STUDY ON DISTRIBUTION, GENETIC DIVERSITY AND DEVELOPMENT OF INDIGENOUS FRUIT SPECIES IN BRUNEI DARUSSALAM

(JPt/TAW/50/2008-2009)

Phase One Report

31st January 2012
STUDY ON DISTRIBUTION, GENETIC DIVERSITY AND DEVELOPMENT OF INDIGENOUS FRUIT SPECIES IN BRUNEI DARUSSALAM (JPt/TAW/50/2008-2009)

Phase One Report

31st January 2012

CAB International
Southeast and East Asia Office
P.O. Box 210, UPM Post Office
43400 Serdang, Selangor, Malaysia
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EXECUTIVE SUMMARY

A project entitled “Study on the distribution, genetic diversity and development of indigenous fruit species in Brunei Darussalam” was formulated between the Department of Agriculture and Agri-food (DOAA), Ministry of Industry and Primary Resources, Brunei Darussalam and CAB International, Southeast & East Asia Regional Centre (CABI SEA). The two and a half year project started in June 2011 to document scientific information on the diversity of indigenous fruits in Brunei Darussalam and their distribution, and to conserve valuable materials and identify potential fruits for commercialization.

Six activities have been implemented during the first six months of the project i.e June 2011 – December 2011 and these can be summarized as follows:-

1. The Project Inception meeting was organized on 28th June 2011 between the DOAA staff and CABI consultant team members to commence the development of a short and long term strategic plan to develop indigenous fruits of Brunei Darussalam. The proposed plan of work and activities was presented and agreed for implementation.

2. The list of required resources for the project which included equipment, transport and other facilities was also prepared, presented and discussed during the inception meeting.

3. A comprehensive survey on fruit species to identify location and distribution of the indigenous fruits of Brunei was started during this phase. The first survey was conducted during the flowering season in October 2011. Fifteen orchards were surveyed i.e. Muara (6), Tutong (3), Belait (3) and Temburung (3). Fifty (50) species of fruits were identified and located during the survey. Passport data and characterization of flowers and fruits for some species were also done.

4. Botanical and systematic identification of fruit species collected from the survey were done. Seventy seven (80) fruit species were identified from literature and the fruit collection garden at Birau. Fifty (50) of the species were identified during the survey. A list of fruit species, arranged by family, in Brunei Darussalam with common and scientific names is shown in Table 1.

5. Information and methodology for the identification of fruit species and germplasm management of fruit species were discussed, formulated and taught during the training as well as during practical and data collection in the field.

6. The map of distribution pattern of indigenous fruit species in Brunei Darussalam can only be constructed after the survey completed.

7. Characterization and evaluation data of each species are still being collected and compiled to be used in the development of a database information system for indigenous fruit species. The collected information will also be used to prepare a
scientific book on Indigenous Fruits of Brunei Darussalam (English and Malay versions) as well as to identify species that have potential for commercialization.

9. On-the-job training was also conducted for the DOAA staff on diagnostics, identification, herbarium and germplasm management of fruit species.

10. A study tour to Botanical gardens, Arboretum, Herbarium and Research Institute at Bogor, Indonesia was organised for three staff to look at the methods and systems being used in other countries.

11. Six copies each of the three (3) books authored by Rukayah Aman entitled: a) Buah-buahan nadir Semenanjung Malaysia, b) Buahan-buahan Malaysia, and c) Tumbuhan Liar Ubatan Malaysia have been purchased and donated for officers of Fruit Development Unit, DOAA
<table>
<thead>
<tr>
<th>Table 1 : List of Indigenous Fruits of Brunei Darussalam</th>
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<tr>
<td><strong>Amarylidiaceae</strong></td>
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<td>Lambo</td>
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<td><strong>Anacardiaceae</strong></td>
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<td>Menungan</td>
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<td><strong>Bombacaceae</strong></td>
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<td>Durian kuning/</td>
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<td>Durian otak udang galah/</td>
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<td>Meritus</td>
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<td><strong>Euphorbiaceae</strong></td>
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<td>Lampaung</td>
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<td>Rambai</td>
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<td>Sonneratiaceae</td>
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1. Introduction

Brunei Darussalam is rich in indigenous fruit species and some of these species may have potentials to be developed for commercialisation. A study on distribution of indigenous fruit species in Brunei Darussalam is therefore necessary to obtain scientific information on the status of fruit distribution, richness, diversity and identification of elite accessions for further exploitation. The Department of Agriculture and Agrifood (DOAA) Brunei Darussalam recognizes that conservation activities are important to avoid extinction of the fruit species due to rapid urbanization. A project entitled ‘Study on distribution, genetic diversity and development of indigenous fruit species in Brunei Darussalam’ was then formulated between Brunei Darussalam and CABI Southeast & East Asia (CABI). A contract was signed between DOAA, Ministry of Industry and Primary Resources, Brunei Darussalam and CABI on 2nd June 2011 with an agreement for CABI to assist Brunei in the implementation of the Brunei indigenous fruits project for a duration of 30 months from June 2011 –December 2013. This two and a half year project is aimed at documenting the scientific information of the diversity of local indigenous fruits in Brunei Darussalam, conserving unique valuable indigenous fruits species for commercialization.

The consultancy project will be carried out over two and a half years and will involve 12 (twelve) major activities.

Activity 1: An initial discussion will be conducted between the Agriculture Department Staff and the consultant team members to commence the development of a short and long term strategic plan to develop indigenous fruits in Brunei Darussalam

Activity 2: Recommend and prepare a list of required resources that would be required for the project and make a specification if necessary. The list of resources shall include equipment, transport and other relevant facilities

Activity 3: Study and conduct a comprehensive survey on fruit species and identify the location of the indigenous fruits distribution in Brunei Darussalam according to family, genera, species, habitat etc.

Activity 4: Conduct botanical or systematic identification of fruits species collected in this project according to family, genera, species, habitat, etc.

Activity 5: Discuss, formulate and document suitable methodology for the identification and germplasm management of fruit species.

Activity 6: Prepare and develop map of distribution pattern of indigenous fruit
Activity 7: Provide the database hardware and software package and developed the database information system of indigenous fruit species.

Activity 8: Publish a scientific book on Indigenous Fruits of Brunei Darussalam (in English and Malay Versions)

Activity 9: Deliver on-the-job training to Department of Agriculture staffs on diagnostics, Identification, herbarium and germplasm management of fruit species.

Activity 10: Identify and study the indigenous fruit species which have potential to be commercialized.

Activity 11: Organize a five-day study tour for three Fruit Development Staff to Botanical Gardens, Arborets, Herbariums and Research Institute to look at the methods and systems being practiced and learn from the experience of other countries.

Activity 12.: Recommend a strategic short and long term implementation plan to conserve indigenous fruits species; and for research and development on fruits in Brunei Darussalam.

The expected outcomes and benefits from the project include:

- A general descriptor list suitable for characterizing and evaluating of fruit species
- Morphological data of fruit species determined
- Diversity of fruit species established
- A database of information on indigenous fruits collected from the survey
- A distribution map for indigenous fruits in Negara Brunei Darussalam
- Manuals on herbarium preparation, plant characterization, propagation, plant identification and genebank management
- Trained Dept. of Agriculture staff competent to independently perform tasks
- Master copies of a scientific publication on Indigenous Fruits of Negara Brunei Darussalam, in English and Malay versions, delivered in electronic format.
- Potential fruit species for commercialization identified

In the phase 1 Report, the activities that were carried out during June to January are as below:
1. Project Inception Meeting (Activity 1 and 2)
2. Provide on-the-job training to Department of Agriculture staffs on diagnostics, identification, herbarium and germplasm management of fruit species (Activity 7)
3. A study visit to Bogor, Indonesia (Activity 11)
4. Conduct as survey on distribution and diversity and characterisation and evaluation of fruit species in orchards and home gardens (Activity 3 & 4)

2. IMPLEMENTATION OF THE PROJECT

2.1. Project Inception Meeting

The Project Inception Meeting was held at Birau Agriculture Research Station, Tutong, Brunei Darussalam on 28th June 2011. The objective of the meeting was to discuss on the implementation plan and to assess the resource capacity of the DOAA and requirements for the project. The meeting discussed the following topics:

- the national fruit survey
- the current capacity and operational details of existing arboretums and herbarium and perceived needs following the implementation of the project
- current fruit crops development, improvement, marketing and promotion strategies
- necessary recommendations made to acquire resources, such as equipment, transport and facilities for the survey

The meeting was attended by:

- Hj Muhammad Amin Chik Bin Ikas
- Hjh Khartini Binti Haji Musa
- Mr Takiyaudin Bin Hj Mohamad – Ketua Unit Pembangunan Buah-buahan
- Dyg Sanah Binti Burut – Ketua Unit Kemajuan Pertanian Daerah Temburong
- Hj Latif Bin Hj Ahmad – Ketua Unit Kemajuan Pertanian Daerah Belait
- Hjh Jamilah Binti Hj Abidin – Unit Pembangunan Buah-buahan
- Hjh Rohani Binti Md. Johari - Unit Pembangunan Buah-buahan
- Hafiz Azizi Bin Abdullah Chuat – Unit Kemajuan Pertanian Daerah Tutong
- Md Mee Lee Bin Hj Abd Halim – Unit Kemajuan Pertanian Daerah Belait
- Ms Jamaliah Binti Tuah – Unit Kemajuan Pertanian Daerah Temburong
- Mr Jumin Bin Lamat – Unit Pembangunan Buah-buahan
- Hjh Kamsinah Binti Hj Ibrahim – Unit Pembangunan Buah-buahan
- Mr Kamal Bin Hj Lakim – Unit Pembangunan Buah-buahan
- Ms Salinda Binti Sitim – Unit Pembangunan Buah-buahan
- Mr Panjang @ Md. Zaqrean Bin Samsu - Unit Pembangunan Buah-buahan
- Dr Soetikno S. Sastrautomo – Project Leader, CABI SEA
- Mrs Rukayah Aman - Malaysia
- Dr. Salma Idris - Malaysia
Several decisions and amendments related to the implementation of project activities and its starting dates for each activity were made. The report of the Project Inception Meeting is given in ANNEX 1.

2.2 On-the-job training to Department of Agriculture staffs on identification, herbarium, diversity assessment, characterisation and propagation of fruit species

Lectures and hands on training on plant identification, herbarium technique, characterisation, diversity assessment and propagation of fruit species were conducted from 26 – 28 September 2011. Sixteen participants from various sections of DOAA who attended the training are listed below:

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Unit</th>
<th>District</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Takiyaudin Bin Hj Muhamad</td>
<td>Unit Pembangunan Buah-buahan</td>
<td>Tutong</td>
</tr>
<tr>
<td>2.</td>
<td>Hjh Jamilah Binti Hj Abdin</td>
<td>Unit Pembangunan Buah-buahan</td>
<td>Tutong</td>
</tr>
<tr>
<td>3.</td>
<td>Hjh Rohani Binti Md Johari</td>
<td>Unit Pembangunan Buah-buahan</td>
<td>Tutong</td>
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<tr>
<td>4.</td>
<td>Jumin Bin Hj Lamat</td>
<td>Unit Pembangunan Buah-buahan</td>
<td>Tutong</td>
</tr>
<tr>
<td>5.</td>
<td>Hjh Kamsinah Binti Hj Ibrahim</td>
<td>Unit Pembangunan Buah-buahan</td>
<td>Tutong</td>
</tr>
<tr>
<td>6.</td>
<td>Panjang @ Mohd Zaqreen Bin Samsu</td>
<td>Unit Pembangunan Buah-buahan</td>
<td>Tutong</td>
</tr>
<tr>
<td>7.</td>
<td>Kamal Binti Hj Lakim</td>
<td>Unit Pembangunan Buah-buahan</td>
<td>Tutong</td>
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<tr>
<td>8.</td>
<td>Salinda Binti Sitim</td>
<td>Unit Pembangunan Buah-buahan</td>
<td>Tutong</td>
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<tr>
<td>9.</td>
<td>Hj Latif bin hj Ahmad</td>
<td>Unit Kemajuan Pertanian Daerah Belait</td>
<td>Belait</td>
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<td>10.</td>
<td>Md. Meelee bin Hj Abd. Halim</td>
<td>Unit Kemajuan Pertanian Daerah Belait</td>
<td>Belait</td>
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<td>11.</td>
<td>Sanah binti Hj Burut</td>
<td>Unit Kemajuan Pertanian Daerah Temburong</td>
<td>Temburong</td>
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</tbody>
</table>
The participants gained knowledge and abled to conduct various techniques taught which include:

- Identification of fruit species in Brunei Darussalam
- Collection, pressing, drying, mounting and labelling of herbarium specimens
- Carry out survey to assess diversity of fruit species
- To gather data about the fruit species i.e. passport data, environment data, characterisation and evaluation data using the fruit descriptor developed
- Propagation techniques (Practical will done later)

During the hands on training on herbarium technique and characterisation, the participants collected 32 herbarium specimens from Brunei Muara and Tutong District and Muara station. The participants also learned to take data on distribution using GPS, diversity and characterisation. Lecture notes are attached in ANNEX 2.

Training on propagation techniques on fruit propagation such bud and cleft grafting was conducted in January and was attended by two participants each from Brunei Muara and Temburong. Further training on other propagation techniques and the use of propagation chamber will be carried out in mid April or May 2012.

### 2.3 Distribution, diversity and characterisation of fruit tree species

A survey on the distribution and diversity of the fruit tree species was made during the flowering season in October 2011. Fifteen orchards were surveyed viz. Muara (6), Tutong (3) districts, Belait (3) and Temburong (3). From the literature 77 fruit tree species were identified in Brunei Darussalam. During the survey 50 species were identified. Passport data and characterisation of vegetative characters and flower characters for some species were determined (ANNEX 3).
A total 82 herbarium specimens were collected and processed. Of these 11 species were from Brunei Muara, Tutong (7 species), Belait (42 species) and Temburong (23 species).

Another trip was made to collect, characterise and evaluate the fruit species from the identified orchards previously and also from new orchards in January 2012. During the this fruiting season among the fruit trees that were found to bear fruits were membangan, terap, pinanasan, *Nephelium* species, durian meragang, *Durio* species, limpaung, pengalaban (in some places), asam aur-aur (end of season), kembayau (also almost end of season), cempedak, kembayau. Durian pulu, mata kucing, tampoi and tampoi belimbing will be matured in early February 2012. During this trip 33 fruit species were collected and characterised (ANNEX 4).

The data gathered are being entered into excell sheet.

### 2.3 Study visit to Bogor, Indonesia

A scientific study visit to several institutions involving with fruit conservation and utilization was organized for three officers from DOAA from 16 – 19 November 2011. The objectives of the visit were as follows:

- To learn the procedures and requirement for establishing and maintaining a fruit arboretum, the steps to be taken in conserving indigenous fruits *in-situ* and *ex-situ*
- To learn on the process of specimen, identification, preservation and management of herbarium specimens of indigenous fruits and management of databases
- To learn new researches and development and commercialization of indigenous fruits

The visit was accompanied by Dr Salma Idris and Mrs Rukayah Aman from Malaysia. The arrangement and coordination of the visit in Indonesia was made by Dr. Nono Sutrisno from ICHORD. The full report of the visit is presented in ANNEX 5.

### 3. ACKNOWLEDGEMENTS

The project team is very grateful to Mr. Takiyaudin Bin Hj Mohamad, head of Fruit Development Unit for his cooperation, assistance, input and direction during the execution of activities in the Phase one period.

Very special thanks are due to all staffs from Fruit Development Unit, Hjh Jamilah Binti Hj Abidin, Hjh Rohani Binti Md Johari, Jumin Bin Lamat, Hjh Ibrahim, Kamal Bin Hj Lakim, Panjang Bin Samsu, Salinda Binti Sitim, Md. Noor Syazwan Bin Hj Mohd Suhaini, Anuar Bin Hj Morni; from Brunei/Muara Extension Unit, Jafar Bin Hj Kamis, Salamuda AnakTandang; from Tutong Extension Unit, Hafiz Azizi Abdullah
Chuat, Nuriyana Binti Abdullah Pikir, Dora Binti Hj Daud, Zainab Binti Hj Mohd Zain; from Belait Extension Unit, Md. Meelee Bin Hj Abd Halim, MB Mazlan Bin Hj Zaini, Jawi Anak Panau; from Temburong Extension Unit, Sabtu Bin Sitai, Jamaliah Binti Tuah and Sanah binti Hj Burut for their help and technical assistance.

Special thanks are also due to all farmers in the districts for their cooperation and hospitality – Hj Johari Bin Mudin, Jait Binti Siput, Norsinah Binti Abdullah, Hj Mutalib Bin Hj Sudin, Zaini Bin Diok, Alias Bin Abdullah, Majang Anak Mudin, Hj Bahar Bin Hj Juned, Hj Ahmad Bin Hj Jaafar, Hj Mamit Bin Bahar and Pn Halimah
Annex 1. Report of the Project Inception Meeting
REPORT ON
THE INCEPTION MEETING (June 28, 2011)

PROJECT TITLE

STUDY ON DISTRIBUTION, GENETIC DIVERSITY AND DEVELOPMENT OF INDIGENOUS FRUIT SPECIES IN BRUNEI DARUSSALAM

Submitted to
CAB International
South East Asia Regional Centre

Prepared by
Ms Rukayah Aman
Dr Salma Idris

24 August 2011
1. A Baseline Assessment of the Current Status of Indigenous Fruits

Brunei Darussalam has varieties of unique local fruits that have potential to be further developed as those having commercial value and meet consumers standard with modern technology currently practiced in the region. Study on species distribution of local indigenous fruits in Brunei Darussalam is necessary to obtain scientific information on status and the richness of fruits resources to be exploited and further developed.

The Department of Agriculture recognizes that conservation activities are important to avoid extinction of the plant species due to rapid urbanization. Currently, the Agriculture Department in its efforts to collect and conserve the fruit species has continuously implementing the collection of indigenous fruits and growing them in the arboretum at:

- Birau Agriculture Research Station in Tutong District.
- Sungai Pedayan Agricultural Station at Temburong District.

A detailed study on the distribution of indigenous fruit species, genetic diversity and the commercialization of indigenous fruits cannot be actively implemented due to the lack of technical expertise. A consultant is engaged to carry a detail study on the project with the goal.

- To explore and document the scientific information on the diversity of local indigenous fruits in Brunei Darussalam.
- To conserve unique valuable fruit species from being extinct through adoption of conservation technology.
- To develop potential indigenous fruits for commercialization.

The department of Agriculture station at Birau had initiated the collection and conservation of these fruit species. To date there are about 70 fruit species were collected and conserved. However, a number of them such as mentega, cermai, clones of durian and cempedak are not native or indigenous and should be excluded from the list. Table 1 shows the list of fruit species in Brunei Darussalam gathered from several sources. It is expected that many species will be added to the list especially in the genus *Artocarpus*. The final list of fruit species will depend on the result from the survey.
Table 1. List of indigenous fruit species in Brunei Darussalam

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<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Common Name</th>
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<tr>
<td>Amarylidiaceae</td>
<td>Lamba</td>
<td>Moniniera latifolia</td>
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<td>Anacardiaceae</td>
<td>Belunu/Binjai / Binglu</td>
<td>Mangifera caesia</td>
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<td>Wani/kuini</td>
<td>Mangifera odorata</td>
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<td>Matan</td>
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<td>Membangan</td>
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<td>Mangifera laurina</td>
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<td>Lenggauh</td>
<td>Mangifera sp.</td>
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<td>Pentaspadan motleyi</td>
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<td>Surapit</td>
<td>Willughbeia angustifolia</td>
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<td>Pitabu</td>
<td>Willughbeia sp.</td>
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<td>Menungan</td>
<td>Willughbeia sp.</td>
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<td>Bombacaceae</td>
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<td>Durio graveolens</td>
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<td>Durian bunga simpur/</td>
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<tr>
<td></td>
<td>Durian siunggung (suluk)</td>
<td>Durio sp.</td>
</tr>
<tr>
<td></td>
<td>Durian pulu</td>
<td>Durio kutejensis</td>
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<td>Durian kura-kura</td>
<td>Durio testudinarium</td>
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<td>Durian sukang</td>
<td>Durio oxleyanus</td>
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<td>Durian meragang</td>
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<td>Durian burung</td>
<td>Durio sp.</td>
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<td>Burseraceae</td>
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<td></td>
<td>Meritus</td>
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<td>Pinanasan</td>
<td>Dacroydes rostata</td>
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<td>Sabal</td>
<td>Dacroydes expansa</td>
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<tr>
<td>Euphorbiaceae</td>
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<td>Baccaurea lanceolata</td>
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<td>Rambai</td>
<td>Baccaurea motleyana</td>
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<tr>
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<td>Tampoi</td>
<td>Baccaurea griffithii</td>
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<tr>
<td></td>
<td>Tampoi belimbing</td>
<td>Baccaurea angulata</td>
</tr>
<tr>
<td>Family</td>
<td>Species</td>
<td>Scientific Name</td>
</tr>
<tr>
<td>---------------</td>
<td>----------------------------------</td>
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<tr>
<td><strong>Fagaceae</strong></td>
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<td><em>Baccaurea pyriformis</em></td>
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<tr>
<td></td>
<td>Tampoi silau</td>
<td><em>Baccaurea sp.</em></td>
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<tr>
<td><strong>Flacourtiaiceae</strong></td>
<td>Kepayang</td>
<td><em>Pangium edule</em></td>
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<td></td>
<td>Rukam</td>
<td><em>Flacourtia rukam</em></td>
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<tr>
<td><strong>Gnetaceae</strong></td>
<td>Bagu</td>
<td><em>Gnetum gnemon</em></td>
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<tr>
<td><strong>Guttifarce</strong></td>
<td>Asam aur -aur</td>
<td><em>Garcinia forbesii</em></td>
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<tr>
<td></td>
<td>Manggis</td>
<td><em>Garcinia mangostana</em></td>
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<td>Kandis</td>
<td><em>Garcinia parvifolia</em></td>
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<td>Luli</td>
<td><em>Garcinia hombroniana</em></td>
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<td><strong>Lauraceace</strong></td>
<td>Pengalaban</td>
<td><em>Litsea garciae</em></td>
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<td><em>Parkia speciosa</em></td>
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<tr>
<td></td>
<td>Petai bunga</td>
<td><em>Parkia sp</em></td>
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<tr>
<td></td>
<td>Jering</td>
<td><em>Pithecellobium jiringa</em></td>
</tr>
<tr>
<td></td>
<td>Keranji</td>
<td><em>Dialum indum</em></td>
</tr>
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<td><strong>Melastomataceace</strong></td>
<td>Senduduk</td>
<td><em>Melastoma malabathricum</em></td>
</tr>
<tr>
<td><strong>Meliaceae</strong></td>
<td>Santul</td>
<td><em>Sandoricum koetjape</em></td>
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<tr>
<td></td>
<td>Langsat</td>
<td><em>Lansium domesticum</em></td>
</tr>
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<td>Langsat berok</td>
<td><em>Lansium domesticum</em></td>
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<td>Duku</td>
<td><em>Lansium domesticum</em></td>
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<td><strong>Moraceae</strong></td>
<td>Cempedak</td>
<td><em>Artocarpus interger</em></td>
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<tr>
<td></td>
<td>Nangka</td>
<td><em>Artocarpus heterophyllus</em></td>
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<td>Tarap</td>
<td><em>Artocarpus odoratissimus</em></td>
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<td></td>
<td>Terap ikal</td>
<td><em>Artocarpus anisophyllus</em></td>
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<td></td>
<td>Tempunik</td>
<td><em>Artocarpus rigidus</em></td>
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<td></td>
<td>Bintawa</td>
<td><em>Artocarpus anisophyllus</em></td>
</tr>
<tr>
<td></td>
<td>Beruni / tempinis</td>
<td><em>Artocarpus dadah</em></td>
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<td>Terap hutan</td>
<td><em>Artocarpus elasticus</em></td>
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<td></td>
<td>Ara</td>
<td><em>Ficus sp.</em></td>
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<tr>
<td><strong>Myrtaceae</strong></td>
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<tr>
<td>Syzygium malaccensis</td>
<td>Rhodomyrtus tomentosa</td>
<td></td>
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<td>----------------------</td>
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<td></td>
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<tr>
<td>Kemunting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jambu bol</td>
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**Palmae**

