

HEART OF BORNEO, SERIES 12

SARAWAK
AGROFORESTRY LANDSCAPE

Forest Department Sarawak

HEART OF BORNEO INITIATIVE

HEART OF BORNEO, SERIES 12

SARAWAK AGROFORESTRY LANDSCAPE

Forest Department Sarawak

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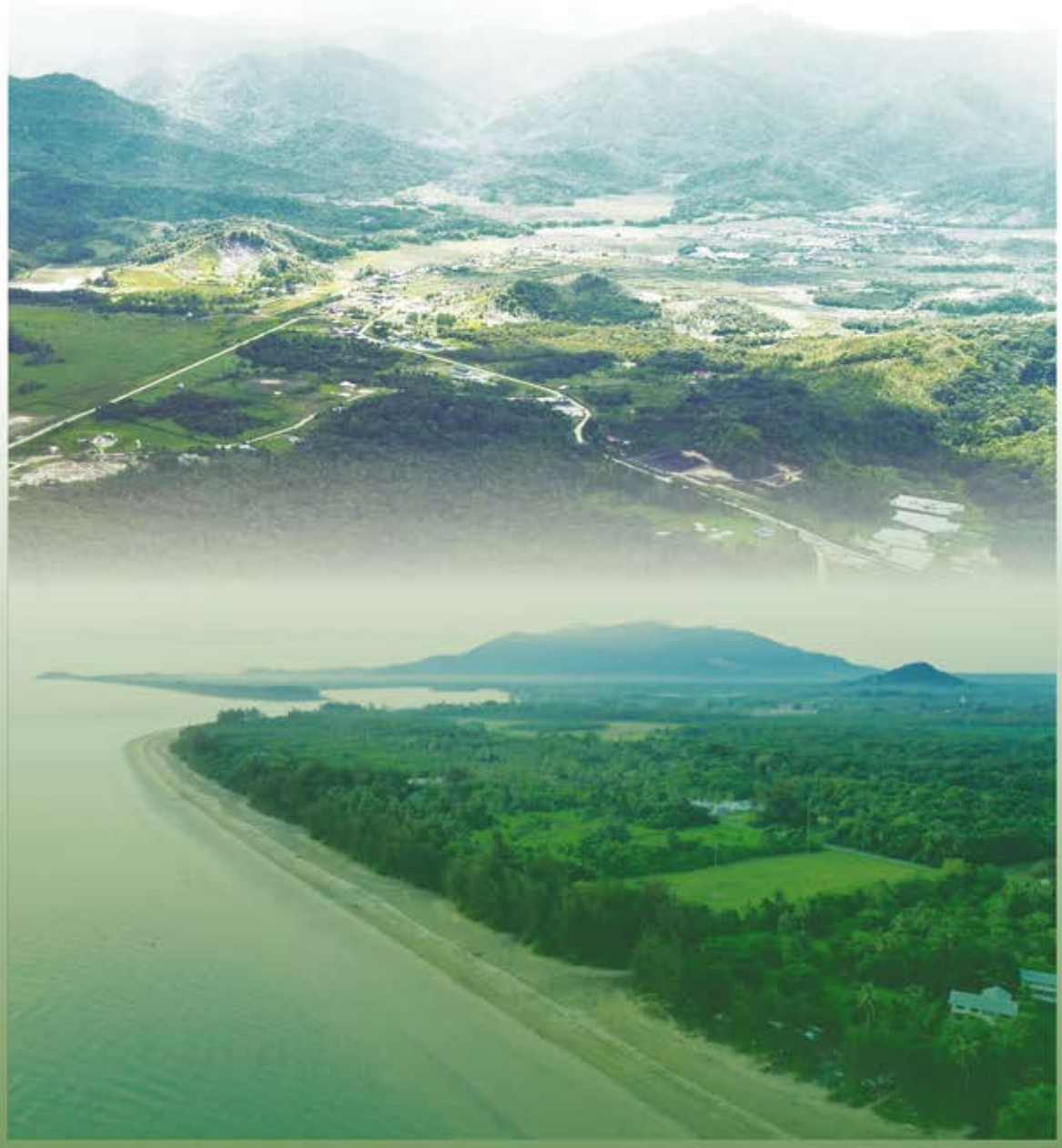
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MESSAGE AND SALUTATION



Message from

THE RIGHT HONOURABLE CHIEF MINISTER OF SARAWAK



The Sarawak Government's Post-Covid-19 Development Strategy 2030 (PCDS) has been formulated to bring about development in a sustainable manner towards 2030. This brings the state economy to focus on the green economy agenda supported by diversification of resources and revenue-generation, rural transformation, eco-tourism, and non-dependence on forest timber products. This shift towards a green economy points to a fundamental fact that agroforestry is poised to be an important industry in the State as part of the PCDS in order for Sarawak to stay on track to achieve a developed status and high-income economy by 2030.

As well as building on practices applied in the forestry and agriculture sectors, agroforestry's practice also works towards land protection and conservation via more effective protection of forest and jungle stocks, crop and animal live-stocks, control of soil erosion, soil salinity, water logging and pollution, floods, forest landscape restoration, and non-damages to water tables. Results and researches in few countries have affirmed that agroforestry has immense benefits for the environment and the industry or farmers.

Thus, being aware of the immense potentials of agroforestry to the State's economy, the State Government is all for an accelerated growth of the agroforestry industry and any effort that can help to inspire the industry and farmers towards this end is very much welcomed. Therefore, I would like to congratulate the Forest Department for the great effort in producing an entertaining and inspiring coffee table book showcasing activities in pursuit of the agroforestry agenda.

Thank you.

YAB Datuk Patinggi Tan Sri (Dr) Abang Haji Abdul Rahman Zohari
Bin Tun Datuk Abg Hj Openg



Message from

DATU HAMDEN BIN HAJI MOHAMMAD
DIRECTOR OF SARAWAK FORESTRY DEPARTMENT

The need to have good forest landscape restoration (FLR) is vital as part of the State Government's ongoing programme to ensure the ecological balance in our State's green environment, as well as to reap the ideal agricultural and forestry revenues without damaging and harm to the natural forest landscapes of our lands. Agroforestry is not a new concept, but is practised by mankind since time immemorial in many countries. It requires a good inter-link or symbiotic cycle among the trees, crops, and animals. Like in many developed and developing countries, agroforestry is now the way forward to integrate forestry and agricultural activities, whether for small holdings or big scale ventures. Researchers have highlighted that agroforestry can reap substantial benefits from economical and environmental angles, given that it can produce more outputs, besides being more sustainable than forestry or agricultural mono-cultures.

An obvious example of agroforestry's benefit is that it facilitates the reclamation of eroded and degraded land, besides augmenting soil water availability to land use systems.

Agroforestry provides a more diverse farm economy, supporting and stimulating the whole rural economy, enabling happy communities with more stable farms and agricultural or forest activities. Revenue or economical risks can be mitigated when agroforestry systems produce multiple products.

I am happy that the Forest Department is able to compile an entertaining coffee table book that showcases amongst others the journey Sarawak has taken, and is embarking upon, to record general highlights and progresses in the State's agroforestry pursuits.

Message from

MR DAWEND JIWAN
SENIOR EXECUTIVE FORESTER
(AGROFORESTRY), SOCIAL FORESTRY DIVISION



- *Pioneer Agroforester*
- *Deputy President, Malaysia Society of Agroforestry (MYSAF)*

Agroforestry, agriculture, and forestry are the three principal land-use sciences. Agroforestry is ecology-driven.

Its concept and application are not complex, and have been practised by rural dwellers in all countries long ago, although they may not have realised it. It takes into account the management and integration of (i) trees, (ii) crops and (iii) animals or livestock at the common location or from the same plot of land. Indeed it is an integral component of productive agriculture.

In Sarawak it includes existing native communal reserve (heritage) or forests that landholders have established on their small or large-sized land holdings.

Unlike forestry and agriculture, agroforestry puts emphasis on the integration of, and interactions among, combined elements of trees, crops and animals, rather than just individual focus on each.

Agroforestry is a good approach to diversify resources and sustainable environmentally-friendly income, especially among rural communities. Inter-cropping is a feature of agroforestry, a practice where two or more crops on the same land plot are cultivated. This is for variety, and maximum multiple product yields. The practice of inter-cropping in agroforestry can reduce operational costs for small or large scale applications.

We are fortunate that in Sarawak, the State Government has clear focus and strong desire to see that the concept and fundamentals of agroforestry are to be properly understood and appreciated by the communities. The government is also serious in ensuring that the sustainability of multiple natural resources and rural income gains continue to be enhanced, with better and wider applications of agroforestry systems or methodologies, and that this agroforestry industry is encouraged aimong the bigger industry players to promote green economy and preservation of ecologically friendly cultivation by both urban and rural dwellers.

Integral concept of agroforestry has the elements of inter-row, strip, hedge row, cluster, swidden, corridor mosaic etc at the aerial perspective, and multi-layer at the vertical level profile. Agroforestry is inclusive. It cuts across all barrier of landscape, habitat, race, religion, gender, and demography.

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INTRODUCTION AND HISTORY OF SARAWAK FORESTRY DEPARTMENT

SARAWAK

Sarawak is on the northwest coast of Borneo Island. Its area is 48,300 square miles.

Formalisation of Forest Department

In 1919, Mr. J.P. Mead became the first Conservator of Forests, Sarawak Forest Department. The Department's objectives were to manage and conserve Sarawak's forest resources. Since then, the Department has grown in strength. Combined with the Sarawak Forestry Corporation's manpower, the Department has a few thousand staff today.

Earlier responsibility of the Department was (a) the constitution of the Permanent Forest Estate and (b) the regulation of the taking of forest produce. Today its responsibilities include (i) resource planning, (ii) forest economics, (iii) forest engineering, (iv) forest and forest product researches, (v) national parks and wildlife conservation, (vi) law enforcement & preventive work.

The Department is a technical and scientific department and has concern for (i) forest management, (ii) forest protection, (iii) the efficient and effective utilisation of the forest resources and (iv) the preservation and conservation of floras and faunas in Sarawak.

Policy

A forest policy was first adopted in 1954, when the Department mapped out strategies for (a) sustainable forest management and (b) forest conservation. These strategies include:

(i) enlarging the Permanent Forest Estate

(ii) enforcing the (a) Forests Ordinance 1958 (Cap. 126), (b) the National Parks and Nature Reserve Ordinance 1998, and (c) the Wildlife Protection Ordinance 1998.

(iii) harvesting forests selectively

(iv) practising multiple-use forestry

(v) undertaking applied research in silviculture, ecology, and forest operations

(vi) establishing more national parks, nature reserves & wildlife sanctuaries, and undertaking a detailed resource inventory of these areas

(vii) developing infrastructure & recreational facilities in national parks & nature reserves to boost their tourism potentials

(viii) conducting long-term research on protected wildlife species, conservation management of hunted species & habitat management

(ix) Researching to improve the utilisation of timber.

Agroforestry

The Forest Department of Sarawak's strategy is (a) to practise multiple-use forestry and (b) to undertake applied research in silviculture, ecology, and forest operations. This is very much in the spirit of, and platform for, agroforestry.

Forest re-creation

Sarawak has a replanting or re-forestation agenda, spurred by awareness like BBtRf or *'Bring Back the Rainforest'* (BBtRF). This is an initiative by Sarawak Forestry Corporation (SFC) as part of the State's habitat rehabilitation efforts to bring back the rainforest landscape. Native plant species are planted to provide good food sources and a conducive environment for the wildlife residing within the designated forest reserve.

Wetness and rain

A dominant feature of the Sarawak landscape is the multitude of its streams and rivers. Sarawak has heavy and constant Rainfall. These waters drain away in a series of rivers that traverse from the highlands to the midlands and lowlands and finally meandering through the Nipah and mangroves found in abundance along with the long vast coastal landscapes.

The climate of Sarawak is typical of the equatorial belt. It is humid and has high rainfall (over 100 inches). Temperature is moderate (mean maximum about 88°F). Rain is all year round, and more heavily during the northeast monsoon of November to March.

The forest

Sarawak's forest is of the tropical evergreen type. There are extensive areas of coastal Nipah peat swamp forest (around 5,000 square miles). Radiocarbondating and pollen analysis proved that these Nipah peat forests developed from mangrove jungles over the past 3,000 to 4,000 years. Peats are built up to depths of 15 feet or more (over 50 feet have been recorded in some areas). These forests are the home of the valuable ramin tree.

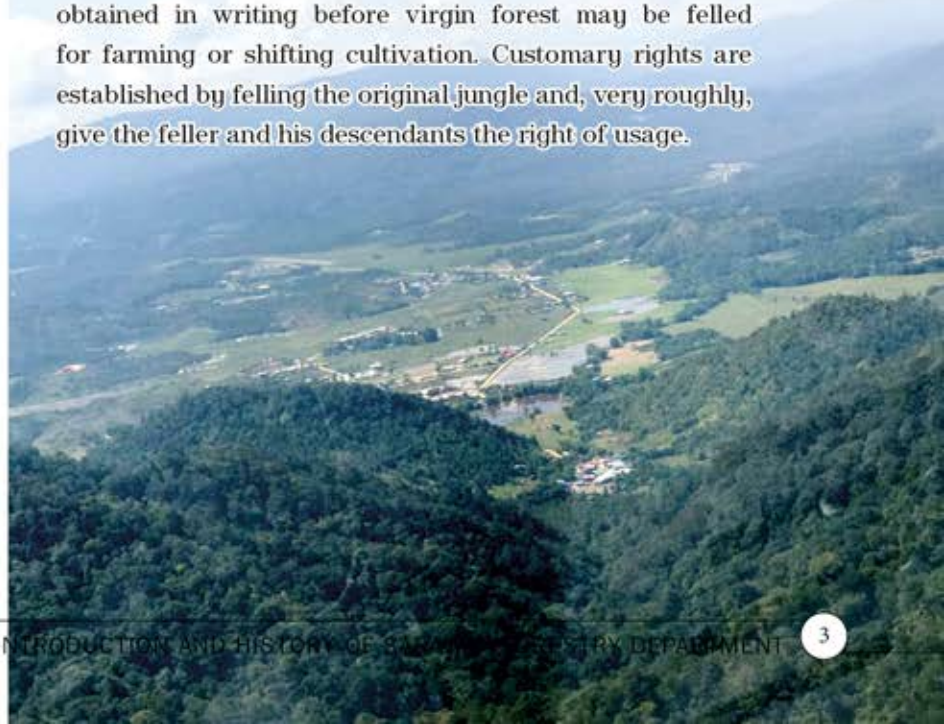
Dipterocarpaceae trees

Borneo (and Sarawak) is a stronghold of the Dipterocarpaceae. There are about 300 species of Dipterocarpaceae(diptero) found in Sarawak. Diptero is a family of tropical lowland rainforest trees. The name is derived from Greek (*di* = two, *pteron* = wing, and *karpos* = fruit). It refers to the two-winged fruit. Many Diptero in Sarawak are large forest emergent species, reaching up to heights of 40–80 metres. Diptero species are valuable and sought after by the timber industry.

The affairs of the land

Sarawak law is that all virgin forest belongs to the State, unless leased under document of title. A licence is required to extract timber, even on leased land. The consent of the lessee is needed before a licence is applied.

Under the current Land Code, permission must be obtained in writing before virgin forest may be felled for farming or shifting cultivation. Customary rights are established by felling the original jungle and, very roughly, give the feller and his descendants the right of usage.



HISTORY & DEVELOPMENT

Sarawak forest management milestones

The forest history in Sarawak is looked at from 6 periods:

A. **Period I.**
Pre 1842.
Before the Rajah Brooke regime.

B. **Period II.**
1842–1918.
James Brooke ruled from August 1842 to 1868. Charles Brooke ruled from 1868 to 1917.

C. **Period III.**
1919–1940.
Vyner Brooke ruled from 1917 to 1946. Forest Department under the Third White Rajah. In 1919 Sarawak had its first Conservator of Forest. So on record, the Sarawak Forest Department era started in 1919.

D. **Period IV.**
1941–1945.
The Japanese occupation. 2nd world war period.

E. **Period V.**
1946–1962.
Forest Department under the British Crown.

F. **Period VI.**
1963 onwards.
Sarawak became independent from the British Crown. Together with Singapore, Sabah, and Malaya to form the Federation of Malaysia in 1963.

The old days

Many centuries of small barter trade existed, exchanging minor forest produces with China (rhinoceros horns, kingfisher feathers, bezoar stones, damar, camphor from the Borneo camphor tree) and casques of the helmeted hornbill (known as hornbill ivory that was more valuable than jade). Chinese traders took them while they brought in beads, iron, cash, crockery, and jars.

Law and order

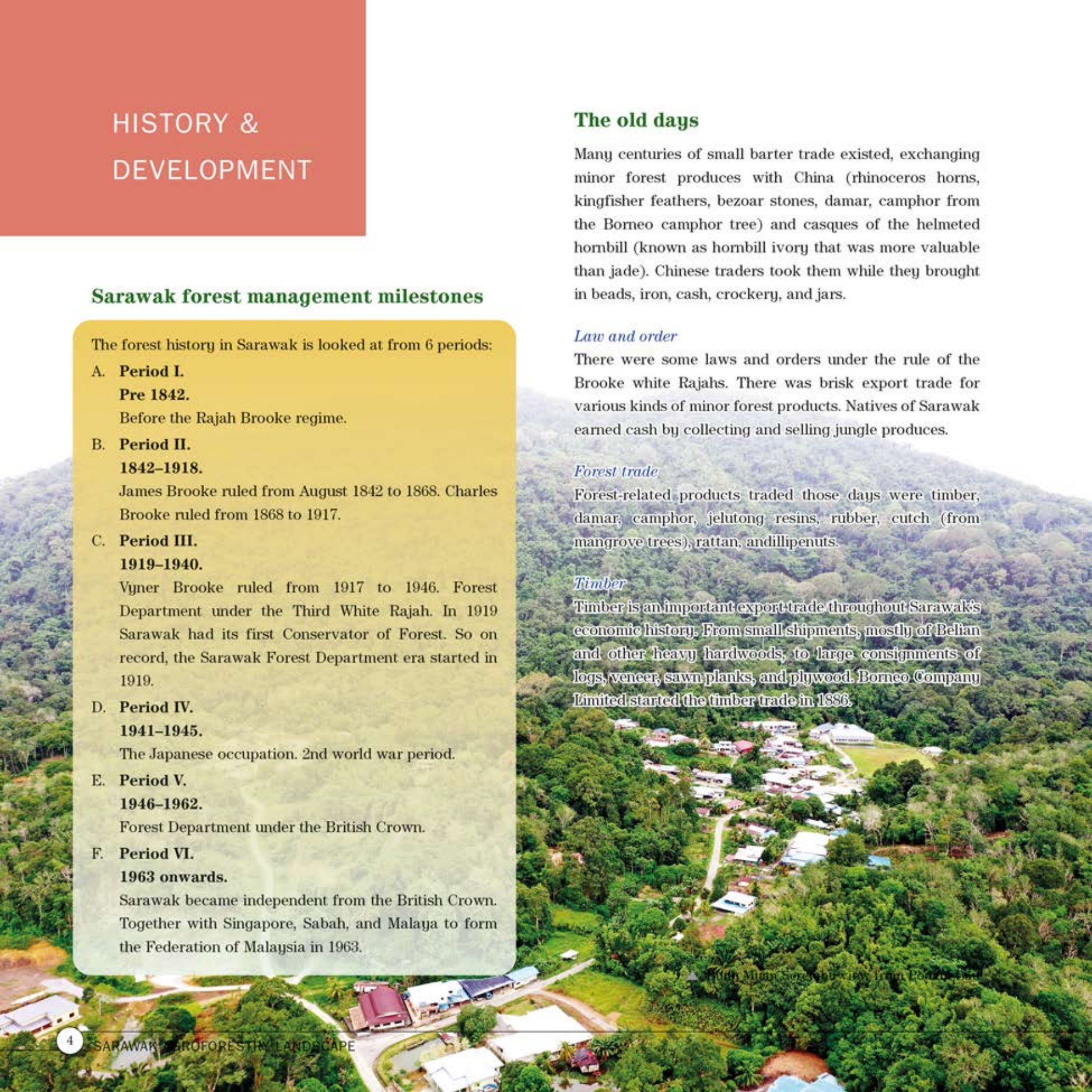
There were some laws and orders under the rule of the Brooke white Rajahs. There was brisk export trade for various kinds of minor forest products. Natives of Sarawak earned cash by collecting and selling jungle produces.

Forest trade

Forest-related products traded those days were timber, damar, camphor, jelutong resins, rubber, cutch (from mangrove trees), rattan, andillipenuts.

Timber

Timber is an important export-trade throughout Sarawak's economic history. From small shipments, mostly of Belian and other heavy hardwoods, to large consignments of logs, veneer, sawn planks, and plywood. Borneo Company Limited started the timber trade in 1886.



▲ Bukit Mian Segerak view from Pejabat Hutan

Legislation& Management

1. Forest operations and management during Period I: The Pre 1842

Rajah James Brooke governed Sarawak from August 1842 to 1868. Before 1842, the forests of Sarawak were virtually without a history of administration or management, nor was there any formal written guideline or rule to adhere to. Suffice to say, the control and ownership of land (and with it the forest) was based on a communal rule (tribal native *adat*) and local customary practices among the various tribes that inhabit the land and cultivate or practised their subsistent livelihood or shifting farm cultivation lifestyles. The Sarawak native tribes who live and survive in the jungles or forests as communities had informal, unwritten traditional terms and conditions they create, and the socialpractices they adhere to. They recognised them as their communal rule and law for some order and discipline. With that, they had harmonious rural or jungle dwelling and land occupation. They freely roam and forage the forest or jungle for food and survival. They collected jungle produce(like damar, resins, camphor, sandalwood, bird's nest) for sale to the Chinese traders.

2. Forest operations and management during Period II: 1841–1918.

The working of timber and other forest produce was virtually uncontrolled by the Government, except that export duty was levied on the items exported. The second Rajah Charles Brooke issued orders and guidelines on collecting forest products and adhering to rules on protected plants.

3. Forest operations and management during Period III: 1918–1940

Forest Department under the 3rd Rajah (Vyner Brooke)

The first step in setting up a forest administration was the appointment of Mr. J. P. Mead, as Sarawak Conservator of Forests in 1919. He drafted the code of rules, gazetted as the Forest Rules, 1919, and came into force on 01 Jan 1920. They were based on the rules in force in Malaya. Under these rules, the taking of timber, firewood, charcoal, and certain forest products was licensed and royalties fixed, minimum girths were established below which certain specified trees could not be felled, the method of tapping Jelutong trees, and the collection of gutta perch. Penalties were imposed for infractions. Those rules were followed by an Order, providing for the constitution and maintenance of reserve forests, gazetted as the Forest Reservation Order, 1920 and came into force on 17 May 1920.





During this period, the efforts of the Department were concentrated on the exploration and demarcation of forests suitable for reservation. The first reserve constituted was the Semenggoh forest reserve, 12 miles from Kuching. It is now a valuable research forest centre and arboretum.

A statement of policy was published in the *Sarawak Gazette* of January 1924. The earlier legislation was replaced in 1934 by Order F-1 (Forests), known as the Forest Order, which came into force on 02 July 1934. The permanent forest is now known as a protected forest.

Management and silviculture

Staff shortage and inadequate budget made silvicultural work minimal, except on an experimental scale.

Research & staff training

There were activities on research and forest management. Staff's skills enhancement, though minimal, was also looked into.

4. Operations and management during Period 1V: 1941–1945

The Japanese occupation period.

The Japanese reached Kuching in December 1941. They left in August 1945. There was no departmental annual report for these years of 1941–1945. During the war, many records were destroyed when some government buildings were burnt in Kuching Sibu and Miri. Under the Military Administration, Forest Department was administered by the Director of Lands and Surveys. It did not become a separate department again until July1946.

5. Operations and management during Period V: 1946–1962.

Forest Department was under the British Crown colony. The Japanese left in August 1945. After the war, the third Rajah (Vyner Brooke) ceded Sarawak to the Crown (01 July 1946). Proper forest records were kept, especially for the annual Commonwealth Forestry Conference.

Forest Administration, Policy and Legislation

No major change was made in the forest policy, but a full and detailed statement of the Government's official policy was approved by the Governor in Council in Dec 1954, and it was issued as a printed paper. This policy statement was after the enactment of a new Forests Ordinance and Forest Rules, which came into force on 01 Jan 1954. The Forest Department was also concerned with the National Parks Ordinance (Feb 1956), and with the Wild Life Protection Ordinance (Jan 1958).

Forest reservation

Three factors significantly speeded up the constitution for permanent forests during the period 1950–1960. These factors were:

(i) availability of aerial photographs taken by the Royal Air Force that pick out suitable areas for the photography

(ii) approval by the Secretary of State of a 10-year Forestry Development Plan 1950–1959 and,

(iii) the allocation of funds under a Colonial Development and Welfare Fund grant.

In 1960 a further 5-year plan (1961-1965) was approved by the Government, to complete the constitution of permanent forests for Sarawak. The main areas to be examined under this plan are swamp forests in the Second and Fourth Divisions.

Exploitation and utilisation

Ramin wood was a popular demand in Europe, Australia, and other timber-hungry countries after the Second World War.

Management and silviculture

The main effort in the 1950–1959 plan was directed at constituting permanent forests. The main emphasis in the 1961-1965 plan was on management and silviculture. Work plans and felling schemes were prepared for most sawmills.

Research

Intensive silviculture research into swamp forests started in 1960.

Staff and Training

A forest school started in Kuching (1950) and another in Semenggok (1960). The Government's policy was to train locals up to a full professional level in silviculture studies.

Finance

The Department had its annual budget for expenditures and operations. Revenues were collected from export levy/duties and timber licence fees.

6. Operations and management during Period VI: 1963 onwards.

Federation of Malaysia period.

After the 2nd World War, the British Crown was preparing Sarawak to be gradually independent. Alexander Waddell was the outgoing British governor. He left, and Sarawak and Sabah to create a new federation known as Malaysia in 1963.

Legislature

The Sarawak Forestry Department has a new chapter or era when it was part of the Malaysian federation. Forestry management takes many common values and policies drafted at the federal level. Besides the federal guidelines and policies, Sarawak also has some peculiar state laws and guides on its wildlife, national parks, forest reserves, land, and specific matters relating to forest and timber industry.

SFC and SFD

09 June 2003

Sarawak Forestry Department (SFD) has a statutory body called Sarawak Forestry Corporation (SFC) that helps manage and operate forestry activities in Sarawak.

SFC was established in 09 June 2003; by the Sarawak Government. The aim is to position Sarawak at the forefront of (i) sustainable forest management and (ii) forest conservation. This is outlined in the Sarawak Forestry Corporation Ordinance, 1995. SFC is a statutory body of the Sarawak government, formed under the SFC Ordinance, 1995.

