area (hectare)			
	Peninsular Malaysia	Sabah	Sarawak	Total
National/ State Parks	434,300	245,172	113,955	793,427
Virgin jungle reserves	19,000	88,304	-	107,304
Wildlife reserves/bird sanctuaries	310,000	143,682	174,851	628,543
Other protection forests/ conservation areas	-	181,666	-	181,666
Total protected areas	763,300	658,824	288,806	1,710,930
Total land area	13,160,000	7,400,000	12,300,000	32,860,000
Total remaining forests	6,150,000	4,520,000	8,700,000	19,370,000
Total permanent forest estate	4,750,000	3,350,000	6,000,000	14,100,000

Source: Soepadmo (1995)

Inventorying work in some of these protected areas has been initiated. For example inventories of wild fruit species, which as a group has recently attracted many interests among local biologists, have been conducted at Taman Negara, Pasoh Forest Reserve and Krau Wildlife Reserve. It was found on the average five individuals of wild fruit trees per ha as

having a 10 cm or more stem diameter and it was also noted that the species remain understorey trees that would not exceed 30 m in height and greater than 30 cm in diameter (Jong *et al*., 1973; Yap, 1980, 1982; Soepadmo, 1979; Saw *et al*., 1991). Extensive studies at Pasoh Forest Reserve further indicated that the densities of adult wild fruit trees also vary greatly between species (Saw *et al.,* 1991). For example within the genus *Mangifera* which is represented by 12 species, the adult density is 0.1 trees per ha as compared to 180 trees for *Xerospermum noronhianum.*

An inventory made on 50 ha of primary lowland rain forest in Peninsular Malaysia at Pasoh Forest Reserves (Negeri Sembilan) further showed that there were 76 fruit species known to bear edible fruits. The most diverse species found include those of the related wild species of mango (*Mangifera* , 12 species), of mangosteen (*Garcinia,* 13 spp), of jackfruit and breadfruit (*Artocarpus,* 10 spp) and of rambutan (*Nephelium*, 5 spp). Another survey inventorying the composition, distribution and abundance of wild fruit species in a 0.99 ha transect in the peat swamp, lowland and ridge forest at Sungai Dusun Wildlife Reserve, Selangor showed the area contained 16 families, 28 genera and 42 species with 359 individuals of wild fruit trees. Here the highest number of individuals belonged to the family Burseraceae. In another instance 32 edible fruit species were recorded in Belum Forest Reserve in Hulu Perak, Perak. These wild fruit tree species recorded in the jungle reserves will therefore contribute to the *in-situ* conservation.

- On-farm conservation of cultivated crops

To-date no major efforts on *in-situ* conservation for cultivated crops (which is synonymous to on-farm conservation as has been explained earlier) have been carried out in Malaysia. In fact, it represents a new approach in conservation (at least to the Malaysian researchers) as it has only been recently advocated to local scientists.

Quite a recent project that deals with the subject entitled “On-farm Conservation and Utilization of Traditional Fruit Species” was initiated and coordinated by International Tropical Fruits Network (TFNet) in collaboration with the Departments of Agriculture Peninsular Malaysia, Sabah and Sarawak, MARDI, University Kebangsaan Malaysia (UKM), International Plant Genetic Resources Institute (IPGRI) and Department of Forestry. Partial funding for the project was received from Fulbright/Humphrey Programme (Salma, 2003). The specific objectives of the study include:

1. To gather information on households involved in the cultivation of the underutilized fruits.
2. To determine the types, status and distribution of the underutilized indigenous fruits and their ethno-botanical information

3. To assess the economic value of the underutilized indigenous fruits
4. To provide information that can assist in strategic planning and project formulation for on-farm conservation of these fruits.

During the study three sites, one each in Peninsular Malaysia, Sabah and Sarawak with the most diverse fruit species were selected for further assessment on the use of the species and their respective contribution to the community livelihoods. The author noted that between 21 to 52 species of traditional fruit trees are cultivated in the selected sites. Each site was found to have differing species ranking in terms of its importance in enhancing the livelihood of the community. For example at Kampong Linkungan, Hulu Cheka in Jerantut, Pahang the three species with the highest ranking are *Garcinia atroviridis*, *Mangifera odorata* and *Parkia speciosa* while it was *Mangifera pnjang*, *Nephelium ramboutan-ake* and *Parkia speciosa* for Kampong Pintas in Beaufort, Sabah. For Rumah Kallang Changkul in Bandar Sri Aman, Sarawak the high value fruit species are *Dialium sp*., *Dimocarpus longan* var. *malesianus*, *Canarium odontophyllum*, *Parkia speciosa* and *Xanthophyllum amoenum. Parkia speciosa* was the only common species ranked as important in all the three sites. This legume is used mainly as 'ulam' (just like vegetable salad) and consumed with rice.