<table>
<thead>
<tr>
<th>Eleodoxa conferta</th>
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<tbody>
<tr>
<td>Kelumbi/Asam paya</td>
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<tr>
<td>Nipah</td>
<td></td>
</tr>
<tr>
<td>Salacca affinis</td>
<td></td>
</tr>
<tr>
<td>Sungsung (sungsum)</td>
<td></td>
</tr>
<tr>
<td>Rotan/Jelayan</td>
<td></td>
</tr>
<tr>
<td>Salak local</td>
<td></td>
</tr>
</tbody>
</table>

**Rubiaceae**

<table>
<thead>
<tr>
<th>Gardenia pterocalyx</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulang</td>
<td></td>
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</table>

**Rutaceae**

<table>
<thead>
<tr>
<th>Fortunela palyandra</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Limau pagar</td>
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**Sapindaceae**

<table>
<thead>
<tr>
<th>Nephelium xerospermoides</th>
<th></th>
</tr>
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<tbody>
<tr>
<td>Arut</td>
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</tr>
<tr>
<td>Bayong</td>
<td></td>
</tr>
<tr>
<td>Mata kucing</td>
<td></td>
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<tr>
<td>Maritam</td>
<td></td>
</tr>
<tr>
<td>Kemanggis</td>
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<tr>
<td>Ketidahan</td>
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<tr>
<td>Sungkit</td>
<td></td>
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<tr>
<td>Lakang</td>
<td></td>
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<tr>
<td>Nagalau/ngalau</td>
<td></td>
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<tr>
<td>Bantut</td>
<td></td>
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<tr>
<td>Sigir</td>
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</table>

**Sonneratiaceae**

<table>
<thead>
<tr>
<th>Sonneratia alba</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Berembang</td>
<td></td>
</tr>
<tr>
<td>Api-api</td>
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</tr>
<tr>
<td>Pedada</td>
<td></td>
</tr>
<tr>
<td>Xerospermum sp.</td>
<td></td>
</tr>
<tr>
<td>Nephelium sp.</td>
<td></td>
</tr>
<tr>
<td>Nephelium sp.</td>
<td></td>
</tr>
<tr>
<td>Nephelium sp.</td>
<td></td>
</tr>
</tbody>
</table>
2. Detailed Recommendation for Acquisition of Needed Resources

The equipments and resources required can be categorized into three groups:

(1) Equipments required for the survey and characterization work
(2) Facilities required for the herbarium
(3) Nursery and field facilities

(1) Equipments required for the survey and characterization work

- Digital Camera - Stationaries
- Binocular - Ladders
- Binocular microscope - Knife and Parang
- Magnifying glass - Cangkul
- Refractometer - ‘Galah’
- Hypsometer - Clear plastics
- Measuring tape - A computer notebook
- Vernier scale caliper - GPS
- Top pan balance - Boots, hats
- Colour chart (Mathuen’s Handbook of Colour)

(2) Facilities for Herbarium

- Ventilated oven
- Refrigerator
- Freezer - 40 °C
- Storage Cabinets
- Clear Bottles
- Chemicals
- Card board
- Mounting board
- Gum
- Labels
- Presses
- Secateurs
- Corrugated aluminium sheet/board
- Specimen folder
- Preparation area

(3) Nursery Facilities

- Planting beds / Planting boxes and polybags
- Propagation chamber
- Sand mixer
- Sprinkler system
- Experience budder
- Staff / research assistant

Many of equipments are already available at the station. However a number of major equipments are not available and will be purchased. Smaller items can be purchased locally.

- Ventilated oven or drier
- Colour chart (Mathuen's Handbook of Colour)
- Hypsometer
- Binocular
- GPS – 2 sets
- Detail map of Brunei Darussalam
- Presser board

Presser board are available at the station but there is a need to have one with bigger air space for better ventilation of the hot air to the specimens.

3. Specification for the Required Equipment & Facilities

CABI will help to search for the specification of some of the equipments and facilities. These equipments include:

- GPS
- Colour chart
- Oven
- Freezer

4. Agreement on the Scale and Scope of the Planned Survey

The survey will start tentatively on the second and third week of September. On job training on the followings will be conducted before and during the survey.

i. Genetic Diversity Analysis
ii. Characterization and evaluation data collection
iii. Herbarium technique

There are 4 districts in Brunei Darussalam. For the genetic diversity analysis it was agreed that 60 samples per district will be taken at random. The samples consists of households, orchard and forest reserves in the proportion that will be decided later. About 10 samples can be surveyed per day and it is estimated that each district will take a week for the survey.
Number of samples / district = 60
Number of sample / day = 10
Total number of days needed = 6
Number of districts = 4

During the survey, indigenous fruit trees encountered will be documented for their passport data. Samples of flowers and fruits if available will be collected and characterized. The agronomic performance of the trees will be documented and evaluated. Currently, flowering and fruiting of fruit trees is observed to be quite erratic due to weather changes. It is expected that not many trees will flower or bear fruit during this September season. The survey will be carried out four times during flowering and fruiting seasons. There are two seasons a year and the survey will be carried out twice a year i.e. around March – April and November – December. The schedule of activities are as listed in Table 2 showing the tentative time and duration for the survey.

The format for the data collection will be provided. The revised format of the fruit descriptor by IPGRI will be used with certain modification to suit the survey (Table 3). The training will produce competent staffs in identification and management of germplasm as well as in setting up of a herbarium.
<table>
<thead>
<tr>
<th>Activity</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. An initial discussion would be conducted between the agriculture Department staffs and the consultant team members to commence the development of a short and long term strategic plan to develop indigenous fruits in Brunei Darussalam.</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>2. Recommend and prepare a list of required resources that would be required for the project and make a specification if necessary. The list of resources shall include equipments, transport and other relevant facilities.</td>
<td>9</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>3. Study and Conduct a comprehensive survey on fruit species and identify the location of the indigenous fruits distribution in Brunei Darussalam according to family, genera, species, habitat, etc.</td>
<td>12</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>4. Conduct botanical or systematic identification of fruits species collected in this project according to family, genera, species, habitat, etc.</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5. Discuss, formulate and document suitable methodology for the identification and germplasm management of fruit species.</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>6. Prepare and develop map of distribution pattern of indigenous fruit species in Brunei Darussalam.</td>
<td>9</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>7. Provide the database hardware and software package and developed the database information system of indigenous fruit species.</td>
<td></td>
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<tr>
<td>---------------------------------------------------------------</td>
<td></td>
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</tr>
<tr>
<td>8. Publish a scientific book on Indigenous Fruits of Brunei Darussalam. (Published in English and Malay version).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Deliver on-the-job training to Department of Agriculture staffs on diagnostics, identification, herbarium and germplasm management of fruit species.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>10. Identify and study the indigenous fruit species which have potential to be commercialized.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Organize a five-day study tour for three Fruit Development Staff to Botanical Gardens, Arboretums, Herbariums and Research Institute to look at the methods and systems being practiced and learn from the experience of other countries.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Recommend a strategic short and long term implementation plan to conserve indigenous fruits species in Brunei Darussalam.</td>
<td></td>
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</tr>
</tbody>
</table>
5. Logistic Plan for the Planned Survey

1. Transport for the survey

The staffs of the Department of agriculture will use the Department’s vehicle while the consultants need to rent a four–wheeled drive for the survey.

2. Laboratory for food analysis.

A laboratory with appropriate equipments and experienced staffs is needed (already available) for the nutritional analysis of the fruits.

3. Field facility / genebank

The materials collected will be conserved at two locations i.e. Birau and Pedayan research stations.
Table 3. Descriptor list for indigenous fruit species

PASSPORT DATA

1. Accession data
   1.1 Accession No
   1.2 Donor Name
   1.3 Donor Address
   1.4 Donor Tel. No.
   1.5 Scientific Name
      1.5.1 Family
      1.5.2 Genus
      1.5.3 Species
      1.5.4 Cultivar
   1.6 Vernacular/Common Name
   1.7 Acquisition date
   1.8 Type of material received
      1 Pollen
      2 Seed
      3 Shoot/budwood/stem cutting
      4 \textit{In vitro} culture
      5 Plant
      99 Other (specify in descriptor 1.9 Notes)
   1.9 Notes

Any additional information may be specified here
2. Collecting descriptors

2.1 Collecting institute(s)
2.2 Collecting number

2.3 Collecting date of original sample [YYYYMMDD]
2.4 Country of collecting
2.5 Province/ state
2.6 Department /county
2.7 Location of collecting site
2.8 Latitude of collecting site
2.9 Longitude of collecting site
2.10 Elevation of collection site [m asl]

2.11 Collecting source

0 Unknown

1 Wild
1.1 Primary forest
1.2 Secondary forest

2 Farm
2.1 Field
2.2 Orchard
2.3 Household Garden
2.4 Store

3 Market
3.1 Town
3.2 Village
3.3 Urban area (around city)
3.4 Other exchange system

4. Institute/Research organization

99. Other (specify )

2.12 Collecting source environment
### 2.13 Status of sample

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
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<td>Unknown</td>
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<tr>
<td>1</td>
<td>Wild</td>
</tr>
<tr>
<td>2</td>
<td>Weedy</td>
</tr>
<tr>
<td>3</td>
<td>Breeder's line</td>
</tr>
<tr>
<td>4</td>
<td>Primitive cultivar</td>
</tr>
<tr>
<td>5</td>
<td>Advanced cultivar/ landrace</td>
</tr>
<tr>
<td>99</td>
<td>Other (specify)</td>
</tr>
</tbody>
</table>

### 2.14 Type of sample

<table>
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<th>Description</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Seed</td>
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<tr>
<td>2</td>
<td>Seedling</td>
</tr>
<tr>
<td>3</td>
<td>Budwood</td>
</tr>
<tr>
<td>4</td>
<td>Graft</td>
</tr>
<tr>
<td>5</td>
<td>Vitroplant</td>
</tr>
<tr>
<td>6</td>
<td>Fruit</td>
</tr>
<tr>
<td>7</td>
<td>Other (specify)</td>
</tr>
</tbody>
</table>

### 2.15 Number of plants sampled

### 2.16 Ethnobotanical data

#### 2.16.1 Ethnic group

#### 2.16.2 Local vernacular name

#### 2.16.3 Parts of the plant used

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Fresh fruit consumption</td>
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<tr>
<td>2</td>
<td>Juice</td>
</tr>
<tr>
<td>3</td>
<td>Cooking</td>
</tr>
<tr>
<td>4</td>
<td>Rootstock</td>
</tr>
<tr>
<td>5</td>
<td>Medicinal</td>
</tr>
<tr>
<td>99</td>
<td>Other (specify)</td>
</tr>
</tbody>
</table>
2.16.4 **Cropping system**
1 Monoculture  
2 Intercropped

2.16.5 **Associated flora**

2.16.6 **Seasonality**
1 Annual  
2 Biannual

2.16.7 **Type of market**
1 Local  
2 National  
3 International

2.17 **Collecting site population structure**

2.17.1 **Number of trees sampled**

2.17.2 **Frequency of plants at collecting site**
3 Low  
5 Intermediate  
7 High

2.18 **Plant population density**
Number of trees per unit area (specify orchard or homestead)

2.19 **Herbarium specimen**
Was a herbarium specimen collected? If so, provide an identification number and indicate in which place (Herbarium) the specimen was deposited, in descriptor
2.20 **Photograph**
Was photograph(s) taken of the accession or habitat at the time of collecting? If so, provide an identification number(s) in descriptor 2.21 **Collectors’ notes**

0  No

1  Yes

2.21 **Collector’s notes**
Additional information recorded by the collector or any specific information on any state in any of the above descriptors
ENVIRONMENT AND SITE

3. Characterization and/or evaluation site descriptors

3.1 Fertilizer application
   1. Yes
   2. No

3.2 Soil drainage
   1. Poor
   2. Moderate
   3. Good

3.3 Topography
   1. Flat
   2. Gently undulating
   3. Hilly
   4. Mountainous
   5. Other (specify)

3.4 Soil type
   1. Clay
   2. Loam
   3. Clay loam
   4. Sandy clay
   5. Sandy clay loam
   6. Sand

CHARACTERIZATION

4 Plant descriptors

4.1 Growth descriptors
   4.1.1 Tree age [y]
   4.1.2 Tree vigour
      3 Low
      5 Medium
4.1.3 **Tree height [m]**

Form ground level to the top of the tree (if grafted, record also height of the graft union and rootstock name). Evaluate only unpruned trees.

4.1.4 **Trunk height [m]**

Record from the base of the tree to the point of emergence of first branch

4.1.5 **Trunk circumference [cm]**

Record at 50 cm above ground level for trees raised through seedlings and above the grafted union for trees raised through grafting

4.1.6 **Bark texture**

1. Smooth
2. Rough
3. Very rough
4. Rough and flaky

4.1.7 **Crown diameter [m]**

Measured the mean diameter using two directions (North-South and East-West)

4.1.8 **Crown shape**

1. Dome
2. Dome to round
3. Conical
4. Oblong irregular
5. Uneven
99. Other (specify)

4.1.9 **Branching pattern**

1. Erect
2. Semierect
3. Horizontal
4. Droopy
4.1.10 Bark Colour

1 Grey
2 Brown
3 Dark brown
4 Other (Specify)

4.1.11 Dwarfness

1 No
2 Yes

4.2 Leaf descriptors

Use the middle leaf or the first pair of leaflets from the terminal leaflet

4.2.1 Leaf length [cm]

4.2.2 Leaf width [cm]

4.2.3 Leaf shape

1 Ovate
2 Elliptic
3 Oblong
4 Obovate
5 Mixed (Specify)
99 Other (Specify)

4.2.4 Texture of leaf

1 Papery
2 Leathery
3 Very leathery

4.2.5 Leaf colour

1 Green
2 Dark green
3 Other (Specify)

4.2.6 Waxiness on adaxial leaflet surface

1 Matt
2 Shiny

4.2.7 Petiole length [cm]

4.3 Inflorescence descriptors

4.3.1 Position of inflorescence

1 Terminal
2 Axillary
3 On branches
4 On trunk
5 Base of trunk
99 Others (Specify)

4.3.2 No. of inflorescence per point

1 Few
2 Intermediate
3 Many

4.3.3 No. of flowers in an inflorescence

1 Single
2 Few
3 Many

4.4 Flower descriptors

4.4.1 Bud length(cm)

4.4.2 Bud width(cm)

4.4.3 Bud shape

1 Globose
2 Ovoid
3 Oblong
4 Ellipsoid

4.4.4 Bud colour

1 Olive
2 Greyish green
3 Yellowish green
4 Olive, yellow distally
5 Greyish yellow
6 Other (Specify)
4.4.5 Flower diameter

4.4.6 Petal length [mm]

4.4.7 Petal width [mm]

4.4.8 Fragrance

1 Mild
2 Strong

4.4.9 Petal colour

1 Cream
2 Light yellow
3 Pale yellow
4 Pink
5 Red
6 Other (Specify)

4.5 Fruit descriptors

4.5.1 Fruit shape

Specify number of fruits evaluated

1 Globose
2 Ovoid
3 Ovoid-Oblong
4 Oblong
5 Obovoid
6 Mixed (Specify)

4.5.2 Fruit weight [kg]

Average of 10 fruits

4.5.3 Fruit length [cm]

Average of 10 fruits

4.5.4 Fruit width [cm]
Average of ten fruits

4.5.5 Pericarp colour

1. Yellow
2. Green
3. Dark green
4. Yellowish green
5. Brownish green
6. Greenish brown
7. Orange
8. Pink
9. Dark red
10. Other (Specify)

4.5.6 Thickness of pericarp centre (cm)

4.5.7 Length of fruit stalk (cm)

4.5.8 Hair/Spine length (cm)

If present

4.5.9 Thickness of flesh (cm)

4.5.10 Colour of flesh

1. White
2. Cream
3. Pale yellow
4. Light yellow
5. Yellow
6. Yellowish orange
7. Orange
8. Pink
9. Red

4.5.11 Texture of flesh

1. Soft
2. Intermediate
3. Firm
### 4.5.12 Taste of flesh

1. Bland
2. Bitter
3. Sour
4. Sub-acid
5. Bitter-sweet
6. Nutty
7. Sweet
8. Astringent
9. Other (specify)

### 4.5.13 Amount of fibre

1. None
2. Fair
3. Moderate

### 4.5.14 Aroma strength

1. Fair
2. Moderate
3. Strong

### 4.5.15 Flavour

1. Fair
2. Moderate
3. Strong

### 4.5.16 Flesh recovery rate (%)

### 4.5.17 Flesh thickness (cm)

### 4.5.18 Fruit juiciness

1. Dry
2. Juicy
3. Very juicy

### 4.5.19 Flesh nutritive value

Recorded on fully ripe fruits
4.5.19.1 Total sugars [%]
4.5.19.2 Total soluble solids [% Brix]
4.5.19.3 Vitamin C [I.U.]
4.5.19.4 Vitamin A [I.U.]

4.6 Seed descriptors

4.6.1 Seed length [cm]
Average of ten seeds

4.6.2 Seed width [cm]
Average of ten seeds at the widest point

4.6.3 Seed weight [g]

4.6.4 Seed thickness (cm)

4.6.5 Seed colour

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Greyed orange to brown</td>
</tr>
<tr>
<td>2</td>
<td>Greyed orange</td>
</tr>
<tr>
<td>3</td>
<td>Brown</td>
</tr>
<tr>
<td>99</td>
<td>Other (Specify)</td>
</tr>
</tbody>
</table>

4.6.6 Seed shape

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Oblong</td>
</tr>
<tr>
<td>2</td>
<td>Round</td>
</tr>
<tr>
<td>3</td>
<td>Ovoid</td>
</tr>
<tr>
<td>4</td>
<td>Ellipsoid</td>
</tr>
<tr>
<td>99</td>
<td>Other (Specify)</td>
</tr>
</tbody>
</table>
5. PRELIMINARY EVALUATION

1. Plant descriptors

5.1 Fruit

5.1.1 Number of years to first fruiting after sowing/planting [y]

5.1.2 Number of days from flowering to fruit maturity [d]

5.1.3 Fruiting season

   1  Early
   2  Mid-season
   3  Late

5.1.4 Fruiting season

   1  Annual
   2  Biannual
   3  Biennial
   4  Non seasonal

5.1.5 Start of fruiting season [YYYYMMDD]

5.1.6 End of fruiting season [YYYYMMDD]

5.1.7 Yield per tree [kg per year]

5.1.8 Number of fruits per tree

   Average of ten trees per accession

5.1.9 Fruit productivity [kg/m2]

   Average of ten trees per accession. Yield relative to tree canopy size
calculated from length and width

5.1.10 Fruit availability [d]

   Number of days from the first to the last harvest date
5.1.11 Maturity period

1 Early
2 Intermediate
3 Late

5.1.12 Fruit bearing

3 Poor
5 Medium
7 Heavy

5.1.13 Fruit quality at storage [d]

Number of days of storage under ambient conditions

5.1.14 Eating quality

1 Poor
2 Intermediate
3 Good
4 Excellent

5.1.15 Notes

Specify here any other additional information

6. Abiotic stress susceptibility

Scored under artificial and/or natural conditions, which should be clearly specified. These are coded on susceptibility scale from 1 to 9, viz.:

1 Very low or no visible sign of susceptibility
3 Low
5 Intermediate
7 High
9 Very high
6.1 Reaction to mineral deficiency
1 Nitrogen
2 Phosphorus
3 Potassium
4 Boron
5 Copper
6 Molybdenum
99 Other (specify)

6.2 Reaction to drought

6.3 Notes
Specify here any additional information

7. Biotic stress susceptibility
1 Very low or no visible sign of susceptibility
3 Low
5 Intermediate
7 High
9 Very high

7.1 Pests
7.1.1 Leaf eating caterpillars
7.1.2 Fruit borer
7.1.3 Squirrels
7.1.4 Bats

7.2 Diseases
7.2.1 Powdery mildew
7.2.2 Sooty mould
7.2.3 Fruit blight
7.2.4 Leaf rim blight

7.3 Notes
Specify here any additional information
Annex 2. On-the-job Training on Identification, Herbarium and Propagation of Fruit Species
Training on Identification, herbarium, Diversity Assessment, Characterization and Propagation of Fruit Species

Training

Monday, 26th September 2011

8.00 a.m - Arrival of participants
8.30 a.m - Lecture on ‘Diagnostic and Identification of Fruit Species’ by Ms Rukayah Aman
9.30 a.m - Lecture on ‘Characterisation of evaluation of fruit species’ by Dr Salma Idris
10.30 a.m - Tea break
11.00 a.m - Lecture on ‘Plant Propagation techniques and Gemplasm management’ by Ms Rukayah Aman
11.30 a.m - Lecture on ‘Herbarium management technique’ by Dr. Salma Idris
12.00 p.m - Lunch break
2.00 p.m - Practical
What is a herbarium?

The word herbarium originally referred to a book of medicinal plants. However Tournefort (1700) used the term for a collection of dried plants.

Purpose of a herbarium

1) a collection of reference materials for research, education, and environment awareness
2) a centre for identification process through comparison with the available specimen
3) an arbiter of correct names maintaining of normenclatural standards
4) a comprehensive data bank representing the diversity and distribution of the region’s vegetation.

Types of herbarium

Four main types of herbaria are known based on their size and function:

1) General (International) herbarium
   Large herbaria with 4 million or more specimens and a global representation of as near a comprehensive range of taxa
   e.g. KEW, England (K) (7 million)
   Rijksherbarnium, Netherlands (L)

   Function:
   Broadscale study of families
   Production of generic monographs
   Major floras, national and local floras, checklist, distributing duplicates

2) National or (Regional) herbarium
   Consists of collection of the country concerned and neighbouring or phytogeographically similar areas
   e.g. Herbarium Bogoriense, Indonesia (BO)
Function:
Contribution to major floras
Production of national and local floras, check lists
Provide loans, facilities to visiting botanists, identify specimens

3) Local herbarium
Consists of flora within the country or region
e.g. Sarawak herbarium (SAR)
   Sabah herbarium (SAN)

Function:
Contribution to national floras
Production of local floras and check list
Identify specimen, collect material and distribute duplicates

3) Special herbarium
Normally small and have limited scope or a specific purpose

Examples
- Historical herbarium
e.g. British Museum, England (BM)
- Forestry
e.g. Kepong herbarium (FRIM)
- Teaching/Education
e.g. Universiti Malaya herbarium, Kuala Lumpur (KLU)
   Universiti Kebangsaan Malaysia herbarium (UKMB)
- Job-related herbarium
e.g. collection of weed species or honey-bee plants
- Herbarium for special research programme
  Voucher specimens for ecological study etc.