SFC's functions include (i) managing the Totally Protected Areas (TPAs), and (ii) conserving the biodiversity of Sarawak. It is entrusted to protect the wildlife of Sarawak, especially the totally protected species. In doing this, it is governed by (a) the National Parks and Nature Reserves Ordinance 1998 and (b) the Wild Life Protection Ordinance 1998.



HISTORY OF AGROFORESTRY IN SARAWAK FORESTRY DEPARTMENT

AGROFORESTRY HISTORY & PLATFORM IN SARAWAK



Name

From its name 'agroforestry', the relevant management bodies and ordinance for agroforestry are (1) Forestry Ordinance and Forestry Department, and (2) Agriculture Department with its guidelines and policies.

The Start

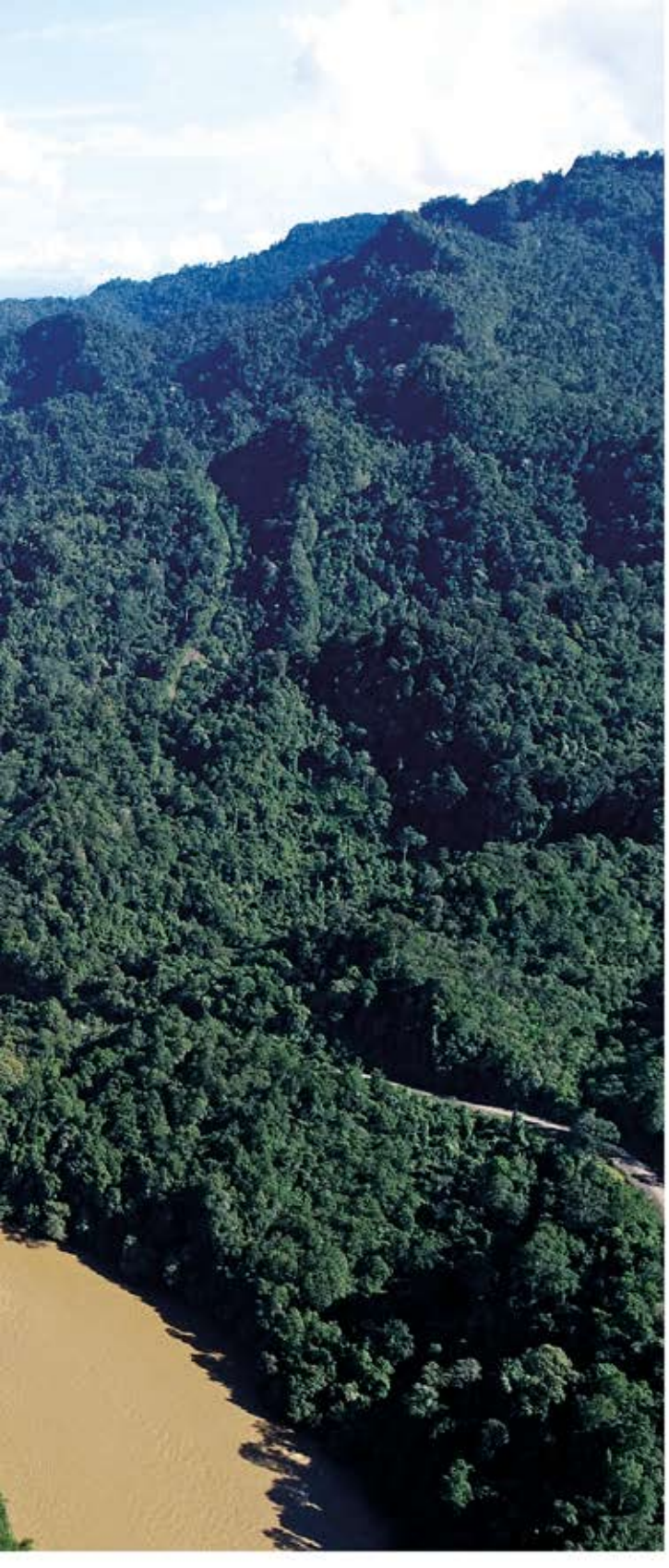
Like in any country and human civilisation, the lifestyle practice of utilising grasses, herbs, flowers, fruits, plants, and trees growing wild or natural in the forest jungle had existed. According to research, the notion behind agroforestry existed since the earlier 1900s. But it became popular from the later half of the 20th century.



▶ Long San Baram panoramic scene







◀ Long San and surrounding Baram region

In human agriculture, people grow and cultivate vegetable and fruit trees for subsistence and commercial. These are augmented by non-cultivated, natural or wild products (herbs, greens, plants, trees, and fruits). People do not disturb (wherever possible) them because they need them as part of their food and medicine. So the natural foliages subsist with their cultivated crops and livestock. Those days there was no formal law to prevent people from the unlawful or deliberate destruction of the forest jungle. People move on, harmonising with nature and the forested wilderness, practising agroforestry.

It can be inferred that the Forests Ordinance 1958 (Cap. 126) started the formal or organised approach for agroforestry. The understanding is that people can cultivate the land, but at the same time in all possible ways, to maintain or restore the forest landscape. The concept is to preserve some forest contents as part of their pasture or cultivate land plots.

Regulatory & Guidelines

Forest

The 1958 Forest Ordinance aims to conserve the Sarawak forest resources.

Important agendas when enforcing the 1958 Forest Ordinance Act are:

(i) The constitution of the Permanent Forest Estate and the regulation of the taking of forest produce.

(ii) The Ordinance guides the Forest Department Sarawak (FDS) to police and administer activities for the forest industry.



▶ Ulu Baram riverine



The past, present and future of Agroforestry in Sarawak

1958	Native claims NCR land and usufructuary rights on cleared forest land under Land Code (Cap. 81) and (Amendment) 2018 under the Native Territorial Domain (NTD) covering "Pemakai Menua" and "Pulau Galau".
1984	Department of Agriculture Sarawak through ARC (Agriculture Research Centre) started three agroforestry research trials.
1987	Sarawak Forest Department initiated agroforestry to address shifting cultivation enroachment.
1990	State came with an Agricultural Perspective Plan to identify potential agroforestry policies and interventions which may contribute to the development of Sarawak's rural sector (1990–2010).
January 2020	YAB Chief Minister approval on the Revised Policy Direction on Industrial Forest Plantation in Sarawak dated 22 January 2020, where Agroforestry to be the win-win model for managing local conflict within Licensed Planted Forest (LPF) and allowing for Licensed Protected Forest size to a minimum 100 hectares instead of 1,000 and allowing for both timber and non-timber species.
February 2020	YAB Chief Minister approved for Projek Rakyat under Commercial Agroforestry at Lubok Antu Samarahan Communal Forest.
March 2020	Forest Landscape Restoration was approved on 4 May 2020 with RM62 million for 5 year period starting 2020, where Agroforestry is the approach under disputed Licensed Planted Forest, Permanent Forest Estate, Totally Protected Area, Stateland and Native Customary Rights.
November 2020	Amendment to the Forest Ordinance 2015 to enable agroforestry inside Communal Forest and Licensed Planted Forest.





Bario Highland



▼ Padi field landscape showing buffer along Sungei Krian



The FDS looks at

(i) resource planning,
(ii) economics,
(iii) forest engineering,
(iv) forest and forest product research,
(v) national parks,
(vi) wild life conservation,
(vii) law enforcement and preventive work.

FDS is a technical and scientific department, with portfolio for

(i) forest management,
(ii) forest protection,
(iii) effective and efficient utilisation of all forest resources,
(iv) conservation, and preservation of fauna and flora in Sarawak.

Forest sustainability

FDS has strategies for sustainable (a) forest management and (b) forest conservation. Some of these strategies are:

(i)	To enlarge the Permanent Forest Estate
(ii)	To enforce the (a) Forests Ordinance 1958 (Cap. 126), (b) National Parks and Nature Reserve Ordinance 1998, (c) Wildlife Protection Ordinance 1998
(iii)	To undertake applied research in silviculture, ecology, and forest operations
(iv)	To harvest forests selectively
(v)	To practise multiple-use forestry
(vi)	To establish (a) more national parks, nature reserves and wildlife sanctuaries, and (b) to undertake detailed resource inventory of these areas
(vii)	To develop the infrastructure and recreational facilities in national parks and nature reserves to boost their tourism potential
(viii)	To conduct long-term research on protected wildlife species
(ix)	To conserve management of hunted species and habitat management
(x)	To conduct research to improve utilisation of timber.

Strategy (iii) is very apt to agroforestry industry development.



Agriculture

The Department of Agriculture, Sarawak (DOAS).

DOAS was formed in 1924, the year the Sarawak government began to get involved in agriculture development. Besides crops, the focus is also on (i) inland fisheries, (ii) research & development, (iii) farmers' institution development and (iv) human resource development and extension.

▼ Bario Highland landscape





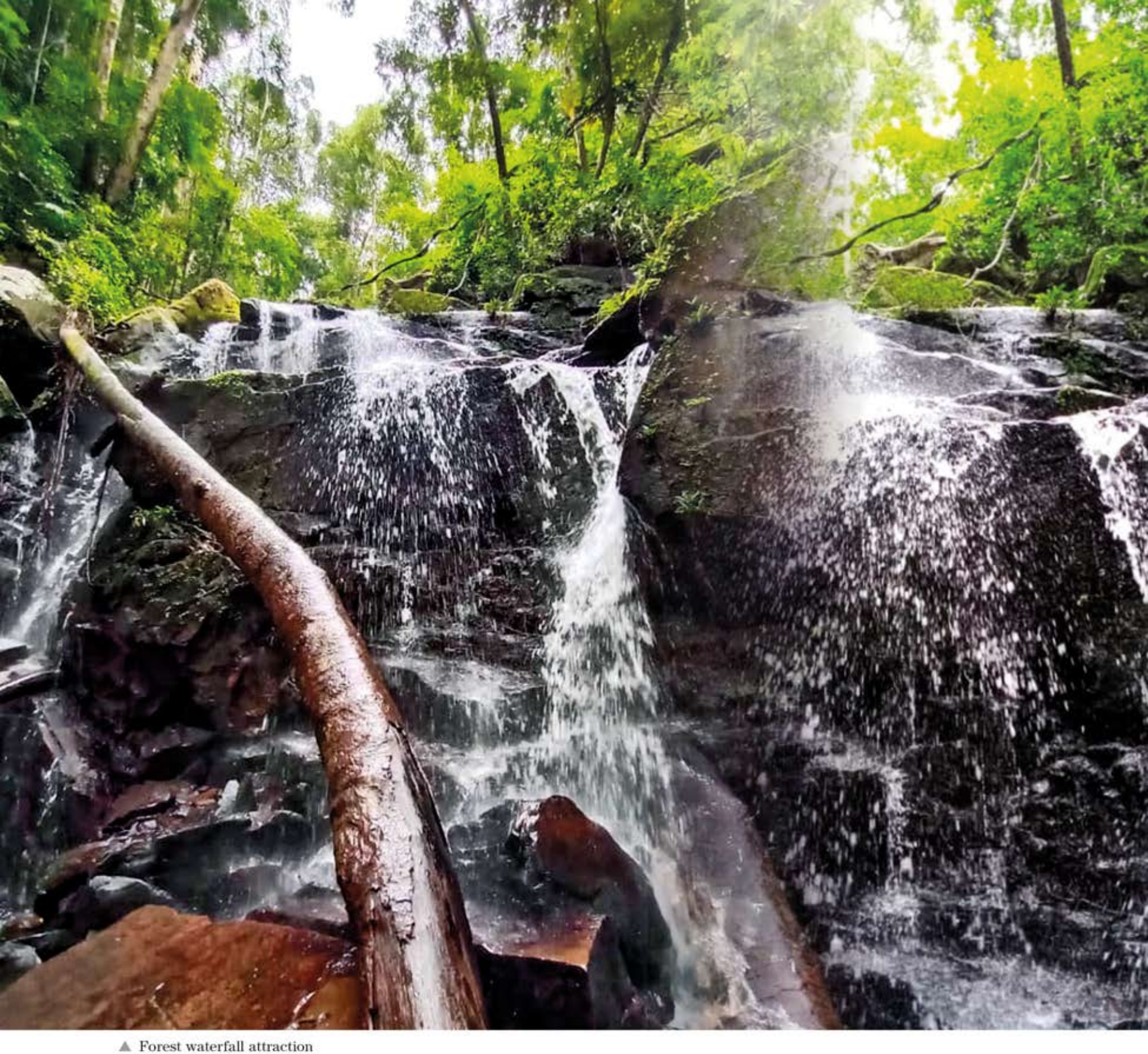


Agarwood (gharu) tree cultivation



▲ Typical multi-cropping practice at Logan Bunut Miri





▲ Forest waterfall attraction





Agarwood agroforestry project





▲ Agarwood flower (*aquilaria beccariana*)



17

GOALS

17 GOALS, THE BLUEPRINT TO ACHIEVING A BETTER AND SUSTAINABLE ENVIRONMENT FOR SARAWAK



THE GLOBAL GOALS
For Sustainable Development



*Global Goals for Sustainable Development by UN


2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE AND JUSTICE STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS

THE GOALS

Guide

The mandate and terms of reference for agroforestry implementation in Sarawak are driven by the globally acknowledged 17 points of Sustainable Development.

The United Nations office has come up with guidelines for Sustainable Development for all countries.

State government

Sarawak in particular (and Malaysia in general) recognised the guidelines. For the Sarawak government, agroforestry is one of its prime focuses in getting the Forestry Department and the Agriculture Department to manage the forest and agriculture industry in the State.

Agroforestry spirit

In the name of social and community development, the government (and the people) do things for noble purposes and objectives. In advocating the practice of agroforestry, the objectives or purposes are in sync with, or also to fulfil, the agenda of the 17 points United Nations sustainable development.





▲ *Licuala* species

The 17 points

As depicted in the graphic illustration on the following pages, the 17 points are as follows:

1	No poverty
2	Zero hunger
3	Good health & well being
4	Quality education
5	Gender equality
6	Clean water & sanitation
7	Affordable & clean energy
8	Decent work & economic growth
9	Industry innovation & infrastructure
10	Reduced inequalities
11	Sustainable cities and communities
12	Reasonable consumption & production
13	Climate action
14	Life below water
15	Life on land
16	Peace and justice, and
17	Partnerships for the goals.



Sustainability

What is our role in safeguard the safety and healthy lifestyles on this fragile earth? We must not forget that agroforestry practice is for the world to ensure healthy air, clean water, and fertile soil. The practice brings with it positive impacts or benefits to people's needs for economics, societal harmony, well-being, welfare and health, wildlife flora & fauna preservation, and surroundings for an eco-friendly environment.



FOREST LANDSCAPE RESTORATION

AIM

Forest landscape restoration or FLR aims
(i) to restore ecological integrity and
(ii) to improve the productivity and economic value of degraded forest landscapes. Other than forest per se, FLR, in fact, encompasses a wide range of land uses.

FLR has the potential to bring back millions of hectares of land to life and functioning. This would help protect watersheds and ensure food security for the rise in world population.



▲ FLR Suling Selaan 15 years old trees

What is forest landscape restoration?

FLR or Forest Landscape Restoration can be perceived as a planned ongoing or continuing process to regain ecological integrity and functionality, and enhance human well-being in deforested (degraded) forests or jungles. FLR is more than just planting trees, as the process is to restore and rehabilitate the whole landscape (a) to meet present and future needs and (b) to offer multiple benefits of land uses over time.



▲ FLR 15 years Suling Selaan after burning



▲ Kelampayan & Gaharu integration at Tinjar

The approach

FLR can include (i) integrating trees into agricultural lands, (ii) restoring tracts of trees amidst the mosaic or tapestry of landclearings, villages, and farms, (iii) recovering vast areas of intact forests.

Restoration can involve in varying degrees of human intervention, like

(a) actively planting trees to facilitate natural processes of forest succession to occur
(b) doing various other activities to rehabilitate and 'green' any void of space or abandoned or barren land.

Why is FLR important or necessary for eco and Earth's survival

Research showed that, some 12% (or two billion hectares) of the Earth's terrestrial land surface is degraded globally. Therefore, FLR is a critical strategy for addressing pressing societal and communal challenges today. The challenges include:

(i) worldwide food security
(ii) climate change
(iii) soil erosion
(iv) access to clean water
(v) Desertification, and
(vi) loss of biodiversity

How to do FLR

How do we restore the forest ecosystems?

Common processes are any of, or all, the following:

(i) Keep it thin. Wood thinning or culling is good for trees. Thinning allows in more sunlight for a more healthy forest floor.

(ii) Keep it controlled.
People like biological diversity in their understory as well as in their forests.

(iii) Re-trace steps.

... tend to the water in your landscaped area

... tend to the land area identified for the landscape

... bank on the streamlets, creeks, or river banks in your landscaped perimeters

... think habitat and prepare the flora/fauna and plants/grass and trees/shrubs for the local animals to roam and forage.

▼ Bario Monnie CF



KEYS



Keys To Launching Successful Forest Landscape Restoration

The World Resources Institute (WRI) and the International Union for the Conservation of Nature (IUCN) are advocates of the FLR. IUCN and research partners published the first global assessment of where FLR might be possible. This map helped build momentum toward the Bonn Challenge. The Bonn Challenge is a worldwide commitment to start restoring 150 million hectares of lost and degraded land throughout the world. Several nations, including Malaysia and Sarawak, have made the Bonn Challenge restoration pledges. What people ask now is not'what' restoration is or 'where' it is possible. Instead the 'how' can it be done successfully?

WRI and IUCN assessed more than 20 examples from around the world of forest landscape restoration over the past 150 years, including both relative successes and failures. Lessons from these countries provide insights into what works, inspiring others to restore their landscapes.



Principles

Successful FLR is dynamic and **forward-looking**. It focuses on beefing up the resilience of landscapes. It creates future options to adjust and further optimise ecosystem goods and services as societal needs change or new challenges crop up. Common guiding principles of forest landscape restoration have a lot to do with humanity's need to live in harmony with nature, and enjoy the Creator's undisturbed earthly natural environment. We look at four principles here.

Macro landscape focus:

Focus on the extensive picture landscape and its simplicity. Remember, forest landscape restoration (FLR) takes place within and across the macro (entire) landscape, and not just on micro (individual) sites. This macro concept represents a blend or mosaic of interacting land uses and management practices under various tenure & governance systems. It is at this macro scale that ecological, social, and economic priorities can be balanced.







Back to nature

There is this need to maintain and enhance the natural ecosystems within the designated identified landscapes. Remember that FLR does not lead to the conversion, or the destruction, of natural forests or other ecosystems. In effect it enhances the (a) conservation, (b) recovery, and (c) sustainable management of forests and other ecosystems within the vicinities.

Commitment by all

The success of FLR can be higher with the engagement of various stakeholders, pledgers, donors/ sponsors, and support of the nature lovers.

Local and global policy

The dictate, direction, framework guide, and encouragement from the authority & government would not just boost up the activities in FLR. It also compelled the local and global communities to have serious thoughts about FLR and its value. Participatory governance comes from the authority. Policies and encouragement from the authoritarian government can change people's mindset to see that FKR is a way of life moving forward, as they exist on this fragile planet Earth.



▶ Mountain homestay



FLR engages stakeholders at different scales (including vulnerable groups) to:

(a) plan and make decisions regarding land use,
(b) map out restoration goals & strategies,
(c) devise implementation methods to come up with benefit-sharing, and monitor and
(d) review their FLR processes.



Summing up

The beauty, value, and necessity for mankind to engage in forest landscape restoration (FLR) is not disputable anymore. It is a way of existence and life process now. Practising FLR successfully needs good understanding and practice of these fundamentals:

(i) *Focus:* focus on landscapes;
(ii) *Engage:* engage stakeholders and support participatory governance;
(iii) *Restore:* restore multiple functions for multiple benefits;
(iv) *Maintain:* maintain and enhance natural ecosystems within landscapes;
(v) *Tailor:* tailor to the local context using a variety of approaches;
(vi) *Manage:* manage adaptively for long-term resilience, and
(vii) *Create:* create, preserve, enjoy, and experience the freshness, beauty & harmony of co-existence amongst the forest, wild habitats, and humans.



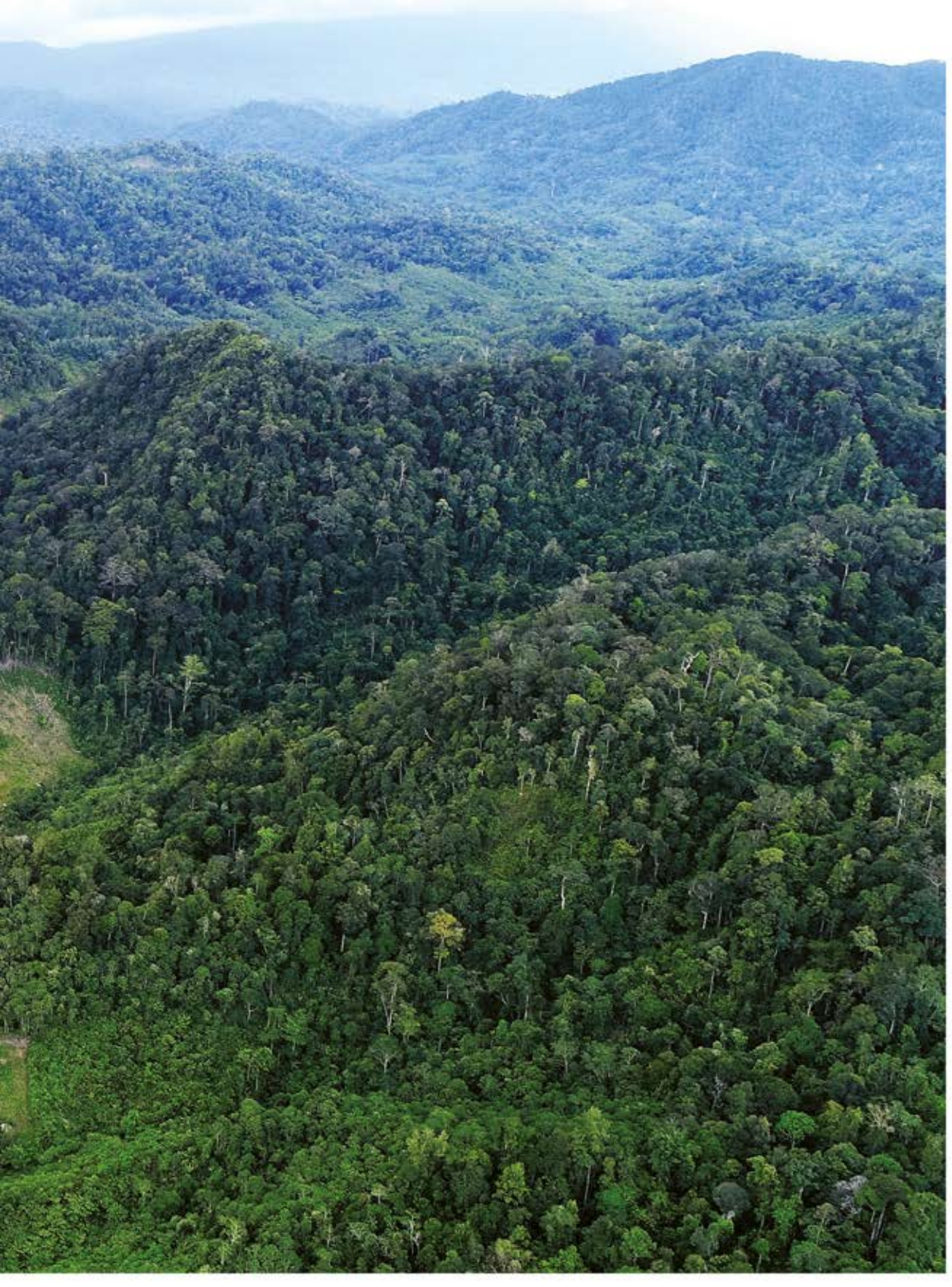
SOME AERIAL VIEWS OF SARAWAK FOREST AND MOUNTAIN LANDSCAPES



▲ Settlement along Baram River (Upper Bemang)







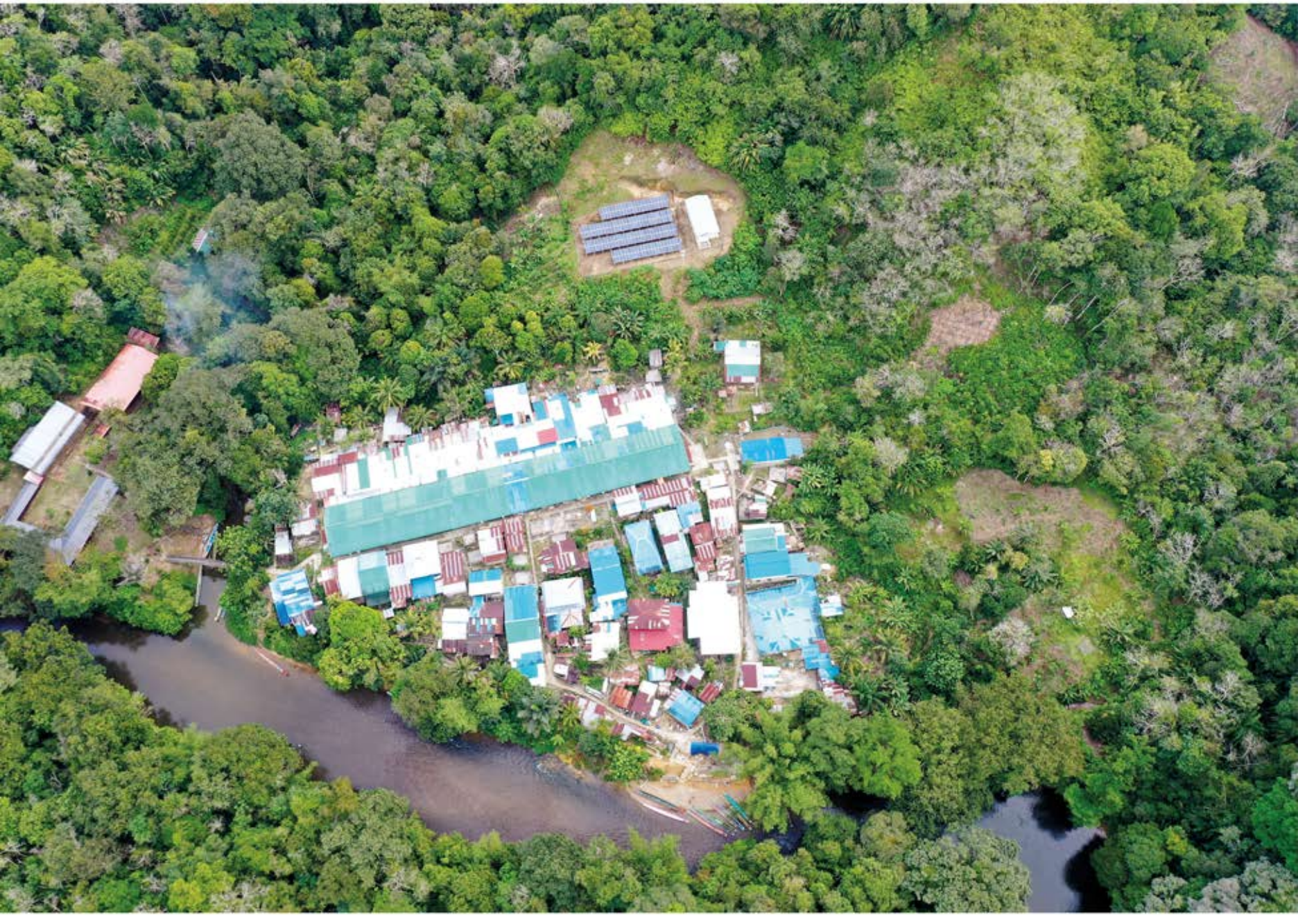
◀ Forest Landscape Restoration in Semiang Ulu Baram



▲ Batu Siman, Ulu Baram



▲ Btg Ai Ulu Sumpa Misty Valley



▲ Btg Ai Sumpa settlement



▲ Telaga Air

8 TYPES OF FOREST IN SARAWAK

1. Mangrove forest

Mangrove Forests occur along the coastline and within estuaries of rivers where alluvium brought down by the rivers is deposited.