A recent proposal for implementation of on-farm conservation of crops has been prepared. The project is entitled "Conservation and Sustainable Use of Cultivated and Wild Tropical Fruit Diversity: Promoting Sustainable Livelihoods, Food Security and Ecosystem Services" to be supported by UNEP/GEF funding (Salma, 2005). It is targeted towards the conservation of various fruits species within the three genera namely *Garcinia*, *Mangifera* and *Nephelium* and it will be implemented in selected sites within Peninsular Malaysia, Sabah and Sarawak. The project proper is scheduled to begin in 2007.

Ex-situ Conservation

- Exploration to collect germplasm

Rice represents the most important food crop grown in Malaysia. Genetic resources activities on the crop started with the sudden recognition of possible genetic erosion taking place in 1960s when double cropping was introduced and coupled with the rapid adoption of modern high yielding varieties. Exploration was initiated then by the Department of Agriculture to collect traditional varieties from the rice farms. This activity continued until 1969. Subsequently, with the formation of MARDI in 1970, all germplasm materials were handed over to MARDI for safe keeping at MARDI Seberang Perai research station. The initial step in genetic conservation of rice by MARDI researchers commences with the collection of traditional rice varieties and landraces from farm fields and storage bins and some wild

relatives of rice from wild habitats. A thorough survey on the distribution of wild relatives of rice throughout the country started in 1980s. Four species of rice, namely *Oryza rufipogon, O. officinalis, O. meyeriana* and *O. ridleyi* were surveyed. During the collection trip in 1989, 29 populations of *O. rufipogon*, one population of *O. officinalis* and one population of *O. meyeriana* were found. *Oryza rufipogon* is noticed to be abundant and most common in Kelantan, Seberang Prai and south Kedah. Seeds were also collected from Perak, Seberang Prai, Kedah, Terengganu, Kelantan, Sarawak and Sabah. The seeds and living plants maintained at MARDI Seberang Prai station were characterized and evaluated.

Surveys on the distribution of traditional fruits, traditional vegetables and herbs including medicinal plants in the home gardens and orchards throughout the country were carried out. The distribution and diversity of the underutilized species of fruits and these herbs were established. Sites for *in-situ* conservation for different underutilized fruit species in the country can therefore be identified. *Garcinia atroviridis* and *G. foetida* are abundant in Pahang and Terengganu, while *Nephelium ramboutan-ake* trees are concentrated in Johore. However a working relationship with tangible benefits for the farmers has to be established to make it successful.

- Seed genebank

The only seed genebank in Peninsular Malaysia is located at MARDI research station at Bertam, Seberang Perai, Penang. To date, the rice genebank consists of a total of 11,470 accessions of *O. sativa*, and 136 accessions of wild rice accessions (Table 1), of which 67% are of local origin. Besides the traditional varieties and the wild rice species, other accessions include pure line varieties, modern high yielding varieties, elite breeding lines and special types (mutants and anther derived plants). Many of the traditional varieties or landraces are no longer kept by the farmers or found in the rice farmland in the country and this situation shows clearly the cause of genetic erosion.

The seed genebank facility was financed jointly by MARDI and IPGRI (formerly known as IBPGR) and became operational in 1989. In addition to providing cold rooms for short-term, medium-term and long-term seed storage, the facility is also equipped with office space, laboratory, seed processing room, drying room and computer room.

Long-term storage: Seeds which are dried to 6-7% moisture are vacuum-sealed in aluminum foil packets each containing 18-20g seeds and stored in a deep freezer at -20^{o}C. Expected seed longevity is 30 years.

Medium-term storage: About 180-200g seeds dried to 8-9% moisture are vacuum-sealed in aluminum foil packets and kept in a cold room at 3-5^{o}C and relative humidity of 35-40%. The expected seed longevity is 15 years.

Short-term storage: Seeds with the moisture level of 10-12% are kept in brown paper envelopes and stored in a cold room at 12-15^{o}C and relative humidity of 40-45%. Expected longevity is 3-5 years.

The seed genebank has the capacity to store 25,000-30,000 accessions of seeds.