HERBARIUM TECHNIQUE

1. COLLECTION OF SPECIMEN

Equipments required for collecting specimen
  - Tools such as parang, pocket knife, secateurs, long handled pruner etc.
  - Paper tags, pencils, notebook, tape measure, Global positioning system (GPS)
- Plastic bags of various sizes
- Lightweight boards, press, straps, newspapers
- Spirit
- Binocular, camera

The specimen collected should be a representative of the population or show a wide range of variation and must be accompanied by an unambiguous collection number. It must have good collecting data recorded (Collector number, date, locality, habitat, plant details such as colour, shape, which is likely to be lost on drying). The specimen should be well preserved. Normally, in practice there is insufficient time to press the specimens in the field. Specimens are placed in the bag and pressed later.

**What and how to collect?**

The procedure below is applicable for trees and shrubs

Decide the plant parts to be collected and how the morphology of the whole plant can be best represented and recorded in the herbarium. A good collection should comprise adequate samples of all the organs and at all stages of development. Guidelines for specimen collection are as follows:

1. Cut a branch with petioles attached, axillary buds and stipules retained
2. Cut woody subject so as to demonstrate as much of the branching pattern as possible (Figs. 1 & 2). Twiglets detached from supporting stem or branches cannot supply the information. Retain the stem apex if possible. Avoid collect leaf pieces.
3. Collect branches bearing flowers and fruits
4. Each collection number should be given only to one taxon. If there is doubt separate collection and collecting number should be made
5. Specimens collected should be able to fill a herbarium sheet. Do not try to collect only small leaves.
6. If the plant is large, collect specimen complete enough to be useful. If the leaf or stem is large, subdivide and label all parts sequentially. Usually the base, middle and apex is adequate, accompanied by measurement and sketches and photographs. All parts of the plant should have the same collecting number. If the plant is small collect sufficient individuals
7. Additional loose flowers, fruits and seeds should be included and must be given the same number as the parent material.
8. MARDI collects 3 duplicates while big herbarium such as FRIM collects 8 duplicates.
9. Specimens with delicate flowers, some should be kept in spirit. For specimens having complex or obscure structures also try to keep some in spirit. For cauliflorous or ramiflorous (flowers and fruits borne on trunk or main branches) detach together with the supporting bark area.
Field Notes

Field notes should consist of the following:

1. Collector’s name, number, date of collection and additional collectors
2. Locality, habitat, latitute, longitude, elevation
3. Tree height, canopy diameter
4. Colour and bark surface
5. Vegetative characters that will disappear after drying (colour, midrib, indumentum)
6. Floral and fruit characters (shape, colour, position)

Put in field identification even if it is only to family or group. e.g. fruit trees

Collecting for voucher specimen

Voucher specimens are necessary for research inventorisation such as in ecological plot or fruit species in home gardens. Sometimes sterile specimen may be collected. Voucher specimens are important

1. For identification of plants
2. To confirm names identified in the field
3. Providing specimens for examination by other researchers
4. Updating of names
5. Maintaining a permanent record

2. PRESSING, DRYING AND LABELING OF SPECIMENS

Plants should be pressed immediately upon return. Taking only a representative portion of the twig, place in between newspapers, making sure that the upper and lower surface of the leaves are seen (Fig. 3). Place the newspaper in between the cardboard and press and tie tightly using a strap. Place the press in an oven at 45°C for 3-4 days. Bulky materials may take longer time for drying. When the specimen is thoroughly dried remove the press. A label containing complete field notes must be appended to the specimen

If the specimens have thick or lumpy parts, folds of newspaper may be added for padding to the more delicate structures to help distribute the pressure. Thick stem and roots can be cut lengthwise and projecting branches trim off.

Some important steps to be remembered during pressing.

- Leaves should be spread to avoid overlapping. Both aspects of flowers should be displayed
- Stems should be bent to fit the sheets
• Any extra flowers collected can be spread out and spread in folds of toilet tissue, if tubular the corolla should be cut lengthwise and opened out
• If there are extra fruits, some should be cut longitudinally and transversely, if large they should be sliced and the individual sections spread out

After pressing and complete drying, plant specimens should be frozen to kill insects in the specimens; freeze at –18°C or below for 2-5 days. At KEW freezing is practiced at -26 to -27°C and this is a preferred temperature.

Top opening domestic chest freezer should be used because when opened there is less cold loss than with front opening cabinet units.

3. MOUNTING HERBARIUM SPECIMENS

While unmounted specimens are best for the purposes of examination, dried material tends to be very brittle and susceptible to damage. However properly prepared and well cared for mounted herbarium specimens will last indefinitely. It is therefore essential to select mounting paper, adhesives etc. of archival quality. Two main aims of mounting process are:

1. To display the specimen and data to allow maximum observation
2. To preserve the specimen by securely attaching it to strong mounting paper, but at the same time allowing for the removal of small portion for more detailed study

Laying out specimen and labelling
Place the specimen in the best way to display all its characters.

It is often to consider the position of the label first, but to attach it last. The best position for the main label is generally at the bottom right. Additional label is placed above the main label or close to it. Ideally a space should be left above the label to allow for the future determination slips. The label should be stuck down completely. If this cannot be done because the specimen is too large, attach the label on by one edge only. Make sure that the label is not lying on part of the specimen. If still it is not possible to mount the label on the right hand corner, it can be mounted elsewhere on the sheet.

Paper capsules
Choose the correct size of paper capsule to contain the loose portion and place on the right hand side of the sheet corresponding to the open edge of the genus cover. The tag bearing the collection number of the specimen usually attached to the specimen by thread must be preserved with the specimen by gluing to the sheet.

Specimens
While arranging the specimens, take note the followings:

• Choose the best side to display as many features as possible
• Expose hidden flowers or fruits
• Display both sides of leaves
• Display both aspects of flowers where possible
• Trim over large specimens if possible
• Overlong specimens can be folded to fit the sheet

Mounting
There are two main ways of mounting the specimen either by strapping or using glue. The straps can be either thread or tape.
When using a glue, apply it on to the reverse side of the specimen using a brush so that the specimen is firmly attached to the sheet.

Specimen sheets are stacked in groups by the species to which they belong and placed into a large lightweight folder that is labelled on the bottom edge. Groups of species folders are then placed together into larger, heavier folders by genus. The genus folders are then sorted by taxonomic family according to the standard system selected for use by the herbarium and placed into pigeonholes in herbarium cabinets.

4. ARRANGEMENT OF HERBARIUM COLLECTIONS

The herbarium is a storehouse of valuable information and thus it should be arranged in a way that the information can be easily retrieved. Essentially there are two ways of organizing a herbarium – the alphabetical and the systematic.

Alphabetical Arrangement
The families are arranged alphabetically, as are the genera within each family and the species within each genus. The first group are ferns and fern-allies, gymnosperm, and flowering plants – monocotyledons and dicotyledons, and arrange subgroups alphabetically.

This method has advantages where it is easy for non specialist to find taxa and mounted material can be added to the herbarium by unskilled person. However the method has also several disadvantages, (1) related taxa are placed far apart so that identification by matching is difficult, (2) Unskilled personnel can create errors

Systematic Arrangement
Here the families are arranged according to one of several phylogenetic systems which placed supposedly closely related families together.

Examples of the systems generally used are Dalla Torre & Harm, Genera Siphonogamarum (1900-1907), Bentham and Hooker, Genera Plantarum (1862-1883)and others.
5. SPIRIT COLLECTION

Some plant materials are ideally preserved in spirit because they do not make good specimens when pressed (e.g. orchid and succulents). Flowers and soft fruits from non succulent plants are also preferred to preserve in spirit.

Preservatives:

KEW mixture

53% industrial methylated spirit (ethanol + 9% water + 2-4% methanol)
37% water
5% formalin (dilute formaldehyde)
or 70% ethanol + 29% water + 1% glycerol
or FAA (formaldehyde, industrial methylated spirit and acetic acid)
The bottle should be labeled with spirit proof permanent ink and must be cross-referenced preferably including the jar number, with the corresponding herbarium sheet. If the specimen is ‘spirit only’ place a dummy sheet bearing the data and cross reference in the herbarium. The bottles should be placed in a well ventilated room. The collection should be checked for evaporation annually and spirit added where necessary.

6. CARPOLOGICAL COLLECTION

Dried specimens which are too large to mount on herbarium sheets can be placed in boxes and labeled. These boxes are stored on trays and shelves. These specimens must be crossed reference with the herbarium sheet.

7. CATALOGUING OF SPECIMENS

Specimen records and photos can be kept in a computer. Herbaria at Kepong, Sandakan and Kuching use BRAHMS to keep herbarium records.

8. HANDLING HERBARIUM SPECIMENS

Herbarium specimens should be handled with special care so that they are not damaged and can be preserved for generations. They are valuable archive and are irreplaceable.

Some good practice to be followed:

- Hold the specimen by both sides rather than the base
- Keep the sheet flat and fully supported
- Never align the specimens in a cover and holding upright
- Never bend a specimen while examining under a microscope
• Never put books, heavy objects or elbows on specimens
• Do not force many specimens in a shelf
• Always make sure that cupboard doors are firmly shut to avoid dust and insects.
• Never keep specimens out of cabinet for too long
Fig. 1. — Cut to keep petiole attached to stem. A. simple leaf; B. pinnate leaf; C. palmate leaf.

Fig. 2. — Cut so keep as much of the branching pattern as possible. A. opposite; B. alternate; C. sympodial. The incorrect example could have come from any of these.
Fig. 3. Specimen showing upper and lower leaf surface
Characterization and preliminary evaluation of germplasm are the prerequisite for utilization in crop improvement. Characterization involves recording characters, which are highly heritable, easily seen by eye, and are expressed in all environments. The role of characterization and evaluation is basically to systematically describe an accession with its various attributes - morphological, physiological, agronomical, biochemical, cytological and reaction to various stresses (biotic/abiotic). Characterization and evaluation will provide diagnostic descriptors for the accession as well as identifying accessions with desirable traits for crop improvement. Hence, high priority should be accorded to characterization and evaluation of both existing and new germplasm collections.

Preliminary evaluation consists of recording a limited number of additional agronomic traits thought to be desirable by users of the particular crop. Evaluation of the materials is normally carried out by multidisciplinary team consisting of breeders, entomologists, pathologists, agronomist and others. The data gathered then should be logged into a documentation system that can help to access information when needed, to analyse the data to determine the pattern of variations, to verify the identity of the accession as well as to determine duplicates in the collection.

Descriptor List
The process of germplasm characterization and evaluation begins with the use of an appropriate descriptor list. The descriptor list can be compiled by the national organization and the collection manager or an existing list may be adopted or used. Descriptor lists produced by Bioversity International are comprehensive and widely used. The descriptors allow the standardization of descriptor definition and thus maintain uniformity in data processing and management. The descriptor lists developed by IPGRI serve as useful guides in standardizing the way in which the information is collected and recorded. Actual users of descriptor lists may select and make necessary changes to the published lists for their use. Bioversity International had published descriptors on many tropical fruits e.g. mango, durian, rambutan,
mangosteen and for temperate fruits e.g. litchi, Citrus, apple, strawberry and many others. A general fruit descriptor is as in appendix 1

**Passport data**
Passport data consists of information about a germplasm sample and the collecting site, recorded at the time of collecting. The information is useful for identification, helps in designating core collection, identifying duplicates as well as planning further collection. Important passport descriptor include site of collection (village, state, country), longitude, latitude, collector’s number, date of collection, botanical name, vernacular name, sample type, status, source, environmental characteristics and also ethnobotanical information.

**Characterisation**
One of the main objective of genetic resource conservation is for utilization in crop improvement. As such characterization and evaluation of all the accessions are the main activities of the germplasm collections. In any improved evaluation programme, both morpho-agronomic and molecular characterization should be considered for improved results and ease of use after. Besides the traditional morphological markers, the modern tools can help not only in better management of genetic resource collections, but also in better using the information. By generating more information on accessions and developing core collections using such information will greatly enhance the utilization of conserved germplasm. Characterization and evaluation will provide diagnostic descriptors for the accession as well as identifying accessions with desirable traits for crop improvement. Evaluation of the materials is carried out by multidisciplinary team consisting of breeders, entomologists, pathologists, agronomist and others.

**Evaluation**
Preliminary evaluation consists of recording a limited number of additional traits, which would help in identifying useful germplasm material. Evaluation data consists of characters that are influenced by environment and mostly quantitatively inherited e.g. yield, nutrition, pest and disease.
Appendix 1

Descriptor list for indigenous fruit species

PASSPORT DATA

1. Accession data
   1.1 Accession No
   1.2 Donor Name
   1.3 Donor Address
   1.4 Donor Tel. No.
   1.5 Scientific Name
      1.5.1 Family
      1.5.2 Genus
      1.5.3 Species
      1.5.4 Cultivar
   1.6 Vernacular/Common Name
   1.7 Acquisition date
   1.8 Type of material received
      1  Pollen
      2  Seed
      3  Shoot/budwood/stem cutting
      4  *In vitro* culture
      5  Plant
      99 Other (specify in descriptor 1.9 Notes)

1.9 Notes

Any additional information may be specified here

2. Collecting descriptors

   2.1 Collecting institute(s)
   2.2 Collecting number
   2.3 Collecting date of original sample [YYYYMMDD]
   2.4 Country of collecting
2.5 Province/state

2.6 Department/county

2.7 Location of collecting site

2.8 Latitude of collecting site

2.9 Longitude of collecting site

2.10 Elevation of collection site [m asl]

2.11 Collecting source

0 Unknown

1 Wild
   1.1 Primary forest
   1.2 Secondary forest

2 Farm
   2.1 Field
   2.2 Orchard
   2.3 Household Garden
   2.4 Store

3 Market
   3.1 Town
   3.2 Village
   3.3 Urban area (around city)
   3.4 Other exchange system

4. Institute/Research organization

99. Other (specify)

2.12 Collecting source environment

2.13 Status of sample

0 Unknown

1 Wild

2 Weedy

3 Breeder’s line

4 Primitive cultivar

5 Advanced cultivar/landrace

99 Other (specify)

2.14 Type of sample

1 Seed

2 Seedling

3 Budwood

4 Graft
5 Vitroplant
6 Fruit
7 Other (specify)

2.15 Number of plants sampled

2.16 Ethnobotanical data

2.16.1 Ethnic group

2.16.2 Local vernacular name

2.16.3 Parts of the plant used

   1 Fresh fruit consumption
   2 Juice
   3 Cooking
   4 Rootstock
   5 Medicinal
   99 Other (specify)

2.16.4 Cropping system

   1 Monoculture
   2 Intercropped

2.16.5 Associated flora

2.16.6 Seasonality

   1 Annual
   2 Biannual

2.16.7 Type of market

   1 Local
   2 National
   3 International

2.17 Collecting site population structure

2.17.1 Number of trees sampled

2.17.2 Frequency of plants at collecting site

   3 Low
2.18 Plant population density

Number of trees per unit area (specify orchard or homestead)

2.19 Herbarium specimen

Was a herbarium specimen collected? If so, provide an identification number and indicate in which place (Herbarium) the specimen was deposited, in descriptor

2.20 Photograph

Was photograph(s) taken of the accession or habitat at the time of collecting? If so, provide an identification number(s) in descriptor 2.21 Collectors' notes

0 No
1 Yes

2.21 Collector's notes

Additional information recorded by the collector or any specific information on any state in any of the above descriptors

ENVIRONMENT AND SITE

3. Characterization and/or evaluation site descriptors

3.1 Fertilizer application

1. Yes
2. No

3.2 Soil drainage
1. Poor
2. Moderate
3. Good

3.3 Topography
1. Flat
2. Gently undulating
3. Hilly
4. Mountainous
5. Other (specify)

3.4 Soil type
1. Clay
2. Loam
3. Clay loam
4. Sandy clay
5. Sandy clay loam
6. Sand

CHARACTERIZATION

4 Plant descriptors

4.1 Growth descriptors

4.1.1 Tree age [y]

4.1.2 Tree vigour

\[\begin{array}{cc}
3 & \text{Low} \\
5 & \text{Medium} \\
7 & \text{High}
\end{array}\]

4.1.3 Tree height [m]

Form ground level to the top of the tree (if grafted, record also height of the graft union and rootstock name). Evaluate only unpruned trees.

4.1.4 Trunk height [m]

Record from the base of the tree to the point of emergence of first branch

4.1.5 Trunk circumference [cm]

Record at 50 cm above ground level for trees raised through seedlings and above the grafted union for trees raised through grafting
4.1.6 Bark texture
1 Smooth
2 Rough
3 Very rough
4 Rough and flaky

4.1.7 Crown diameter [m]
Measured the mean diameter using two directions (North-South and East-West)

4.1.8 Crown shape
1 Dome
2 Dome to round
3 Conical
4 Oblong irregular
5 Uneven
99 Other (specify)

4.1.9 Branching pattern
1 Erect
2 Semierect
3 Horizontal
4 Droopy

4.1.10 Bark Colour
1 Grey
2 Brown
3 Dark brown
4 Other (Specify)

4.1.11 Dwarfness
1 No
2 Yes

4.2 Leaf descriptors
Use the middle leaf or the first pair of leaflets from the terminal leaflet

4.2.1 Leaf length [cm]

4.2.2 Leaf width [cm]
4.2.3 **Leaf shape**

1. Ovate
2. Elliptic
3. Oblong
4. Obovate
5. Mixed (Specify)
99. Other (Specify)

4.2.4 **Texture of leaf**

1. Papery
2. Leathery
3. Very leathery

4.2.5 **Leaf colour**

1. Green
2. Dark green
3. Other (Specify)

4.2.6 **Waxiness on adaxial leaflet surface**

1. Matt
2. Shiny

4.2.7 **Petiole length** [cm]

4.3 **Inflorescence descriptors**

4.3.1 **Position of inflorescence**

1. Terminal
2. Axillary
3. On branches
4. On trunk
5. Base of trunk
99. Others (Specify)

4.3.2 **No. of inflorescence per point**

1. Few
2. Intermediate
3. Many

4.3.3 **No. of flowers in an inflorescence**

1. Single
2. Few
3. Many

4.4 **Flower descriptors**
4.4.1 Bud length (cm)

4.4.2 Bud width (cm)

4.4.3 Bud shape

1  Globose
2  Ovoid
3  Oblong
4  Ellipsoid

4.4.4 Bud colour

1  Olive
2  Greyish green
3  Yellowish green
4  Olive, yellow distally
5  Greyish yellow
6  Other (Specify)

4.4.5 Flower diameter

4.4.6 Petal length [mm]

4.4.7 Petal width [mm]

4.4.8 Fragrance

1  Mild
2  Strong

4.4.9 Petal colour

1  Cream
2  Light yellow
3  Pale yellow
4  Pink
5  Red
6  Other (Specify)

4.5 Fruit descriptors

4.5.1 Fruit shape

1  Globose
2  Ovoid
3  Ovoid-Oblong
4  Oblong
5  Obovoid
6  Mixed (Specify)
4.5.2 Fruit weight [kg]
Average of 10 fruits

4.5.3 Fruit length [cm]
Average of 10 fruits

4.5.4 Fruit width [cm]
Average of ten fruits

4.5.5 Pericarp colour
1. Yellow
2. Green
3. Dark green
4. Yellowish green
5. Brownish green
6. Greenish brown
7. Orange
8. Pink
9. Dark red
10. Other (Specify)

4.5.6 Thickness of pericarp centre (cm)

4.5.7 Length of fruit stalk (cm)

4.5.8 Hair/ Spine length (cm)

4.5.9 Thickness of flesh (cm)

4.5.10 Colour of flesh
1. White
2. Cream
3. Pale yellow
4. Light yellow
5. Yellow
6. Yellowish orange
7 Orange
8 Pink
9 Red

4.5.11 Texture of flesh
1 Soft
2 Intermediate
3 Firm

4.5.12 Taste of flesh
1 Bland
2 Bitter
3 Sour
4 Sub-acid
5 Bitter-sweet
6 Nutty
7 Sweet
8 Astringent
9 Other (specify)

4.5.13 Amount of fibre
1 None
2 Fair
3 Moderate

4.5.14 Aroma strength
1 Fair
2 Moderate
3 Strong

4.5.15 Flavour
1 Fair
2 Moderate
3 Strong

4.5.16 Flesh recovery rate (%)

4.5.17 Flesh thickness (cm)

4.5.18 Fruit juiciness
1 Dry
2 Juicy
3  Very juicy

4.5.19  Flesh nutritive value

Recorded on fully ripe fruits

4.5.19.1  Total sugars  [%]

4.5.19.2  Total soluble solids  [% Brix]

4.5.19.3  Vitamin C [I.U.]

4.5.19.4  Vitamin A [I.U.]

4.6  Seed descriptors

4.6.1  Seed length [cm]

Average of ten seeds

4.6.2  Seed width [cm]

Average of ten seeds at the widest point

4.6.3  Seed weight [g]

4.6.4  Seed thickness (cm)

4.6.5  Seed colour

1  Greyed orange to brown
2  Greyed orange
3  Brown
99  Other (Specify)

4.6.6  Seed shape

1  Oblong
2  Round
3  Ovoid
4  Ellipsoidal
99  Other (Specify)

5.  PRELIMINARY EVALUATION

1.  Plant descriptors
5.1 Fruit

5.1.1 Number of years to first fruiting after sowing/planting [y]

5.1.2 Number of days from flowering to fruit maturity [d]

5.1.3 Fruiting season

1. Early
2. Mid-season
3. Late

5.1.4 Fruiting season

1. Annual
2. Biannual
3. Biennial
4. Non seasonal

5.1.5 Start of fruiting season [YYYYMMDD]

5.1.6 End of fruiting season [YYYYMMDD]

5.1.7 Yield per tree [kg per year]

5.1.8 Number of fruits per tree

Average of ten trees per accession

5.1.9 Fruit productivity [kg/m2]

Average of ten trees per accession. Yield relative to tree canopy size calculated from length and width

5.1.10 Fruit availability [d]

Number of days from the first to the last harvest date

5.1.11 Maturity period

1. Early
2. Intermediate
3. Late

5.1.12 Fruit bearing

3. Poor
5. Medium
5.1.13 Fruit quality at storage [d]

Number of days of storage under ambient conditions

5.1.14 Eating quality

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Poor</td>
</tr>
<tr>
<td>2</td>
<td>Intermediate</td>
</tr>
<tr>
<td>3</td>
<td>Good</td>
</tr>
<tr>
<td>4</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

5.1.15 Notes

Specify here any other additional information

6. Abiotic stress susceptibility

Scored under artificial and/or natural conditions, which should be clearly specified. These are coded on susceptibility scale from 1 to 9, viz.:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Very low or no visible sign of susceptibility</td>
</tr>
<tr>
<td>3</td>
<td>Low</td>
</tr>
<tr>
<td>5</td>
<td>Intermediate</td>
</tr>
<tr>
<td>7</td>
<td>High</td>
</tr>
<tr>
<td>9</td>
<td>Very high</td>
</tr>
</tbody>
</table>

6.1 Reaction to mineral deficiency

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nitrogen</td>
</tr>
<tr>
<td>2</td>
<td>Phosphorus</td>
</tr>
<tr>
<td>3</td>
<td>Potassium</td>
</tr>
<tr>
<td>4</td>
<td>Boron</td>
</tr>
<tr>
<td>6</td>
<td>Copper</td>
</tr>
<tr>
<td>7</td>
<td>Molybdenum</td>
</tr>
<tr>
<td>99</td>
<td>Other (specify)</td>
</tr>
</tbody>
</table>

6.2 Reaction to drought

6.3 Notes

Specify here any additional information

7. Biotic stress susceptibility
1 Very low or no visible sign of susceptibility
3 Low
5 Intermediate
7 High
9 Very high

7.1 Pests

7.1.1 Leaf eating caterpillars
7.1.2 Fruit borer
7.1.3 Squirrels
7.1.4 Bats

7.2 Diseases

7.2.1 Powdery mildew
7.2.2 Sooty mould
7.2.3 Fruit blight
7.2.4 Leaf rim blight

7.3 Notes

Specify here any additional information
The fruits of Brunei Darussalam belong to widely different botanical families. Table 1 shows the diversity i.e the list of the families and the common names of the fruits. Table 2 shows the list of the families and the genus in each family.