The Mangrove Forests have been harvested mainly for firewood, charcoal, poles, cutch, thatch and woodchips. The nipah sugar is derived from the Nipah palm. The intertwined tree roots of mangrove grow densely together stabilising the coastline, protecting it from erosion. The forest is a natural habitat for the proboscis monkeys which feed on the leaves of mangrove trees. Various forms of marine life also thrive in the mangrove.



▲ *Pokok Bakau (*Rhizophora spp.)



▲ Nipah palm (Nypa fruticans)

2. Beach forest

Beach forests are ecosystems that can be found adjacent to beaches. Some fruits and seeds are adapted to be dispersed by sea currents by evolving sea water resistance fruits. To a certain degree, beach forest trees are able to prevent coastal erosion.



▲ Pokok Ru



▲ Coconut palm

3. Kerangas or Tropical Heath forest

Kerangas forest, is a type of tropical moist forest found on the island of Borneo.

The word Kerangas, which means "land which cannot grow rice", comes from the Iban language. Heath forests occur on acidic sandy soils that are the result of the area's siliceous parent rocks.



▲ Pokok selomah



▲ Pitcher Plant

4. Riverine & Alluvial forest

Alluvial forest occurs along streams and rivers that seasonally or intermittently flood their banks. Alluvial forests vary in size from broad river valleys to narrow strips of streamside vegetation.



▲ Borneo Ironwood (Belian)



▲ Illipenut (Meranti) Engkabang

5. Peat Swamp forest

Peat swamp forests are tropical moist forests where waterlogged soil prevents dead leaves and wood from fully decomposing. Over time, this creates a thick layer of acidic peat.

Peat swamp forests are typically surrounded by lowland rain forests on better-drained soils, and by brackish or salt-water mangrove forests near the coast.



▲ Ramin (Gonystylus bancanus)



▲ Jongkong (Dactylocladus stenostachys)

6. Dipterocarp forest

Dipterocarp forests refer to any forest in which the dominant species of trees are members of the family Dipterocarpaceae.

It is widespread, covering more then 80% of Sarawak's natural forest area. The Hill Mixed Dipterocarp Forests are richly diversified and contain the greatest number of economically important trees.



▲ Dipterocarpaceae trees

7. Montane forest

Montane Forest is ecosystem found in mountains. It gets affected by colder climate at moderate elevations. In these areas dense forest are common. In Mountain Forest, rainfall and temperate climate leads to change in natural vegetation.



▲ Montane forest

8. Limestone forest

Limestone forest are forest that can be found on hills and mountain that are formed from limestone rocks and covered with shallow or thin layer of soil.

Limestone forest only covers less than 1% of land area in Sarawak.



▲ Gunung Mulu

EXAMPLE OF AGROFORESTRY & FOREST LANDSCAPE RESTORATION

Noble Objective

The need to

(i) maximise the use of land space,

(ii) keep trees and crops interspersed, and

(iii) maintain as far as possible the shape and feature of a natural jungle or forest-setting, fulfil the spirit or practice of Agroforestry and Forest landscape restoration.

In this example, a family has used their 1 acre plus of land space behind their house to grow 200 *gharu* trees (agarwood or botanical name of *Aquilaria malaccensis)*. On each of these *agarwood* trees they have planted or kept vanilla vines. The *agarwood* trees is about 8 years old now, while the vanilla vines are already 4 years, with the past 3 years providing side business income from the sale of the ripe and dried vanilla pods,

1. Forest landscape with Gharu trees







fetching good price in the market. The *agarwood* trees remain healthy and waiting for resins to form before harvesting the trees. Like vanilla pods, *agarwood* resin fetches high sales value in local and overseas market, with current unending demand.

Plant Variety

Besides the *agarwood* trees and vanilla vines as the main focus or economic activity, the family also planted short term cash crops in between the rows. They plant coffee trees, mulberry trees and banana in between the *agarwood* trees, making sure there is no over- crowding.

Aesthetic

The aesthetic beauty of seeing the area is that the garden landscape looks very much like a natural forest (*fulfilling the noble need to promote or practise forest landscape restoration*).

People can see and admire a natural forest-like picturesque views, with the tall *agarwood* trees providing the scenic views of a forest-landscape (or a forest has been born or 'restored').

2. Vanilla vines





3. Vanilla pods





4. Banana



5. Coffee



6. Mulberry trees





PRACTICAL OR INDIRECT FOREST LANDSCAPE RESTORATION IN SARAWAK



▲ Rubber Alley

Protect fragile planet

All over the world today, partly because of

(i) the necessity to safeguard the world's fragile natural environment,

(ii) to balance or maintain the natural ecosystem,

(iii) to replenish fresh air and fresh safe water, and especially

(iv) to reduce pollution and minimise global warming, the need to amplify the spirit and practice of Forest Landscape Restoration (FLR) is important and a compulsion for every country on this Earth.

The unwitting FLR spirit

How do people exemplify the spirit or practice of FLR?

Other than the formal government-triggered or NGO-initiated FLR projects, what can be seen or have been in practice at rimes in Sarawak is that FLR is in a way '*indirect*' (or not an obvious nor formal FLR programme or activity *per se* that villagers and dwellers spend time on).

But when people:

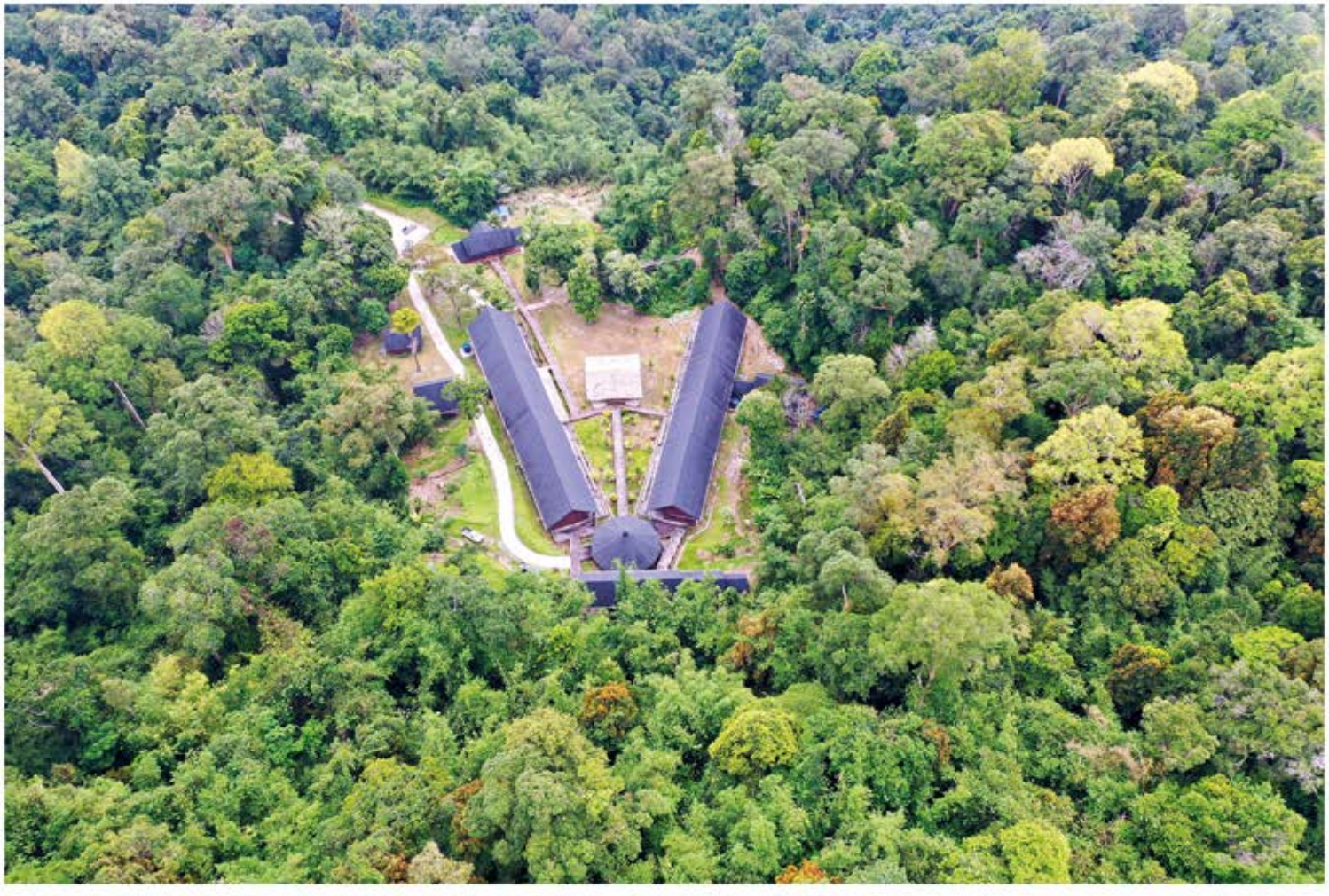
(1) preserve within their compounds or home dwelling sites some parts of the natural forests to thrive freely or go undisturbed, and

(2) grow fruit or crop trees within the natural forests while they do not destroy the forest fringes (nor bulldoze them entirely but just very minimal cuttings or sparse clearings of land spaces with the big natural jungle trees still intact), they are in fact restoring the original patches of forests to their former glory, or preserve natural landscapes that look picturesque. Such are the efforts or good deeds of these noble 'silent' local forest landscapers who unwittingly may not be aware that what they labour in is a lot to do with the reality of FLR practice.

Besides the fresh air, and stress-free feeling to see the green lushness of the plants and trees, such views have scenic aesthetic values for us to enjoy.

Here are 4 examples of what can be found or practised in Sarawak (that is FLR in the spirit):

(1) Fruit trees planted that blend well with natural forest scenery



▲ Bung Bratak Heritage Centre (forest trees include 100 years old durian and other fruit trees)

(2) Growing ironwood (*belian*) in the house compound for forest garden landscape



▲ Belian tree flowers

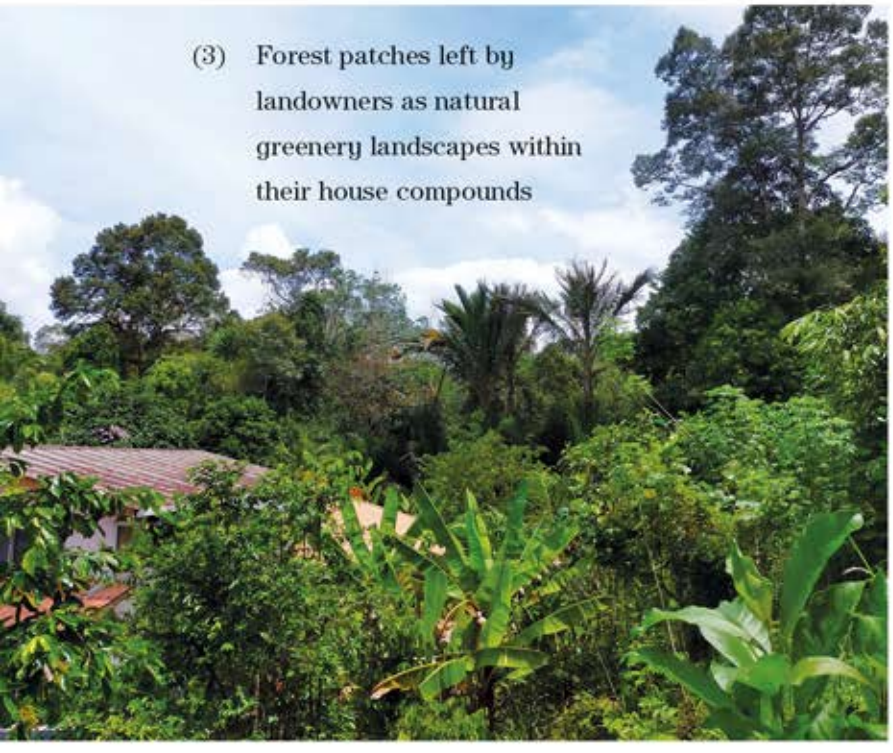


▲ The fruit of belian tree





(3) Forest patches left by landowners as natural greenery landscapes within their house compounds









(4a) Big undisturbed forest trees at the villagers' farm house fringes, Scene I.



◀ Bung Bratak – Regeneration area along Binawa Trail

(4b) Big undisturbed forest trees at the villagers' farm house fringes, Scene II.













THE FOUR ATTRIBUTES AND SYSTEMS OF AGROFORESTRY



THE FOUR ATTRIBUTES AND SYSTEMS OF AGROFORESTRY



Agroforestry:

how it originated, and what is it today

What

The concept of agroforestry has existed since the earlier 1900s. The practice became popular after the second half of the 20th century. In 1978 the International Council for Agroforestry (ICA) was established. ICA provides continued research and promotion for the 'agroforestry' practice.

Agroforestry is a farming and a land system, as well as concept that compliments any eco-system programme.



▶ Example of agroforestry activity within wildlife corridor at Samarakan Bintulu


SARAWAK PLANTED FOREST SDN. BHD.
WELCOME
TO
BUKIT MINA FIELD STATION



▲ Collecting fallen fruits along the river



▲ Selecting *engkabang* fruits (illipenut)

Practice

Globally, there is the practice to cultivate tree species and crops in intimate combination. The 'derelict forest' is clear-felled, the slash burnt, then food crops for varying periods are grown on the cleared areas, and tree species (like rubber, coconut, fruit trees, gharu, cocoa, etc) are planted along with, or after, the sowing of the agricultural crop. Farmers simulate forest conditions in their farms to obtain the beneficial effects of forest structures.

Example:

They create the form and species diversity of tropical forests by planting various crops with different growth habits. Farm plots can contain two or more different species of plants, each with a different form, corresponding to mixed tropical forests' layered configuration of mixed tropical forests. The crop could be anything like coconut or papaya with a lower layer of bananas or citrus, a shrub layer of coffee or cocoa, tall and low annuals such as yam or maize, and a spreading ground cover of plants like pumpkin, long bean, or cucumber.

Some South East Asian natives practise a complex type of shifting cultivation. Like when clearing a forest for agricultural use, they may purposely leave certain selected trees which, by the end of the rice-







▲ Sadir waterfall

growing season, would provide a partial canopy of new foliage to prevent excessive exposure to the sun, at a time when moisture is more important than sunlight for the maturing grain. (A good example is on the cocoa plantation with the practice of planting giricida trees among the cocoa trees to provide shade and a good root system for the cocoa trees).

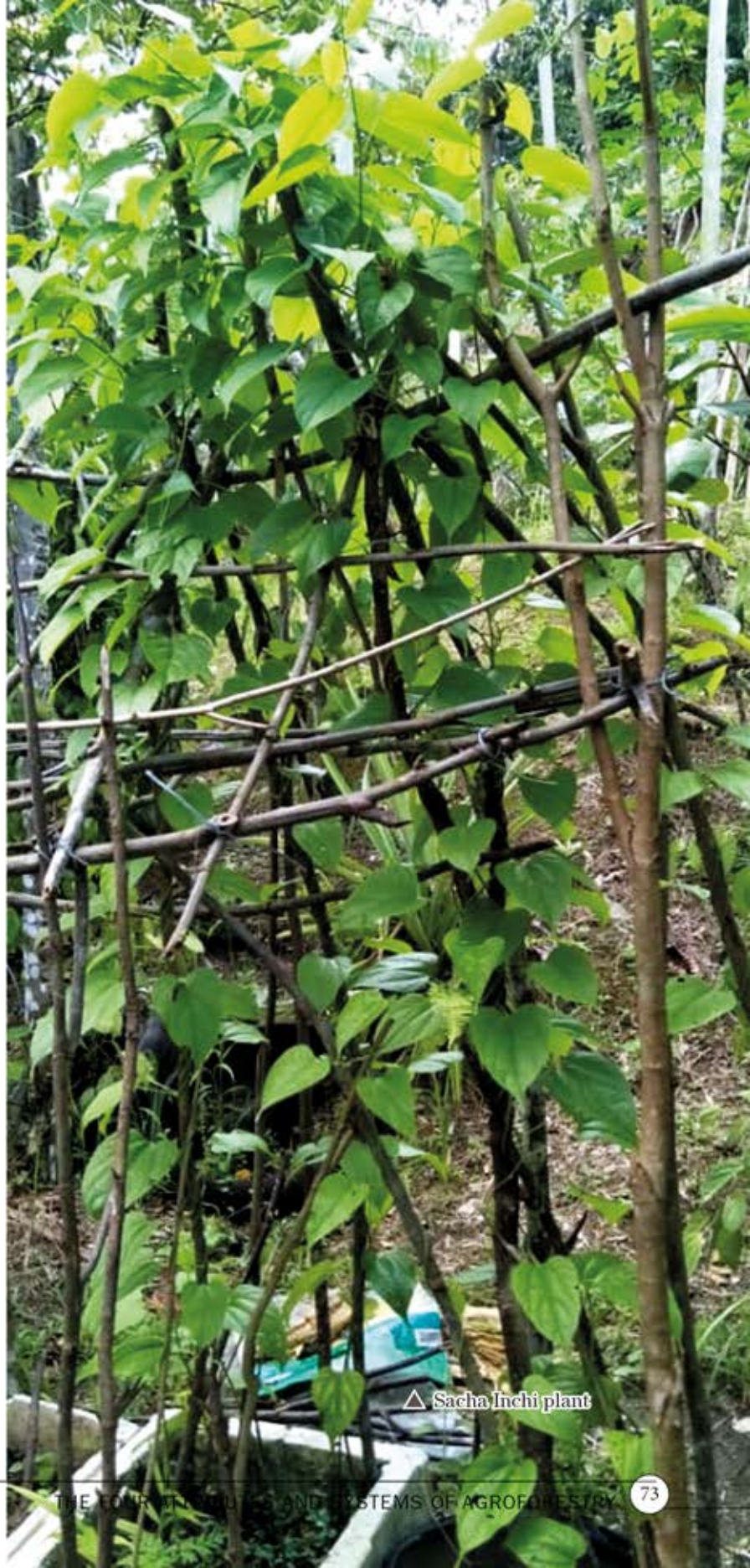
For some Asian tribes, trees are an indispensable part of their farming system.

▼ Forest Landscape Restoration, Sabal Agroforestry grazing plus pond





△ Mixed fruit trees



△ Sacha Inchi plant

They either plant or conserve from the original forests to provide food, medicines, construction wood, and cosmetics.



▲ Mahkota dewa tree



▶ Wild golden gooseberry plant (*buah letop*)

In some villages, beans, yams, pumpkins, maize, is grown together under a layer of scattered trees. Apart from the main crop in the homestead, there are other subsidiary crops grown in a mixture of tree species. Tree cropping, is an example of conserving human energy by making full use of the limited land space that was laboriously won from the dense forest. It is cheap means of combating erosion and leaching, and maintaining soil fertility. The plants eat and drink, as it were, not from one source but many sources under the same sky.





The above practices show that the earliest practitioners of what has now become known as ***'agroforestry'*** perceived food production as the system's *raison d'être.*

Trees

Crops like bananas, maize, vegetables, yams, tapioca can be grown at the sides of the oil palm terraces.



▶ Engkabang tree planted in Semengok

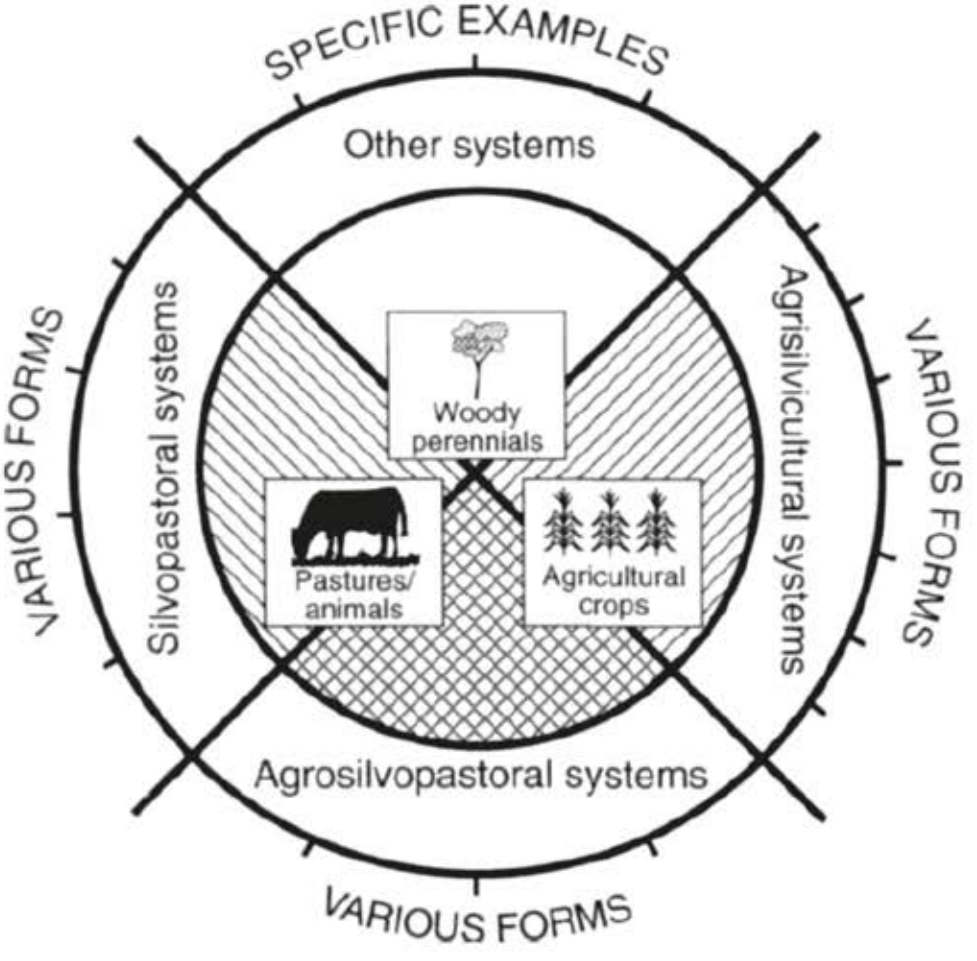
Forester not farmer

For more than a hundred years (period 1856 to the mid-1970s), little thought was given to the practice of agroforestry system, to the farm, to the farmer, and his agricultural outputs. The agroforestry system was designed and implemented more for the forester. In the old days, some asserted that in many parts of the world, local farmers were exploited in pursuit of the goal of establishing cheap forest plantations. In the old days some asserted that the socio-economic conditions necessary for compelling initiation of the agroforestry system would be 'land hunger' and 'unemployment', and the standard of living standard low enough to border on poverty. Not anymore now, as with better awareness and education, people start to see good land-space and multi-usage land maximisation values.



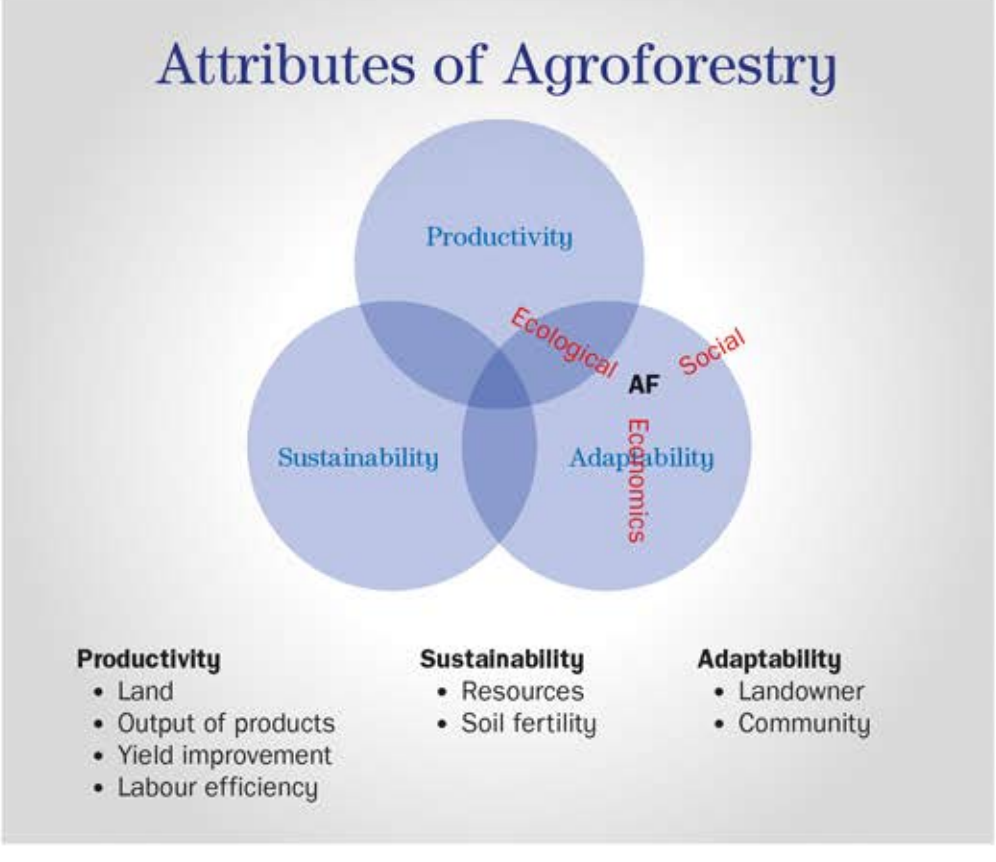
FOUR ISSUES

To appreciate the implications of meaningful agroforestry, there are four factors to understand. One, the forest estate is inviolable. Two, the threat to the forest estate come from peasants, particularly those practising shifting cultivation. Three, it is advantageous to replace 'derelict or low-yielding natural forests' with forest plantations. And four, the establishment of forest plantations is a costly business, due to its long gestation period (the long delays before returns are obtained from the initial investment).