However, the traditional vegetable seeds and *ulam* (or salad-equivalent vegetable) seeds are stored in the seed genebank. Currently about 130 accessions of traditional vegetables mainly of brinjal, *Luffa,* spinach, and chili, as well as 100 accessions of *ulam* are kept in the medium-term storage (see Table 2).

In addition the seed genebank at the Agriculture Research Centre (ARC) in Tuaran, Sabah maintain 941 accessions and 18 varieties of rice as well as 38 species of vegetables (Wong, 2006). A further 1,651 accessions of rice and 29 species of vegetables are also being maintained at various research centres in Sarawak (Table 2) (Chai, 2006).

Table 2. Germplasm collection conserved at seed genebank

No.	Crops	Location	No. of accessions
1	Rice	MARDI Seberang Perai,. West Malaysia	11,470
		DOA Tuaran, Sabah	941*
		Various Centres, Sarawak	1,651
2	Traditional vegetables	MARDI Seberang Perai	130
		Specific MARDI stations	50**
		DOA Tuaran, Sabah	38***
		Various Centres, Sarawak	646****
3	*Ulam*	MARDI Seberang Seberang Perai	100

* 18 varieties of rice are also conserved
** total for chilli and tomato (non-traditional vegetables)
*** number of species
**** encompassing 29 species

- Field genebank

Conservation of tropical fruits has been given special emphasis. A sizeable germplasm collection of fruits are being maintained in MARDI as well as in other agencies (Table 3). Other field genebank collections involving coconut, coffee, root and tubers, medicinal plants, spices and beverages and *ulam* are also being established in MARDI research stations (Table 4).

Table 3. *Ex-situ* conservation of indigenous fruit species maintained at various institutions in Malaysia (Field genebanks/arboretum)

Institutions	Location (Field genebank/arboretum)	No. of species	No. of accessions
MARDI	Various stations	165	3,757*
DOA, Pen.	Serdang	17	1,000
Malaysia	Hulu Paka	110	235
DOA, Sabah	Various Agriculture Research Stations	204	n.a
DOA, Sarawak	Bintulu Agriculture Park	48	60
DOA, Sarawak	Betong Layar Station	54	n.a.
FRIM	Kepong	100	816
UPM	Serdang	36	239
UKM	Bangi	38	na
UM	Rimba Ilmu Petaling Jaya	71	207

*: Inclusive of over 1,000 accessions of traditional cultivar and land races involving 14 major fruit species

Table 4: Germplasm collection conserved in MARDI field genebank

No.	Crops	Location (Research Station)	No. of accessions
1	Coconut	Hilir Perak	45
2	Coffee	Kluang	425
3	Roots and tubers	Serdang	800*
4	Medicinal plants	Cameron Highlands Jerangau	62 3,377
5	Spices and beverages	Kluang	300
6	*Ulam*	Jerangau Seberang Perai	78 60

* Estimates

As in the above tables illustrated, collections of fruits accessions are more prominent in terms of the number of accessions collected with the next substantial collections involves medicinal plants. The collection of medicinal plants in MARDI which currently encompasses 275 species and other herbs are expected to expand further in the future with more importance being placed to it. Already the Dept. of Agriculture Sarawak has recently

established over 200 accessions of live herbal plant collections (Chai, 2006).

Utilization of Genetic Resources

Many of the wild or semi-wild species of cultivated crops possess unique and outstanding characteristics. An important activity in the management of PGRFA is on their characterization and evaluation. Researches on some wild species of rice have shown that they are resistant to major pests and diseases. The appropriate lines have been utilized in rice resistant breeding programme. *Oryza rufipogon* collected at MARDI Bumbung Lima was tested in a cross which resulted in a selection line (RU2242-2-2-1) which shows resistance to tungro virus diseases and possesses high tillering characteristics (Abdullah, 1991).

Characterization and evaluation of accessions involving under-utilised fruits such as *pulasan* (*Nephellium ramboutan-ake*) and *kuini* (*Mangifera odorata*) have resulted in the identification of 2 elite accessions within each of them. These selected accessions have high total soluble solids content (Salma, 2005). Also the assessment of the proximate contents, vitamins and minerals of over 240 accessions representing 70 underutilised fruit species showed some accessions of sour and sweet/sour *binjai* (*Mangifera caesia*) have high vitamin C content whereas *mangga telor* and *mangga bemban* (both Mangifera sp.) high vitamin A. Antioxidant activity determined on about 150 accessions representing 51 species showed some accessions of sweet/sour *binjai, kuini* and *belimbing buluh* possess superior characteristics (Salma, 2005).