The important genus and the characteristics of the families, genus and the species are highlighted using the lists of fruits in Sabah as guides. Table 1, 2, 3, 4 shows the list of the genus (Mangifera, Artocarpus, Durio, Nephelium) and the species. The detail of the characteristics of the families, genus and species are given in the handouts.

Table 1 : List of Indigenous Fruits of Brunei Darussalam by Family

*Amaranthaceae*

<table>
<thead>
<tr>
<th>Family</th>
<th>Common Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lembah / Lumbah</td>
<td>Moniniera latifolia</td>
<td></td>
</tr>
</tbody>
</table>

*Anacardiaceae*

<table>
<thead>
<tr>
<th>Subfamily</th>
<th>Common Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belunu</td>
<td>Mangifera caesia</td>
<td></td>
</tr>
<tr>
<td>Binjai</td>
<td>Mangifera caesia</td>
<td></td>
</tr>
<tr>
<td>Bacang</td>
<td>Mangifera foetida</td>
<td></td>
</tr>
<tr>
<td>Binglu</td>
<td>Mangifera odorata</td>
<td></td>
</tr>
<tr>
<td>Kuini</td>
<td>Mangifera odo</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lenggauh</td>
<td></td>
</tr>
<tr>
<td>Matan</td>
<td>Mangifera torquenda</td>
</tr>
<tr>
<td>Membangan</td>
<td>Mangifera pajang</td>
</tr>
<tr>
<td>Pauh</td>
<td>Mangifera petandra</td>
</tr>
<tr>
<td>Pelanjau</td>
<td>Pentaspadon motleyi</td>
</tr>
<tr>
<td>Rancah-rancah</td>
<td>Mangifera quadrifida</td>
</tr>
<tr>
<td>Sengkuang</td>
<td>Dracontomelon dao</td>
</tr>
</tbody>
</table>

*Apocynaceae*

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surapit</td>
<td>Willughbeia sp.</td>
</tr>
<tr>
<td>Pitabu</td>
<td></td>
</tr>
</tbody>
</table>

*Bombacaceae*

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Durian kuning</td>
<td>Durio graveolens</td>
</tr>
<tr>
<td>Durian otak udang galah</td>
<td>Durio graveolens</td>
</tr>
<tr>
<td>Malay Name</td>
<td>Scientific Name</td>
</tr>
<tr>
<td>----------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>Durian bunga simpur</td>
<td><em>Durio graveolens</em></td>
</tr>
<tr>
<td>Durian pulu</td>
<td><em>Durio kutejensis</em></td>
</tr>
<tr>
<td>Durian suluk</td>
<td><em>Durio sp</em></td>
</tr>
<tr>
<td>Durian kura-kura</td>
<td><em>Durio testudinarium</em></td>
</tr>
<tr>
<td>Durian sukang</td>
<td><em>Durio oxleyanus</em></td>
</tr>
<tr>
<td>Durian meragang</td>
<td><em>Durio dulcis</em></td>
</tr>
<tr>
<td>Durian burung</td>
<td><em>Durio sp</em></td>
</tr>
<tr>
<td>Durian siunggung</td>
<td><em>Durio sp</em></td>
</tr>
</tbody>
</table>

**Burseraceae**

<table>
<thead>
<tr>
<th>Malay Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kembayau</td>
<td><em>Canarium adontophyllum</em></td>
</tr>
<tr>
<td>Meritam</td>
<td><em>Canarium litorale</em></td>
</tr>
<tr>
<td>Meritus</td>
<td><em>Canarium litorale</em></td>
</tr>
<tr>
<td>Pinanasan</td>
<td><em>Dacroydes rostata</em></td>
</tr>
<tr>
<td>Sabal</td>
<td><em>Dacroydes expansa</em></td>
</tr>
</tbody>
</table>

**Euphorbiaceae**

<table>
<thead>
<tr>
<th>Malay Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limpaung</td>
<td><em>Baccaurea lanceolata</em></td>
</tr>
<tr>
<td>Rambai</td>
<td><em>Baccaurea motleyana</em></td>
</tr>
<tr>
<td>Tampoi</td>
<td><em>Baccaurea griffitli</em></td>
</tr>
<tr>
<td>Tampoi bunga</td>
<td><em>Baccaurea reticulata</em></td>
</tr>
<tr>
<td>Tampoi silau</td>
<td><em>Baccaurea sp</em></td>
</tr>
<tr>
<td>Tampoi belimbing</td>
<td><em>Baccaurea angulata</em></td>
</tr>
</tbody>
</table>

**Flacourtiaceae**

<table>
<thead>
<tr>
<th>Malay Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kepayang</td>
<td><em>Pangium edule</em></td>
</tr>
<tr>
<td>Rukam</td>
<td><em>Flacourtia rukam</em></td>
</tr>
</tbody>
</table>

**Gnetaceae**

<table>
<thead>
<tr>
<th>Malay Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bako</td>
<td><em>Gnetum gnemon</em></td>
</tr>
<tr>
<td>Asamaur-aur</td>
<td><em>Garcinia parvifolia</em></td>
</tr>
<tr>
<td>Manggis</td>
<td><em>Garcinia mangostana</em></td>
</tr>
<tr>
<td>Sangkuang</td>
<td><em>Garcinia sp</em></td>
</tr>
<tr>
<td>Kandis</td>
<td><em>Garcinia sp</em></td>
</tr>
</tbody>
</table>

**Lauraceace**

<table>
<thead>
<tr>
<th>Malay Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pengalaban</td>
<td><em>Litsea garciae</em></td>
</tr>
</tbody>
</table>

**Leguminosae**
<table>
<thead>
<tr>
<th>Plant Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petai</td>
<td>Parkia speciosa</td>
</tr>
<tr>
<td><em>Petai</em> bunga</td>
<td>Parkia sp</td>
</tr>
<tr>
<td>Jering</td>
<td>Pithecellobium jiringa</td>
</tr>
<tr>
<td>Keranji</td>
<td>Dialum indum</td>
</tr>
<tr>
<td><em>Melastomataeceae</em></td>
<td></td>
</tr>
<tr>
<td>Senduduk</td>
<td>Melastoma malabathricum</td>
</tr>
<tr>
<td><em>Meliaceae</em></td>
<td></td>
</tr>
<tr>
<td>Santul</td>
<td>Sandoricum koetjape</td>
</tr>
<tr>
<td>Langsat</td>
<td>Lansium domesticum</td>
</tr>
<tr>
<td>Langsat berok</td>
<td>Lansium domesticum</td>
</tr>
<tr>
<td>Langsat susu</td>
<td>Lansium domesticum</td>
</tr>
<tr>
<td>Duku</td>
<td>Lansium domesticum</td>
</tr>
<tr>
<td><em>Moraceae</em></td>
<td></td>
</tr>
<tr>
<td>Ara</td>
<td>Ficus spp</td>
</tr>
<tr>
<td>Cempedak</td>
<td>Artocarpus interger</td>
</tr>
<tr>
<td>Nangka belulang</td>
<td>Artocarpus heterophyllus</td>
</tr>
<tr>
<td>Tarap</td>
<td>Artocarpus odoratissimus</td>
</tr>
<tr>
<td>Pedalai</td>
<td>Artocarpus sericarpus</td>
</tr>
<tr>
<td>Bintawa</td>
<td>Artocarpus anisophyllus</td>
</tr>
<tr>
<td>Tempunik</td>
<td>Artocarpus rigidus</td>
</tr>
<tr>
<td><em>Myrtaceae</em></td>
<td></td>
</tr>
<tr>
<td>Jambu bol</td>
<td>Syzygium malaccensis</td>
</tr>
<tr>
<td>Kemunting</td>
<td>Rhodomyrtus tomentosa</td>
</tr>
<tr>
<td><em>Palmae</em></td>
<td></td>
</tr>
<tr>
<td>Asam paya</td>
<td>Eleodoxa conferta</td>
</tr>
<tr>
<td>Nipah</td>
<td>Nypa fruticans</td>
</tr>
<tr>
<td>Rekam</td>
<td>Salacca wallichiana</td>
</tr>
<tr>
<td>Remayong</td>
<td>Salacca magnifica</td>
</tr>
<tr>
<td>Rotan/Jelayan</td>
<td>Calamus sp</td>
</tr>
<tr>
<td>Salak</td>
<td>Salacca edulis</td>
</tr>
<tr>
<td><em>Rubiaceae</em></td>
<td></td>
</tr>
<tr>
<td>Sulang</td>
<td>Gardenia sp</td>
</tr>
</tbody>
</table>
**Rutaceae**

Limau pagar  
*Fortunela palyandra*

**Sapindaceae**

Arut  
*Nephelium xerospermodies*

Bantut  
*Nephelium macrophyllum*

Bayong  
*Nephelium ramboutan - ake*

Mata kucing  
*Dimocarpus longan sp malesianus*

Maritam  
*Nephelium uncinatum*

Kemanggis  
*Nephelium beccarianum*

Lakang  
*Nephelium sp.*

Lahang  
*Xerospermum sp.*

Ngalan  
*Xerospermum sp.*

Sigir  

Serait  
*Nephelium maingayi*

Sungkit  
*Xerospermum sp.*

**Sonneratiaceae**

Berembang  
*Sonneratia alba*

Pedada  
*Sonneratia caseolaris*
Table 2: List of important families and genera of fruit species in Brunei Darussalam

<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amaryllidaceae</td>
<td>Moniniera</td>
</tr>
<tr>
<td>Aracardiaceae</td>
<td>Mangifera, Dracontomelon</td>
</tr>
<tr>
<td>Apocynaceae</td>
<td></td>
</tr>
<tr>
<td>Bombacaceae</td>
<td>Durio</td>
</tr>
<tr>
<td>Burseraceae</td>
<td>Dacryodes, Canarium</td>
</tr>
<tr>
<td>Euphorbiaceae</td>
<td>Baccaurea</td>
</tr>
<tr>
<td>Fagaceae</td>
<td>Castanopsis</td>
</tr>
<tr>
<td>Flacourtiaeae</td>
<td>Pangium</td>
</tr>
<tr>
<td>Guttiferae</td>
<td>Garcinia</td>
</tr>
<tr>
<td>Lauraceae</td>
<td>Litsea</td>
</tr>
<tr>
<td>Lecythidaceae</td>
<td>Barringtonia</td>
</tr>
<tr>
<td>Leguminosae</td>
<td>Parkia, Dialum, Pithecellobium</td>
</tr>
<tr>
<td>Melastomataceae</td>
<td>Melastoma</td>
</tr>
<tr>
<td>Meliaceae</td>
<td>Lansium, Aglaia</td>
</tr>
<tr>
<td>Moraceae</td>
<td>Artocarpus, Ficus</td>
</tr>
<tr>
<td>Myrsinaceae</td>
<td>Ardisia</td>
</tr>
<tr>
<td>Myrtaceae</td>
<td>Rhodomyrtus, Eugenia, Syzygium,</td>
</tr>
<tr>
<td></td>
<td>Decaspermum</td>
</tr>
<tr>
<td>Palmae</td>
<td>Salacca, Calamus</td>
</tr>
<tr>
<td>Passifloraceae</td>
<td>Passiflora</td>
</tr>
<tr>
<td>Rubiaceae</td>
<td>Morinda</td>
</tr>
<tr>
<td>Rutaceae</td>
<td>Citrus halimi ?</td>
</tr>
</tbody>
</table>
• Sapindaceae  
  *Nephelium, Xerospermum, Pometia, Erioglossum, Dimocarpus*

Sterculiaceae  
  *Scaphium*

Sonneratiaceae  
  *Sonneratia, Avecenia*

**What to do**

**Data collection**

- Number of species/sample
- What species? / Common names
- Number of tree / species

**Characterisation data**

- Flowering / fruiting / vegetative
  - Heavy / light flowering / fruiting

Sample for herbarium

- Flowers, fruits, leaves

Sample for germplasm / propagation / herbarium

- Fruits (seeds) cutting, budwood, seedlings

Photograph
Handout (Example): Baccaurea species

S. EUPHORBIACEAE (Chin & Yong 1982)

- a. Baccaurea reticulata Hook f. (belimbing Dayak) slaid 5 - red pointed 5-angled fruits
- b. B. motleyana Muell.-Arg. var. milambe (Bid.) - round fruit with translucent flesh
  Var. limpiyu (Bid.) - smaller fruit, white skin.
- c. B. macrocarpa (Miq.) Muell.-Arg. (mak) - larger fruit, reddish skin.
- d. B. pyriformis Gage (tampoi kuning) (mpe) - fruit with six glossy segments, white flesh
  - similar to macrocarpa but flesh yellow
- e. Ostedes spp. Blume (mirenii) - locular nut with hard black endocarp.

Key to the Species

Fruits crowded along hanging strings, generally obovate and thin-skinned: Rambai
Leaf-blade large 6-14" long

Twigs, leaf-stalks and undersides of the leaves finely velvety:
  Village tree: base of leaf-blade rather heart-shaped
  Wild: base of leaf-blade tapered: seeds with blue pulp
  Glabrous

  Fruit-strings on the trunk
  Fruit-strings on the branches and the trunk
  Leaf-blade smaller, 3-8" long: glabrous or nearly so
  Small forest-tree with fruiting strings from the base of the trunk
  Not so

  Small wild tree: fruits rose-pink, ridged and wrinkled
  Wild or village-tree: fruit not so
  Fruits 3-4 together in stalked bunches, round, thick-skinned: Tampoi

Fruits 1½-2½" wide: fruiting from the branches or trunk
  Leaf-blade large, 7-14" long, glabrous
  Leaf-blade smaller, 4-8" long; twigs and leaf-stalks finely downy
  Fruits about 1" wide: leaf-blade 4-8" long: fruiting on the twigs or branches
  Twigs and leaf-stalks finely velvety
  Glabrous

B. Motleyana
B. brevipes
B. lanceolata
B. sapida
B. parviflora
B. Scortechinii
B. sapida
B. Griffithii
B. reticulata
B. pyriformis
B. bracteata
Different kind of fruits: a & b, Neopogoni um compressum Radik., in b the fruit wall partly removed [Beccari PS 1268]; c, N. uncinatum Leenh. (Hotta 12984); d, N. nudatum Leenh. [Barawak Forest Dept. S 32399]; e, N. laurinum Blume, young fruit [Griffith 995]; f, N. daedaleum Radik., dry fruit (NBFD SAN 50490); g, N. juglandifolium Blume (M. Shah s.n. in herb. L. sh., nr. 7624); h, N. hypoleucum Kurz (Geesink c.s. 6475). All natural size but for e, which is x 1.5.
**Table 6: Nephelium species in Sabah, 10/11 in Brunei?**

<table>
<thead>
<tr>
<th>Species</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>N. aculeatum</td>
<td>Wild and not much to eat</td>
</tr>
<tr>
<td>N. maingayi</td>
<td>- Kemanggis</td>
</tr>
<tr>
<td>N. reticulatum</td>
<td></td>
</tr>
<tr>
<td>N. uncinatum</td>
<td></td>
</tr>
<tr>
<td>N. beccarianum</td>
<td>Ketidahan</td>
</tr>
<tr>
<td>N. macrophyllum</td>
<td>Bayong in Brunei</td>
</tr>
<tr>
<td>N. xerospermoideas</td>
<td>Arut</td>
</tr>
</tbody>
</table>

Common species are:

*Nephelium lappaceum* – rambutan

*N. ramboutan ake* – maritam / pulasan

*N. cuspidatum* –

- Large tree, high stem
- Open foliage / not dense
- Leaflet dangling, hairy on both sides
- Fruits like rambutan but with curl hairs
- Has 6 varieties
  - *var. robustum* – giant rambutan
  - *var. eriopetalum* – lotong / gumpal benang

*Var. robustum*
- fruits in big bunches
- pink to scarlet or magenta
- very sweet and juicy but can be sour
- dwarfing rootstock is needed!
<table>
<thead>
<tr>
<th>Species</th>
<th>Vernicular Name</th>
<th>Distribution</th>
<th>Potential</th>
<th>Cultivation Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>V A.anisophyllus</strong></td>
<td>Terap Ikal</td>
<td>E.coast</td>
<td>Good</td>
<td>Rarely cultivated</td>
</tr>
<tr>
<td><strong>V A.communis</strong></td>
<td>Sukun &amp; Kulur</td>
<td>Introduced</td>
<td>Many good</td>
<td>Scattered cultivars</td>
</tr>
<tr>
<td><strong>V A.dadah (P)</strong></td>
<td>Beruni</td>
<td>Wide dist</td>
<td>Low</td>
<td>Rarely cultivated</td>
</tr>
<tr>
<td><strong>V A.elasticus</strong></td>
<td>Talun/Togoh</td>
<td>Common</td>
<td>Low</td>
<td>Not cultivated</td>
</tr>
<tr>
<td><strong>V A.glaucus (P)</strong></td>
<td>Beruni</td>
<td>Scattered/Rare</td>
<td>Low</td>
<td>Rarely cultivated</td>
</tr>
<tr>
<td><strong>V A.heterophyllus</strong></td>
<td>Jackfruit or Nangka</td>
<td>Introduced</td>
<td>Many good</td>
<td>Widely cultivated cultivars</td>
</tr>
<tr>
<td><strong>V A.integer</strong></td>
<td>Chempedak</td>
<td>Wide dist</td>
<td>Good pot.</td>
<td>Widely cultivated cultivars</td>
</tr>
<tr>
<td><strong>V A.kemando</strong></td>
<td>Pudu</td>
<td>Rare</td>
<td>Not Known</td>
<td>Not cultivated</td>
</tr>
<tr>
<td><strong>V A.lanceifolius</strong></td>
<td>Timakon, Kledang</td>
<td>Localized</td>
<td>Good</td>
<td>Not cultivated</td>
</tr>
<tr>
<td><strong>V A.nitidus</strong></td>
<td>Beruni</td>
<td>Scattered/Rare</td>
<td>Low</td>
<td>Not cultivated</td>
</tr>
<tr>
<td>Species</td>
<td>Common Name</td>
<td>Frequency</td>
<td>Quality</td>
<td>Cultivation</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------</td>
<td>-----------</td>
<td>---------</td>
<td>----------------------</td>
</tr>
<tr>
<td>A. odoratissimus</td>
<td>Terap</td>
<td>Common</td>
<td>Many good</td>
<td>Widely cultivated</td>
</tr>
<tr>
<td>A. rigidus</td>
<td>Peruput</td>
<td>Wide dist.</td>
<td>Good</td>
<td>Rarely cultivated</td>
</tr>
<tr>
<td>A. sericicarpus</td>
<td>Togop/Pedralai</td>
<td>Common</td>
<td>Good</td>
<td>Cultivated</td>
</tr>
<tr>
<td>A. tamaran</td>
<td>Tamaran</td>
<td>Common</td>
<td>Medium</td>
<td>Not cultivated</td>
</tr>
<tr>
<td>A. tormentosulus</td>
<td>(P)-</td>
<td>Rare/montane</td>
<td>Not known</td>
<td>Not cultivated</td>
</tr>
</tbody>
</table>
### Table 4: *Durio* in Sabah and Brunei (V)

<table>
<thead>
<tr>
<th>Species</th>
<th>Vernacular Name</th>
<th>Distribution</th>
<th>Potential</th>
<th>Cultivation Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>D. acutifolius</em></td>
<td>-</td>
<td>Scattered</td>
<td>Not edible</td>
<td>Not cultivated</td>
</tr>
<tr>
<td><em>D. affinis</em></td>
<td>-</td>
<td>Localized/Rare</td>
<td>Not edible</td>
<td>Not cultivated</td>
</tr>
<tr>
<td><em>D. crassipes</em></td>
<td>-</td>
<td>Localized/Rare</td>
<td>Good</td>
<td>Not cultivated</td>
</tr>
<tr>
<td>✓ <em>D. dulcis</em></td>
<td>D. Tahis</td>
<td>Scattered</td>
<td>Good</td>
<td>Rarely cultivated</td>
</tr>
<tr>
<td>✓ <em>D. grandiflorus</em></td>
<td>D. Hantu</td>
<td>Scattered/Rare</td>
<td>Ornamental</td>
<td>Not cultivated</td>
</tr>
<tr>
<td>✓ <em>D. graveolens</em></td>
<td>D. Merah</td>
<td>Wide dist.</td>
<td>Good</td>
<td>Widely cultivated</td>
</tr>
<tr>
<td><em>D. griffithii</em></td>
<td>D. Kuyu</td>
<td>Rare</td>
<td>Not edible</td>
<td>Not cultivated</td>
</tr>
<tr>
<td><em>D. Kinabaluensis</em></td>
<td>D. Tapuloh</td>
<td>Localized</td>
<td>Good</td>
<td>Rarely cultivated</td>
</tr>
<tr>
<td>✓ <em>D. kutejensis</em></td>
<td>D. Luas/Lai, D. Kuning</td>
<td>Localized/Rare</td>
<td>Good</td>
<td>Cultivated</td>
</tr>
<tr>
<td>Species</td>
<td>Common Name</td>
<td>Distribution</td>
<td>Characteristics</td>
<td>Cultivation Status</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
<td>--------------</td>
<td>-----------------</td>
<td>--------------------</td>
</tr>
<tr>
<td><em>D. lanceolatus</em></td>
<td>D.Burung</td>
<td>Localized/Rare</td>
<td>For timber</td>
<td>Not cultivated</td>
</tr>
<tr>
<td><strong>D. oxleyanus</strong></td>
<td>D.Sukang</td>
<td>Common</td>
<td>Very good</td>
<td>Rarely cultivated</td>
</tr>
<tr>
<td><em>D. purpureus</em></td>
<td>-</td>
<td>Very rare</td>
<td>Breeding ?</td>
<td>Not cultivated</td>
</tr>
<tr>
<td><strong>D. testudinarum</strong></td>
<td>Kura-kura</td>
<td>Scattered/Rare</td>
<td>Breeding ?</td>
<td>Not cultivated</td>
</tr>
<tr>
<td><strong>D. zibethinus</strong></td>
<td>D.putih</td>
<td>Common</td>
<td>Many good cultivars</td>
<td>Widely cultivated</td>
</tr>
<tr>
<td><em>D. sp</em></td>
<td>D.Dalit</td>
<td>Localized</td>
<td>Good</td>
<td>Cultivated</td>
</tr>
</tbody>
</table>
## Table 5: *Mangifera* species in Sabah and Brunei (√)