Philosophy

A common practice of agroforestry is to establish forest plantations where ever possible, utilising available unemployed or landless labourers. In return for the forestry tasks they are paid to undertake, these labourers are allowed to cultivate land spaces between the rows of the forest-tree seedlings. They would be permitted to retain their agricultural produces. This is a simplification of an agroforestry system that may vary from locality to locality or from country to country.

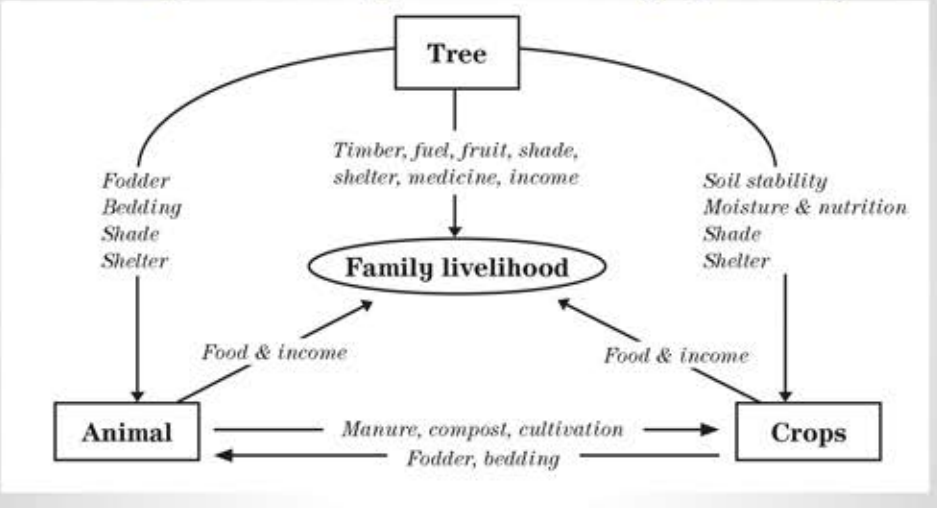


Forest landscape restoration

Agroforestry farming expects minimal damage to soil (evading soil erosion), environment, and forest foliage.

Preoccupations with the forests and the forest estate entails minimal damage to the forest-tree species; that the rates of growth of the forest-tree species are not unduly inhibited by competition from the agricultural crop; that the optimum time and sequence of planting of either the tree or agricultural crop be ascertained to ensure survival and rapid growth of the tree crop; that forest species that are capable of withstanding competition from agricultural species be identified; and that the optimum planting-out espacements for the subsequent growth of the tree crop be ascertained.

Concepts of Agroforestry (cont.)

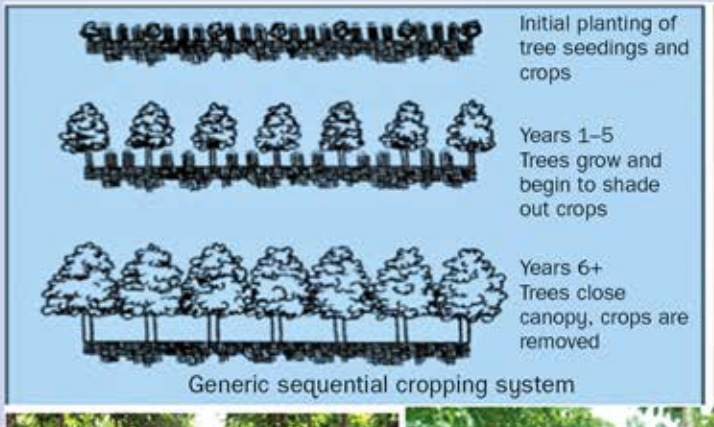


Ecological and economic interactions between the trees and crops and/or livestock elements on an agroforestry system

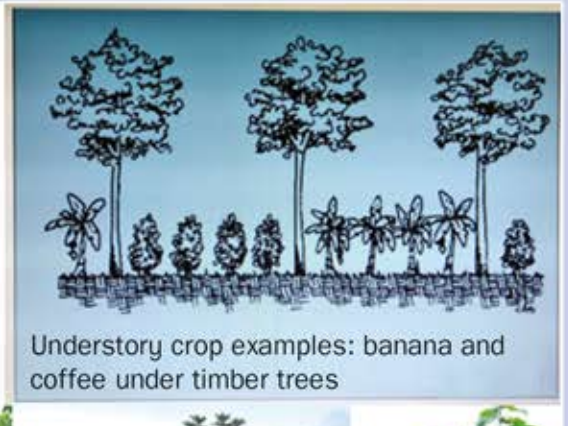
Land management

Is agroforestry a *forest system* versus *agriculture system*, or a combination of both?

Agroforestry is no more just a mindset or concept of the '*main crop forest plantation first and planting supplementary crops second*' programme. Today it is in fact a *land management* both in the farm and in or for the forest.



Generic sequential cropping system


Understory crop examples: banana and coffee under timber trees






Inter-cropping

There is now the re-awakening of interest in both inter-cropping and farming systems to address the deteriorating food situation in many areas of the developing world. The (i) increasing spread of ecological



▲ Cash crop (sweet potatoes) for inter-cropping by farmers

(ii) degradation; environmental pollution due to increased forest lumbering and felling, (iii) land cultivation for monoagricultural crops, and (iv) the energy crisis have compelled the world to find value in agroforestry.



▲ Cash crop (chilli) for mono cropping



◀ Cash plant (papaya) for mono cropping



TYPES OR GROUPS OF AGROFORESTRY SYSTEM

AGROFORESTRY TYPE I
AGRISILVICULTURE

AGROFORESTRY TYPE II
AGROSILVIPASTORAL

AGROFORESTRY TYPE III
SILVIPASTORAL

AGROFORESTRY TYPE IV
AQUASILVICULTURE/
AQUAFORESTRY

AGROFORESTRY TYPE V
APISILVICULTURE

AGROFORESTRY TYPE VI
POULTRY AGROFORESTRY

AGROFORESTRY TYPE VII
AGROFORESTRY TOURISM

TYPES OR GROUPS OF AGROFORESTRY SYSTEM



▲ Sago worm

Structure

The idea behind agroforestry is:

(i) To create a beneficial opportunity.

(ii) It goes beyond aesthetic value. When a landowner undertakes agroforestry, he gets the specific benefits that trees provide.

(iii) It is a good step towards replenishing the world where resources are diminished, due to humanity's expansion and consumption.

With agroforestry, the world gets immediate benefits and continues to study the practice and develop new methods.



▲ Sago palm tree fruits

Purposes or intentions

The nature of the components can identify which group the agroforestry systems belonged. The purpose or intention of the system could be to have:

(a) an improved fallow species in shifting cultivation
(b) the Taungya system
(c) multispecies tree gardens
(d) alley cropping (hedgerow inter-cropping)
(e) multipurpose trees and shrubs on farmlands or
(f) crop combinations with plantation crops or a combinations of any of these six purposes and intentions.



▲ Yam plant for mixed cash cropping





▶ Pepper plant

The groups

The standard agroforestry practices can be grouped into 4 types as follows:

Agrisilvocultural

The other common term is ***Alley Cropping System.***

Trees and agriculture (farming, crops). Planting trees between rows of already grown shrubs or trees. And cultivating spaces in between the trees for vegetables and food crops. The trees form the perennial crops, while the vegetables and other planted plants are annual croppings like maize, soya bean, bananas, potatoes, tapioca, yams etc. Alley cropping system provides benefits and outputs like (i) erosion control, (ii) scenic natural landscape and (iii) watershed recharge while (iv) producing forest products (fruits, nuts, medicine), and wood/timber for sale, and (v) crop and farm harvests for family consumption and commerial revenue.



▲ *Belimbing* fruit tree



▲ Fruit trees seedlings for inter cropping

Here the (a) land for the production of agricultural crops and (b) forest products are managed.

Silvopastoral system

Trees, livestock

Sustainable integration of grazing-land and forestry to produce both wood products and livestocks.

Agri-silvo-pastoral system

Trees, agriculture, livestock

Or also known as the *Mixed garden system*



▲ Wild jackfruit tree

▼ Planted forest (acacia plantation) – Bintulu



A mixture of three activities.

To produce (i) tree products, (ii) crops, and (iii) livestocks.

This integrates (a) trees, (b) crops, and (c) animals on small land plots, with the goal to supply nutrients, materials, and commercial products for the family.

▼ Mix of rubber and fruit tress







◀ Forest and fruit trees

Others

Trees, epiculture (honey bees), *alley, landscape tourism, windbreaker, erosion control, tagang.*

Under ***Others*** there are the following activities:

(i) *Riparian forest buffers system*:

Planting trees next to bodies of water

(ii) *Apiculture system*:

Rearing bees for honey. Growing trees, shrubs, flowers for bees' food (pollen, nectar).

(iii) *Perma-culture system*:

Landscape and beautification. Trees for aesthetic value and picturesque scenery to attract visitors and nature lovers.

Planting ornamental trees, shrubs for scenic landscaping. Maintain resorts and homestays for guests to promote tourism business.

(iv) *Tagang system*:

Planting and keeping trees along river or stream banks keeping and protecting fresh water fish for ornaments, tourism, and food.

The freshwater fish are reared in their wild habitat.

(v) *Windbreak system*:

Planting trees or shrubs to mitigate the effects of wind on erosion and soil moisture.



▲ Combination of cash crops(tapioca, kenanit, yam) and fruit trees (durian)



The Fit

Agroforestry is typically practised on large individual sites, like the farm-lands and range-lands.

The purposes or intention for the agroforestry system should fit the resources and needs of the community or individual (farmer/forester), as well as be in sync with the local environment. The specific design depends on the knowledge of the farmer/forester, plus the technical resources available, which would include manuals and public information, local people, extension agents and local people.

There are many options available to a community. *Example:* A strategy to incorporate *multiple agro-systems* and produce various outputs from the land. These multiple-use projects are effective methods of (i) re-forestation and (ii) make productive use of the land for the benefit of local people.

◀ A garden showing mixed cropping



Multiple-use of a land resource implies (i) proper use and management of the land to (ii) produce various types of outputs simultaneously.

(a) These products may compete with each other (the increase in output of one product may decrease the output of others).
(b) The products may be complementary (the outputs increase or decrease together).
(c) They may be supplementary (a change in one output does not affect others).

◀ Forest scene

Community forest projects that are well planned can include many complementary systems and products, where overall productivity of the land is increased and numerous benefits emanate from it. At times, due to limited resources, many foresters/farmers are skeptical of systems unless they perceive some tangible benefits forestry projects incorporated into existing agricultural systems ought to provide multiple benefits like higher family income, food, fuel and fodder, and erosion control to arrest such skeptics.

The multiple-use agroforestry system involves the interaction of trees with food crops. The system can be complex, but enjoyable to establish and manage. Successful multiple-use programmes have improved the local people's standard of living.



▶ Forest vines





▲ Agroforestry strata

Integration

Agroforestry is an integration of (i) forestry and (ii) agriculture that includes many different planting strategies. Various systems can be designed to produce products annually on sustainable basis. Land productivity can be increased in many ways. Agricultural land is improved when erosion is controlled, as more water is made available at a more regular flow rate.

If no prime space is available for large tree projects in the community, other less used areas can be planted. These include hedgerows, yards, paths and streets, market areas, and steep, unproductive land. In this manner villagers can have easy access to the benefits (food, seeds, shade, fodder, fuelwood, etc.) without having to travel long distances. It may also lead to a greater acceptance and appreciation of trees and the services they provide, increasing people's awareness of the need for tree conservation.



▲ Sandalwood with dil, early stage

AGRISILVICULTURAL SYSTEMS

Agrisilvicultural Sytems: Crops including shrubs/vine/tree crops – and trees

Agroforestry practice	Brief description on arrangement of components	Major group of components	Project site, time frame and rationale
Improved fallow	Woody species planted and left to grow during the "fallow phase"	Local fruit trees, rubber, bamboo and saplings regeneration of pioneer species. Common agricultural crops like ginger, terong (Solanum sp.), kenchala (Phaemeria sp.), tapioca and banana	In shifting cultivation areas practice by indigenous native from coastal till mountain region. Subsistence farming since time immemorial.
Alley cropping (Hedgerow inter-cropping)	Woody species in hedges; agricultural species in alleys in between hedges; micro zonal or strip arrangement	Rubber under single, double and triple hedges. Common agricultural crops like banana, tapioca, cocoa, coffee, fruits trees like mango, durian, jackfruit, etc.	Across lowland to hilly land as promoted under rubber integration by.Malaysia Rubber Board, Sabal and Niah Forest Department project since 1988 and 1994 respectively.
Multi-layer tree gardens/ Homegarden	Multi-species, multi-layer dense plant associations with no organised planting arrangements	Durian, engkabang/illipenut, Artocarpus/cempedak, Lansium/ langsat, mangosteen, rubber self-multiplied, Sugar Palm, Betel nut, Bamboo and regenerated within the area. Usually absent; shade-tolerant ones sometimes present like wild ginger and pepper.	Areas with fertile soils resemblance of old communal reserve land (Tembawang concept) since time immemorial as evident at mountains settlement.
Fuelwood production	Interplanting fuelwood species on or around agricultural lands	Species like Casurina nobile (Rhu Ronang) and Casurina sumatrana (Rhu Bukit) with pineapple	Bario Highland to processing of highland salt. Fuelwood price at RM700 per stacking of 6ftx6ftx3ft. About 5,000 trees were planted from 1999 till 2004.

Agroforestry practice	Brief description on arrangement of components	Major group of components	Project site, time frame and rationale
Plantation crop combinations	1. Mixtures of plantation crops in alternate or other regular arrangements 2. Inter-cropping with agricultural crops	1. Oil palm trees with Kelampayan (Neolamarckia cadamba); 2. Multiple bamboo species fast growing tree species; 3. Aquilaria spp./Agarwood with pineapple 4. Kelampayan (Neolamarckia cadamba), Shorea spp with Durian	1. Implemented inside LPF0010 since 2013, Pelita Assan NCR project, Pelita Durian project, Zumida Tg. Manis and Mega Bumimas under Ta Ann group. 2. Implemented inside LPF0026 where 515 ha was planted with bamboo since 2017 out of the 20,000 ha of total planted area since 2002. 3. Implemented since 2010 during strong interest in agarwood/ gaharu throughout the State. 4. Implemented since 2018 under Kaki Wong NCR joint venture.
Multi-purpose trees on croplands	Trees scattered haphazardly or according to some systematic patterns on bunds, terraces or plot/field boundaries	Agathis (Bindang), Dacrydium spp. (Sempilor), Shorea argentifolia (Meranti binatoh), Casurina sumatrana (Rhu Bukit), bamboo and other fruit trees Common agricultural crops, paddy, pineapple, corn, etc.	In all ecological regions, especially in subsistence wet paddy farming; also commonly integrated with animals. Presently practice in Bario Highland by the Kelabit community. Forest Department assistance was from 1999 till 2004. After 20 years, maintained trees already reach commercial size.

Silviculture

(i) Silviculture is the practice of controlling the growth, composition, structure, and quality of forests to meet values and needs, like wood, pulp, and timber production. In specific, silviculture is the practice of controlling the establishment and management of forest stands. Silviculture focuses on making sure that the treatments of forest stands are utilised to improve and conserve their productivity. It is the science and art of growing and cultivating forest crops based on the knowledge of silvics.



▲ Alley 1

(ii) Silvics as a subject delves on the study of the life-history and general characteristics of forest trees and stands, with particular reference to local and regional factors.

(iii) The word silvicultureis a Latin word, 'silvi' for forest, and culture (growing).

(iv) Silvology is the study of forests and woods.



▲ Alley 2

Forestry & silviculture

(i) The distinction between silviculture and forestry is that silviculture is applied at the stand-level; while forestry is a broader concept.

(ii) Adaptive management is practised in silviculture. While forestry study includes natural/conserved land without stand-level management and treatments being applied.

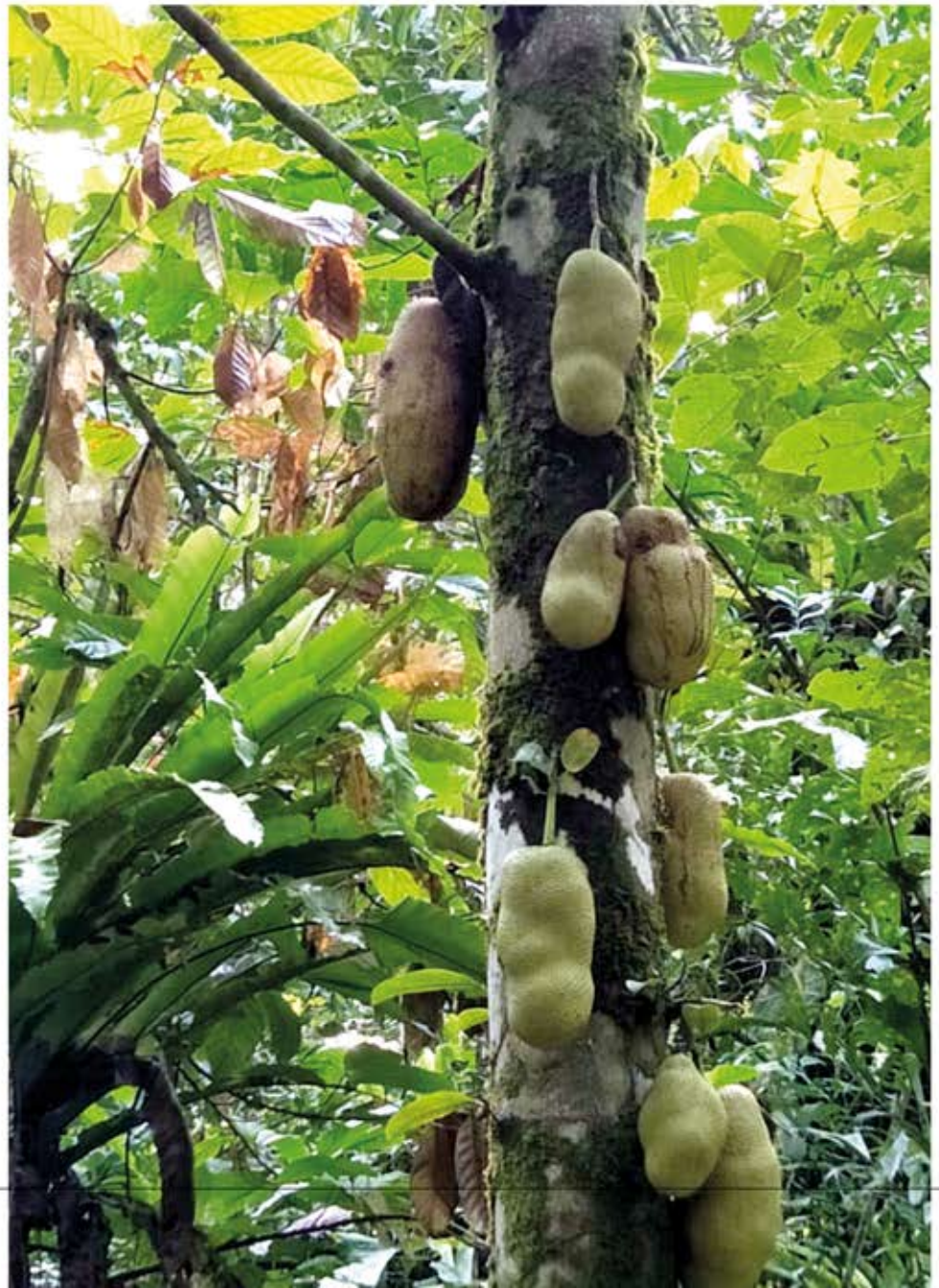


▲ Swidden

Origins of agri-silviculture

Agri-silviculture is a concept on multiple-use of land, whereby forest crops are raised in tandem with or to complement agricultural crops. This system started in Nigeria in 1972, known as 'taungya'.

▼ Wild jackfruit





▲ Belimbing buloh

▼ Wild sour mangoes



Outline of silviculture

(a) Principle: What are the principal issues in silviculture? Silviculture is part of the forest management study. It deals with (i) the biology of tree growth and (ii) the art and science of producing, tending, and manipulating forest stands.

(b) Practices: Silvicultural practices include (i) re-generating the forest, (ii) maintaining tree growth, and (iii) harvesting trees in order to satisfy the landowner's objectives.



▲ Strip plant

(c) Landowner's objectives

If the land is on lease or rented from an owner, some undertakings or agreement with him is to be formalised on issues like:

(i) Meeting his objectives

(ii) provisions for re-generating the stand after harvest

(iii) efficient use of growing space and site productivity

(iv) control of damaging agents such as fire, insects, and disease

(v) provision for maintaining the flow of products from the forest (sustained yield)

(vi) best use of available financial resources

(vii) concentration and efficient arrangement of operations, and

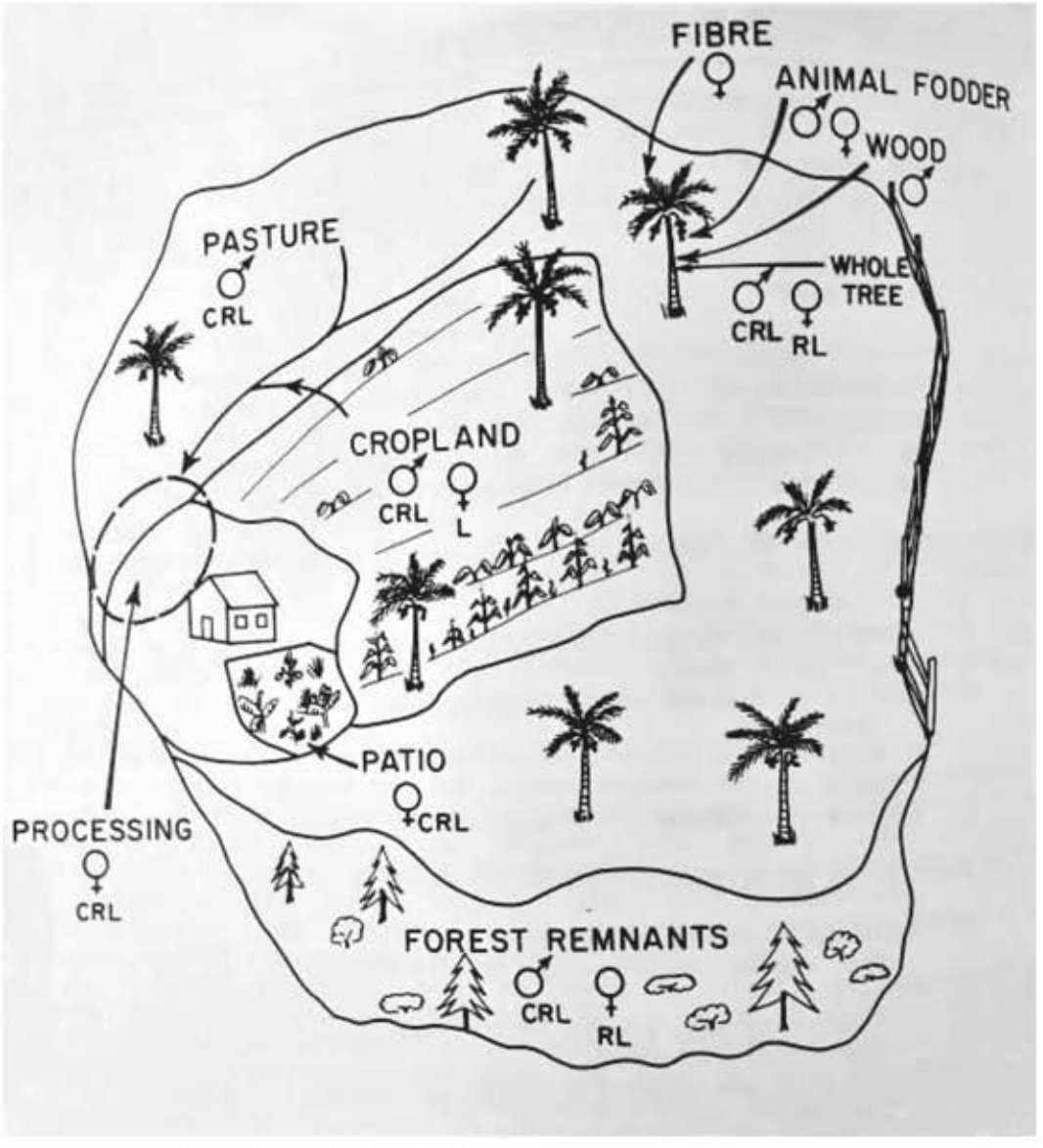
(viii) provisions for maintaining site quality and ecosystem functions.



▲ Alley cropping



◀ Wild balsam herb



▲ Village Agroforestry Mapping

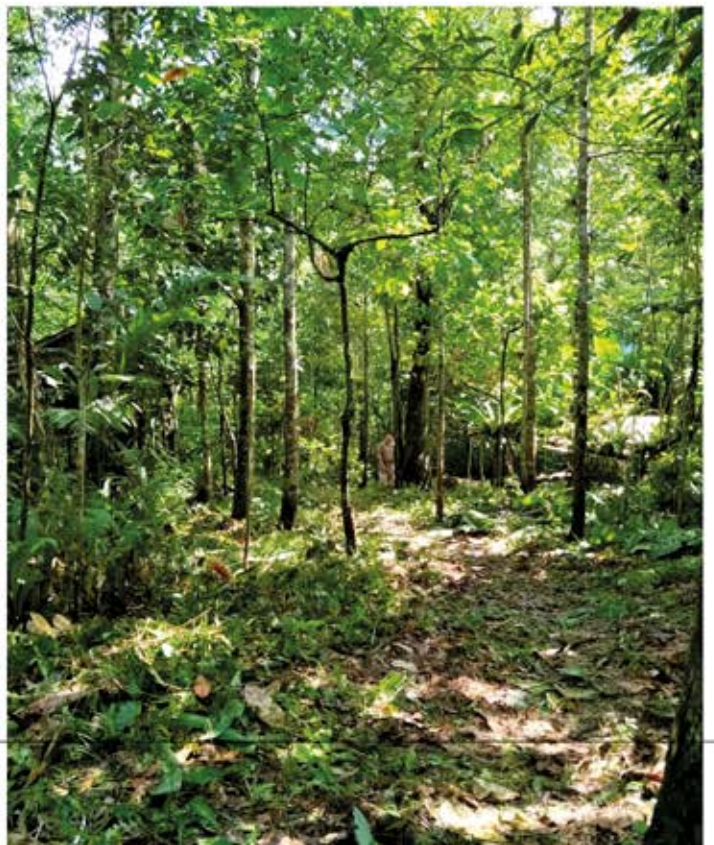
Advantages of silviculture

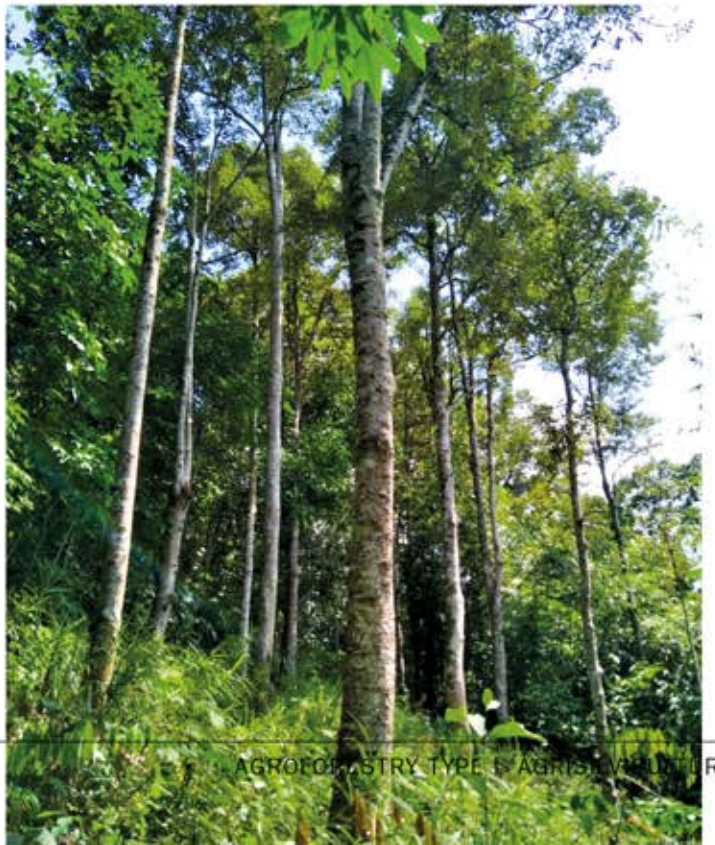
The apparent advantages of this system are:

(i) It can produce abundant raw materials for industries like paper and timber.