Community-Driven Utilization of Crop Diversity

There are clear instances within Peninsular Malaysia, Sabah and Sarawak where agricultural utilization by the rural community themselves could have contributed to the continued sustainability of the species in a particular area. Despite minimal technical and advisory assistance from the relevant agencies the community is able to sustain the present activities and maintain it for the future generations to come. This means an *in-situ* but at the same time on-farm approach of conserving the crop species has been indirectly being pursued by the local community in that particular locality. The following examples give a brief account of such specific cases involving domesticated and semi-wild species of crop plants:

(i). Banana cv. *Pisang Kapas* (*Musa* sp.)

'Pisang Kapas' is a cooking or processing type of banana. It is considered not a popular variety if comparison is made to the more popular desert varieties such as *'Pisang*

Berangan' and *'Pisang Mas'* or even the processing variety such as '*Pisang Nipah'* and *'Pisang Tanduk'*. Substantial acreage to the extent of about few hundred acres of 'Pisang Kapas' is found only in the Batu Pahat district of Peninsular Malaysia and not in other places. They are planted along stretches of the river bank reserves, mixed with other banana varieties on the farmer's land or sometimes intercrop with immature oil palm.

The local communities here have been utilizing the variety for the production of 'pisang salai', a product derived after grilling the flesh of the ripe fruits on fire. The product is only peculiar to the area. The activities have existed a long time ago and are still actively going on.

Banana 'dealers' will initially collect the mature bunches from the field and send it to the '*pisang salai'* operators. An interesting observation is that although the mature bunches fetches about RM0.25 per kg which is considered the lowest price ever for any type of banana (as compared to RM0.40 per kg for *'Pisang Nipah'*, RM0.80 for *'Pisang Berangan'* and RM1.00 for *'Pisang Tanduk'*) the farmers continue to produce the fruits. Further analysis of the activities showed that the final product is mainly marketed within the surrounding areas especially at the Parit Raja and Ayer Hitam town centres. The latter is a popular stop-over destination for local and overseas tourists coming to and from Singapore.

To-date no proper socio-economic analysis on the viability of this home-based industry has been carried out. However interviews with a number of stall owners at those town centers mentioned earlier do indicate that there are good demands for the product.

(ii). *Mangifera caesia* (Binjai)

This fruit species is indigenous to this region. Together with the commercial mangoes, *Mangifera indica*, they belong to the family Anacardiaceae. Binjai trees are found scattered in almost all parts of the country but more plantings are observed in Negeri Sembilan, Malacca and Perak in Peninsular Malaysia. The trees are planted around the homes and along roadsides. The fruits are consumed fresh especially the sweeter types. The sour fruits are ground with chilly and prawn paste to form a palatable delicacy and consumed with rice.

Generally the species have two periods of fruiting. The first one occurred during the months of June-July while the other is from November-December. It is interesting to note that although some fruits are available at many of the town markets; substantial quantities of the fruits are displayed and sold during those months at the roadside fruit stalls in Alor Gajah district of Peninsular Malaysia. This activity existed a long time ago and this indicates there is already good linkage between the small growers (despite having few trees around their homes), fruit 'dealers' and stall owners in the area. There is no involvement of any government extension and marketing agency in the course of their production and marketing of the produce.

(iii). *Mangifera odorata* (Kuini), *M. laurina* (Mangga air) and *M. pajang* (Bambangan)

These three Mangifera species are commonly found in Sabah. Kuini is widespread throughout Malaysia whereas the last named species is endemic to Borneo Island. Many of their plantings can be found in the Kota Belud, Tuaran and Papar area in Sabah. These areas are located on the west coast of Sabah. However, in Kota Belud, many diverse forms of Mangifera plantings in the area are found on the alluvial plains of the Tempasuk River. Between the three mangifera species, kuini are the most common followed by mangga air while bambangan appear to be more scattered.

The trees are mainly planted around the houses and near the roadside with very few stands along the fringes of the forests. To-date there is no organized planting of the crop in the area. Initial studies showed that many of the plantings are very old and younger plantings have also been established especially near to the houses. Older trees have also been seen planted near and in the vicinity of the cemeteries indicating perhaps a cultural link to the use of the species concerned.

The main economic crop within the area is rice but these Mangifera species are supplementing the household income of many members of the community. The fruits are sold mainly for fresh consumption at the "Tamu" or Sunday market as well as at "Pasar Tani" markets. In general there is no assistance rendered by any of the state authorities to cater specifically to the needs of these crops.