<table>
<thead>
<tr>
<th>Species</th>
<th>Vernacular Name</th>
<th>Distribution</th>
<th>Potential</th>
<th>Cultivation Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>M. applanata</em></td>
<td>Lumpingas</td>
<td>Rare</td>
<td>Rootstock</td>
<td>Not cultivated</td>
</tr>
<tr>
<td><em>M. aquaea sp nov</em></td>
<td>M. Air</td>
<td>Widespread</td>
<td>Juice/rootstock</td>
<td>Cultivated</td>
</tr>
<tr>
<td><em>M. caesia</em></td>
<td>Beluno or Binjai</td>
<td>Common</td>
<td>Good</td>
<td>Cultivated</td>
</tr>
<tr>
<td><em>M. decandra</em></td>
<td>Bududahau</td>
<td>Rare</td>
<td>Some</td>
<td>Not cultivated</td>
</tr>
<tr>
<td><em>M. foetida</em></td>
<td>Bacang</td>
<td>Common</td>
<td>Good</td>
<td>Some cultivated</td>
</tr>
<tr>
<td><em>M. griffithii</em></td>
<td>Baab/Bahab/Rawa</td>
<td>Scattered</td>
<td>Good</td>
<td>Some cultivated</td>
</tr>
<tr>
<td><em>M. indica</em></td>
<td>Common Mango</td>
<td>Introduced</td>
<td>Many good cultivars</td>
<td>Only cultivated</td>
</tr>
<tr>
<td><em>M. macrocarpa</em></td>
<td>M. Hutan</td>
<td>Scattered</td>
<td>Not known</td>
<td>Not cultivated</td>
</tr>
<tr>
<td><em>M. odorata</em></td>
<td>Kuini/Wani</td>
<td>Common</td>
<td>Good</td>
<td>Cultivated</td>
</tr>
<tr>
<td>Species</td>
<td>Common Name</td>
<td>Rarity</td>
<td>Characteristics</td>
<td>Cultivation</td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------------------------</td>
<td>---------------</td>
<td>-----------------</td>
<td>-------------</td>
</tr>
<tr>
<td>M. pajang</td>
<td>Bambangan</td>
<td>Localized</td>
<td>Good</td>
<td>Cultivated</td>
</tr>
<tr>
<td>M. parvifolia</td>
<td></td>
<td>Rare</td>
<td>Not Known</td>
<td>Not cultivated</td>
</tr>
<tr>
<td>M. pentandra</td>
<td>Pauh or M. dodol</td>
<td>Rare</td>
<td>Possibly good?</td>
<td>Not cultivated</td>
</tr>
<tr>
<td>M. quadrifida</td>
<td>Rancha-rancha</td>
<td>Localized</td>
<td>Good</td>
<td>Few cultivated</td>
</tr>
<tr>
<td>M. rigida</td>
<td></td>
<td>Localized/Rare</td>
<td>Rootstock perhaps?</td>
<td>Not cultivated</td>
</tr>
<tr>
<td>M. rubrapetalata</td>
<td>Mempelam</td>
<td>Scattered</td>
<td>Good/Juice</td>
<td>Cultivated</td>
</tr>
<tr>
<td>M. rufocostata</td>
<td>Dumpiring or Talupid</td>
<td>Rare</td>
<td>Timber + ?</td>
<td>Rarely cultivated</td>
</tr>
<tr>
<td>M. subsessilifolia</td>
<td>-</td>
<td>Rare</td>
<td>Not known</td>
<td>Not cultivated</td>
</tr>
<tr>
<td>M. swintonioides</td>
<td>-</td>
<td>Very Rare</td>
<td>Not known</td>
<td>Not cultivated</td>
</tr>
<tr>
<td>M. torquenda</td>
<td>Bunitan/Lamantan</td>
<td>Localized/Rare</td>
<td>Not known</td>
<td>Not cultivated</td>
</tr>
</tbody>
</table>
Pembiakan dan pengurusan tanaman

Rukayah bt Aman

Penyediaan bahan tanaman di tapak semaian

Percambahan


Pengurusan di tapak semaian


Pembiakan biji benih

Penanaman daripada biji benih biasanya menghasilkan
- pokok yang tidak tulen
- pokok yang tempoh juvenilnya lama
- bahan tanaman tidak seragam
- pokok terlalu besar

Pembiakan tampang

Jenis atau teknik pembiakan tampang
- Keratan
- Tut dan lenturan
- Cantuman mata tunas
- Cantuman baji dan baji sisi
- Sandingan
• Kultur tisu
• Tunas akar

Kebaikan

- Mengekalkan baka induk
- Membuang baka yang tidak baik / jantan
- Memendekkan tempoh juvenil
- Menghasilkan pokok bersudur kecil
- Bahan tanaman yang seragam
- Bahan tanaman bebas penyakit

Kaedah tut


Kaedah tut kerap diamalkan untuk membiak pokok ciku dan jambu batu. Pokok yang dibiak menggunakan kaedah ini dapat mencapai peringkat matang lebih awal bebanding dengan pokok cantuman mata tunas.
Gambar rajah 1 : Cara-cara mengetut

Lenturan


Tut lenturan

Kebanyakan pokok akan mengeluarkan akar apabila dahan atau rantingnya tertanam ke dalam tanah. Dahan atau ranting ini akan menjadi satu pokok yang lain. Lenturan boleh dilakukan pada pokok yang memanjat dan pokok yang rendah dahannya seperti tomato dan melur.
Lenturan paritan


Lenturan udara / tut

Pembiakkan cara ini sesuai digunakan untuk pokok yang suakr dibibakkan dengan cara tampang yang lain, terutamannya untuk pokok jenis kayu keras seperti pokok cempaka, limau kasturi dan ciku.

Cantuman mata tunas

Cantuman mata tunas boleh dibuat apabila anak pokok telah berumur 5-6 bulan atau lebih. Pada peringkat ini cantuman baji tidak sesuai dijalankan.

Potongan kulit 0.5 x 3.0 cm dibuat pada pokok penanti. Mata tunas hendaklah diambil daripada dahan yang berumur setahun dan dorman daripada pokok yang subur dan diketahui baik mutu buahnya. Mata tunas tersebut ditampal di tempat potongan pada pokok penanti dan cantuman perlu dibalut dengan pita (gambar rajah 2). Pokok yang telah dicantum perlu diletakkan di bawah 50% naungan. Pita ditanggal selepas 4 minggu dan
pokok penanti dipotong 4-5 cm di atas tempat cantuman. Semua tunas lain yang keluar dari pokok penanti hendaklah dibuang dari semasa ke semasa. Selepas lebih kurang 5-6 bulan, pokok cantuman bolehlah ditanam di ladang.

Gambar rajah 2 : Kaedah cantuman mata tunas

Cantuman baji

Bagi cantuman baji, pokok penanti hendaklah berumur antara 3-6 bulan untuk mendapatkan anak pokok membesar dengan cepat kerja. Cantuman baji hendaklah disegerakan apabila anak pokok telah sesuai untuk dicantum.

Anak pokok yang tingginya 25-40 cm dengan saiz lilitan batang 0.8-1.0 cm sesuai digunakan sebagai pokok penanti. Pada ini saiz batang anak pokok hampir sama dengan saiz hujung pucuk yang akan digunakan. Anak pokok penanti dipotong dengan membiarkan 2 helai daun di bahagian bawah. Dengan menggunakan pisau cantuman, bahagian tengah batang dibelah sepanjang 2 cm ke bawah.

Untuk cantuman baji, pucuk baka diambil daripada pokok yang sihat dan mengeluarkan hasil yang tinggi. Pucuk yang sihat (7-10 cm panjang) dan mempunyai 2 helai daun dipilih sebagai tunas baka. Dengan menggunakan pisau cantuman yang bersih dan tajam, pangkal tunas dipotong menjadi bentuk “V”. Permukaan yang dipotong hendaklah rata dan licin serta sama panjangnya dengan belahan yang dibuat pada pokok.
penanti (2cm). Hujung pucuk dan daun dikerat bagi mengurangkan kehilangan air. Pucuk yang telah disediakan disisipkan ke dalam turihan pada pokok penanti dengan teliti dan kemas bagi memberikan satu pertemuan kambium yang betul (gambar rajah 3). Cantuman ini dibalut dengan menggunakan parafilem. Pokok cantuman disiram dan diserukup dengan beg plastik dan diletak di bawah 75% naungan. Dengan cara ini lembapan yang tinggi dapat dikekalkan untuk menggalakkan pucuk daripada kering. Beg plastik bolehlah ditarik keluar setelah pucuk baru mula keluar dan ini mengambil masa tidak kurang daripada 2 minggu selepas cantuman.

Cantuman baji ialah teknik pembiakan yang amat sesuai untuk manggis dan durian belanda. Cantuman ini bukan saja dapat mempercepat pengeluaran anak benih malahan dapat menghasilkan anak pokok yang seragam.

Gambar rajah 3 : Cara membuat cantuman baji

**Cantuman baji sisi**

Teknik ini memerlukan pokok penanti yang subur dan berumur kira-kira sebulan. Belahan dibuat dengan memotong kira-kira 2cm ke bawah dan tidak lebih ⅓ daripada bahagian dahan.

Untuk cantuman ini, tunas baka diambil daripada pokok yang matang. Tunas baka ialah pucuk hujung yang subur dan mempunyai dua helai daun. Daun pucuk ini dikerat setengah untuk mengurangkan kehilangan air. Bahagian pangkal tunas baka dipotong supaya berbentuk “V” tetapi mempunyai satu bahagian permukaan kira-kira 2 cm dan satu bahagian permukaan lagi 1 cm.

Selepas dicantum, pokok disiram dan ditempatkan di dalam ruang plastik yang boleh mengekalkan kelembapan yang tinggi. Pokok-pokok ini disiram sekali setiap 2 hari dan ruang plastik ini diletakkan di bawah lindungan sekurang-kurangnya 50%. Kelembapan yang tinggi adalah penting untuk menggalakkan pertumbuhan kalus di bahagian permukaan yang dipotong dan mengelakkan tunas baka daripada kering.


Gambar rajah 4 : Cara membuat cantuman baji sisi

**Sandiningan**

(A) A longitudinal cut is made on the stock
(B) A corresponding length of cut is made on the scion
(C) Tie together firmly with suitable tying material

(B) A newly inarched graft for planting in...

Figure 4.3 Propagation by inarching
Lenturan Pucuk

Tut lenturan
Lenturan paritan

Lenturan udara
AGRONOMIC PRACTICES AND MANAGEMENT OF FRUIT FIELD GENEBANK

RUKAYAH AMAN

LOCATION

To ensure the success of a genebank location is very important. It should be save from any interference e.g. from any hind of development (housing, roads etc. The soil should be flat with uniform soils of high fertility and rich in nutrient and organic matter. Besides, it must be well-drained, swampy area and sub-soil should be avoided. Cultivation on steep land may present a number of problems in operation and management. Besides, it is more costly. Spraying, pruning and harvesting are much more difficult on hilly areas than on flat or gentle slopes. Exposed area which are subjected to heavy winds should also be avoided. Spraying is more difficult in such areas and it is also damaging for the trees as the wind can cause them to break apart, especially during heavy fruiting.

PREPARATION OF PLANTING MATERIALS

Nursery facilities

Nursery facilities are very important for field genebank not only to prepare planting materials but also to carry out appropriate propagation techniques e.g. in preparing clonal materials and to save endangered species. Nursery is also needed from time to time to raise new seedlings of new species or clones collected, to keep seedlings or planting materials for replacement and to keep rootstocks for future use.

Choice of planting materials

Planting materials (clones, species or varieties) to be chosen for the genebank may depend on what we can get and what are available to us. However, due to cost involved, the choice can be tricky and depends on the decision of the collector involved.

In the case of fruit species, for instant, fruits may vary in their shapes, sizes, taste and texture. For the genebank, we need to have the widest range of the characteristics possible. However, taking into consideration the constraint such as adequate financial and land availability, a representative collection of each, characteristic should be included.

Germination requirement and propagation techniques

Many species of tropical fruits can be propagated vegetatively by budding, grafting and marcotting. However, seeds are important for these species to raise their rootstock. For rare and wild species, very few studies have been done on seed germination. A sound knowledge about the nature of seeds and the mode and their requirement for germination is very important to ensure the seeds collected germinate well and the seedlings are healthy to be planted in the field. It is important to remember that seeds are not available all the time due
to seasonal of these species and they cannot be kept for a long period because their vigour last in a short period normally in a few days and should be cleaned and sown as soon after the collection is made. Seeds like 'malacca tree', bael, wa~ ap~le, lobi-lobi and rokam do not germinate easily. Seed of sour 'belimbi' for instant need to be washed with soap first to remove the oil layer surrounding them. Some seeds like Indian and Barbados cherries do not germinate easily. The knowledge about seeds and their germination is very important to ensure the survival of the endangered species.

Vegetative propagation techniques of most major fruit species had been studied and used extensively to produce clonal materials. Most rare and wild species on their other hand cannot be propagated vegetatively as the techniques have not been studied fully.

PLANTING SYSTEM

It is easy to decide planting system to be used if only one crop is involved. We can use either square, triangular, quincunx planting system or contour planting on hilly areas. But, in the case when many species are involved we have to find out a suitable system so that most species can be seen from a distance, not only it is nice to look at but also practical to maintain. The knowledge about size and shape of the canopy is very important in this case so that a special planting system can be made. An advice from a landscape architect can be obtained if is not too costly.

PLANTING AND REPLANTING

To ensure good growth in the field first of all the nursery trees need to be vigorous. Vigorous nursery trees have to be properly grown and handled to ensure good growth and production. Young plants are preferred since they are easier to handle and cheaper to transport. They also could withstand transplanting shock.

Planting and replanting should be done during rainy period preferably to avoid transplanting shock. The plant must be hardened for few days before transplanting. The number of plants per accession / clone / specie recommended for planting is 6-10, again depending on the area available to us.

TREE TRAINING AND PRUNING

Tree training and pruning is important for major and commercial fruits to obtain regular and high fruit yield. For the purpose of the genebank these aspect, though important have to be done carefully. Tree training, for instant has to be done as minimum as possible in order not to loose the original shape of the tree canopy. This is important as the shape of the tree is one of the characteristics than can be used to identify the different species or clones. The subsequent pruning should also be done with care. With fruit trees pruning once a year or when necessary i.e. to remove dead branches is suffice to make sure the canopy of a species do not interfere much with other species.

FERTILIZER AND MANURING
At planting stage it is common to incorporate rock phosphate and organic matter (cow dung or chicken dung) into the planting hole to enhance root growth and improve soil texture. Before bearing stage growth mixture should be applied (normally the first 1-3 years depending on crop) at least three times a year to ensure vigorous vegetative growth. This is then followed by fruiting mixture i.e. from 3rd or 4th year onwards. For perennial crops such as fruits, chemical fertilizer should be applied at least twice a year although it is normal to apply three times a year where fruit production is emphasized. The fertilizer is applied after harvesting so that the plants recover fully after fruiting. A bag of organic fertilizer is placed near the tree trunk to maintain good soil structure.

WEED MANAGEMENT

One of the major problems in a field genebank is weed management. Although a schedule for weeding management had been developed for effective weed control it cannot be followed strictly and several considerations, have to be made according to locations and soil types. For example on hilly areas maintenance of some weeds is important in order to prevent erosion. Weeding is done generally to remove plant which tend to compete with trees for sunlight and nutrient. The operation may be done manually or with the help of machinery. Circle weeding may not be necessary if mulching has been successfully carried out. Weeding with machinery is confined only to the inter-row spacing. Service cutting may not be necessary if the spacing is filled with legume covers. Spots of lalang are eradicated by spraying appropriate weedicide (e.g. Roundup) and general weeds are controlled by other recommended herbicides.

PEST AND DISEASE MANAGEMENT

Crop protection is an important aspect in field genebank. At all stages of crop growth they are susceptible to pests and pathogens. Prevention is an important step in controlling infestations and some phytosanitary measures should be practiced. There are several methods to control pests and diseases, chemical control is still the most popular. For effective chemical control, proper choice of insecticides and method of application should be made. The present trend of pest control is integrated in approach, i.e. utilisation of more than the method of control such as combination of chemical and biological.

Wild boar, monkeys, birds, bats and insects are common pests that can damage the plants and feed on flowers and fruits and therefore interfere with data collection. One of the most serious pests in this region is fruit flies. Fruit flies affect carambola industry in this country.

Important pests and diseases of fruits are:

- Banana
- Citrus
- Papaya
- Jackfruit and cempedak
- Durian and citrus
Fusarium wilt / panama disease Greening disease and triteza virus ringspot virus
bacterial wilt, stem borer Phytophthora

Salak
Nephelium spp Mango and others Most fruit crops

wild boar, monkeys
Birds, bats
anthracnose and flpwers and fruits fruit flies

**HARVESTING**

Harvesting is done manually by hand, by using poles or climbing up the trees depending on
crops or species. Most species and clones collected are seasonal in their flowering and
fruiting. One of the problems faced is that most trees produce fruits almost at same time and
this could be a heavy burden to researchers since too much data to be collected at the same
time.

**DATA COLLECTION**

Data collected from the genebank are passport, characterisation and evaluation data for each
accession. Passport data provide basic information of the accession, including the -...
registration at the genebank and other identification (species name, vernacular name) and the
origin of the accession. Characterisation description enable us to differentiate between
phenotypes, species or clones. They are highly heritable, can be easily seen by the eye and
are expressed in all environments. Evaluation descriptors on the other hand are susceptible to
environment differences but are useful for selection and crop improvement.

**REFERENCE**

Anon. (1980) Fruit production in Malaysia. Othman, Y. (ed.). Faculty of Agriculture, UPM.
Serdang, Selangor.
**The Survey**

*Tuesday, 27th September 2011*

Survey on indigenous fruit species in Muara district.

*Wednesday, 28th September 2011*

Survey on indigenous fruit species in Muara and Tutong district.

*Thursday, 29th September 2011*

Visit ‘Tamu’ and collect fruit samples
Discussion.

26/9/2011

8.30 a.m – 12.45 p.m - Lecture
2.00 p.m - Practical is done around the station. A number of samples such as flowers and leaves of kembayau and pauh are brought to the laboratory for demonstration of Herbarium specimen and characterisations. Survey at Tutong district cannot be done as it was raining.

27/9/2011

Survey on indigenous species was done at three selected sites, one at Kg Kasat and two others at Kg Putat. The survey at the first site at Kg Kasat took the whole morning as so many fruit species involved and the participants learnt how to collect characterisation data, identify species and collect specimens for herbarium. About 23 species were recorded at the site.

Afternoon

Three sites were chosen for the survey two of them are mixed orchards and another one is a semi wild condition.

28/9/2011

Short visit to Muara District Office, there is a map of Brunei suitable for the survey at the station.

It was decided that two participants remains in the lab at Birau station with Dr Salma to study the data collected and to save the data in the computer while the others continued with the survey.
Near the station we came across a hybrid tree that needs further research. It is probably a cross between Bembangan and Wani/Kuini (Bembangan x Kuini). The tree shows that:

- Natural cross within the same family (*Anacardiaceae*) does occur though it is very rare.
- The hybrid has bembangan fruit but the tree like kuini (smaller)
- Most interesting fact is it gets dwarfing effect from the kuini and thus small tree of bembangan with kuini branching habit.
- Another important fact is unlike bembangan which is highly seasonal it is nonseasonal and fruit all the year round.
- Maybe also shorter juvenile period. This observation need further study especially breeding and crossing work.

We then proceed to Kg Kulapis and survey was done on two commercial farm i.e mixed orchard.

In the afternoon another two sites were chosen, one is an orchard in semi-wild condition and the other commercial mixed orchard in Kg. Sg. Kelugas. At the first site we come across with a Kandis plant and a citrus plant (*Fortunella polyandra*) or ‘limau pagar’ growing under semi-wild condition, which is quite rare.