(ii) Forest cover is increased. This is necessary for the conservation of wildlife as their natural habitat and, for foliage (iii) It helps maintains the perfect water cycle in nature.

▲ Inter Row







▲ Typical forest scene behind a farm house





Garden compound of a rural community







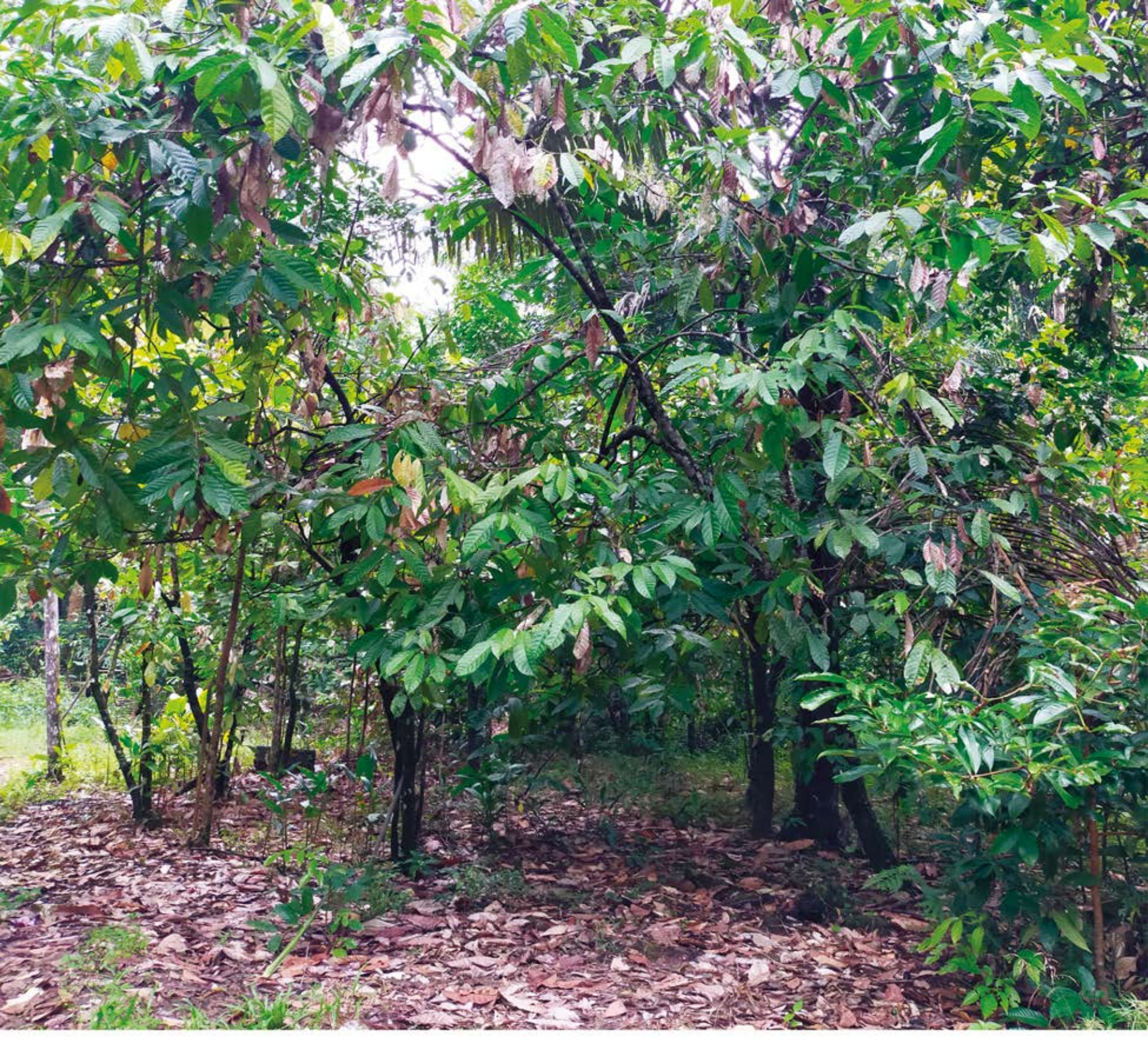




Mixed cash crop activity in rural villages



▲ Rubber and durian with Bungo Range NP at the background



▲ Planting cash crop (cocoa) within the forest



▲ Rubber row within fruit trees in the inter-row in Bau

▼ Forest scenes behind villagers' farm houses



▼ Subsistent economic activity in a village… growing cash crops (long bean, chilli, pepper, tapioca, sour brinjal) mix with fruit trees (durian, langsat, etc)





▼ Matured wild trees and fruit trees





▲ Cash crops in the forest fringes



▲ Cash crops (Tapioca) blends well with bamboo forest



▲ Vanilla plants



▲ Wild herb vegetable (*Hmong*)





▲ Rozelle (cash crop) for agrisilvicultural system

◀ Cash crops and forest

A LOCAL AGRISILVICULTURE ACTIVITY IN SARAWAK

... Mixing tree planting and crop farming

The concept

For farmers in Sarawak, land may not be that scarce, given the immense size of Sarawak itself, with many parts still undisturbed or not developed. However, not all the undeveloped or undisturbed land belonged to individuals, given that vast areas still remain as state-owned. So, villagers and farmers prefer to maximise their land utilisation in places where land is scarce. Planting trees and crops together can make farmlands more productive (able to provide more and with different food or income products). Care in choosing trees to plant, and what crop to grow, is good planning.

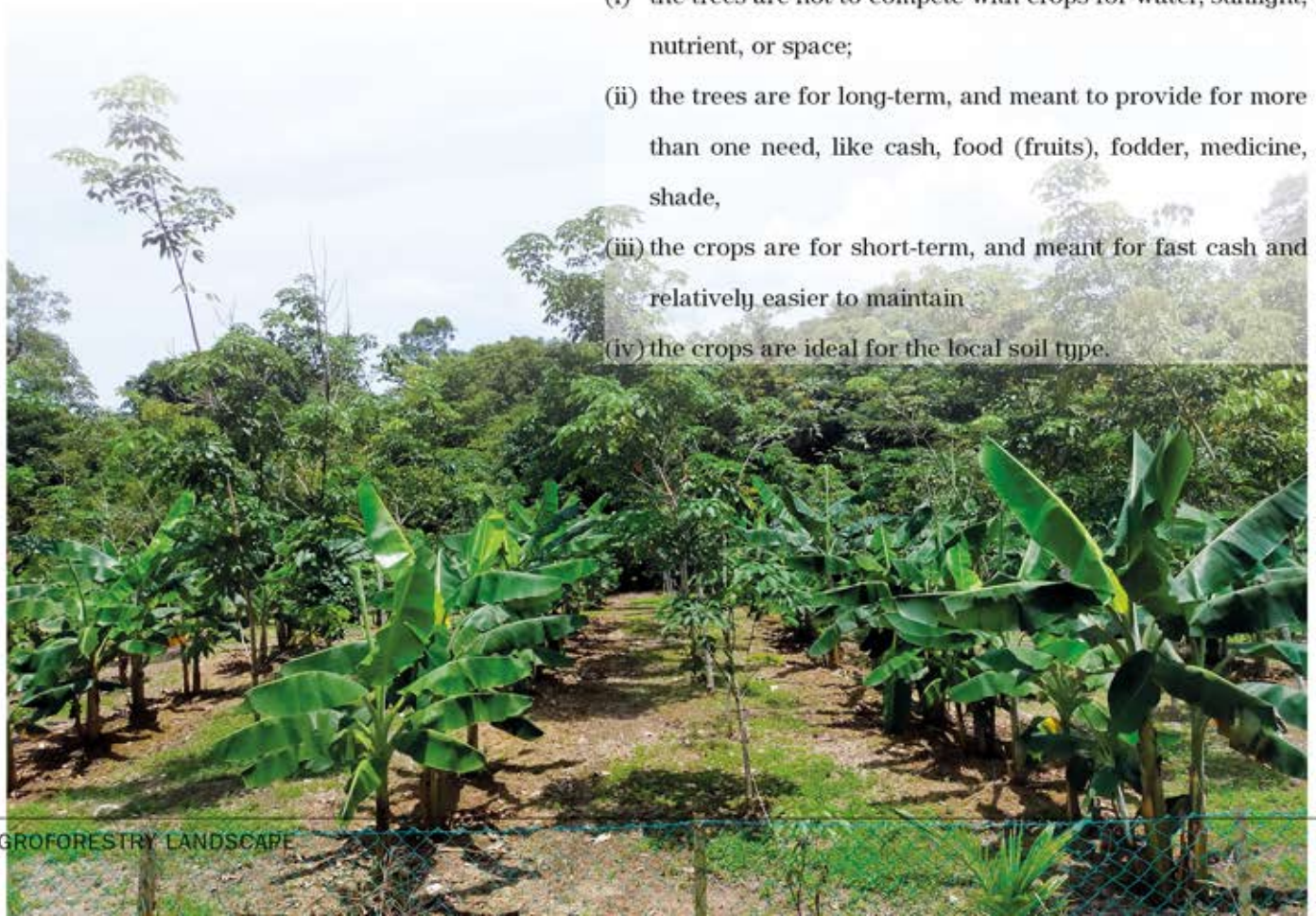
Simple planning guides to follow would be

(i) the trees are not to compete with crops for water, sunlight, nutrient, or space;

(ii) the trees are for long-term, and meant to provide for more than one need, like cash, food (fruits), fodder, medicine, shade,

(iii) the crops are for short-term, and meant for fast cash and relatively easier to maintain

(iv) the crops are ideal for the local soil type.



Agri-silviculture practitioner

Many Sarawakian farmers, especially small holders or subsistent self-income villagers , indulge in agri-silviculture (having trees and crops on one farm site or garden).

Below is an example of a farmer planting rubber trees and cash crop banana in between rows of the rubber trees.

The rubber trees are for long term, to be tapped for latex/ rubber sheets for sale after the trees reached maturity for tapping (usually 8–10 years old onwards). The trees generate long term income as the trees can produce abundant latex up to 20–25 years.

Old trees can be cut down for making much sought after exotic furnitures and house decorations, or for fire wood. Villagers also use the young rubber leaves for vegetables.

The banana is a short term cash crop, able to produce fruits after 18 months to 24 months. The short period for fruit-bearing can provide food, and cash to the farmers, while waiting for the rubber trees to mature.

Below are photos of the rubber trees interspersed with banana plants.



▼ Mixed trees of fruits and cash crops (an agrisilviculture practice)





AGROSILVIPASTORAL SYSTEM

What is agropastoral farming system?

It is a system of farming that combines
(i) crop cultivation with
(ii) Livestock rearing on the same area or plot of land.

The structure of an agropastoral farming system is influenced by
(i) the mix of crop and animal components,
(ii) the extent of each,
(iii) the use of 'on-farm' resources,
(iv) interactions among the components,
(v) flows of energy and nutrients, and
(vi) the eventual individual contribution of each component to farm and livestock productivity.



▲ Silvi-pastoral

Example lowland:

In lowland or swampy areas, keeping cattle, buffalos, or cows provide

(a) traction for cultivating the paddy fields and

(b) milk and meat that are consumed or sold to get ringgit income.

Chickens, ducks, and pigs can be raised on farms. Available feeds include crop residues, weeds, peelings, hulls, agasse, tops of root crops, and other agricultural by-products.

Example highland:

In highland areas, pigs, poultry, buffalo, cattle, goats, and sheep can be reared by farmers growing hill paddy, tapioca, maize, yams, lentils, and tropical vegetables.





Livestock

They are kept or reared for money (sale), as well as for family consumption. Livestock has value for plants and trees on the farms. They either

(i) forage or graze freely in pastures, are tethered to clean specific areas, or

(ii) are fed with tree cuttings.



▶ Buffalo village pastoral

Sustainable land plot

Sustainable farmland and pasture need to be managed efficiently, especially with the rapidly growing world population in dire need of food and the limited space to cultivate them.

To ensure farm or land sustainability, emphasis is on these four values:

(i) full and maximal utilisation of space/acreage for crops and livestock,

(ii) farm diversification, (iii) soil and pasture management, and (iv) crop nutrient management.





Benefit & the good plus

What are the benefits of agropastoral farming practice?

(i) *Harmony in relationship*

There are many advantages or benefits, but the most obvious is the close interaction between trees, crops, and livestock, and their symbiotic inter-dependency.

(ii) Reduce wastage

The incorporation of livestock into crops reduces wastages. The livestock are fed with plant residues, weeds, and fallows with little impact on crop productivity. This turns the otherwise unusable biomass into animal protein, especially in the case of ruminants.

(iii) Manure and fertiliser

Animals recycle the nutrient content of plants, and their wastes or dungs become manure that allows a broader range of natural fertilisation alternatives for the soil.

(iv) Conserve soil and water

The need for animal feed also broadens the crop base to include species useful in conserving soil and water.



▲ Grass-free and tranquil and cooling mountain forest



Land characteristic

What determines the kinds of crops and types of livestock to cultivate or keep? The terrain, landscape, and type of soil or land characteristic determinants of crop and livestock combinations.

Example: Fine textured soil and frequent heavy downpours make the lowlands very suitable for paddy fields. Buffaloes are reared to help till the earth, apart from its meat. Ducks that like water and mud would complement the farmers' rice harvest. They can be sold in the markets for income or consumed (meat) for the family. Ponds for rearing freshwater fish are a common sight on the lowland farms.

Pigs are often raised by shifting cultivators, but the interactions between the animals and crops are largely unstructured. On more permanent farms, pigs are typically raised in close association with vegetable grown for cash crops.

SILVIPASTORAL IN NIAH... A GOOD MODEL

Silvopastoral system in Sarawak has been ongoing. One example is the activity undertaken in Niah.

Below are the pictures of this Niah silvopastoral undertaking.



▲ Niah FRS complex









SILVIPASTORAL FARM... A LOCAL EXAMPLE

Planting trees combined with animal rearing is a silvopastoral practice.

Grass growing and goat rearing

When you (a) grow grass like the napier species in the open spaces for (i) landscape beauty and (ii) animal feed, and (b) rear animals like sheep and goat the activity would also fall into the category of silvopastoral. There is a local farm not far from Kuching city that operate just that. The farm has been in operation since 2013, on a 1.5 acre of land. Grasses for the goat feed are grown within the goat houses. To ensure uninterrupted supply of feed the grass is also grown elsewhere (and this forms part of the farm's extension).

Permaculture

Besides the pastoral practice of goat husbandry to be the principal activity, this goat farm of some 160 goat heads (and has been successfully in operations for the last 8 years), is also a permaculture business, as it is a popular attraction for eco-tourism (recreational and educational study-tour group visits).

(i) Photo showing the goats









(ii) The goat house









(iii) The grass grown within the farm compound





(iv) The forest environment, and preserving natural forest landscape











SILVIPASTORAL SYSTEM

Silvo is a Latin word for forest, and pasture is a grassy grazing space for livestock. So, keeping trees/forest together with livestocks is silvopastoral,
integrating trees, forage, and the grazing of animals and foraging livestock.

What is silvopasture?

Silvopasture or silvopastoral is an agroforestry system where trees or timber, livestock, and forages are intentionally combined and managed on the same parcel of land. It is a common form of agroforestry in many countries today.

Production

Silvopasture practice increases overall productivity and long-term income due to the dual or complementary sources of commercial revenues from trees or tree crops (fruits nuts, pines, poplar, pecan) and livestock. Properly managed silvopasture increases overall productivity and long-term income and can accrue environmental benefits such as carbon sequestration.



▶ Live fence

Tree, forage, livestock

Silvopasture integrates livestock, forage, and trees. Domesticated animals are kept in a mutually beneficial way on the pasture lined with trees. It utilises the principles of managed grazing, and it is one of several distinct forms of agroforestry today.

Silvopasture is one of the oldest known forms of agriculture, and has been practiced in many parts of the world for centuries.

Silvopasture is not the same as unmanaged grazing in woodlands, which has many known negative environmental consequences.





Silvopastoral Systems: Trees and pasture and/or animals

Agroforestry practice	Brief description on arrangement of components	Major group of components	Project site, time frame and rationale
Plantation crops with pastures and animals	Trees scattered irregularly or arranged according to some systematic pattern	1. Cattle rearing under Acacia mangium 2. Breeding of deer and bearded pig under plantation 3. Sheep rearing under Agriculture Pawah Scheme	1. Implemented at Sabal from 1987 till 2001 within 47 ha area. 2. Implemented at Sabal since 1989 for research only. 3. Implemented in Niah where 44 heads of sheep were on loan to the project since 1995 and by 2000 all the 44 heads were successfully returned back. The remaining stock after that belonged to the project participants which they sold out by mid 2003.



Diversified land use

An obvious benefit of silvopasture is increased farmland utilisation. Silvopasture practice incorporates new woodlands into valuable commercial value and produces multiple products on the same acreage. This diversifies farm income sources. Farm viability is also increased.







▲ Baram… enjoying coolness, vegetation layering and ample panoramic view

Tree crops

Trees in silvopasture system provide livestock with protection from sun and wind. So,animal comfort is increased, and production improved. Trees provide shade in the summer and windbreaks in the winter. This allows livestock to moderate their own temperature.

Certain tree types also serve as fodder for livestock. Trees produce fruit or nuts that livestock can eat, while still on the tree or after they have fallen. Many tree leaf species serve as forage for livestock too. Silvopasture managers can utilise trees as forage by felling the tree so that it can be eaten by livestock, or by using pollarding or coppicing to encourage leaf growth where it is accessible to livestock. Silvopasture is compatible with fruits, nuts, and timber production. Grazing can serve as a cost-effective vegetation and weed control strategy.



Wildlife's abundance

Studies done on silvopasture practices in many countries showed the tendency for increase in wildlife abundance and diversity.



▲ Deer pasturing

▼ Deer acacia





▲ Cow acacia

TAGANG WAY

Tagang way

A visit was made to a village farm. The farmer's principal activity is in the oil palm cultivation, on a 100-acre family-owned land. The farm is into its 18th year of oil palm business now. Previously, besides oil palm, the family also involved in rubber trees.

Empurau rearing

For a hobby at first by the farm-owner, and supplementary activity, there is also the rearing of fresh river water fish. The breed is a very expensive type of fish found in Sarawak, the *empurau* species. This fish fetches very high price, and much sought after as special delicacy dish by the wealthy elites. The farm has been rearing this fresh river water fish for the past 8 years. The big advantage for this farm is that this area has a good running stream of natural fresh water from the hill top. With good planning and strategy, the farm-owner is able to take advantage of the clean natural fresh stream water that is very essential for *empurau* fish. Making active his hobby of fish- keeping also brings in additional income, besides the revenue from his previous rubber trees and now the oil palm plantation.



▲ Fresh water for empurau farm, Robert Ahon Serikin.

Lessons learnt:

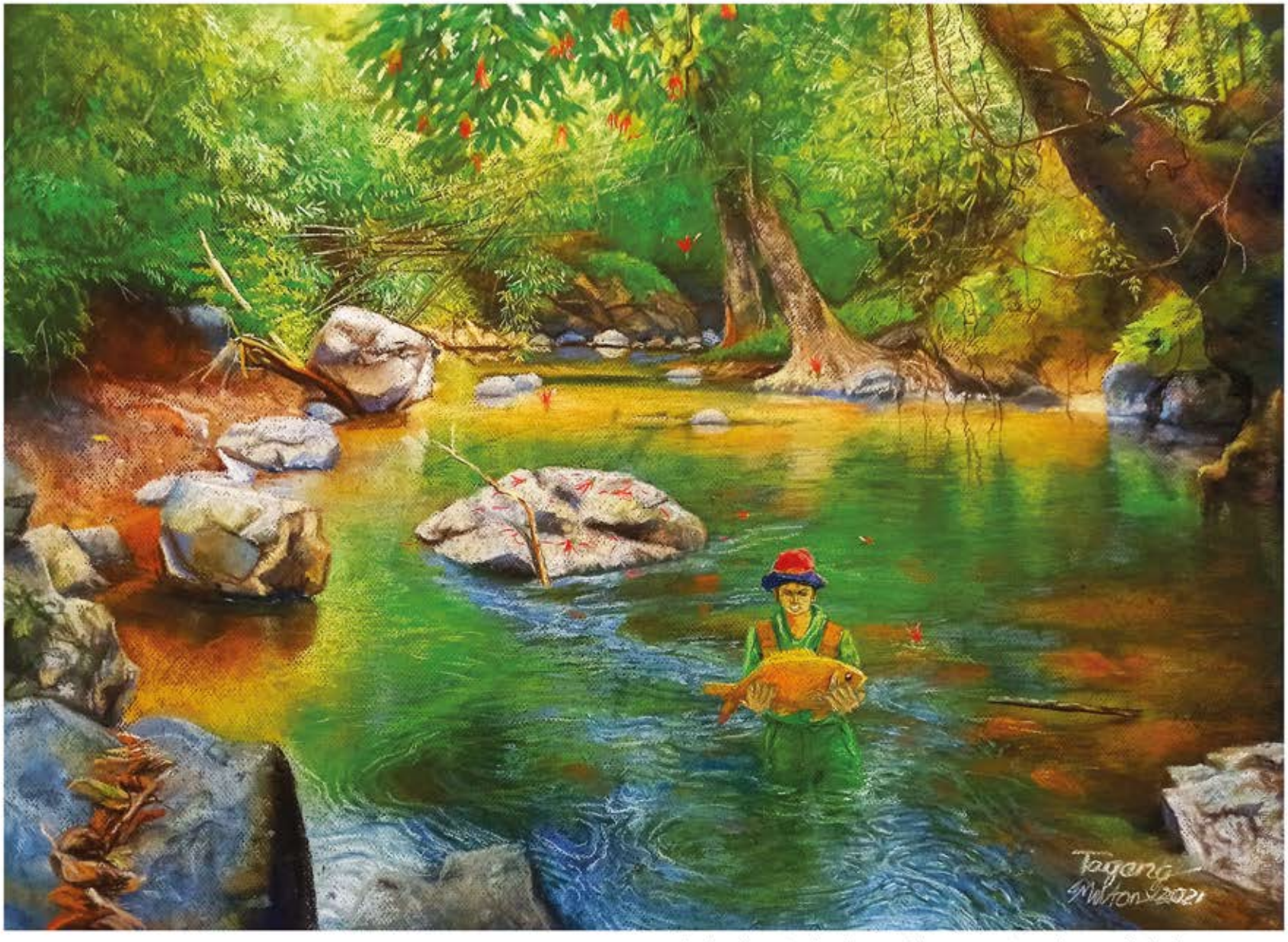
The secret or formula here is harnessing the natural forest environment (unspoilt clean fresh natural running water) to ensure *empurau* fish can thrive like in their wild natural habitat, while the agriculture activity (oil palm cultivation) sustains and blends well with the forest eco-system. This is smart and practical agroforestry.



▲ Overview of aquasilviculture practice in Serikin



▲ Riverside plant



▲ Agroforestry landscape of tagang system aka aquasilviculture

FISH PONDS AND TREES



▲ Aquapoultrysilviculture at SABAL near nursery



Blending of two cultures

Generally farmers like to indulge in activities that (i) they are good at,

(ii) are fun or interesting to involve in as they enjoy the fruits or rewards for their hard work later

(iii) suits the soil condition, topography, terrain, or location of the land, and

(iv) brings in better revenue or rewards and high yield or productivity.

Multiple activities

There are some farmers who undertake more than just one type of activity; that is, not just cultivating the land (***agri or agro culture***), but also involved in keeping poultry and livestock (pastoral) or rearing fish, prawn, cockerel and crab (***aquaculture***).

Practical example

In many parts or areas of Sarawak, there are farmers who plant vegetables, herbs, and fruit trees (orange, *dabai*, *longan* or local lychee, *rambutan*, *langsat*, jackfruit, guava, mango, papaya, crystal fruit, *durian*, star fruit), as well as maintaining fish ponds; and rearing poultry, having the chicken sheds constructed alongside the fish pods, so the droppings can drop down to the water for the fish to feed on.

The farmers also use the dungs as fertiiiser for their cash crops (vegetables) and fruit trees.

Ornamental landscaping materials

There are farmers who,instead of planting fruit trees or cash crops, commit to the production and supply of flowers, decorative shrubs and other living plants (materials for landscaping at private garden homes and public areas).

Tranquil views and lustic scenery

Typically, from the road side one can see (i) the beautiful sight of aquaculture (fish ponds) on the lower areas of the farm,

(ii) cash crops of vegetables, herbs, bananas and pineapples on the middle areas, and

(iii) many tall fruit trees (*forest*) at the other adjacent areas.

Photos

Photos below show the fish ponds, and the fruit trees at the same garden or farm location belonging to a common owner.