(iv). Dimocarpus longan subsp. malesianus (Isau group)

Dimocarpus longan subsp. *malesianus* is commonly found throughout Peninsular Malaysia, Sabah and Sarawak. Three different forms of the species from Sarawak can be distinguished from the ones in the Peninsular Malaysia (Rukayah, 1999). The local community in Sarawak recognized them as '*isau'*, '*sau*' and *'kakus'*. The most distinct feature of these fruits compared with the ordinary longan is that their skins has protruded, soft and blunt spots. Many regard these fruits as typical longan unique to Sarawak. They are almost solely found along the upper reaches of the banks of the Rajang River and its tributaries covering the Kanowit, Song, Kapit and Belaga districts. They therefore thrive well on the alluvial deposits of river banks.

The *'isau'* or green longan has rounded fruits whereas 'sau' are oblong. The '*kakus'* also produce rounded fruits but upon ripening the skin changes to brownish whereas it remains green for *'isau.*' '*Isau*' are more popular as it has thicker arils and are generally sweeter with higher calcium, vitamin C and mineral contents.

Traditionally the farmers have been using seeds as planting materials. Due to its out breeding nature there are great variation in yield and fruit characteristic. *Isau* trees can grow

tall reaching a height of 20 m and it take about ten to twelve years to bear fruits. Mature trees have been recorded to yield 200 kg of fruit per season. The fruit commands a high market price. The normal fruiting season is from March to April.

(v). *Durio kutejensis* (*Durian nyekak*)

This species of *durian* can be found in Sabah and Sarawak. It is mainly found growing wild in mixed dipterocarp forests in the Bintulu and Miri divisions in Sarawak. Its fruit is popular amongst the local populace. The tree is small to medium in size having a height of 12-20 m. The tree has a close and low branching habit giving it a dense crown that is pyramidal in shape.

A mature tree may carry up to 500 fruits per season. *Nyekak* generally flowers and ripens about a month after the common *durian, Durio zibethinus*. Its flowers are deep red in colour and produce a smell. Its fruits are medium size weighing on average 1 kg per fruit. Its thorns are short and slightly bent. Another good feature is its seeds are relatively small and often flat and thin. The flesh is sweet, starchy and drier than the ordinary durians.

Nyekak has a long history in cultivation. They are mainly planted from seeds. Over the years farmers are known to select and identify apparently superior individuals. Some individuals have in fact started to systematically plant them although at small acreages.

Genebank Information System

At present database for rice genebank maintained at MARDI called Rice Genebank Information System (RGBIS) (Abdullah, 2003) have been developed. It was a relational database developed using Microsoft Access which is actually a modified version of MARDIGEN developed earlier using Dbase III that followed the format of International Rice Research Institute (IRRI) genebank. The RGBIS can facilitate two subsystems namely on documentation of the accessions and seed management. Information on seeds management includes quantity of seeds stored, tray number, age, tested date, germination rate, etc. The information helps the genebank manager to easily locate and track the accession in the genebank.

The RGBIS is currently under review with the availability of funding from Global Crop Diversity Trust. With the advantages and added features of International Crop Information System (ICIS) the rice genebank databases would be deployed for incorporation into the system. This project is again carried out with the collaboration of IRRI. The core of ICIS is it is a relational database structure that store data on plant genetic resources, pedigrees, field and laboratory evaluations, and auxiliary data on locations, institutions and people. It is expected

that with the project completion, rice genebank information in both MARDI and IRRI could be accessible via www (World Wide Web) (Tosiah and Mohd. Shukor, 2005).

Information pertaining to other crops beside rice is being developed by MARDI under the Agrobiodiversity Information System project (Tosiah, *et. al.* 2006).

Conclusion

There exists a wealth of plant genetic resources in Malaysian flora. Considerable efforts have been initiated to conserve many of the PGFRA. Extensive conservation of genetic accessions has been established in field genebanks for some of the major fruit types. Seed genebanks have been established for the conservation of rice and other orthodox-seed type of crops. Despite the availability of designated forest land gazetted as protected areas, there is a need for more concerted effort to collect and conserve more crop species encompassing wild accessions, land races and adapted ecotypes before they are lost. Emphasis in collecting a wider range of diversity within species should be attempted. There is also a need for more effort on the characterization and evaluation of PGRFA. This will allow their potential to be realized before further utilization can be effected.

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