**Attendance**

**Date : 27/9/2011**

1. Takiyaudin Hj. Mohamad
2. Hjh Jamilah Hj. Abidin
3. Jumin bin Lamat
4. Kamal bin Hj. Lakim
5. Jafar Kamis
6. Salamuda Anak Tandang
7. Norsyham Hj. Lamit
8. Md Mee Lee Hj. Abd Halim
9. Mazlan bin Zaini
11. Salinda binti Sitim – makmal
12. Anuar bin Hj. Morni – makmal

Sites : Kg Kasat (a.m) – 1
Kg Putat (p.m) – 2
Attendance

Date: 28/9/2011

1. Takiyaudin Hj. Mohamad
2. Sanah Hj. Bunut
3. Hjh Jamilah Hj. Abidin
4. Jumin bin Lamat
5. Panjang @ Zaqreen bin Samsu
6. Kamal bin Hj. Lakim
7. Sabtu bin Sitai
8. Jamaliah Hj. Tuah
9. Jafar bin Kamis
10. Salamuda Anak Tandang
11. Norsyam bin Hj. Lamit
12. Hjh Kamsinah binti Hj. Ibrahim – makmal
13. Salinda binti Sitim – makmal

Sites: Ladang Kg. Kulapis (a.m)
      Ladang Kg. Sg Kelugus (p.m)
Table 1: List of Indigenous Fruits of Brunei Darussalam by Family

**Amaryllidaceae**

<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amaryllidaceae</td>
<td>Lembah / Lumbah</td>
</tr>
<tr>
<td></td>
<td><em>Maniniera latifolia</em></td>
</tr>
</tbody>
</table>

**Anacardiaceae**

<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anacardiaceae</td>
<td>Belunu</td>
</tr>
<tr>
<td></td>
<td><em>Mangifera caesia</em></td>
</tr>
<tr>
<td></td>
<td>Binjai</td>
</tr>
<tr>
<td></td>
<td><em>Mangifera caesia</em></td>
</tr>
<tr>
<td></td>
<td>Bacang</td>
</tr>
<tr>
<td></td>
<td><em>Mangifera foetida</em></td>
</tr>
<tr>
<td></td>
<td>Benglu</td>
</tr>
<tr>
<td></td>
<td><em>Mangifera odorata</em></td>
</tr>
<tr>
<td></td>
<td>Kuini</td>
</tr>
<tr>
<td></td>
<td><em>Lenggauh</em></td>
</tr>
<tr>
<td></td>
<td><em>Mangifera torquenda</em></td>
</tr>
<tr>
<td></td>
<td>Matan</td>
</tr>
<tr>
<td></td>
<td><em>Mangifera pajang</em></td>
</tr>
<tr>
<td></td>
<td>Pauh</td>
</tr>
<tr>
<td></td>
<td><em>Mangifera petandra</em></td>
</tr>
<tr>
<td></td>
<td>Pelanjau</td>
</tr>
<tr>
<td></td>
<td><em>Pentaspadon motleyi</em></td>
</tr>
<tr>
<td></td>
<td>Rancah-rancah</td>
</tr>
<tr>
<td></td>
<td><em>Mangifera quadrifida</em></td>
</tr>
<tr>
<td></td>
<td>Sengkuang</td>
</tr>
<tr>
<td></td>
<td><em>Dracontomelon dao</em></td>
</tr>
</tbody>
</table>

**Apocynaceae**

<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apocynaceae</td>
<td>Surapit</td>
</tr>
<tr>
<td></td>
<td><em>Willughbeia sp.</em></td>
</tr>
<tr>
<td></td>
<td>Pitabu</td>
</tr>
</tbody>
</table>

**Bombacaceae**

<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bombacaceae</td>
<td>Durian kuning</td>
</tr>
<tr>
<td></td>
<td><em>Durio graveolens</em></td>
</tr>
<tr>
<td></td>
<td>Durian otak udang galah</td>
</tr>
<tr>
<td></td>
<td><em>Durio graveolens</em></td>
</tr>
<tr>
<td></td>
<td>Durian bunga simpur</td>
</tr>
<tr>
<td></td>
<td><em>Durio graveolens</em></td>
</tr>
<tr>
<td></td>
<td>Durian pulu</td>
</tr>
<tr>
<td></td>
<td><em>Durio kutejensis</em></td>
</tr>
<tr>
<td></td>
<td>Durian suluk</td>
</tr>
<tr>
<td></td>
<td><em>Durio sp</em></td>
</tr>
<tr>
<td></td>
<td>Durian kura-kura</td>
</tr>
<tr>
<td></td>
<td><em>Durio testudinarianium</em></td>
</tr>
<tr>
<td></td>
<td>Durian sukiang</td>
</tr>
<tr>
<td></td>
<td><em>Durio oxleyanus</em></td>
</tr>
<tr>
<td></td>
<td>Durian meragang</td>
</tr>
<tr>
<td></td>
<td><em>Durio dulcis</em></td>
</tr>
<tr>
<td></td>
<td>Durian burung</td>
</tr>
<tr>
<td></td>
<td><em>Durio sp</em></td>
</tr>
<tr>
<td></td>
<td>Durian siunngung</td>
</tr>
<tr>
<td></td>
<td><em>Durio sp</em></td>
</tr>
</tbody>
</table>
**Burseraceae**

- **√ Kembayau** *Canarium adontophyllum*
- **Meritam**
- **√ Meritus** *Canarium litorale*
- **Pinanasan** *Dacroydes rostata*
- **Sabal** *Dacroydes expansa*

**Euphorbiaceae**

- **√ Limpaung** *Baccaurea lanceolata*
- **√ Rambai** *Baccaurea motleyana*
- **√ Tampoi** *Baccaurea griffitii*
- **Tampoi bunga** *Baccaurea reticulata*
- **Tampoi silau** *Baccaurea sp*
- **Tampoi belimbing** *Baccaurea angulata*

**Flacourtiaceae**

- **√ Kepayang** *Pangium edule*
- **Rukam** *Flacourtia rukam*

**Guetaceae**

- **√ Bako** *Gnetum gnemon*
- **√ Asamaur-aur** *Garcinia parvifolia*
- **√ Manggis** *Garcinia mangostana*
- **Sangkuang**
- **√ Kandis** *Garcinia sp*

**Lauraceae**

- **√ Pengalaban** *Litsea garciae*

**Leguminosae**

- **√ Petai** *Parkia speciosa*
- **Petai bunga** *Parkia sp*
- **√ Jering** *Pithecellobium jiringa*
- **Keranji** *Dialum indum*
**Melastomataceae**

- **Senduduk** (*Melastoma malabathricum*)

**Meliaceae**

- **Santul** (*Sandoricum koetjape*)
- **Langsat** (*Lansium domesticum*),
  - Langsat berok (*Lansium domesticum*),
  - Langsat susu (*Lansium domesticum*),
  - Duku (*Lansium domesticum*)

**Moraceae**

- **Ara** (*Ficus spp*)
- **Cempedak** (*Artocarpus interger*)
  - Nangka belulang (*Artocarpus heterophyllus*)
- **Tarap** (*Artocarpus odoratissimus*)
  - Pedalai (*Artocarpus sericicarpus*)
  - Bintawa (*Artocarpus anisophyllus*)
  - Tempunik (*Artocarpus rigidus*)

**Myrtaceae**

- **Jambu bol** (*Syzygium malaccensis*)
  - Kemunting (*Rhodomyrtus tomentosa*)

**Palmae**

- **Asam paya** (*Eleodoxa conferta*)
  - Nipah (*Nypa fruticans*)
  - Rekam (*Salacca wallichiana*)
  - Remayong (*Salacca magnifica*)
- **Rotan/Jelayan** (*Calamus sp*)
  - Salak (*Salacca edulis*)

**Rubiaceae**

- **Sulang** (*Gardenia sp*)

**Rutaceae**

- ****
√ Limau pagar  

*Fortunella palyandra*

**Sapindaceae**

- Arut  
  *Nephelium xerospermodies*
- Bantut  
- Bayong  
  *Nephelium macrophyllum*
- Mata kucing  
  *Dimocarpus longan sp malesianus*
- Maritam  
  *Nephelium ramboutan - ake*
- Kemanggis  
  *Nephelium uncinatum*
- Ketidahan  
  *Nephelium beccarianum*
- Lakang  
  *Nephelium sp.*
- Lahang  
  *Xerospermum sp.*
- Ngalan  
  *Xerospermum sp.*
- Sigir  
- Serait  
  *Nephelium maingayi*
- Sungkit  
  *Xerospermum sp.*

**Sonneratiaceae**

- Berembang  
  *Sonneratia alba*
- Pedada  
  *Sonneratia caseolaris*

√ Species of fruits already found during the survey. Data are being collected for these species
Fruit species in flowering and fruiting during the survey (26-29 September 2011)

<table>
<thead>
<tr>
<th>Flowering</th>
<th>Fruiting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rambai</td>
<td>Membangan</td>
</tr>
<tr>
<td>Durian pulu</td>
<td>Belunu</td>
</tr>
<tr>
<td>Durian kura-kura</td>
<td>Limpaung</td>
</tr>
<tr>
<td>Kembayau</td>
<td>Bako</td>
</tr>
<tr>
<td>Pengelaban</td>
<td>Jelayan</td>
</tr>
<tr>
<td>Asamaur-aur</td>
<td>Asam paya</td>
</tr>
<tr>
<td>Limpaung</td>
<td>Tampoi</td>
</tr>
<tr>
<td>Bako</td>
<td>Jambu bol</td>
</tr>
<tr>
<td>Kandis</td>
<td>Santul</td>
</tr>
<tr>
<td>Manggis</td>
<td>Sulang</td>
</tr>
<tr>
<td>Petai</td>
<td>Jering</td>
</tr>
<tr>
<td>Tarap</td>
<td>Mempelam</td>
</tr>
<tr>
<td>Mempelam</td>
<td>Bembangan / Kuini</td>
</tr>
<tr>
<td>Bacang?</td>
<td>Senduduk</td>
</tr>
<tr>
<td>Asam paya</td>
<td></td>
</tr>
</tbody>
</table>

Fruits gathered from Tamu, Tutong

Asam paya
Jelayan
Jering
Limpaung
Kepayang(seeds)
Pengelaban
Mempelam
Santol

Except for pengelaban the rest are local fruits. These are seasonal fruits in Brunei. The pengelaban could be from nearby areas in Sarawak. In Brunei pengelaban trees are flowering heavily.
Characterization and preliminary evaluation of germplasm are the prerequisite for utilization in crop improvement. Characterization involves recording characters, which are highly heritable, easily seen by eye, and are expressed in all environments. The role of characterization and evaluation is basically to systematically describe an accession with its various attributes - morphological, physiological, agronomical, biochemical, cytological and reaction to various stresses (biotic/abiotic). Characterization and evaluation will provide diagnostic descriptors for the accession as well as identifying accessions with desirable traits for crop improvement. Hence, high priority should be accorded to characterization and evaluation of both existing and new germplasm collections Preliminary evaluation consists of recording a limited number of additional agronomic traits thought to be desirable by users of the particular crop. Evaluation of the materials is normally carried out by multidisciplinary team consisting of breeders, entomologists, pathologists, agronomist and others. The data gathered then should be logged into a documentation system that can help to access information when needed, to analyse the data to determine the pattern of variations, to verify the identity of the accession as well as to determine duplicates in the collection.

Descriptor List
The process of germplasm characterization and evaluation begins with the use of an appropriate descriptor list. The descriptor list can be compiled by the national organization and the collection manager or an existing list may be adopted or used. Descriptor lists produced by Bioversity International are comprehensive and widely used. The descriptors allow the standardization of descriptor definition and thus maintain uniformity in data processing and management. The descriptor lists developed by IPGRI serve as useful guides in standardizing the way in which the information is collected and recorded. Actual users of descriptor lists may select and make necessary changes to the published lists for their use. Bioversity International had published...
descriptors on many tropical fruits e.g. mango, durian, rambutan, mangosteen and for temperate fruits e.g. litchi, Citrus, apple, strawberry and many others. A general fruit descriptor is as in appendix 1

**Passport data**
Passport data consists of information about a germplasm sample and the collecting site, recorded at the time of collecting. The information is useful for identification, helps in designating core collection, identifying duplicates as well as planning further collection. Important passport descriptor include site of collection (village, state, country), longitude, latitude, collector’s number, date of collection, botanical name, vernacular name, sample type, status, source, environmental characteristics and also ethnobotanical information.

**Characterisation**
One of the main objective of genetic resource conservation is for utilization in crop improvement. As such characterization and evaluation of all the accessions are the main activities of the germplasm collections. In any improved evaluation programme, both morpho-agronomic and molecular characterization should be considered for improved results and ease of use after. Besides the traditional morphological markers, the modern tools can help not only in better management of genetic resource collections, but also in better using the information. By generating more information on accessions and developing core collections using such information will greatly enhance the utilization of conserved germplasm. Characterization and evaluation will provide diagnostic descriptors for the accession as well as identifying accessions with desirable traits for crop improvement. Evaluation of the materials is carried out by multidisciplinary team consisting of breeders, entomologists, pathologists, agronomist and others.

**Evaluation**
Preliminary evaluation consists of recording a limited number of additional traits, which would help in identifying useful germplasm material. Evaluation data consists of characters that are influenced by environment and mostly quantitatively inherited e.g. yield, nutrition, pest and disease.
Appendix 1

Descriptor list for indigenous fruit species

PASSPORT DATA

1. Accession data
   1.1 Accession No
   1.2 Donor Name
   1.3 Donor Address
   1.4 Donor Tel. No.
   1.5 Scientific Name
      1.5.1 Family
      1.5.2 Genus
      1.5.3 Species
      1.5.4 Cultivar
   1.6 Vernacular/Common Name
   1.7 Acquisition date
   1.8 Type of material received
      1 Pollen
      2 Seed
      3 Shoot/budwood/stem cutting
      4 In vitro culture
      5 Plant
      99 Other (specify in descriptor 1.9 Notes)
   1.9 Notes
      Any additional information may be specified here
2. Collecting descriptors

2.1 Collecting institute(s)
2.2 Collecting number

2.3 Collecting date of original sample [YYYYMMDD]

2.4 Country of collecting

2.5 Province/state

2.6 Department/county

2.7 Location of collecting site

2.8 Latitude of collecting site

2.9 Longitude of collecting site

2.10 Elevation of collection site [m asl]

2.11 Collecting source

   0   Unknown
   1   Wild
       1.1 Primary forest
       1.2 Secondary forest
   2   Farm
       2.1 Field
       2.2 Orchard
       2.3 Household Garden
       2.4 Store
   3   Market
       3.1 Town
       3.2 Village
       3.3 Urban area (around city)
       3.4 Other exchange system
   4.   Institute/Research organization

99.   Other (specify )

2.12 Collecting source environment
2.13 Status of sample

0  Unknown
1  Wild
2  Weedy
3  Breeder's line
4  Primitive cultivar
5  Advanced cultivar/landrace
99 Other (specify)

2.14 Type of sample

1  Seed
2  Seedling
3  Budwood
4  Graft
5  Vitroplant
6  Fruit
7  Other (specify)

2.15 Number of plants sampled

2.16 Ethnobotanical data

2.16.1 Ethnic group

2.16.2 Local vernacular name

2.16.3 Parts of the plant used

1  Fresh fruit consumption
2  Juice
3  Cooking
4  Rootstock
5  Medicinal
99 Other (specify)

2.16.4 Cropping system

1  Monoculture
2  Intercropped

2.16.5 Associated flora
2.16.6 Seasonality

1 Annual
2 Biannual

2.16.7 Type of market

1 Local
2 National
3 International

2.17 Collecting site population structure

2.17.1 Number of trees sampled

2.17.2 Frequency of plants at collecting site

3 Low
5 Intermediate
7 High

2.18 Plant population density

Number of trees per unit area (specify orchard or homestead)

2.19 Herbarium specimen
Was a herbarium specimen collected? If so, provide an identification number and indicate in which place (Herbarium) the specimen was deposited, in descriptor

2.20 Photograph
Was photograph(s) taken of the accession or habitat at the time of collecting? If so, provide an identification number(s) in descriptor

2.21 Collectors' notes

0 No
1 Yes


2.21 Collector’s notes

Additional information recorded by the collector or any specific information on any state in any of the above descriptors.

ENVIRONMENT AND SITE

3. Characterization and/or evaluation site descriptors

3.1 Fertilizer application

1. Yes
2. No

3.2 Soil drainage

1. Poor
2. Moderate
3. Good

3.3 Topography

1. Flat
2. Gently undulating
3. Hilly
4. Mountainous
5. Other (specify)

3.4 Soil type

1. Clay
2. Loam
3. Clay loam
4. Sandy clay
5. Sandy clay loam
6. Sand
CHARACTERIZATION

4 Plant descriptors

4.1 Growth descriptors

4.1.1 Tree age [y]

4.1.2 Tree vigour

3 Low
5 Medium
7 High

4.1.3 Tree height [m]

Form ground level to the top of the tree (if grafted, record also height of the graft union and rootstock name). Evaluate only unpruned trees.

4.1.4 Trunk height [m]

Record from the base of the tree to the point of emergence of first branch

4.1.5 Trunk circumference [cm]

Record at 50 cm above ground level for trees raised through seedlings and above the grafted union for trees raised through grafting

4.1.6 Bark texture

1 Smooth
2 Rough
3 Very rough
4 Rough and flaky

4.1.7 Crown diameter [m]

Measured the mean diameter using two directions (North-South and East-West)
4.1.8 Crown shape
1 Dome
2 Dome to round
3 Conical
4 Oblong irregular
5 Uneven
99 Other (specify)

4.1.9 Branching pattern
1 Erect
2 Semierect
3 Horizontal
4 Droopy

4.1.10 Bark Colour
1 Grey
2 Brown
3 Dark brown
4 Other (Specify)

4.1.11 Dwarfness
1 No
2 Yes

4.2 Leaf descriptors
Use the middle leaf or the first pair of leaflets from the terminal leaflet

4.2.1 Leaf length [cm]
4.2.2 Leaf width [cm]
4.2.3 Leaf shape
1 Ovate
2 Elliptic
3 Oblong
4 Obovate
5 Mixed (Specify)
99 Other (Specify)
4.2.4 Texture of leaf

1. Papery
2. Leathery
3. Very leathery

4.2.5 Leaf colour

1. Green
2. Dark green
3. Other (Specify)

4.2.6 Waxiness on adaxial leaflet surface

1. Matt
2. Shiny

4.2.7 Petiole length [cm]

4.3 Inflorescence descriptors

4.3.1 Position of inflorescence

1. Terminal
2. Axillary
3. On branches
4. On trunk
5. Base of trunk
99. Others (Specify)

4.3.2 No. of inflorescence per point

1. Few
2. Intermediate
3. Many

4.3.3 No. of flowers in an inflorescence

1. Single
2. Few
3. Many

4.4 Flower descriptors

4.4.1 Bud length(cm)
4.4.2 Bud width(cm)
4.4.3 Bud shape

1  Globose
2  Ovoid
3  Oblong
4  Ellipsoid

4.4.4 Bud colour

1  Olive
2  Greyish green
3  Yellowish green
4  Olive, yellow distally
5  Greyish yellow
6  Other (Specify)

4.4.5 Flower diameter

4.4.6 Petal length [mm]

4.4.7 Petal width [mm]

4.4.8 Fragrance

1  Mild
2  Strong

4.4.9 Petal colour

1  Cream
2  Light yellow
3  Pale yellow
4  Pink
5  Red
6  Other (Specify)

4.5 Fruit descriptors

4.5.1 Fruit shape

1  Globose
2  Ovoid
3  Ovoid-Oblong
4  Oblong
5  Obovoid
6  Mixed (Specify)
4.5.2 **Fruit weight** [kg]

Average of 10 fruits

4.5.3 **Fruit length** [cm]

Average of 10 fruits

4.5.4 **Fruit width** [cm]

Average of ten fruits

4.5.5 **Pericarp colour**

1. Yellow
2. Green
3. Dark green
4. Yellowish green
5. Brownish green
6. Greenish brown
7. Orange
8. Pink
9. Dark red
10. Other (Specify)

4.5.6 **Thickness of pericarp centre** (cm)

4.5.7 **Length of fruit stalk** (cm)

4.5.8 **Hair/Spine length** (cm)

If present

4.5.9 **Thickness of flesh** (cm)

4.5.10 **Colour of flesh**

1. White
2. Cream
3 Pale yellow  
4 Light yellow  
5 Yellow  
6 Yellowish orange  
7 Orange  
8 Pink  
9 Red

4.5.11 Texture of flesh
1 Soft  
2 Intermediate  
3 Firm

4.5.12 Taste of flesh
1 Bland  
2 Bitter  
3 Sour  
4 Sub-acid  
5 Bitter-sweet  
6 Nutty  
7 Sweet  
8 Astringent  
9 Other ( specify )

4.5.13 Amount of fibre
1 None  
2 Fair  
3 Moderate

4.5.14 Aroma strength
1 Fair  
2 Moderate  
3 Strong

4.5.15 Flavour
1 Fair  
2 Moderate  
3 Strong
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.5.16</td>
<td>Flesh recovery rate (%)</td>
</tr>
<tr>
<td>4.5.17</td>
<td>Flesh thickness (cm)</td>
</tr>
<tr>
<td>4.5.18</td>
<td>Fruit juiciness</td>
</tr>
<tr>
<td></td>
<td>1 Dry</td>
</tr>
<tr>
<td></td>
<td>2 Juicy</td>
</tr>
<tr>
<td></td>
<td>3 Very juicy</td>
</tr>
<tr>
<td>4.5.19</td>
<td>Flesh nutritive value</td>
</tr>
<tr>
<td></td>
<td>Recorded on fully ripe fruits</td>
</tr>
<tr>
<td>4.5.19.1</td>
<td>Total sugars [%]</td>
</tr>
<tr>
<td>4.5.19.2</td>
<td>Total soluble solids [% Brix]</td>
</tr>
<tr>
<td>4.5.19.3</td>
<td>Vitamin C [I.U.]</td>
</tr>
<tr>
<td>4.5.19.4</td>
<td>Vitamin A [I.U.]</td>
</tr>
<tr>
<td>4.6</td>
<td>Seed descriptors</td>
</tr>
<tr>
<td>4.6.1</td>
<td>Seed length [cm]</td>
</tr>
<tr>
<td></td>
<td>Average of ten seeds</td>
</tr>
<tr>
<td>4.6.2</td>
<td>Seed width [cm]</td>
</tr>
<tr>
<td></td>
<td>Average of ten seeds at the widest point</td>
</tr>
<tr>
<td>4.6.3</td>
<td>Seed weight [g]</td>
</tr>
<tr>
<td>4.6.4</td>
<td>Seed thickness (cm)</td>
</tr>
<tr>
<td>4.6.5</td>
<td>Seed colour</td>
</tr>
<tr>
<td></td>
<td>1 Greyed orange to brown</td>
</tr>
<tr>
<td></td>
<td>2 Greyed orange</td>
</tr>
<tr>
<td></td>
<td>3 Brown</td>
</tr>
<tr>
<td></td>
<td>99 Other (Specify)</td>
</tr>
<tr>
<td>4.6.6</td>
<td>Seed shape</td>
</tr>
<tr>
<td></td>
<td>1 Oblong</td>
</tr>
<tr>
<td></td>
<td>2 Round</td>
</tr>
</tbody>
</table>
5. PRELIMINARY EVALUATION

1. Plant descriptors

5.1 Fruit

5.1.1 Number of years to first fruiting after sowing/planting [y]

5.1.2 Number of days from flowering to fruit maturity [d]

5.1.3 Fruiting season

1 Early
2 Mid-season
3 Late

5.1.4 Fruiting season

1 Annual
2 Biannual
3 Biennial
4 Non seasonal

5.1.5 Start of fruiting season [YYYYMMDD]

5.1.6 End of fruiting season [YYYYMMDD]

5.1.7 Yield per tree [kg per year]

5.1.8 Number of fruits per tree

Average of ten trees per accession

5.1.9 Fruit productivity [kg/m2]

Average of ten trees per accession. Yield relative to tree canopy size calculated from length and width
5.1.10 Fruit availability [d]

Number of days from the first to the last harvest date

5.1.11 Maturity period

1 Early
2 Intermediate
3 Late

5.1.12 Fruit bearing

3 Poor
5 Medium
7 Heavy

5.1.13 Fruit quality at storage [d]

Number of days of storage under ambient conditions

5.1.14 Eating quality

1 Poor
2 Intermediate
3 Good
4 Excellent

5.1.15 Notes

Specify here any other additional information

6. Abiotic stress susceptibility

Scored under artificial and/or natural conditions, which should be clearly specified. These are coded on susceptibility scale from 1 to 9, viz.:

1 Very low or no visible sign of susceptibility
3 Low
5 Intermediate
7 High
9 Very high
6.1 Reaction to mineral deficiency

1 Nitrogen
2 Phosphorus
3 Potassium
4 Boron
6 Copper
7 Molybdenum
99 Other (specify)

6.2 Reaction to drought

6.3 Notes

Specify here any additional information

7. Biotic stress susceptibility

1 Very low or no visible sign of susceptibility
3 Low
5 Intermediate
7 High
9 Very high

7.1 Pests

7.1.1 Leaf eating caterpillars
7.1.2 Fruit borer
7.1.3 Squirrels
7.1.4 Bats

7.2 Diseases

7.2.1 Powdery mildew
7.2.2 Sooty mould
7.2.3 Fruit blight
7.2.4 Leaf rim blight

7.3 Notes

Specify here any additional information
REPORT ON SURVEY, CHARACTERISATION AND HERBARIUM COLLECTION OF INDIGENOUS FRUIT SPECIES IN BRUNEI DARUSSALAM

THIRD VISIT (23 – 27 OCTOBER 2011)

Project Title

STUDY ON DISTRIBUTION, GENETIC DIVERSITY AND DEVELOPMENT OF INDIGENOUS FRUIT SPECIES IN BRUNEI DARUSSALAM

Submitted to

CAB International
South East Asia Regional Centre

Prepared by

Salma Idris

1 Nov 2011
Programme

24 Oct 2011 - Survey, characterization and herbarium collection of indigenous fruit species at Belait

Preparation of herbarium specimen at Birau Agriculture Station


26 Oct 2011 - Survey, characterization and herbarium collection of indigenous fruit species at Brunei Muara

27 Oct 2011 - Discussion on the problems encountered and suggestion

Day 1 - 24 Oct 2011

a. Preparation of herbarium specimen at Birau Agriculture Station

Two DOA staffs, Mrs Salinda and Mrs Hjh Kamsiah were present to prepare the herbarium specimens. Herbarium specimens which were previously dried and put in the freezer were ready to be mounted. The mounting technique of herbarium specimen was demonstrated. The specimens were mounted on a special paper using glue and also by sewing the thick twig or stem or use some special tape. It was stressed that the specimen should be arranged leaving a space on the bottom right hand corner for putting the label, and also some space at either top right or left hand corner for the herbarium number. It is also important that one should avoid overlap of plant parts. A minimum of one leaf showing upper and lower surface should be displayed. If the leaf is too long or big it can be folded. Any specimens that break off should be put in an envelope and glued together. A mounted specimen should then be labeled.