(i) Fish ponds

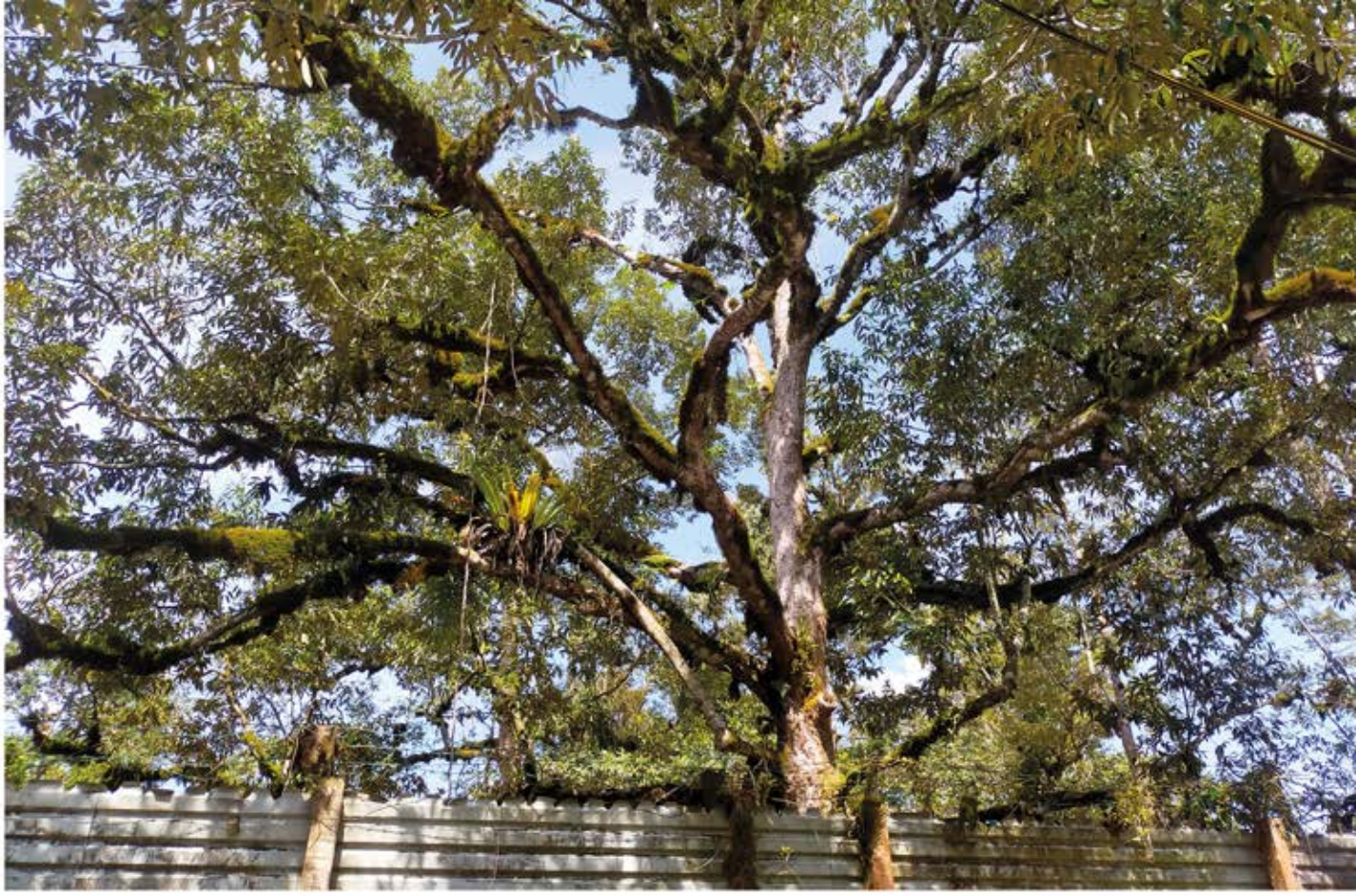








(ii) Fruit tree







PRAWN FARMING

The location

Villagers having dwelling homes and land along the coastal areas of Sarawak find space and time to do small holders farming.

Example: in the coastal Sempadi, Lundu area. They engage in prawn rearing activity that has features of (i) agroforestry, (ii) forest landscape restoration, and (iii) aquaculture.

Related to agroforestry

The farmers plant fruit trees, greens, and some cash crops on their land adjacent to, or besides, the sites where they dug the mangrove swamps and nipah palm areas to keep their prawns. With this practice the farmer, to an extent, keep the coastal forest landscape green and natural. The vegetables and greens they grow are for household and family consumption, so being self-sufficient, they need not buy vegetables in the local market, and a great savings of family food expenses.

Practice forest landscape

Without the farmers being aware of what they practice, they are in fact indulging in indirect forest landscape restoration. How so? Well, when they clear their land for prawn farming, they leave many mangrove trees and Nipah palms that were not in the way as unspoilt or uncut. They also need the mangrove roots around the prawn-ponds or prawn-canals for the prawns to forage in. This way they partly use the mangrove tree systems as habitat for their prawn farming.

Related to aquaculture

The feature of aquaculture is obvious here, since the farmers have formal ponds and prawn trenches. These ponds or trenches are maintained properly every day.

(i) Prawns







(ii) New pond canals, trenches, or breeding places







(iii) Harmony with natural landscape and environment









(iv) Mixed fruit trees.













MUD CRAB FARMING

Mangrove or mud crab

The common name is Mud crab, Green crab or Mangrove Crab. Botanically the name is *Scylla serrata*.

Economic importance

It is an important species of crab from an economic viewpoint. It lives in the estuaries and mangrove-forested areas. The shell colour varies from a deep, mottled green to very dark brown. Mangrove or mud crab aquaculture is popular today because of the good demand and high price that these crabs fetch in the market. Mangrove crabs have high flesh content. They have rapid growth rates even in captivity, making crab aquaculture a lucrative venture. Mangrove crabs' colossal market demand is global, especially in South East Asian countries. Crab meat is a seafood delicacy. Mangrove crab's meat is said to be the tastiest of all crab species.

Ecological importance

Scylla serrata (mud or mangrove crab or black crab) is also ecologically an important species of crab found in the estuaries and mangroves. Mud crabs prefer sheltered waters such as estuaries and mangrove areas.

Types of mangroves or mud crab

There are 4 species of mud crab.

Lifespan

Mangrove or mud crab can grow to around 10 cm in width in about a year. It can become 'sexually matured' in about two years. Its typical life span is 3 to 4 years.

What do mud crabs like to eat?

Feeding in its natural environment, they eat mainly shellfish and other crustaceans. In aquaculture conditions, alternatives like trash fish, fish waste, and other waste streams are used as feeders.

Widespread

Mud crab or mangrove crab refers to any crab that lives in or near mud or mangrove. It is found in the Indo-Pacific, from South Africa, around the coast of the Indian Ocean where it is especially abundant in Sri Lanka, to the Southeast Asian Archipelago, as well as from southern Japan to south-eastern Australia, northern New Zealand, and as far east as Fiji and Samoa. The was introduced to Hawaii and Florida USA.

In Hawaii, mud crabs are known as Samoan crabs, (as they were originally imported from American Samoa). As these crabs are known for their robust size and dense meat content, they have been greatly sought after over the years.

Crab Aquaculture

(i) Small holding aquaculture

Some small farms and part timers, (family owned) keep crabs in their natural mangrove environment, getting crabs to move around in the enclosed mangrove areas. They make small patches of ponds (few square metres only) to keep the cabs in. The mangrove trees and some nipah palms in the locations are not largely disturbed or cut down, so the forest landscape is still intact.

(ii) Large scale aquaculture

The farm here is of a big scale, in multiple acres. It involved large capital investment on purchase of (a) mangrove-type of land or soil, (b) feeder roads and infrastructures, (c) sheds, store houses, feeders, breeding labs/ponds, workers and labourers' quarters, bunds or access roads inter-connecting huge breeding and rearing ponds, aeration systems, filtering equipment, surveillance and monitoring system, research and development facility, safety & security infrastructures, fencing of protected or secured and 'no trespassing' compounds, and office administration building.

The site and soil environment need to be conducive, or similar, to the natural environment of 'mangrove and mud' crab that have conducive atmosphere to their natural habitat. Although the big ponds do not have mangfove trees and nipah pams for the crabs to forage around for food, the surrounding compound areas and farm outskirts are all covered by the natural mangrove and nipah forests that provide the greenery atmosphere, and the real mangrove forest landscape.

Eco-tourism

....permaculture of crab farming

Due to the natural surroundings, and the farm is in the midst of the lush green mangrove and nipah forest in the coastal region of Sarawak, the location is well placed.' It is within the fast easy access of good modern country road. Thus, soon to come, there is the likelihood that the farm owners may like to open the farm to paid visitors and tourists, so that the farm can have an indirect spin-off for attraction to people keen to understand how mangrove crabs are reared, and to even have the novelty of buying fresh live crabs direct on the spot from the farm.

See photos below.

(i) The crab









(ii) The crab ponds









(iii) The undisturbed natural surrounding outside the pond areas















APISILVICULTURE IS BEE FARMING

What is apiculture?

It is a form of farming where bees are kept or reared for the production of honey.

Bees collect pollen and nectar from flowers, and they produce or prepare honey from them. Honey is sweet. Humans consume it. Colonies of honey bees live in hives.



◀ Typical wild honey bees in the Sarawak forest (favourite place for making big hives are the huge *tapang* trees. *This one is from Bung Bratak apis dorsata hive on tapang tree*)

Beekeeping

Apiculture is a term for beekeeping for commercial purposes. Humans maintain bee colonies in man-made hives. Honey bees of the Apis species are commonly reared and domesticated bees. Hence the term or name 'apiculture'. Other honey-producing bees like the Melipona stingless bees are also kept.



Apiarist

A beekeeper is known as an apiarist. He keeps bees to collect their honey, and other products that the hive produces like beeswax, propolis, flower bee pollen, and royal jelly.



Agroforestry and apiculture

Bees fly around to gather nectar and pollen. In the process of pollen-gathering, they help in the fertilsation and pollination of flowers to produce fruits. Bees, besides honey production, are very useful in crop pollination.













Early practice

People collect honey from wild bees as early as 10,000 years ago.

History

Studies show that beekeeping in pottery vessels started about 9,000 years ago in North Africa. Egyptian art portrayed bees domestication around 4,500 years ago. Honey was stored in jars, and some were found in the Pharoah's tombs (like Tutankhamun). From the 18th century onwards, farmers in Europe began to understand bee colonies and bee biology. They knew bee biology and behaviours. They constructed movable comb hive to harvest honey while not damaging and destroying the entire colony.



Bee colony

People maintain colonies of wild bees in artificial hives made from hollow logs, wooden boxes, pottery vessels, and skeps (woven-straw baskets).

Honey, apiculture, and civilisation

Beginning about 7,000 BCE, beeswax traces were found in potsherds throughout the Middle East.

The oldest archaeological finds directly relating to beekeeping were discovered at Rehov, an archaeological site in the Jordan Valley. This valley thrived during the Bronze and Iron Ages. Intact hives (made of straw and unbaked clay) were discovered in the city's ruins, dating from about 900 BCE. The hives were found in orderly rows, three high, in a manner that could have accommodated around 100 hives, held more than 1 million bees, and had a potential annual yield of 500 kilograms of honey and 70 kilograms of beeswax. This is evident that the advanced honey industry existed in ancient Israel 3,000 years ago. *(facts extracted from Wikipedia).*







△ Apiculture (bee rearing) ... the bee house or honey log

In the olden days, beekeeping was considered a highly valued industry, controlled by beekeeping overseers (whose gold rings depicted apiculture scenes instead of religious background). Beekeeping was depicted in Roman literature. It was also practised in ancient China, as shown in ancient Chinese antiquity. The Chinese described the art of apiculture or beekeeping, stressing the importance of the quality of the wooden box used and how this can affect the quality of the honey.







A BIG TIME APICULTURE ACTIVITY... RIMBUNAN HIJAU WAY

In 2013, R H Bee Farms Sdn. Bhd, wholly owned by Rimbunan Hijau Group, was formed. It started on small scale for their own consumption. By 2015, the farm had more than 2,500 bee (kelulut) colonies or huts. The right equipment, proper bee rearing systems, and farm management enabled the company to deliver higher quality products to consumers.

The kelulut farm is in a tropical rainforest highland in Sarawak, 900 ft above sea level, and far away from urbanisation pollution. The bees feed on flowers and pollens of a tree specie (*Acacia mangium*).

Stingless bee is known as 'kelulut' in Malaysia. Kelulut is biologically different from honey bees (*Apis mellifera)*

What makes stingless bee (kelulut) honey different?

Unlike other bee honey, kelulut honey is stored in propolis pot. So the nutrition and goodness of propolis is infused into kelulut honey. Kelulut honey provides great health and medicinal source of antioxidant, anti-inflammatory, and antibacterial elements.

Kelulut honey has been used by old folks as traditional remedy for illnesses and diseases.



▲ One product type from RH farm

There are more than 600 species of kelulut in the world, and in Malaysia, there are approximately 45 kelulut species.

Kelulut have existed in tropical rain forests for the last 50 million years, according to research. Their sizes range from 3mm to 13mm long. This 'small size' enables them to sip nectar from deepest space in tiny flowers. So their honey contains more vitamins and minerals. Kelulut bees harvest pollens and resins from flowers and trees.

Popular kelulut bee farm products are kelulut honey, kelulut propolis, and kelulut pollen. These products are for healthy life style.



▲ Kelulut colony or huts in RH farm

FREE ROAMING POULTRY FARMING

Agroforestry and poultry farming

... free range poultry rearing

Poultry rearing normally is done in permanent huts or poultry sheds. The birds do not roam freely, but are always in the enclosed huts or sheds. Another method of poultry farming is to let the birds run loose. They roam freely on open spaces, usually within or near forest areas. This is popular among villagers that have land spaces surrounded by forests. Keeping poultry by this free range approach is associated with agroforestry, as the forest is also the area where the birds roam and forage.

Keeping poultry using free range' poultry farming approach means the birds have 'access to the outdoors'.

▼ Rearing chicken within bamboo forest grove



Chickens and ducks enjoy fresh pasture. They care allowed constant access to the outdoors, with plenty of fresh vegetation, sunshine, and room to roam around. The advantages of free range poultry farming is that the birds are able to practise a range of natural behaviours, including nesting, foraging for food, perching, and dust bathing. The meat of free range farm birds is also tastier than enclosed birds. Research has shown that those meat are significantly lower in fat; and higher in protein, iron, and zinc, compared with meat from conventional birds.

▲ Free-range-chickens- farm



▶ Free roaming poultry farm within forest area

BIRDS-NEST REARING

Bird's nest

The Bornean swiftlet is a woodland species. It is a small bird of the swift family. Swiftlets make their nests with their saliva. The nests fetch a high price in the food and medicinal market. Due to its known medicinal values, it has a long history as a soup-delicacy for food lovers (especially among Asians).

Swifts make natural nests in deep caves or rock-cliff caverns all over Sarawak (and Borneo). The birds need natural unspoilt forests where they source for food and roam in the clean pollution-free environment.

How does a swiftlet make its nests? Instead of twigs, feathers, and straw, it makes a nest from strands of its gummy saliva that hardens when exposed to air. The opaque and whitish nest is made exclusively of solidified saliva and is the main ingredient of bird's nest soup, a delicacy of cuisine lovers. The edible-nest swiftlet (Aerodramus fuciphagus), is also known as the white-nest swiftlet.

Why is bird's nest expensive?

Swiftlets build nests out of their sticky saliva on cave walls and cliff sides three times in year. These nests are where they raise their young. It is the high cost of these saliva nests that makes bird's nest soup very expensive.

Why is bird's nest illegal to transact in without licence?

Most bird nests are protected under the International Migratory Bird Treaty Act

(MBTA). Harming migratory birds, or tampering with their eggs, is illegal and make a person liable to prosecution under the MBTA. Due to the biological and behavioral characteristics of some migratory bird species, destruction of their nests implies violating the MBTA.

Collecting bird's nest for commercial use requires a permit or licence from the relevant authorities.

For Sarawak (and Borneo), the commercial activities involving bird's nest have been going on since the ancient trading days with the Chinese traders sailing to Borneo for spices, bird's nest, and agarwood.

Licensed bird's nest farming

To ensure the sustainability (and non-extinction) of the swiftlet population, bird's nest farming has to be regulated to minimise environmental and noise pollution as well as to ensure the safety and good care of the birds, and to prevent any unethical activities by rogues. Farmers can acquire licence to rear or keep swiftlets in constructed bird houses and less densely populated sites or forested areas. This bird farming is popular among coastal inhabitants. The swiftlets thrive in coastal areas and mountain forests, since food is aplenty in those natural habitats.



Harmony

Harmony of the undisturbed forest is the goal for farmers to build their bird houses within the forest fringes. There is little destruction or disturbances to the natural forest landscapes.

The bird's nest farmers get periodical income from the maintenance of their bird's houses. For the public and nature-loving enthusiasts (or jungle lovers), the bird's nest farming activities can also be a sideline to eco-tourism, thus the permaculture that bird's nest farming is grouped into as a form of agroforestry activity.

Below are photos of bird's nest houses, the swiftlets, the nests, and the unspoilt natural forest surroundings.

(i) Bird's house





(ii) The bird (swiftlet)





(iii) The bird's nest



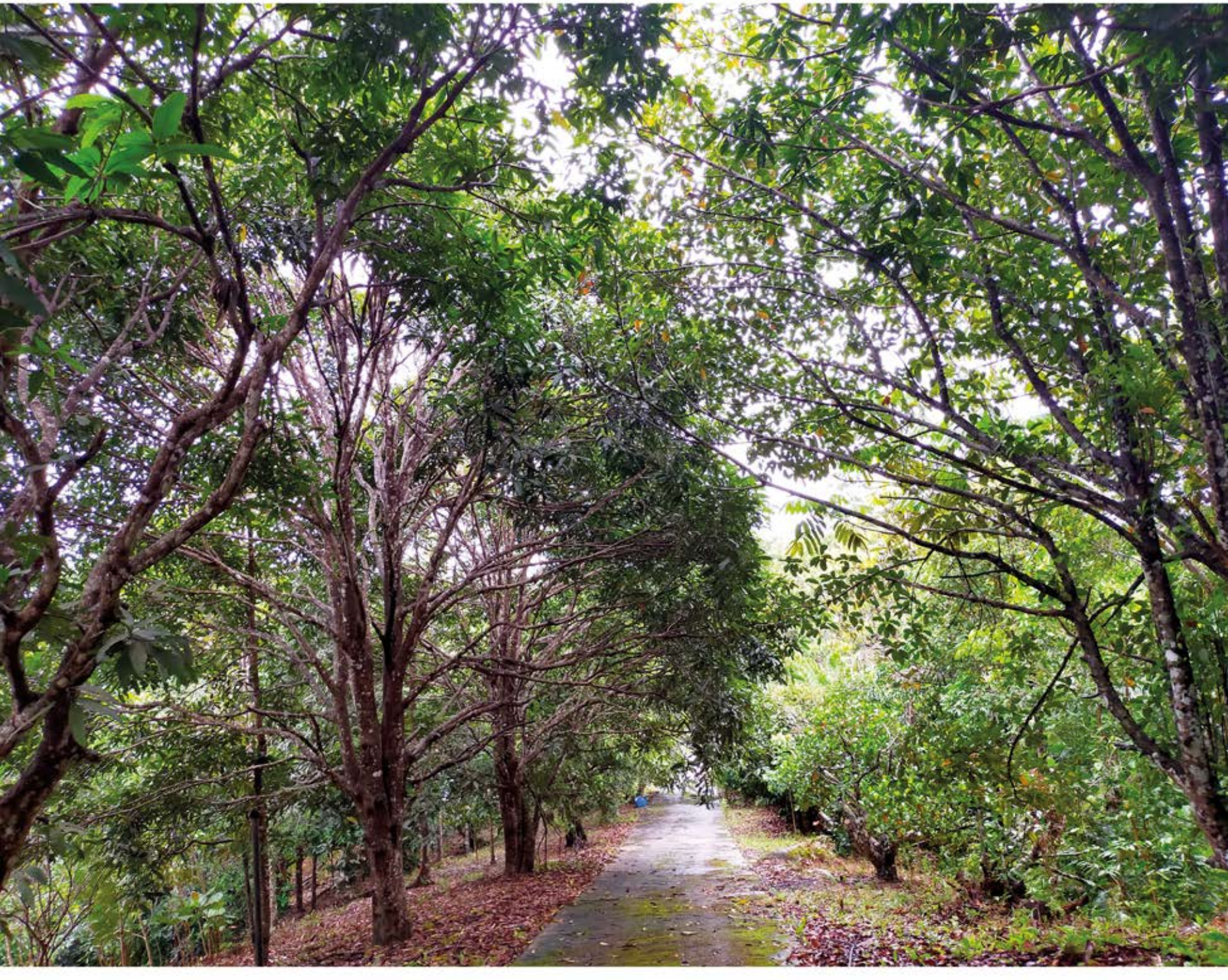
(iv) Natural surroundings within the bird's nest houses left undisturbed for the birds to forage and move around











TOURISM IN AGROFORESTRY

Permaculture... an idea

Permaculture is a form of agroforestry . Why so? Because forest (and trees) or natural surroundings are preserved. When tourists visit the farms or agricultural activities going on, they also find the natural forest landscape and awesome to look at.

What do we understand permaculture to be? Permaculture is a system in itself.

It is a design system, based on ecological principles. The system draws together the diverse skills and ways of living that need to be rediscovered and developed to empower people to move from being dependent consumers, to becoming responsible producers.

People interpreted permaculture as the growth of agricultural ecosystems in (a) a self-sufficient and (b) sustainable way. This form of agriculture draws inspiration from nature to develop synergetic farming systems based on (i) crop diversity, (ii) plant resilience, (iii) natural and organic productivity, and (iv) sustainability.



What is permaculture farming?

Permaculture farming is an approach to agricultural design. It focuses on whole systems thinking, and simulating or using patterns from nature.

'Care for the earth' mindset is central to permaculture spirit. The idea is to help all life systems continue to exist and multiply.

Examples of permaculture:

... buildings that support outside plant life

... backyard and balcony gardens

... energy-saving green initiatives like installation of gray water reclamation systems

... preserving heritage and farm dwellings or old farm settlements for tourists to visit, explore, and experience

ECo-tourism

Permaculture can boost eco-tourism activity. Tourists would feel, touch, see, interact, discuss, observe and participate in live sessions of the activities in the locations they visit or tour.



▶ Layout of Borneo Happy Farm as model for agroforestry tourism

Agroforestry and permaculture... eco tourism

Natural forest landscapes that are preserved provide attractions to the public. Some parts of the land areas or farms have also been cultivated with tree crops or plants that people like to visit or to do research and gain knowledge. The visits by people to these places promote healthy lifestyle, and regarded as a permacultural activity. Such activity is indeed educational, informative, recreational, and adventurous. Some places that are showcased here are the followings:

- Bung Bratak Heritage
- Bung Jagoi Heritage
- Borneo Tribal Village
- Borneo Happy Farm
- Bung Muan Serembu
- Bario Highland

▼ Bario rice fields



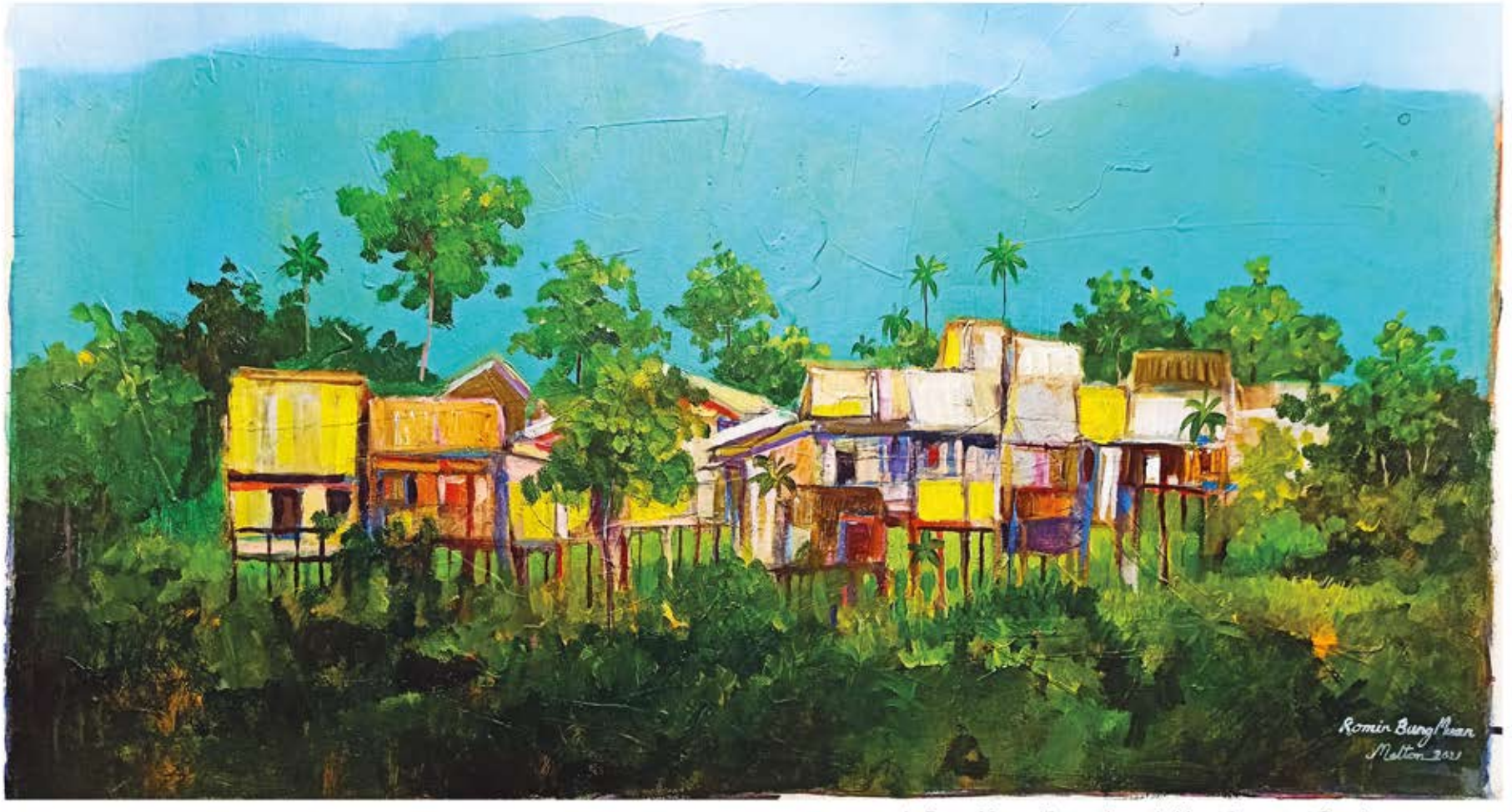




▼ Bung Jagoi and foothill cultivations



▲ Bung Muan Serembu, view from Kg Podam



▲ Bung Muan_illustration of old settlement at Romin



▲ Borneo Happy Farm, Silvopastoral



▲ Borneo Tribal Village, Sarawak





◀ Bung Bratak Heritage Complex

FOREST LANDSCAPE RESTORATION... NATURAL BEAUTY OF WATERFALLS, LAKES, VIEWS, FAUNAS & WILD FLORAS, RIVER ROCKS, AND FOREST GREEN TAPESTRY FOR ECO TOURISM







▲ Natural lakes and mountain scenery

▼ Eco-tourism, Tasik Biru in Bau







▲ The Three Sisters Keluan waterfall, Long San, Miri



▲ Forest landscape orchard







◀ Niah stream….clear water



◀ Rainforest landscape, Mt Mulu


Mountain scenic views....for eco-tourism





LESSONS LEARNT: CHALLENGES AND OVERCOMING OBSTACLES

THE GLOBAL LESSONS LEARNT

If Agroforestry is effective and the way forward for agricultural and economical pursuit, is it widely adopted, and is it a popular option to manage the land, forest and environment? Or how is it that it is still not that popular as yet?