The labels should contain the date and site of collection (altitude, latitude and longitude) of the plant specimen, the name of the collector, an unique collection number, common name, the species and the botanical family of the plant and the name of who determined the species. A label for the herbarium was prepared as in Fig.1. A lengthy discussion with Mr Takiyuddin, Ms Salinda and Ms Kamsiah was
made as to the name of the herbarium. The name of the herbarium was not decided and it was agreed that Mr. Takiyauddin will discuss and take views of his seniors. This was because the herbarium was previously named ‘BIRAU FRUITS HERBARIUM’ since this herbarium is dedicated to fruit collection in the country. As such the technique of preparing the labels was not done. There were only a few samples mounted for one day work.

**Important points to be remembered:**

The staffs have to bear in mind that for each field survey they have to do three tasks, i.e. diversity survey, characterization and herbarium collection.

For herbarium collection, each collector must have his own collection note book, and the following information must be written in the book. Collector’s number, locality (altitude, longitude, latitude), habitat, family, species, common name and some notes on the characters that do not present in the herbarium specimen. This information has to be given to the technician for preparing the labels for the specimen.

**b. Survey, characterization and herbarium collection of indigenous fruit species at Belait**

Three sites at Belait district were selected for the survey, two of them were semi-wild orchards where as the other one was a home garden. The first two sites completed were:

1. Kampung Ratan, Labi, Belait

   About 20 species of fruits were recorded. Durian, mata kucing and sagu and terap at geowering stage, most interesting is few durian kura-kura flowers near the base of the trunk. New species recorded are sungkit and pitabu. Samples of and flowers were collected for herbarium and data collection.

   Fruit species recorded were:

   1. Durian pulu
   2. Durian kuning
   3. Durian kura-Kura
   4. Bambangan
   5. Belunu
   6. Sungkit
   7. Menungan
   8. Pitabu
   9. Sumsum
   10. Asam Aur
   11. Bago
   12. Tampoi belimbing
   13. Rambai
   14. Langsat
   15. Cempedak
   16. Mata kucing
   17. Terap
   18. Duku
   19. Lemba
2. Kampung Tenunan Labi, Belait District

The species recorded are 17, however one of them, ranca-ranca is dead. New species recorded are binjai nasi and luing.
1. Belunu
2. Binjai nasi
3. Bambangan
4. Mata kucing
5. Tampoi
6. Cempedak
7. Santul
8. Luing
9. Terap
10. Maritus
11. Durian kuning
12. Durian kura-kura
13. Langsat
14. Pauh
15. Pitabu
16. Ranca-ranca – dead
17. Pinanasan

Pinanasan tree is estimated more than a hundred years in age.

3. Kampung Tenunan, Labi, Belait, Stalus – Home garden

There are three species in fruiting, they are bambangan, tampoi and terap. Most interesting is bambangan tree about 5m tall fruits for the second time. Due to time constraint this site is not completely done and will be completed by the staff. We also visited as commercial orchard near station where most clonal materials of commercial fruits are planted, mostly introduced species.

Day 2 - 25 Oct 2011

Survey, characterization and herbarium collection of indigenous fruit species at Temburong

A total of 27 identified species and 7 unidentified species were recorded from four orchards at Temburong district (Table 1). Twelve participants involved in the survey (Appendix 1).
The first farmer, Hj Bahar bin Hj Juned from Kg Bokok, Jln Pendaruan, Temburong possessed a 5 ac orchard. Twenty four fruit species were identified including meritus
(Nephelium sp.) and mahau (Dimocarpus longan subsp. malesianus) (Table 2). The number of trees for the species varied from 1 as in petai, manggis, pengalaban, mata kucing and durian pulu to 500 trees for durian putih and durian kuning. Eight species Parkia speciosa (Petai Thailand, Petai local, Petal bunga), Garcinia forbesii (Asam aur-aur), Artocarpus chempeden (cempedak kampong), Mangifera pajang (membangan), Rhodomyrtus tomentosa (kemunting), Dimocarpus longan sp. malesianus (mata kucing/ mahau), Syzygium malaccense (jambu putat/jambu bol), Garcinia mangostana (manggis putih, manggis masak merah) were characterized (Table 2). Petai Thailand was identified as having the commercial value.

The second orchard (2 ac) belonged to Hj Ahmad Hj Jaafar from KPLB Kg Meniup (Ladang Kelompok), Temburong. A total of 19 fruit species were identified in his orchard. Unfortunately he was not able to give the number of trees for each specie. Six species Nephelium cuspidatum var. robustum (bayong), Dimocarpus longan (mata kucing), Garcinia sp (asam kandis), Durio kutejensis (durian pulu), Baccaurea macrocarpa (tampoi) and Baccaurea angulata (tampoi belimbing) were characterized. It is advised that the staffs should be able to count the number of trees as they walk along the the orchard.

The third orchard which belonged to Hj Mamit Bin Bahar situated adjacent to Hj Ahmad’s orchard. Survey of fruit species was not done in his orchard but two fruit species demaran and bantut were characterised. Similarly, another three species jelayan, limpaung and surapit were characterized from his friend’s orchard of the same area. The staffs from Temburong are advised to revisit the place and record the data for the diversity analysis as well as do characterization of other interesting species if available.

Fruit species that were characterized were collected for the herbarium. Voucher specimens of 19 species and 3 landraces were collected for the herbarium.
Day 3 - 26 Oct 2011

Survey, characterization and herbarium collection of indigenous fruit species at Brunei Muara

Two farmers were visited and a total of 30 species identified (Table 3). Nine participants took part in the survey (Appendix 2).

Tn Hj Johari Mundin from Kg. Batang Perhentian owned an orchard of about 0.75 ac. A total of 19 species were recognized representing from 1 to 20 trees for each specie (Table 4). He obtained the seedlings from Department of Agriculture and also from his friends in the village. Tarap bantal was identified to have potential value where each fruit can cost B$ 3.00 – 6.00. The fruit trees were planted for income and also for conservation of the rare species. Four species Tarap bantal hijau and kuning, Kembayau, Durian kura-kura and Pengelaban were characterized and herbarium specimens collected.

At ladang commercial KPLB Pengkalan Batu Hj. Mutalib Hj Sudin owned 4 ac of orchard land. Twenty two species were identified representing 1 to 50 trees for each specie. A few species such as durian kuning, langsat, tarap, cempedak, kembayau, manggis and duku are identified as having potential value since they fetch high price. Four species *Pithecellobium jiringa* (jering), *Nephelium* sp. (meritus), *Mangifera quadrifida* (rancah-rancah) and *Durio oxleyanus* (sukang) were characterized and herbarium specimens collected.

General observation at these two sites and at Kampung Kuala Lurah shows that:

**Species in flowering**

- Binjai
- Belunu
- Durian pulu
- Durian kura-kura
- Tarap
- Mata kucing
- Cempedak
- Manggis
Species in fruiting

Kembayau
Membangan
Tarap
Jelayan
Sungsum
Menungan
Pengelaban
Asam aur-aur
Kandis
Limau mata kerbau
Bagu
Tampoi
Limpaung
Petai
Jering
Rambai

New species recorded during this trip were:

1. Mahau
2. Damaran
3. Sumsum
4. Bayong
5. Sungkit
6. Menungan
7. Pitabu
8. Rancah-rancah
9. Linggauh
10. Durian sukang
11. Binjai nasi
12. Luing
13. Pelajau
14. Kandis
15. Langsat berok
16. Kamunting
17. Limau kapas
Day 4 (27 Oct 2011) – Discussion

A meeting or discussion was held with Mr Takiyauddin and the staffs at Birau station to discuss about several matters. The participants are remained that the project has many objectives namely to study/do:

- The distribution of fruit trees
- The diversity of fruit trees
- Characterisation and evaluation
- Selection and propagation of elite materials
- Set up herbarium
- Development of database
- Book writing

1. Diversity and distribution of fruit species in terms of diversity of fruit species the progress is very good. Many species were found, identified and located during the survey. There are about so fruit species identified so far and some of them are fruiting. Fruits, seedings and seedings were collected for conservation purpose. As for the distribution of fruit tree species the progress are quite satisfactory. So far is samples/sites were selected and surveyed. They are

   - Brunei Muara: 6
   - Tutong: 3
   - Belait: 3
   - Temburung: 3

   The total number of sites far each district was decided to be 60. It is quite slow as we decided to choose the more difficult sites first i.e the semi-wild stands and the groups planting or ‘ladang kelompok’ owned by many farmers. Such stand consists of many species of fruit trees and many trees per species. It is suggested the staffs carry on doing the survey by themselves in home gardens as such stands are much easier to do.

2. Characterisation and evaluation

   Characterisation of many species have been done. Most of them are not complete, however as many species are at flowering or fruiting stage except for non-seasonal fruits such as limpaung, jering and kelumbi/asam paya, the rest only the trees are characterised, 12 sets of data are entered into computer.
   Characterisation of seasonal fruits are being done. Flower samples are being collected followed by fruit samples during fruiting season (December – January)
Incentive for the guides

It was agreed that the guides involved in the survey and the participants in carrying out the survey are given incentive at the rate of 15 – 30 BD i.e 30 BD for 1 day and 15 BD for ½ day work. As such the amount involved so far is:

<table>
<thead>
<tr>
<th>District</th>
<th>Day</th>
<th>Amount</th>
<th>Total (BD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muara</td>
<td>2(1)</td>
<td>30x2</td>
<td>60</td>
</tr>
<tr>
<td>Tutong</td>
<td>6(½)</td>
<td>15x6</td>
<td>90</td>
</tr>
<tr>
<td>Belait</td>
<td>3(½)</td>
<td>15x3</td>
<td>45</td>
</tr>
<tr>
<td>Temburung</td>
<td>3(1)</td>
<td>30x3</td>
<td>90</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>285</strong></td>
</tr>
</tbody>
</table>

The payment should be made to the guide before the next survey.

3. Problems on herbarium preparation was discussed and the following suggestions were made:

1. Since the staffs are new and do not have any experience in the herbarium technique, they request for an experienced technician who can work together with them in preparing the various types of herbarium samples.
2. They request for a simple pictorial or illustrated guide for preparation of herbarium in Malay language.
3. They request to bring along some samples of herbarium specimens

In view of the above suggestions I have decided the following actions to be taken if they are agreeable to CAB International:

1. To bring along my Assistant Research Officer, Mr. Masrom Hasran to work with the staffs at Birau Agriculture station for three days in late November 2011.
2. A simple pictorial guide for the preparation of herbarium with be prepared
3. Some samples of herbarium specimens may be taken along during the next visit.
4. For characterization of fruit tree species, there is a request to translate the descriptors into Malay language.
For this purpose I will make the translation and at the same time make a revised version based on the data manged to be taken previously.

5. A template for data entry into excel was prepared and given to the staffs (Appendix 3). Data will be given to me to be entered into excel sheet.

5. There was a request for preparing database for characterization data and for herbarium. CAB International should be looking into this matter.

Trip to Bogor
The itenary is more or less planned but the staff involved in the trip still not finalised.

Others matters
Food analysis should be done on fruits during the season. This is not finalised as it is uncertain whether there are enough staff to carry out the anaylysis and the cost involved.

The meeting was adjourned at 11.30 a.m
Table 1. Total number of fruit species in Temburong District

<table>
<thead>
<tr>
<th>No.</th>
<th>Species</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Artocarpus integer</td>
<td>Cempedak</td>
</tr>
<tr>
<td>2</td>
<td>Artocarpus odorotissimus</td>
<td>Tarap</td>
</tr>
<tr>
<td>3</td>
<td>Baccaurea angulata</td>
<td>Tampoi belimbing</td>
</tr>
<tr>
<td>4</td>
<td>Baccaurea lanceolata</td>
<td>Limpaung</td>
</tr>
<tr>
<td>5</td>
<td>Baccaurea macrocarpa</td>
<td>Tampoi</td>
</tr>
<tr>
<td></td>
<td>Baccaurea macrocarpa</td>
<td>Tampoi kampong</td>
</tr>
<tr>
<td>6</td>
<td>Baccaurea motleyana</td>
<td>Rambai</td>
</tr>
<tr>
<td>7</td>
<td>Canarium odontophyllum</td>
<td>Kembayau</td>
</tr>
<tr>
<td>8</td>
<td>Citrus medica</td>
<td>Limau kapas</td>
</tr>
<tr>
<td>9</td>
<td>Dimocarpus longan var. malesianus</td>
<td>Mata kucing kampong</td>
</tr>
<tr>
<td>10</td>
<td>Dimocarpus longan</td>
<td>Mata kucing kahwin</td>
</tr>
<tr>
<td>11</td>
<td>Durio graveolens</td>
<td>Durian kuning</td>
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<tr>
<td>12</td>
<td>Durio kutejensis</td>
<td>Durian pulu</td>
</tr>
<tr>
<td>13</td>
<td>Durio oxleyanus</td>
<td>Durian sukang</td>
</tr>
<tr>
<td>14</td>
<td>Durio testudinarum</td>
<td>Durian kura-kura</td>
</tr>
<tr>
<td>15</td>
<td>Durio zibethinus</td>
<td>Durian putih</td>
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<td>Durio zibethinus</td>
<td>Durian putih kampong</td>
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<tr>
<td></td>
<td>Durio zibethinus</td>
<td>Durian siunggong</td>
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<tr>
<td>16</td>
<td>Garcinia forbesii</td>
<td>Asam aur-aur</td>
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<tr>
<td>17</td>
<td>Garcinia mangostana</td>
<td>Manggis hitam</td>
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<tr>
<td></td>
<td>Garcinia mangostana</td>
<td>Manggis putih</td>
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<tr>
<td>18</td>
<td>Lansium domesticicum</td>
<td>Dokong</td>
</tr>
<tr>
<td></td>
<td>Lansium domesticicum</td>
<td>Duku langsat</td>
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<td>Lansium domesticicum</td>
<td>Langsat</td>
</tr>
<tr>
<td>19</td>
<td>Litsea gracie</td>
<td>Pengelaban</td>
</tr>
<tr>
<td>20</td>
<td>Mangfera pajang</td>
<td>Membangan</td>
</tr>
<tr>
<td>21</td>
<td>Mangifera caesia</td>
<td>Belunu</td>
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<tr>
<td></td>
<td>Mangifera caesia</td>
<td>Binjai</td>
</tr>
<tr>
<td>22</td>
<td>Nepelium ramboutan-ake</td>
<td>Pulasan</td>
</tr>
<tr>
<td>23</td>
<td>Nephelium cuspidatum var. robustum</td>
<td>Bayong</td>
</tr>
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<td>24</td>
<td>Nephelium lappaceum</td>
<td>Rambutan</td>
</tr>
<tr>
<td>25</td>
<td>Parkia speciosa</td>
<td>Petai</td>
</tr>
<tr>
<td></td>
<td>Parkia speciosa</td>
<td>Petai bunga</td>
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<td>Petai Thailand</td>
</tr>
<tr>
<td>Name of Farmer</td>
<td>Locality</td>
<td>Acreage (ac)</td>
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<td>-----------------------</td>
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<td>--------------</td>
</tr>
<tr>
<td>Hj Bahar bin Hj Joned</td>
<td>Kg Bokok, Jln Pendaruan, Temburong</td>
<td>5</td>
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<tr>
<td>No.</td>
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<td>Common Name</td>
</tr>
<tr>
<td>-----</td>
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</tr>
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<td>15</td>
<td><em>Lansium domesticum</em></td>
<td>Dokong</td>
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<td>16</td>
<td><em>Litsea gracae</em></td>
<td>Pengalaban</td>
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<td>17</td>
<td><em>Mangifera pajang</em></td>
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<td>Belunu</td>
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<tr>
<td>19</td>
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<td>Rambutan</td>
</tr>
<tr>
<td>20</td>
<td><em>Parkia speciosa</em></td>
<td>Petai</td>
</tr>
<tr>
<td>21</td>
<td><em>Parkia speciosa</em></td>
<td>Petai bunga</td>
</tr>
<tr>
<td>22</td>
<td><em>Rhodomyrtus tomentosa</em></td>
<td>Kemunting</td>
</tr>
<tr>
<td>23</td>
<td><em>Syzygium malaccense</em></td>
<td>Jambu putat (jambu bol)</td>
</tr>
<tr>
<td>24</td>
<td><em>Nephelium/Dimocarpus sp.</em></td>
<td>Mahau</td>
</tr>
</tbody>
</table>

**Hj Ahmad Hj Jaafar**
KPLB Kg Meniup (Ladang Kelompok), Temburong

<table>
<thead>
<tr>
<th>No.</th>
<th>Plant Name</th>
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<td><em>Baccaurea macrocarpa</em></td>
<td>Tampoi</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td><em>Canarium odontophyllum</em></td>
<td>Kembayau</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td><em>Dimocarpus longan</em></td>
<td>Mata kucing kampong</td>
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</tr>
<tr>
<td>6</td>
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<td>Durian kuning</td>
<td>29</td>
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<tr>
<td>7</td>
<td><em>Durio zibethinus</em></td>
<td>Durian putih</td>
<td>35</td>
</tr>
<tr>
<td>8</td>
<td><em>Lansium domesticum</em></td>
<td>Langsat</td>
<td>16</td>
</tr>
<tr>
<td>9</td>
<td><em>Mangifera pajang</em></td>
<td>Membangan</td>
<td>3</td>
</tr>
<tr>
<td>10</td>
<td><em>Nephelium rambutan-ake</em></td>
<td>Pulasan</td>
<td>6</td>
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<tr>
<td>11</td>
<td><em>Nephelium macrophyllum</em></td>
<td>Bayong</td>
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</tr>
<tr>
<td>12</td>
<td><em>Nephelium lappaceum</em></td>
<td>Rambutan</td>
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<td>Species</td>
<td>Locality</td>
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<td>Achras zapota</td>
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<td>Artocarpus camansi</td>
<td>Kamansi</td>
<td></td>
</tr>
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<td>Artocarpus integer</td>
<td>Cempedak</td>
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<td>Tarap</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Artocarpus odorotissimus</td>
<td>Tarap bantal (hijau &amp; kuning)</td>
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</tr>
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<td>Tarap kampong</td>
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</tr>
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<td>5</td>
<td>Baccaurea macrocarpa</td>
<td>Tampoi</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Baccaurea motleyana</td>
<td>Rambai</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Canarium odontophyllum</td>
<td>Kembayau</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Citrus microcarpa</td>
<td>Limau kasturi</td>
<td></td>
</tr>
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<td>9</td>
<td>Dacyodes rostrata f. cuspidata</td>
<td>Penindasan</td>
<td></td>
</tr>
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<td>Dimocarpus longan</td>
<td>Mata kucing</td>
<td></td>
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<td>11</td>
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<td>Durian kuning</td>
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<td></td>
<td>Durio graveolens</td>
<td>Durian suluk</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Durio oxleyanus</td>
<td>Durian sukang</td>
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</tr>
<tr>
<td>13</td>
<td>Durio testudinarum</td>
<td>Durian kura-kura</td>
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<tr>
<td>14</td>
<td>Durio zibethinus</td>
<td>Durian putih</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Garcinia forbesii</td>
<td>Asam aur-aur</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Garcinia mangostana</td>
<td>Manggis local</td>
<td></td>
</tr>
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**Table 3. Total number of fruit species in Brunei / Muara District**
<table>
<thead>
<tr>
<th>No.</th>
<th>Scientific Name</th>
<th>Common Name</th>
</tr>
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<td>1</td>
<td>Achras zapota</td>
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<td>Artocarpus camansi</td>
<td>Kamansi</td>
</tr>
<tr>
<td>3</td>
<td>Artocarpus odorotissimus</td>
<td>Tarap bantal hijau</td>
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<tr>
<td></td>
<td>Artocarpus odorotissimus</td>
<td>Tarap bantal kuning</td>
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<td>Tarap kampong</td>
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<td>4</td>
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<td>5</td>
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<td>Mata kucing</td>
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<td>6</td>
<td>Durio graveolens</td>
<td>Durian kuning</td>
</tr>
<tr>
<td></td>
<td>Durio graveolens</td>
<td>Durian suluk</td>
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<tr>
<td>7</td>
<td>Durio testudinarum</td>
<td>Durian kura-kura</td>
</tr>
<tr>
<td>8</td>
<td>Durio zibethinus</td>
<td>Durian putih</td>
</tr>
<tr>
<td>9</td>
<td>Garcinia forbesii</td>
<td>Asam aur-a'ur</td>
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</table>

He mentioned about the species but not seen

Table 4. List of fruit species owned by farmers at Brunei / Muara District

<table>
<thead>
<tr>
<th>Name of Farmer</th>
<th>Locality</th>
<th>Acreage (ac)</th>
<th>Spp. No.</th>
<th>Scientific Name</th>
<th>Common Name</th>
<th>No. of trees</th>
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<td>3</td>
<td>Artocarpus odorotissimus</td>
<td>Tarap bantal hijau</td>
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<td></td>
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</table>

• He mentioned about the species but not seen
<table>
<thead>
<tr>
<th>No.</th>
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<th>Quantity</th>
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<td>Langsat</td>
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<td>12</td>
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<td>Pengalaban</td>
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<td>13</td>
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<td>Belunu</td>
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<td>14</td>
<td>Mangifera pentandra</td>
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<td>Mempelam</td>
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<td>15</td>
<td>Nephelium lappaceum</td>
<td>Rambutan biji</td>
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<td>16</td>
<td>Nephelium lappaceum</td>
<td>Rambutan klon</td>
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<tr>
<td>17</td>
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<td>Rolline</td>
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<td>Kamansi</td>
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<tr>
<td>21</td>
<td>Baccaurea macrocarpa</td>
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<td>Tampoi</td>
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<tr>
<td>22</td>
<td>Baccaurea motleyana</td>
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<td>Rambai</td>
<td>3</td>
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<td>23</td>
<td>Canarium odontophyllum</td>
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<td>Kembayau</td>
<td>7</td>
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<tr>
<td>24</td>
<td>Citrus microcarpa</td>
<td></td>
<td>Limau kasturi</td>
<td>20</td>
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<tr>
<td>25</td>
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<td>Penindasan</td>
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<td>26</td>
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<td>27</td>
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<td>Durian sukan</td>
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<td>28</td>
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<td>Durian putih</td>
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<td>29</td>
<td>Garcinia forbesii</td>
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<td>Asam aur</td>
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<tr>
<td>30</td>
<td>Garcinia mangostana</td>
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<td>Manggis local</td>
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<tr>
<td>31</td>
<td>Lansium domesticum</td>
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<td>Langsat</td>
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<td>Mangfera pajang</td>
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<td>Membangan</td>
<td>4</td>
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<tr>
<td>33</td>
<td>Mangifera caesia</td>
<td></td>
<td>Beluno</td>
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<td>Location</td>
<td>Count</td>
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<td>22</td>
<td><em>Nephelium sp.</em></td>
<td>Meritus</td>
<td>1</td>
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</tr>
</tbody>
</table>
Appendix 1.

Name of participants joined the survey at Temburong on 25 Oct 2011

1. Dr Salma Idris
2. Mrs Rukayah Aman
3. Mr. Takiyaudin Hj Mohamad
4. Mrs. Hjh Jamilah Hj Abidin
5. Sanah Hj Burut
6. Sabtu Sitai
7. Jumin Lamat
8. Kamal Hj. Lakim
9. Abd Aziz Abdullah Rangau (Driver)
10. Rahim Othman (Driver)
11. Hj. Abdul Latif Adnan (Driver)

Appendix 2.

Name of participants joined the survey at Brunei Muara on 26 Oct 2011

1. Dr Salma Idris
2. Mrs Rukayah Aman
3. Mr. Takiyaudin Hj. Mohamad
4. Mrs. Hjh Jamilah Hj Abidin
5. Jumin Lamat
6. Kamal Hj Lakim
7. Jaafar Hj Khamis
8. Selamuda Kandang
9. Radin Ali
Annex 4. Report on Fruit Collection Trip
REPORT ON SURVEY, CHARACTERISATION AND HERBARIUM COLLECTION OF INDIGENOUS FRUIT SPECIES IN BRUNEI DARUSSALAM

FOURTH VISIT (8 – 13 January 2012)

Project Title

STUDY ON DISTRIBUTION, GENETIC DIVERSITY AND DEVELOPMENT OF INDIGENOUS FRUIT SPECIES IN BRUNEI DARUSSALAM

Submitted to
CAB International
South East Asia Regional Centre

Prepared by
Salma Idris
Rukayah Aman

17 January 2012
**Programme**

Day 1 & 2 (9 -10 Jan 2012). Collection and characterization of fruit species from Brunei Muara and Tutong Districts

Day 3 (11 Jan 2012) Collection and characterization of fruit species from Belait District

Day 4 (12 Jan 2012). Collection and characterization of fruit species from Temburong District

Day 5 (13 Jan 2012). Visit to Agriculture Station Pedayen

Day 5 (13 Jan 2012). Characterization and photography

1. **Collection and characterization of fruit species (9 Jan 2012)**

   a. **Brunei Muara District**

   Two homegardens from Kampong Bebuloh were visited. Pn Jait bt Siput owned a land of about 3 ac consisting of about 13 fruit tree species. Among the fruit trees available are terap (10 trees), membangan (3), durian kuning (20) mempelam (2), mata kucing (5), maritus (2), cempedak (10), kembayau (5), pengalaban (1), sukun (2), lakang (1) langsat (6), durian putih (10). The fruit samples collected for characterization from her orchard were tarap bantal and bantut. The other fruit trees that are fruiting but not matured yet are mata kucing and bantut. The other fruit trees that are fruiting but not matured yet are mata kucing and bantut.

   The second farmer Pn. Norsinah Abdullah from Kg Bebuloh has about 10 fruit species planted in the home garden. These species are pengelaban (1), bambangan (1), kembayau (2), terap (1), durian pulu (1), durian kuning (1), limpaung (2), rambutan (3), kulor (2), tampoi (2). Fruit samples collected were limpaung and bambangan. For the other species such as tampoi, mata kucing and pengelaban the fruits will be matured in another month.

   b. **Tutong District - Orchard farm**

   Two sites in the Kg. Kupang was selected for fruit sample. In these site only one sample was collected, i.e ngalau. In the surrounding areas, several species were spotted. They are rancah-rancah, santul, kecapi, jambubol and ngalau. Rambai, durian pulu and tarap are fruiting but not yet ripe.

   Samples of fruits, collected from the two sites were as follows:

   1. Sulang
   2. Pengelaban
   3. Tampoi
4. Mangosteen
5. Durian putih
6. Mambangan
7. Ngalau
8. Asam aur-aur
9. Langsat

**Propagation technique**

Propagation techniques suitable for a number of fruit species was demonstrated by Hj. Ruslan Daud to DOAA staffs from Temburong. It is felt that a simple propagation chamber is needed to facilitate propagation and also to increase the percentage of success of the materials.

2. **Collection and characterization of fruit species (10 Jan 2012)**

   i. **Kampong Batang Perhentian**

   The diversity data was taken before from Tn. Hj Johari’s orchard from kg. Batang Perhentian. Not all fruit trees in his orchard were fruiting. Fruit samples collected were terap bantal kuning and hijau, durian kura-kura, asam aur-aur, kembayau, and membangan. Other fruits such as langsat, durian kuning, durian pulu and mata kucing will be matured by next month.

   ii. **Kampong Kasat**

   Three other orchards in the kampung Kasat surveyed during the last visit were chosen for fruit samples. There were not many species fruiting at the site selected and a number of them such as kembayau, asam aur-aur, jackfruit and cempedak were already harvested. However, in the villages and the surrounding areas, species such as tarap, rambai, mata kucing, belunu, binjai and kembayau were fruiting heavily. A number of rare species were located in the area. They were rancah-rancah, lakang, meritam temuda, jambu bol, kepayang matan and sungkit.

   In general at Muara district, the fruit season is not a heavy one. Not many trees in the orchards produce fruits and those that bear fruits also do not produce many fruits. Fruits that are maturing during the time of collection are terap, durian kuning, bambangan, limpaung, pengalaban (in some places), aroi-aroi (end of season), kembayau (also almost end of season), durian kura-kura, rambutan.
2. Collection and characterization of fruit species from Belait District
   (11 Jan 2012)

Four sites were surveyed and samples of fruits were brought to the laboratory for
characterization and evaluation. The four sites are Kg. Tenunan, Kg. Lait Lakang, Kg.
Kukup and Kg. Sukang, Ulu Belait.

This is also not a good fruiting season in Belait district. At Labi, very few trees were
fruiting. Only one fruit sample, tampoi, was collected from Pn Halimah’s home garden at
Kg Tenunan.

A new orchard belonged to En Zaini Diok from Kg. Lait Lakang was visited. The
orchard about 3.6 acres consists of about 16 species of fruit trees which are semi
cultivated. The fruit trees were tampoi kuning (10), durian kuning (1) sukang (1), langsat
(>50), cempedak (>10), durian pulu (50), durian isi merah (1), mata kuching (8), bantut
(1), kemanggis (1), tampoi belimbing (1), bayung (1), arut (1), Lakang (1), durian kura-
kura (1) and langir hutan (1). Fruit samples collected from this orchard were durian
kuning isi merah, bantu, lakang, bayung, arut, lakang kuning, kemanggis, langsat, langir
hutan, durian merah. Durian pulu and tampoi belimbing will be matured in a month time.

Another the two sites visited were at Kg. Kukup and Kg. Sukang, Ulu Belait. At
Kampung Sukang 15 species of fruits were recorded which includes a wild edible
species called Bendulang. The species recorded were :-

1. Matan
2. Bendulang
3. Membangan
4. Mangosteen
5. Langsat
6. Durian Sukang
7. Durian Kura-Kura
8. Cempedak
9. Sum sum
10. Jelayan
11. Tampoi Belimbing
12. Durian Kuning
13. Mata Kucing
14. Pinanasan
15. Kembayau

Samples of matan, mambangan, mangosteen, langsat and bendulang were
collected. At Kg. Kukup, although many fruit trees and species were recorded only two
sample of fruits i.e sungkit and jackfruit were collected as many fruits were eaten by
monkeys. The species recorded were:-
3. Collection and characterization of fruit species from Temburong District (12 Jan 2012)

From Tn Hj Bahar’s orchard at Kg Bokok, fruit samples collected were cempedak, manggis masak putih and hitam and bambangan. Manggis merah/hitam is indigenous to Brunei where the fruit is ovoid in shape and leaves are incurved while manggis putih which actually turns black also on ripening the fruits are round and the leaf surface is flat.

While at Kampung Meniup, many species were seen fruiting. Membangan, tarap, cempedak, kandis, kembayau, maritam, terap, cempedak, kandis, kembayau, maritam, surapit, tampoi and durian were fruiting heavily and fruits of membangan dropped abundantly under the trees.

The fruits collected for characterisation and evaluation were:

1. Membangan
2. Cempedak
3. Pengelaban
4. Kandis
5. Asam aur-aur
6. Limpaung
7. Langsat
8. Bantut
9. Maritam
10. Surapit

i. Visit to Agriculture Sg. Perdayan station, Temburong

The station has field genebank of indigenous Brunei fruit tree species. Many species were fruiting. Ten fruit species collected from this station were maritam arang, maritam, durian-kura-kura, durian kuning, durian putih, meritus, maritam temuda, durian meragang, tampoi belimbing, surapit
ii. Tamu Temburong

A number of species are sold in the tamu. Fruits collected from tamu are binjai, durian kuning, kembayau, bambangan and the dry fruit of asam aur.

5. Characterization and photography (13 Jan 2012)

Characterization work on the collected fruit and leaf samples was done. Photographs of the fruit samples were taken. Some samples were processed for herbarium.

6. Discussion (14th January 2012 - Saturday)

A discussion was held with the staffs involved in the data collection to discuss the data collection and the list of fruit species. The list was shown the staffs and they were reminded about the species in fruiting, data should be collected when the fruits ripe and can be harvested. About 33 species were collected so far and characterisation were done (Table 1). A number of species are fruiting now. The others bear flower and fruit at different time of the year. Observation will be done from time to time for these species. The staffs were also reminded to refer the handouts given during the lecture and the books to help them in the data collection.

6. Data entry

Data from the previous collection and some from the recent collection were taken back. Data are being entered into excel data sheet.

Table 1. List of fruit species collected

1. Terap (bantal & biasa)
2. Membangan
3. Limpaung
4. Lakang
5. Bantut
6. Kembayau
7. Durian kuning
8. Durian kura-kura
9. Durian merah (Meragang)
10. Tampoi
11. Arut
12. Asam aur-aur
13. Langsat
14. Bayong
15. Langir hutan
16. Kemanggis
17. Cempedak
18. Manggis merah
19. Maritam arang
20. Maritam temuda
21. Maritam merah
22. Meritus
23. Matan
24. Bendulang
25. Sungkit
26. Jackfruit
27. Tampoi belimbing
28. Surapit
29. Pengalaban
30. Kandis
31. Binjai
32. Sulang
33. Durian putih
34. Ngalau
35. Kandis
Annex 5. Report on the Study Visit to Bogor, Indonesia
REPORT ON STUDY TOUR TO BOGOR, INDONESIA 15 – 20 NOVEMBER 2011

for

project on

STUDY ON DISTRIBUTION, GENETIC DIVERSITY AND DEVELOPMENT OF INDIGENOUS FRUIT SPECIES IN BRUNEI DARUSSALAM

By

SALMA IDRIS
MARDI, SERDANG
30 November 2011
1. **Participants**

1. Mr. Takiyaudin Mohmad (DOA Brunei Darussalam)
2. Hajah Kamsinah binti Haji Ibrahim (DOA Brunei Darussalam)
3. Ms. Salinda Binti Sitim (DOA Brunei Darussalam)
4. Mrs. Rukayah Aman (Consultant)
5. Dr. Salma Idris (Consultant, MARDI)

2. **Officer in charge of the visit**

   Dian Kurniasih - ICHORD

3. **Tour Guide**

   1. Mrs. Apri Laila Sayeki – ICHORD (16-18 Nov. 2011)
   2. Mr. Aditya Marendra Kiloes – ICHORD (19-20 Nov. 2011)

4. **Programme of visit**

   **Day 1:** 16 Nov. 2011  
   Cibodas Botanical Garden (morning)  
   Taman Bunga Nusantara (evening)

   **Day 2:** 17 Nov. 2011  
   Herbarium (morning)  
   Bogor Botanical Garden (evening)

   **Day 3:** 18 Nov. 2011  
   Mekarsari Tourism Park (morning)  
   Visit ICHORD (evening)

   **Day 4:** 19 Nov. 2011  
   Warso Farm (morning)  
   Visit an exhibition on innovation in agriculture by the Department of Agriculture (evening)

5. **Objectives of study visit**

   i. To learn the procedures and requirement for establishing and maintaining a Fruit Arboretum, the steps to be taken in conserving indigenous fruits in-situ and ex-situ
   ii. To learn on the process of specimen, identification, preservation and management of herbarium specimens of indigenous fruits and management of databases
   iii. To learn new researches & development and commercialization of indigenous fruits
1. **Cibodas Botanical Garden**

Cibodas Botanical garden (Kebun Raya Cibodas) about 85 ha is situated at about 1,300 – 1,425 m at the foot of Mount Gede-Pangrango at Cianjur in the subdistrict of Cibodas. The temperature is 20°C while the humidity is 60-80 %. It was first founded by the Dutch Botanist Johannes Elias Teysjmann in 1862 who first planted the Cinchonna trees for the production of quinine. The garden consists of indigenous highland flora and also introduced species represented by about 1,293 species of plants, 144 species of lichen and also herbarium collection. Orchids, cactus, and succulents are maintained in glasshouses. *Amorphophallus titanum* or Carcass flower is another interesting plant being collected and conserved. The main aim of the garden is for conservation, research, education and recreation.

During the trekking along the footpath among the plant species observed were *Ficus ferrigata*, *Strobilatus*, *Pandanus* sp., *Zingiber*, *Ardesia crenatum*, *A. cestrum*. Other plants include the fern, palms, bamboos, *Rhododendron*, *Prunus*, *Magnolia*, *Begonia* and *Amorphophallus*. The group also visited the lichen collection and the glasshouse collection for orchid and cactus.

**Lessons learned:**
1. Exchange of planting materials with other botanical gardens from other parts of the world such as Australia, Japan, China, Burma, India and many others has been practiced and this helps to enrich the botanical garden with exotic plant species
2. The beautiful mountain scenery with undulating topography and cool weather together many interesting sites has attracted many students, researchers and tourists for ecotourism.
3. Each officer is specialized in one family and thus expedite collection and conservation.

2. **Taman Bunga Nusantara**

The garden covers an area of 23 ha and was officially declared by President Soeharto in 1995. It displays flowers with a variety of colours and shapes from all around the world. The largest display is the giant peacock which is made up of over 25,000 flowering plants. There are also a variety of specialty gardens ranging from water gardens, rose gardens, French garden, secret garden (labirynth), American bali garden, Mediterranean garden, palm garden, and Japanese style gardens. Besides there are also other facilities for entertainment especially for children.
Lessons learned:
1. Taman Bunga Nusantara is well planned and managed and attracted many visitors and tourists to visit the place
2. The beautiful flowers displayed in the garden has created public awareness on the existing of wonderful flowers from local and abroad

3. Herbarium Bogoriense

The herbarium is under the facility and collection division of LIPI (Lembaga Ilmu Pengetahuan Indonesia) situated at Cibinong. The herbarium focused on conservation and curation of specimens, human resources development and information system management. The Herbarium Bogoriense hosts about 2 million specimens of plants and fungi, and is a source of biodiversity information for the Malesian region.

The group was exposed to the various steps in herbarium preparation starting from sample pressing, drying in the oven, mounting, labeling, freezing, and cataloguing. The specimens which are completely labeled are stored in the cabinet. The liquid preservation specimens and the carpological collection are also visited. The old specimens are remounted. In addition, the specimens are also kept as digital collection. The exchange of herbarium specimens with other herbaria in the world helps to increase the collection. All records are kept in database and information can be retrieved. At present there are about 30 botanists working in the herbarium.

The herbarium functions as a referral centre for the botanists and Botany/taxonomy/diversity education and to students and public.

Molecular Laboratory

This laboratory is concentrated in determining the ploidy level of the cultivated and wild bananas using ISSR and RFLP. The wild and cultivated bananas are used in breeding programme for disease resistant..

Tissue culture Laboratory

Tissue culture technique is used to mass propagate selected plants such as orchids, bananas, Coleus sp. (kentang hitam).

Lessons learned:

1. Each botanist is specialized in one or two genera or families and thus facilitate in identification of specimens.
2. Specimens are also being identified and verified by visiting scientists
3. The herbarium is opened to visitors on Thursday and is visited by many people including the school children and university students. The students are exposed to plants, conservation and diversity at an early age.
4. The herbarium offers training on herbarium processing and maintenance.
5. Preparation and maintenance of herbarium specimens learned.

4. Bogor Botanical Garden

The Botanic Garden was established on 18 May 1817 by Dr C.G.C. Reinwardt who became the first director of the garden. The garden functions as a place for conservation, research, education, recreation and ecotourism. Its mission is to be the best botanical garden in the world. The garden is made up of 87 ha comprising more than 3,000 species and 18,000 specimens.

Besides the in situ conservation research is also being carried out on the ex situ conservation of priority species. Priority species were selected based on the IUCN list of endangered species. Three fruit species tampoi (Baccaurea macrocarpa), belimbing merah (Baccaurea angulata) and gitak madu (Willughbeia sp.) were selected. Collection of the fruits was carried out in Kalimantan. Variation within the species was noted and elite accessions were determined. The superior accession was propagated vegetatively and planted for observation.

Lessons learned:
1. Cleft grafted seedling of tampoi bear flowers after five years of planting
2. Grafted Baccaurea dulcis took three years to bear fruits

6. Mekarsari Amazing Tourism Park

Makarsari is a beautiful park opened in 1995 with an area of 264 ha. located in the Cileungsi, Kabupaten Bogor. It is a conservation centre of plant diversity of tropical fruit crops collected from all regions in Indonesia and also from other parts of the world. Fruit trees occupy an area of about 90 ha. Fruits such as durian, salak, rambutan, oranges, jackfruit, starfruit and many others were planted in plots. Introduced fruits such as Pouteria champechiana and Annona muricata were also planted. A stall selling fruits to the visitors is also located in the park. The fruit crops are also planted in glasshouses for display to the visitors e.g. melon. Fruit seedlings are produced or propagated and managed in the nursery of about 5 ha. The visitors can walk around the park or they may use a tramp. The main objective of the park is for conservation, education, recreation and agrotourism. Besides the fruit trees
there are also other areas of attractions and exciting facilities such as family walk zone, festival point, central park, Mediteran exotic zone, Greenland zone and water zone to be visited by family, friends and school children.

Lessons learned:

1. Linking fruit trees to ecotourism has proven to be successful.

2. The public learned about the local fruit species and also the exotic fruits and thus increased public awareness on the diversity of fruit species.

7. WARSO Farm

The 23 ha farm is located at Gihideung. Seventeen hectares were planted with 11 types of durian such as Petruk, Otong, Sitokong, Emas, Matahari, Kan yau and Monthong. The good durian are Petruk, Otong, Matahari and Emas which can fetch a price of Rp 40,000 per kilogram. Durio kutejensis or locally known as buah lai is also cultivated. The age of the plants ranged from 5-18 years old. Another 6 ha of land is planted with dragon fruit. One kilogram of dragon fruit costs about Rp 35,000. The farm is opened during weekends and they sell the fruits produced from the farm only. The nursery propagate elite accession of fruit planting materials and sell them to the farmers. The farm also provide facilities such as meeting room and children’s playground.

Lessons learned:

1. Durian fruits are tied with a string to avoid fruit damage if it fell down

2. Thinning of the fruit is being practiced so as to get big and uniform size fruit

3. Organic fertilizer is applied to the durian trees once a year, but those trees that do not produce regular fruits they are being fertilized twice a year

4. The trees are sprayed with flowering hormone to make it produce flower and fruit

5. Assisted pollination is being practiced in the dragon fruit plants so as to get more fruit production
8. Other places visited

1. Exhibition on innovation of agriculture technology by the Department of Agriculture in Indonesia which was held in Bogor. The booth displayed on the diversity and use of mango by DOA from Kalimantan is related to our work. The value added product from *Mangifera kasturi* such as juice and dodol were displayed.

2. Visit to ICHORD, courtesy visit to Dr Nono Sutrisno who has helped in arranging the programme and made our visit a reality.

9. Contact Persons

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<tr>
<th>No.</th>
<th>Name</th>
<th>Institution</th>
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<td>1.</td>
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<td>5.</td>
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<td>6.</td>
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<td>Tour guide from ICHORD</td>
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<tr>
<td>7.</td>
<td>Dr Nono Sutrisno</td>
<td>Contact person for the visit</td>
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11. SUMMARY

The group has gained benefit from this visit particularly in the area of herbarium preparation and maintenance, planting of fruit trees for ecotourism and also diversity research on underutilized fruit.
Research on activities of fruit genebanks is being carried out at Malang (Java) and Solok (Sumatra).

12. ACKNOWLEDGEMENT

The group would like to thank CABI for giving us the opportunity to visit various places in Bogor Indonesia.

Special thanks is also due to the ICHORD staff particularly Dr Nono Sutrisno and Ms Dian Kumiasih for their kind help in arranging the programme of the visit and their hospitality during our visit to ICHORD.
Photos during Study Tour

1. Cibodas Botanical Garden

Walking along the trek

Algae garden

Orchid collection in a glasshouse

Cactus collection in a glasshouse
2. Taman Bunga Nusantara

Flowers displayed forming a peacock

Flowers in a France Garden

Surinam cherry tree

Japanese Garden
3. **Herbarium Bogoriense**

- Tissue culture laboratory
- Tissue cultured banana plants
- Pressing herbarium specimens
- Tying specimens within the presses
- Drying of specimens in an oven
- Mounting of specimens using tape
Labelling of specimen
Specimens in a low temp freezer
Type specimens in a special folder
Herbarium cabinets
Herbarium samples in a cabinet
Spirit collection
4. Bogor Botanical Garden

Pandanus species

Palm garden

Nursery

Old trees with big buttresses
5. Mekarsari Tourism Park

- Propagation of orchids through tissue culture
- Planting melons in a glasshouse
- Salak garden
- Salak garden (Pondoh)
- Fruit selling centre
- Entrance to Mekarsari
WARSO Farm

Durian farm

Dragon fruit farm

Entrance to office

Durian fruits tied with strings to prevent from falling down