Hence the big question is '*why few people or group practise it*' ?
Some pointers that shed lights to the above posers are briefly discussed below.

Agriculture

Whatever be the 'in thing' in our today's lifestyles, economical and societal fabrics and pursuits, agriculture or farming and food cultivation and production, and the appreciations or values for trees/plants still matters. Agriculture can be said to be the biggest 'employer' globally. Humans have yet to discover another more effective way to lift up people from hunger, under-nourishment, and poverty. Money alone from any industrial or economic pursuit or success cannot eradicate the famine, hunger, and global food shortages if agriculture is ignored and no one tend to the land for food cultivation and pastoral rearing.



Agroforestry

The big worrying aspect of Agriculture alone is that it is the biggest driver of deforestation, and also the biggest water user.

Agroforestry, an agricultural method where trees and crops are cultivated and husbandry or animal rearing activities are practised on the same land area, is declared to be a *win-win-win* formula approach. It has many benefits, from (i) climate to (ii) biological diversity to (iii) economic and sustainable development.

Sustainable development

Many experts and researchers advocate that Agroforestry can contribute to achieve most of the sustainable development goals.

Agroforestry goodness

If Agroforestry is good, having the 'win-win-win' miracle, why does not everyone do it? This issue was debated at the World Agroforestry Congress 2019. Here are some impediments (barriers) to Agroforestry practices. Ways to overcome them are also in the briefs below.

The impediments ... Lessons learnt

Lesson 1: Fear of change

Change is always a risk and no one likes to move away from the comfort zone of traditional (and some successful) agricultural and pastoral ways and systems.

Lesson 2: New risk

The wonders of agroforestry are well understood. However farmers switching from accustomed practices to new approaches that they have not tried before make it a new risk for them. So no matter what the promised increases in yields as compensation would be, few farmers would venture out from their conventional agricultural ways.

Farmers may be reluctant to apply agroforestry, even after receiving training on the matter.

Solution: The fear could decrease if the training has a consistent follow-up, instead of being a one-off novelty event. Farmers may find it difficult to know if they had adopted the techniques correctly and according to the specific conditions on their farms. That transition to agroforestry needs to go along with safety nets. This way the farmers can change without too much risking their livelihood.

It was revealed that farmers with larger land slots are more likely to adopt agroforestry. Abundant land allows them to experiment with agroforestry on a piece of their acreage, while keeping traditional agriculture on the rest for their safety net. With this approach the farmers' perceived risk decreases and, after that, if successful, the agroforestry area could expand.

Lesson 3: Conflicting messages and strategy

Example seen in one country, where the farmers receive conflicting messages from the authorities and the promoters or development partners. The government advocated and announced its fertilizer support programmes, offering subsidies for chemical fertilizers, while researchers (promoters and development partners) were promoting agroforestry as a means to reduce the dependency on these same fertilizers.

Solution: The transition from traditional agriculture to agroforestry requires a coordinated effort, and a supportive enabling environment.

Lesson 4: Habitus (or Social norms and values)

Farmers may know how to farm with agroforestry system. They know about its benefits and there are plenty of projects providing training in agroforestry. But more often than not, agroforestry interventions lack understanding of the social context and human or people's values.

Amongst other things, the way we define ourselves entails where we draw the boundary of what we are not. This interaction has a strong influence on people's sense of being that is expressed in the sociological concept of habitus.

An example: A farmer may be uncomfortable with tree planting and logging of trees, as he associated such actions with forestry, not with agriculture.

Another example of habitus getting in the way of agroforestry adoption is witnessed in Nepal, where a farmer was offered support to adopt agroforestry practices, but women were reluctant to adopt agroforestry. This is mainly because in Nepal's traditional social structure speaking to government officials is the men's domain, even though it is mainly the women who farm.

Lesson 5: Peer-to-peer influence lacking

Training on agroforestry methods does not necessarily result in high uptake rates. Effective capacity development requires consistent communication, to draw normative stories illustrating how other farmers use agroforestry. Fostering inter-personal communication between farmers (through which they can learn from one another) is key. Peer-to-peer influence can change attitudes towards agroforestry. Although reluctant initially, by seeing his neighbour's success, a farmer can get excited and adopt agroforestry practices. This and the adoption pattern could even expand beyond the training programme. Thus with time, and continuous follow ups, values can change. Successful sustainable agroforestry project implementation needs to consider values and norms (habitus) and let the trust grow on the foundation of mutual understanding.

Lesson 6: No clear land rights

This is an example that happened in one country where a large project on using 'fertilizer trees' to improve soil quality and to reduce the cost and need for fertilizers. The project was to identify and plant or maintain tees that help in the natural or self-soil fertilizing. Some years later when the project promoters returned to the project site after the active part of the project was complete, there was almost no 'fertilizer trees', and as if the project had never existed. What happened was that the farmers did not have clear land rights and for that reason did not want to invest in planting trees. So, the promoters were *barking up the wrong tree* (so to speak) when they were trying to convince the farmers to adopt agroforestry for the sake of soil fertility.

Solution: The issue of land tenure is central to agroforestry. Many agroforestry projects were known to fail because farmers have no or little right to the land they live off.

Lesson 7: Tree ownership

Two important elements or ingredients of agroforestry are (i) land and (ii) trees.

Who owns what? In some countries (like in Vietnam and Ghana), all trees belong to the state as stipulated in the forest protection policy. This discourages farmers to plant trees. That is why the official agriculture and forestry policies need to include specific land use conditions and tree ownership to facilitate agroforestry practices.

Lesson 8: Unutilised plant species need better marketing

Studies showed that people only make use of 0.5 % of all the edible plant species existing on planet earth. Agroforestry offers many products that could satisfy human being's nutritional needs. The trouble may be that the local and indigenous species are often neglected (in favour of the commercial products popular in demand) by the global market. This is an example from the Pacific island. There are ecological benefits of cultivating the local galip nut tree in the Pacific Islands. But the farmers could not get decent local market value for the nut, and therefore did not want to plant the galip trees. This situation creates the domino effect: if there are no galip nuts on the market, there are no buyers, and with that, there is no demand, and no processing factories, and therefore even lower willingness to plant the galip trees.

Solution: The promoters worked closely with the private sector across the entire value chain, establishing the links between smallholder farmers, small scale entrepreneurs, food processors, food distributors, and food retailers. It was only then when they created a market for the product that brought about that real impact on the livelihoods in the community, and demand for galip nuts surged locally and globally. Farmers find planting galip nut trees very rewarding and the tree species become one of the important trees for their agroforestry activities.

Lesson 9: Context is magic

When working or dealing with Agroforestry one cannot forget that it is really context specific. Context is king, so to speak. That is, what works on one farm might turn into a disaster on the neighbours' farm. It is not quite possible to advocate for a one-size-fits all, or for just one structured methodology that can be assumed to work for everyone. There is that need to understand each individual farmer, his land, his needs, and the environmental conditions he is in. The key word here is customisation, as one area is unique to another.

Lesson 10: Properly understood local/global standard practices

Do we have a compass for agroforestry practice? Are there some guiding principles and informal or formal standards that cn be referred to for use and guide so farmers will not be off-track? Proper principles, concepts, and basic framework on agroforestry practice are necesssary. Despite the 'customisation' of every project or agroforestry site/location, the one fundamental that does not change is making people know (i) the concept or spirit of agroforestry, and (ii) using as a general guide or compass.

Solution:

On agroforestry framework

Framework: USDA Agroforestry Strategic Framework: Fiscal Year 2019-2024

Although mainly for the land, farmers, and practices in the continent of Americas (North and South America), many of the concepts and guides in this framework are also 'doable' or practical, when fine-tuned, for other parts of the planet earth.

On guidelines and standard practices

(i) UN-FAO: There are guides and principles to follow on agroforestry issued by the United Nations Food & Agricultural Organisations (FAO). The discussions and guides are on agroforestry practices for all continents (Europe, Asia, Island Pacifics), given that land/soil, trees/plants, climate/environment are not similar for these locations.

(ii) ASEAN: ASEAN guidelines for agroforestry development. ASEAN senior officials on forestry 2018. This standard guideline was discussed at the 2018 conference of ASEAN senior officials on forestry.

Policies and guidelines from Forestry Department, Sarawak (FDS)

Agroforestry is an activity or programme that FDS acknowledges to be one of its principal responsibility and commitment. Thus on its own, or sometimes in collaboration with the Agricultural Department, it formulates and identify key areas and activities to promote or encourage in the ongoing effort to fulfill its agroforestry's short, medium and long term planning and strategies. Practical guidelines and standards are discussed and issued from time to time by it.

There are (i) huge potential in agroforestry and the (ii) many varieties of plants (and trees), (iii) different terrains and soil conditions, and (iv) opportunities for creating open pastoral or grazing areas within the forest, available in Sarawak forest. Given these four push or drivers, the FDS aims to help and encourage local practitioners and farmers to adopt and venture into agroforestry.

Challenges:

(a) No proper or minimum management system which gives a low economic return, thus making it not very productive and attractive to the younger generation.

(b) Shortage of interested personnel and trained extension workers to implement this project in the rural areas due to no vocational training available and less attractive. This project was assigned to one officer who also handled two other projects with the assistance of two full time supporting staffs at FD Headquarters and another 10 part time workers on the basis of as-and-when required assignment.

(c) Marketability of lumber not well understood. At present, there is no legal provision for the timber harvested from the farmers or community forest area (small unit area) to be commercially marketed except for domestic use and processed to finish products (furniture and handicraft) within the village.

(d) Survey of the farms designated under community forest remains an arduous task due to the shortage of funds, workforce and scattered distribution of the areas. The other situation arose once the area is surveyed prior to planting, The farmers would not continue with the planting but take the advantage to make a claim of right from other interested parties.

(e) Another constraint faced was the logistics for transporting planting materials from the designated FD nurseries to the farmers far away by boats or logging roads.

(f) Lack of organisational and /or skills among the communities to deal with externalities due to illiteracy and lack of confidence (poor knowledge and information and weak bargaining power) especially if they are physically distant and remote.

Elucidation:

(a) Availability of land bank under NCL and Communal Forests. Due to the rugged terrain, remoteness, its scattered distribution and need for conservation, the available land bank in Sarawak should be turned into a community forest project. IRAD (1996) reported that 1.5 million ha of NCR land are not fully utilised and unproductive in Sarawak. A review of these areas should be done to improve its full potential and further benefits the local people.

(b) Establish the brokering approach, based on strategic alliances and networks with an NGO, trading company or research institute, in which planning, implementation, marketing and training issues are addressed through a partnership with the local community.

(c) The community forest is one of the approaches to meet strong demand for high price exploited NTFP such as *Gaharu*, *Tongkat Ali* and others, habitat and ecosystem management for endangered plant species through development of buffer zone.

MOUNTAIN LANDSCAPE & SCENES



▶ Mountain forest fruit tree





Mixed fruit trees planted in the mountain forest



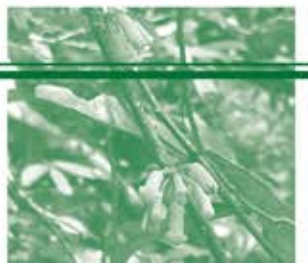
Big matured fruit tree in the mountain forest





THE CATALYST, THE PUSH AND POLICY INFRASTRUCTURES ESCALATING TODAY'S SUCCESS FOR AGROFORESTRY IN SARAWAK

GOVERNMENT AND PRIVATE SECTORS' NOBLE INITIATIVES



DRIVERS & MOVERS OF AGROFORESTRY AND FOREST LANDSCAPE RESTORATION IN SARAWAK

MANDAT YAB KETUA MENTERI SARAWAK

"Projek Pengkomersialan Hutan Tani di Hutan Komunal Lubok Antu Samarahan haruslah menekankan aspek Penyelidikan & Pembangunan (R&D) agar ia boleh menjadi contoh bagi tujuan pembangunan tanah NCR di seluruh negeri, disamping melibatkan penggunaan teknologi tinggi seperti dron dan mesin pemprosesan serta penanaman dari spesis cepat tumbuh mengikut kesesuaian spesis di atas tanah di kawasan tersebut."

"YANG AMAT BERHORMAT DATUK PATINGGI (DR) ABANG HAJI ABDUL RAHMAN ZOHARI BIN TUN DATUK ABANG HAJI OPENG
KETUA MENTERI SARAWAK
4 Februari 2019

ASPIRASI DAN HARAPAN

"Pelaksanaan Projek Hutan Tani di Hutan Komunal Lubok Antu Samarahan dibawah pengurusan generasi muda iaitu pihak KLARSB ini diharap dapat meningkatkan sosio-ekonomi penduduk kampung. Semua penduduk kampung menyokong sepenuhnya pelaksanaan projek ini dengan harapan ia dapat menjamin masa depan yang cerah dan memberikan manfaat kepada penduduk dalam jangka masa yang panjang."

TUAN HJ. BOH BIN HJ. SABIL
PENGHULU BIDANG KUASA LADANG, SAMARAHAN

"Saya amat berbesar hati dan yakin terhadap pelaksanaan projek hutan tani di kawasan Hutan Komunal Lubok Antu Samarahan dan berharap ia dapat dibangunkan secara berterusan pada masa akan datang. Dengan adanya projek ini, saya juga berharap agar ia dapat mewujudkan peluang pekerjaan kepada generasi muda dan semua penduduk kampung dapat menikmati hasil projek ini kelak."

TUAN HJ DORHAN BIN MAIL
KK KPG. LUBOK RIA

"Penduduk kampung amat berminat dan menyokong sepenuhnya pelaksanaan projek hutan tani di tanah Hutan Komunal Lubok Antu Samarahan dengan harapan projek ini berjalan dengan lancar dan berjaya memberi impak positif kepada sosio-ekonomi penduduk kampung."

EN. AWANG HOT BIN HAJI UDIN
KK KPG. REBAN,

Pihak KLARSB sentiasa memerlukan bimbingan dan khidmat nasihat daripada agensi-agensi berkaitan terutama sekali Jabatan Hutan Sarawak dalam pentadbiran dan pengurusan projek hutan tani di kawasan Hutan Komunal Lubok Antu Samarahan memandangkan projek ini merupakan satu pengalaman yang baru bagi kami. Kami juga berharap projek ini akan mendapat perhatian daripada pihak luar ataupun agensi-agensi lain untuk bekerjasama bagi membangunkan tanah tersebut agar ia dapat memberikan hasil yang positif kepada semua peserta yang terlibat."

EN. FAIZAL BIN BUJANG,
PENGERUSI KOPERASI LUBOK ANTU REBAN SERIAN BHD

Sumber:
Kajian Sosio-Ekonomi Projek Pengkomersialan Hutan Tani LASCF, 2 4 September 2020
Jabatan Hutan Sarawak

All over the world, or in every country on this planet earth, there are authorities and centres that give excitement and commitment to make agroforestry and forest landscape restoration (AFLR) taking shape and gaining momentum. These are the movers and drivers. In Sarawak they are as follows:

Government

There are various initiatives and programmes initiated or supported by (i) the Ministry for Modernisation Of Agriculture, Native Land & Regional Development of Sarawak, (ii) The Forest Department of Sarawak (*Social Forestry Division*), (iii) The Sarawak Forestry Corporation, The Agricultural Department, and (iv) the Veterinary Department.

NGOs

The non-governmental organisations (NGOs) are self-sponsored, government-aided, public or private funded, or a combination of all these. Some are academic and research groups, or implementers, or part-participants and joint undertakers of planned projects that relate to AFLR. There are societies like

(i) The Malaysian (Sarawak) Nature Society,
(ii) WWF or World Wildlife (Malaysia) Foundation,
(iii) GEF Small Grants Programme

Established in 1992 (year of the Rio Earth Summit), GEF Small Grants Programme embodies the essence of sustainable development to *'thinking globally acting locally'. It is an initiative of the UNDP.* GEF Small Grant Programme provide financial and technical support to projects that conserve and restore the environment that also enhance people's well-being, health and economy.



▲ Lubok Antu CF, Samarahan

Corporations

CSR... *corporate social responsibility*

Some large business entities have activities related to agriculture, forestry, or to both. Some are into heavy industries using lots of fossil energy that badly affect the green house effects. In line with the global or international plan to protect the environment and force them to achieve their carbon credit points, these entities have programmes and projects to maintain sustainability and healthy planet by looking at how to innovate and maximise the use of materials and spaces (land), and maintaining natural surroundings (environment), to reduce wastages or put idle natural resources to good use. So they start practising agroforestry for their agricultural and pastoral businesses, and or engage in forest landscape restoration programmes. They do these as part of their direct businesses or operations. Or they undertake and commit such programmes by sponsoring other groups or parties. Such sponsorships become part of their CSR (corporate social responsibility).

Individual players

The land owners or property title holders can be individuals farmers, family members, or companies. They are the direct implementers of agroforestry and forest landscape restoration (AFLR). Thus the success and popularity of AFLR starts with them. In fact they are indeed the 'true' movers and drivers of AFLR in that sense. So good knowledge, concept, policy, principle, and process of effective AFLR is vital for them. As such they need to be educated and made aware of what is AFLR, the values, benefits, and the art and techniques of AFLR.



Answering SIX questions

Effective successful AFLR comes about only with:

(i) Good direction, guidance and national policies from the authority,

(ii) when the fourth category (that is the individuals) of movers and drivers of AFLR know answers to these fundamental questions:

- *What* is AFLR (or agroforestry, and forest landscape restoration) ?
- *Why* is AFLR important and necessary today?
- *Who* can practise AFLR?
- *When* can AFLR be practised?
- *Where* can AFLR be practised?
- *How* is AFLR implemented or practised?

Layout Landuse Master Plan for Commercial Agroforestry Project at Lubok Antu Communal Forest Samarahan, Serian Division



THE PUSH... INITIATIVES & INCENTIVES FOR AGROFORESTRY & FOREST LANDSCAPE RESTORATION IN SARAWAK

Special centre established

The Sarawak government has created a centre to showcase agroforestry and forest landscape restoration (AFLR). The Centre is known as Sabal Agroforestry Centre or SAC. It is within the Sabah Forest Reserve and Sabah National Park at Balai Ringin, Sarawak.

This Centre showcased the activities and programmes typical to, or that are characteristic of, agroforestry and forest landscape restoration's system and practice.

Those programmes are conducted at the forest reserve area.

Example of agroforesty practices in Sarawak

Location: In Padawan area Sarawak

1. Agricultural sustainability remains a priority and challenge for Sarawak.
2. Subsistence and local or indigenous system of agroforestry practices are carried out by the villagers (semi urban) and urban dwellers in the area and within the vicinity. Those activities meet the agricultural sustainability, reflecting the richness of existing heritage of agroforestry that the local rural communities there indulge in (mix of subsistence and present-day urban agroforestry and non-cultural cash-cropping). The farmers also cultivate wild tree species that are for household utilisation. The wild plants and fruit tress embody the localised economic, cultural and ecological importance of the Padawan agroforestry.

▼ Sabal aerial 2019



Other practices

In other areas of Sarawak, there are farmers and family-clustered ownership of agro and pastoral activities like (a) the rearing of sheep/goat in an open pasture area within the village forest, (b) family keeping of fresh jungle stream-water fish (*tagang* system) like the famous and expensive *empurau* fish, (c) coastal villagers rearing of bakau or mangrove type crab and prawn in the natural habitat of nipah

palms and mangrove trees, and (d) farmers keeping stingless bees in their garden compounds, taking advantage of the wild forest flowers (as well as those they cultivated) for pollens and nectars the bees need to produce honey.

Views

1. Sarawak State government today has the foresight to steer the State's economy based on agroforestry and forest landscape restoration principles. It augurs well for the future generations to preserve and enjoy.
2. The direction to achieve healthy, resilient, and clean environment for the current and future generations is very



◀ Sabal 1997

Global catalyst for agroforestry and forest landscape restoration

GEF Small Grants Programme (GEF-SGP)

SGP is a Global Environment Facility (GEF) funded corporate programme implemented by the United Nations Development Programme (UNDP) on behalf of the GEF partnership. UNDP's role in implementation assures government support within each country, as well as links to national development frameworks and priorities. SGP(small grant programme) provides grants of up to US$50,000 (RM200,000) directly to local communities including (a) indigenous people, (b) community-based organisations and (c) other non-governmental groups for projects in the areas of (i) Sustainable forest management, (ii) Land degradation, (iii) Biological Diversity, (iv) Climate change mitigation & adaptation,and others like (v) International Waters, and (vi) Chemicals.



In Malaysia

To date, SGP Malaysia has provided funds to support over seventy NGOs and CBOs through more than one hundred projects.

Good standard guide

SGP Country Programme Strategy (SGP CPS) SGP CPS document serves as a framework for the country programme operations and provides a programmatic guidance for development, implementation, monitoring and evaluation of the GEF SGP in Malaysia.

GEF-SGP set up

- Established in 1992, the year of the Rio Earth Summit, the GEF Small Grants Programme embodies the very essence of sustainable development by *'thinking globally acting locally'*.
- GEF-SGP provides financial and technical support to projects that conserve and restore the environment while enhancing people's well-being and livelihoods.
- SGP demonstrates that community action can maintain the fine balance between human needs and environmental imperatives.
- SGP recognises that environmental degradation such as the destruction of ecosystems and the species that depend upon them, increasing levels of carbon dioxide and other greenhouse gases in our atmosphere, pollution of international waters, land degradation and the spread of persistent organic pollutants are life-threatening challenges that endanger us all.
- SGP's primary stakeholders are often the vulnerable communties, and they are most at risk because they depend on access to natural resources for their livelihoods and often live in fragile ecosystems.

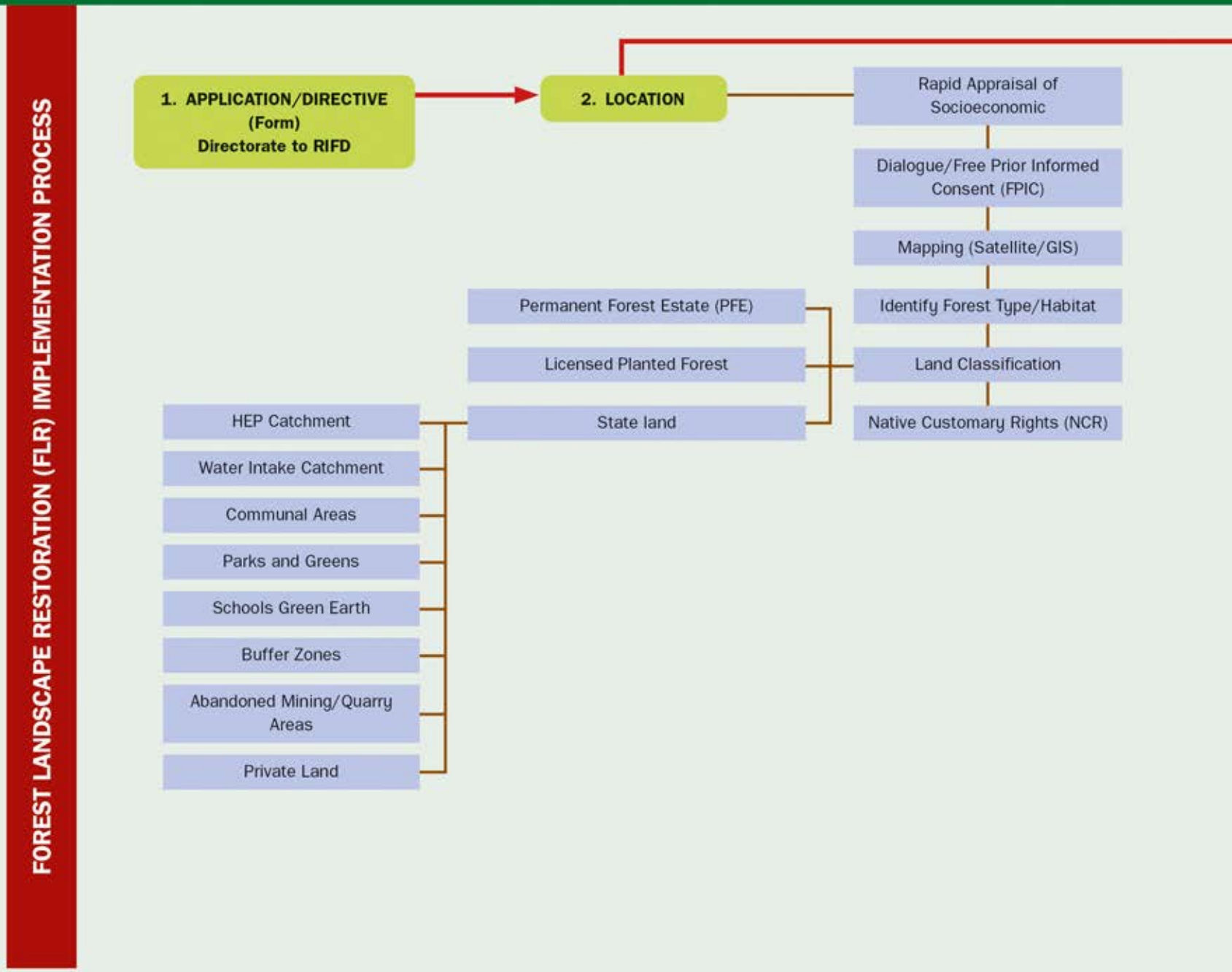
THE PUSH & CATALYST FROM MySAF

Malaysian Society of Agroforestry (MySAF) was established to encourage and promote discussins, and research activities, on agroforestry. It organises forums, seminars, conferences for members and the public to meet, interact and discuss ideas, issues, and matters pertaining to the promotion and propagation of agroforestry concepts, principles, practices and lifestyles.

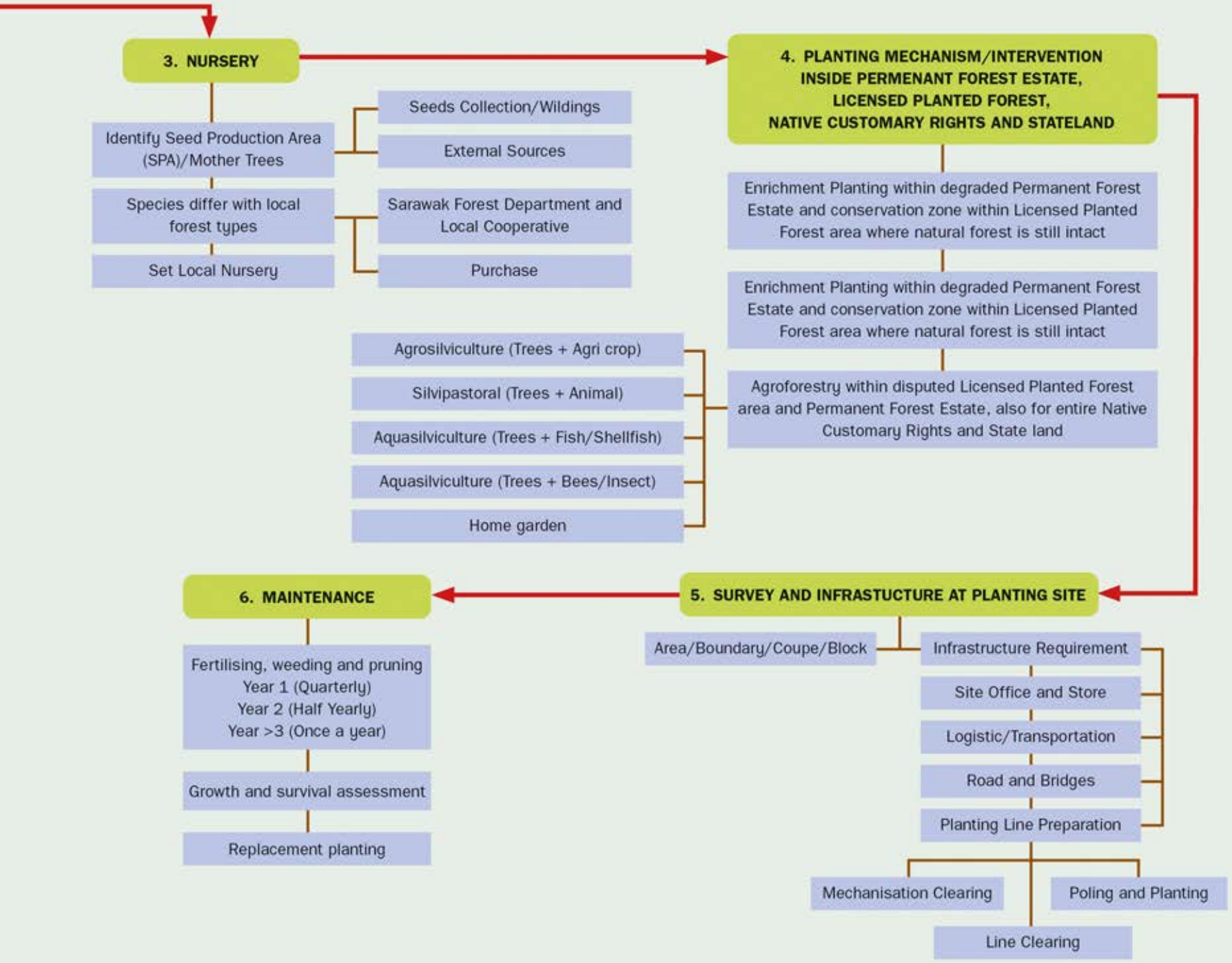
It is a society or association for members but the public also benefits from its discourses and can participate in public activities the Society organises. MySAF helps to provide the push and catalyst to spur creative thinking and concepts on agroforestry.



CHART SHOWING FOREST LANDSCAPE RESTORATION INITIATIVES BY SARAWAK FORESTRY DEPARTMENT



Source from Sarawak Forestry Department


3. NURSERY
Identify Seed Production Area (SPA)/Mother Trees
Seeds Collection/Wildings
External Sources
Species differ with local forest types
Sarawak Forest Department and Local Cooperative
Purchase
Set Local Nursery
4. PLANTING MECHANISM/INTERVENTION INSIDE PERMENANT FOREST ESTATE, LICENSED PLANTED FOREST, NATIVE CUSTOMARY RIGHTS AND STATELAND
Enrichment Planting within degraded Permanent Forest Estate and conservation zone within Licensed Planted Forest area where natural forest is still intact
Enrichment Planting within degraded Permanent Forest Estate and conservation zone within Licensed Planted Forest area where natural forest is still intact
Agroforestry within disputed Licensed Planted Forest area and Permanent Forest Estate, also for entire Native Customary Rights and State land
Agrosilviculture (Trees + Agri crop)
Silvipastoral (Trees + Animal)
Aquasilviculture (Trees + Fish/Shellfish)
Aquasilviculture (Trees + Bees/Insect)
Home garden
5. SURVEY AND INFRASTUCTURE AT PLANTING SITE
Area/Boundary/Coupe/Block
Infrastructure Requirement
Site Office and Store
Logistic/Transportation
Road and Bridges
Planting Line Preparation
Mechanisation Clearing
Poling and Planting
Line Clearing
6. MAINTENANCE
Fertilising, weeding and pruning
Year 1 (Quarterly)
Year 2 (Half Yearly)
Year >3 (Once a year)
Growth and survival assessment
Replacement planting

FOREST LANDSCAPE RESTORATION PROJECT IN SARAWAK

(facts and information extracted from Sarawak Forestry Corporation)



An example

Bring Back the Rainforest' (BBtRF) project is an initiative by Sarawak Forestry Corporation. It is part of the habitat rehabilitation efforts to bring back the rainforest landscape to one area in Sarawak: the Piasau Nature Reserve.

Project's goal: To rehabilitate degraded forest areas in the Piasau Nature Reserve (PNR) via (i) enrichment planting, and (ii) adoption programme.

Various native plant species are planted at PNR to provide sufficient food sources and conducive environment for the wildlife residing within the NPR when the trees grow and start bearing fruits. Experimental plot with a area of 0.22 hectare was initially set up at PNR to identify plant species that could suitably grow on the soils there, and the suitable methods to plant them. Several tree planting activities were carried out at the NPR.

Under the BBtRF Project, five gardens, Piasau Garden, Mixed Species Garden, Fruit Tree Garden, Ficus Garden and Herbal Garden have been established. The 'Bring Back the Rainforest' project was launched on 11 September 2016.

Adoption Programme

The adoption programme was developed to provide platform to engage stakeholders (general public, NGOs, learning institutions, government agencies, private companies and others) to participate and contribute in the habitat restoration and wildlife conservation efforts at PNR. The programme is also (i) to promote awareness on wild life conservation and (ii) foster a sense of environmental stewardship amongst adopters.

What to achieve

(i) Sufficient food supply and a conducive environment for wildlife species residing in PNR

(ii) To evolve PNR as a major birding spot in Sarawak

(iii) Increase in visitors' arrival to PNR that offers opportunities for visitors to experience rainforest landscape in an urban setting



To accomplish

The project is to produce

(a) Gardens

Piasau Garden, Mixed Species Garden, Fruit Tree Garden, Ficus Garden and Herbal Garden

(b) Develop horticultural and cultivation skills

Species diversity is conserved in the gardens when

horticultural and cultivation skills allow original species that were once at Piasau to be planted back. In addition, restoration and rehabilitation of degraded habitats are possible through the development of these skills.

(c) Life collections of plants

Collection of the various plant species in the gardens serve as gene pools, where plant genetic materials are conserved.

(d) Education

The gardens provide avenues for outdoor learning experiences through thematic interpretation.

(e) Provide suitable habitat for hornbills

PNR is now renowned for the breeding of oriental-pied hornbills (OPH) residing within the NPR. The planting of food trees provide shelter and supply sufficient food to not only hornbills, but also other wildlife species at the NPR.

(f) Transforming Piasau Nature Reserve as major birding area

With the trees maturing and producing fruits, PNR is a haven for the birds and other wildlife species. The congregation of the birds and other wildlife is a sight to behold. This can attract birders and nature lovers to the NPR.

Studies and research

Studies on PNR and its biodiversity components were carried out by SFC, UNIMAS and Malaysian Nature Society. PNR is located within the urban area of Miri city. Despite the city-nearness, notable number of plant and animal species at PNR were recorded: 107 plant species, and 75 fauna species. More importantly, PNR now also has small population of Oriental-pied hornbill.

FOREST PLANTATION PROJECT



Malaysia experienced (i) short falls in supply of logs from natural forests for domestic requirements, and (ii) the need to establish short rotation wood resource for wood chips to supply domestic chipboard, fiberboard, pulp and paper mills, and various other reconstituted wood product mills.

FPP

The Forest Plantation Project (FPP) was launched in 1992 to avoid the possibility of shortage of timber and timber products due to population growth and the basic wood supply problems. The aim is to grow and supply general utility timber to meet the expected increase in the domestic market. The forest plantations are established to realise the following goals:

(1) To provide general utility timber to meet local demand.
(2) To alleviate the lower income group by the production of general utility timber at affordable prices.
(3) To create new employment opportunities.
(4) To increase the productivity of forest land by converting those land areas carrying poor forest stands into forest plantation.
(5) To check excessive drain on foreign exchange by reducing importation of timber and timber products.

The plan

The project plans to establish plantations on a 15-year rotation of fast growing hard-woods species like *acacia mangium*, *gmelina arborea* and *paraserianthes falcataria*. The choice of these species is based on

(a) Fast growing and able to attain sawlog and wood chips size in about 15 years or less.
(b) Able to produce timber suitable at least for general utility purposes and wood chips.
(c) Amenable to planting under plantation conditions in Malaysia with reasonable growth rate.
(d) Able to produce seed in abundance under local conditions or large quantities of seed can be imported from overseas.

THIRD NATIONAL AGRICULTURE POLICY (NAP3)



I Over-riding objective

The overriding objective of NAP 3 is the maximisation of income through optimal utilisation of resources in the agricultural sector. This is to include (i) maximising agriculture's contribution to national gross domestic product (GDP), (ii) export earnings as well as (iii) maximising income of farmers, breeders and fishermen.



II Objectives

The objectives of NAP 3 are:

(1) to enhance food security

(2) to increase productivity and competitiveness of the sector

(3) to deepen linkages with other sectors

(4) to create new sources of growth for the sector

(5) to conserve and utilise natural resources on a sustainable basis.

Objective (3) is very relevant to forestry link (agroforestry).

III Strategic approach

Achieving the above objectives require new strategic approaches and policy thrust to enhance the economic contribution and growth of the agricultural sector. Towards this end, NAP 3 introduces two new strategic approaches (i) the ***agroforestry*** approach and (ii) product-based approach.

IV – Agroforestry

The agroforestry approach addresses the issue of scarce resources including land, labour, and raw material availability. This approach recognises *agriculture* and *agroforestry* as mutually compatible and complementary. Thus both provide a scope for joint development that brings about mutual benefits.

– Integrated agroforestry and agriculture development strategy

The *integrated agroforestry & agriculture development* aims at creating larger productive base for both sectors. This integrated approach brings about benefits of

- Creating larger productive base for agriculture and forestry by allowing wider range of agroforestry enterprise mix, optimise resources utilisation (particularly the land resources) and enhance the income generating potential of *agroforestry investments.*

- Enable the production of both *agricultural* and *forestry* products on the same land thus mitigating the demand pressure for new available land.
- Support various symbiotic relationships like planting of forest species with industrial crops to optimise land utilisation and maximise returns.
- Provide avenues for early and continuous returns from the agriculture component of the mixed enterprise. This can encourage the participation of the private sector in commercial forest plantations, thereby increasing the supply of timber for the wood-based industries.

V Product based approach strategy

Through this approach, key products and markets are identified, based on demand, market potential, and consumer preferences. The conventional commodity-based approach, limits the effectiveness to serve markets that are of higher value. The product based approach is more specialised to meet the needs of various markets. These market demand and preferences are translated into strategies for upstream marketing of the agricultural products to enhance production and marketing of the agricultural and forestry products.

This approach

- reinforces and complements the cluster-based agro industrial development as identified in the Malaysian Second Industrial Master Plan (IMP 2) 1996-2005 through strengthening both inter and intra-sectoral linkages, including the development and expansion of intermediate and supporting industries.
- enhances the development of agricultural industries through the transmission of market signals and consumer preferences upstream to the farm.
- through this approach, agricultural production is more specialised to meet the needs of various domestic and global market segments and identification of opportunities for market expansion and deepening.



The strategy of utilising market signals transmitted upstream can facilitate agricultural producers in making decisions to produce the necessary raw materials to support agro-based manufacturing and other economic activities. This broadens the scope of agricultural and forestry development and create business opportunities for a wider range of business ventures through a system of linkages. This includes R&D and technology generation, primary production and processing, manufacturing of intermediate and final products as well as distributing and marketing the final products and services to the consumers.

VI The right way

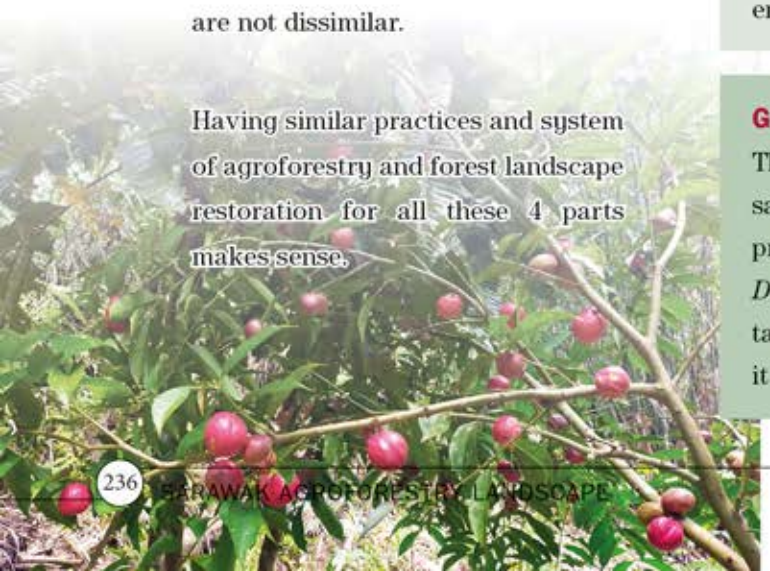
New sources of growth are expected to emerge in agriculture resulting from various initiatives to promote new emerging industry groups like agroforestry, specialty natural products, bamboo and rattan, biotechnology products, floriculture, and aquarium fish.

The agricultural sector, in particular the industrial crop and forestry sub-sector, continues to play a crucial role as key suppliers of raw materials to the resource-based industries. Agriculture contributes substantially to the nation's economy, as more raw materials are processed into finished products for export, earning valuable foreign exchange for the country.

FOREST LANDSCAPE RESTORATION BORNEO

Sarawak is one part of the big island of Borneo, together with the other three parts namely Sabah, Kalimantan and Brunei. Because of the 'similarity' any forest landscape programme and any system or practice of agroforestry would be common for all the four parts, given that the nature and forest type, climate, environment, soil, and ecosystem are not dissimilar.

Having similar practices and system of agroforestry and forest landscape restoration for all these 4 parts makes sense.





Across border commitment

To balance economic development with international commitments to protect biodiversity can be a big task or effort, but would benefit all the 4 parts. How to achieve this balance? It needs understanding of the likely impacts and consequences of alternative future scenarios affecting many stakeholders.

Planning

An integrated economic and environmental planning approach is relevant to evaluate alternative futures for this big Borneo island. Joint planning by the 4 components (Sarawak, Sabah, Kalimantan, Brunei) is a start to common practices that these 4 components amplify. The plan can highlight

(i) what could be achieved if the four components or national jurisdictions of Borneo co-ordinate efforts to achieve their public policy targets by allowing partial re-allocation of planned land uses.

(ii) the potential for Borneo to retain say about half (50%) of its land as forest,

(iii) protect adequate habitat for the its (Borneo) wildlifes.

Co-ordination

Co-ordination is necessary for (i) enhanced information sharing and (ii) reforms to land-use planning (agroforestry and forest landscape restoration concept).

The willingness to co-ordinate and co-operate is not new, knowing today's necessity to fulfil the international nature of economies and environment(forest) conservation efforts.

Global commitment

The comfort for us today is that all United Nations member states sanctioned national efforts to pursue environmental sustainability. This is premised on the *Convention on Biological Diversity and the Millennium Development Goals*. So every country is setting its ambitious national targets for economic growth, development, and trade. Moving forward now it is not pragmatic to set such ambitious targets without assessing how

such targets are conflicting or aligning with sustainability, biodiversity, pollution, and climate change agendas.

Balancing the needs for economic development with international commitments to protect biodiversity is a global issue and task. Achieving this balance requires whole-landscape approach to land-use planning that incorporates targets sought by multiple sectors. Systematic planning approaches to deliver large gains in economic and environmental efficiency is useful. This approach is practical for re-designing protected area networks within and across political borders.

Desirable result

Good potential can be realised in regions with multiple land uses, even when there are conflicting objectives. Sustainable allocation of land uses require dialogue on potential futures, and understanding of the possible consequences of alternative strategies for diverse sectors.

Forest of the tropics

Borneo island is an epitomy of a tropical forest. Tropical forests (i) regulate regional and global climate, (ii) provide wide range of eco-system services to about half of the world population, (iv) support around half (50%) of described species of wildlifes, flora, and fauna.

Uniqueness of Borneo

Borneo is the 3rd largest island in the world. From studies and research, we know that its forest has 14,423 plant and 1,640 vertebrate species (of which 28% are endemic and 534 or 3% are said to be at the risk of being extinct).

Inter-governmental effort

Perhaps the high rates of forest conversion and degradation had prompted inter-governmental agreements among Indonesia, Malaysia and Brunei. They realise the necessity to protect, and use sustainably, the forests that remain in Borneo.

Example:

(i) *The Borneo Initiative* is a project focused on sustainable forest management.

(ii) *The Heart of Borneo* initiative is an attempt to manage sustainably the mountainous core of the island.

The political co-ordination across borders improves the efficiency of meeting local or national economic (and global conservation) goals. These are the potential across border's gains.

Systematic research done

A past research or study was done, looking at 4 alternative futures for Borneo.

The 4 approaches were

(a) Baseline focused on the then current land-use allocations that were executed

(b) Uncoordinated, state-based planning to achieve policy targets

(c) Co-ordinated planning in the mountainous interior of Borneo, with state-based planning outside this area

(d) integrated planning across all four states (allowing for both jurisdictional co-ordination and the re-allocation of some land uses) to achieve either (i) existing public policy targets or (ii) alternative biodiversity targets seeking to achieve representative protection of dominant vegetation types.

Value

The value of integrating economic and conservation goals through trans-border collaboration is substantial. The costs and opportunities for achieving goals vary across borders.

Forest landscape restoration

Protecting the mountainous interior of Borneo that is unique in its bio-diversity is good, locally and globally.

The Heart of Borneo project coordinated efforts that focused on the mountainous and heavily forested interior of island Borneo.



VALUES OF FOREST LANDSCAPE RESTORATION FOR HUMAN APPRECIATION

THE MARVELS OF AGROFORESTRY & FOREST LANDSCAPE RESTORATION

.... the spin offs, offshoots, and direct or indirect products

Keeping the jungle or forest in its natural pristine, or enhancing forest landscape restoration (FLR) has great values in terms of (a) asthethetic and (b) commercial. We are aware that since the era when mankind has taken up agricultiure as one of its core survival activities, FLR programme is in sync with agroforestry (AF) practices.

Aesthetically, FLR and AG give us that great serene, peaceful, first hand views of nature's environment, the crispy unpolluted air, the clean good fresh waters in riverlets and streams, the thriving of 'nice-to-appreciate' exotic floras and faunas, ants, insects, fungus & mushrooms, creepers & lianas, and shrubs or low height bushy evergreen trees. Then of course there are the majestic medium height to big tall trees, with scented sweet- smell blooms & flowers and branches laden with edible and non edible wild berries and fruits. And animals frolick and nourish themselves in those forest areas. For humans, the nice things is that edible varieties of berries and fruits for human consumption provide energies, good natural nutrients, minerals, vitamins. Some also have medicinal efficacies.

In this section we showcase some of the food types (vegetables, herbs, fruits, nuts, fungus) that are growing wild and easily found in the typical forests of Sarawak.

These naturally available forest materials or produces are inexhaustable and sustainable too with Agroforestry and Forest Landscape Restoration practices (that is, even with minimal cultivational care or human nurturing these forest products thrive in abundance in the natural habitat).



The products or forest outputs showcase here are:

(i)	Bamboo
(ii)	Wild olive or dabai
(iii)	Wild herbs
(iv)	Forest leafy plant or dowon kii for wrapping
(v)	Snake fruit or buah salak
(vi)	Custard fruit or buah angkarak
(vii)	Nipah palm
(viii)	Sago palm
(ix)	Terap
(x)	Bread fruit
(xi)	Jackfruit
(xii)	Tampoi
(xiii)	Sugar or toddy palm
(xiv)	Wild mango or bowang
(xv)	Sour wild apple or buah konis
(xvi)	Wild ferns or paku
(xvii)	Rattan
(xviii)	Miscellaneous decorative trees
(xix)	Kepayang tree
(xx)	Lipstick palm tree
(xxi)	Areca palm
(xxii)	Asam paya
(xxiii)	Bemban
(xxiv)	Belimbing buloh
(xxv)	Crystal fruit tree
(xxvi)	Durian Tree
(xxvii)	Lianas and vines
(xxviii)	Illipenut
(xxix)	Mangosteen
(xxx)	Jering and petai
(xxxi)	Mata kuching
(xxxii)	Medicinal & eedible mushrooms and fungi
(xxxiii)	Rembai
(xxxiv)	Pandan
(xxxv)	Pulasan and rambutan
(xxxvi)	Pitcher plant or pokok kera or tramuo
(xxxvii)	Wild water cress
(xxxviii)	Wild star fruit or belimbing
(xxxix)	Plant for decoration
(xl)	Kapok
(xli)	Keranji
(xlii)	Kemayau
(xliii)	Wild Chestnet or Berangan

Brief descriptions and photos of each of these 43 'agroforestry and forest landscape restoration' related plants or product materials are summarised here.

Bamboo

- There are many types and species of bamboo, from small dwarfy variety, to huge-girded and tall sky-reaching trunks.
- Bamboo has many many uses.
- The trunks are for building materials, house walls, ceiling and floor panelling.
- Also for decorative pieces and arts, for home ornaments, kitchen utensils, and office decorative tools and writing/drawing appliances.
- For making baskets, mats, floor tilings, and roofing.
- It is also edible (the shoots) and a popular delicacy for Asian and global cooking.
- The leaves are used as fodder for animals, or mixed with other materials for making fertilisers.
- The trunk and levaes are also raw materials for producing pulp and paper.

















Wild Olive or *Dabai*

- This wild Borneo 'olive' or locally known as d*abai* is an indegenious Sarawak plant, and can grow in the lowlands, but more widespread in its natural habitat of the hilly terrains of mountaineous Sarawak.
- The botanical name for dabai is ***canarium.*** And it belonged to the *burseraceae* family.
- Dabai trees are evergreen. They can naturally grow up to 40m to 50 m or 130 feet to 160 feet high. They have alternately arranged pinnate leaves. The male and female flowers grow on separate trees.
- It is a popular fruit, taken as desserts, or used to garnish meat and vegetable dishes. It can also be eaten just like that on its own after it is lightly boiled to make the oil-riched flesh soft enough to consume.
- Originally found wild and in abundance in the forests, today many village farmers and gardeners plant them on small to big scale for commercial and lucrative cash generation. Local demand often always is greater than the supply, even during its peak fruiting seasons.
- The sleek tree trunks and bushy branches are also ideal for garden dedoration and mini forest landscaping especially for house owners with big compound and free surrounding spaces.



Wild Forest Herbs

- Sarawak forest is endowed with so many floras and faunas that include many herbs, both wild and cultivated.
- Some of the wild herbs of the forest are the local *daun sup (culantro)* or the sawblade herb, *tepus* (etingera coccinga), *pegagga* (centella asiatica).
- There are also the native leaf soup (*dowon sirimou*) which is found in the hilly forests of Sarawak, and popular as seasoning (*aji no motto)* amongst the local villagers. Other wild herbs are missai kuching, tiung tukak, lengkuas (Alpinia galanga) and tomiet (tumeric).

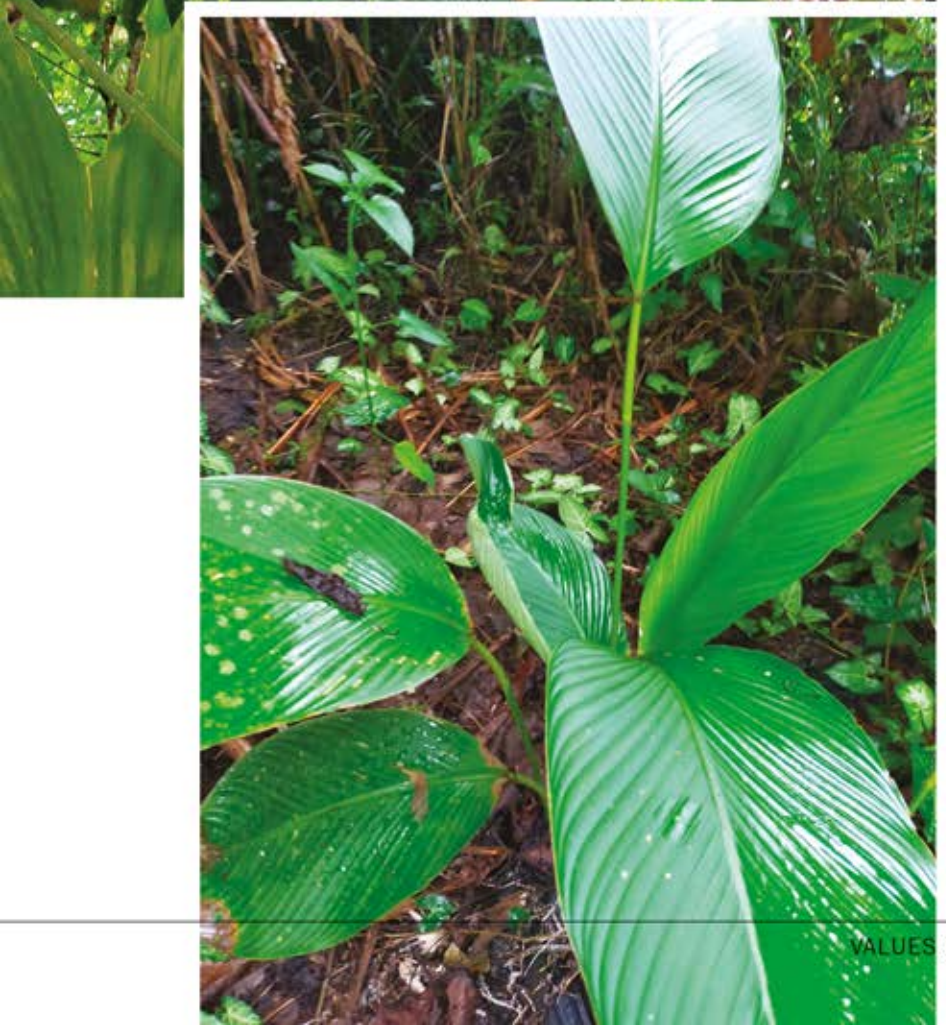












Big Leafy Plants

- There are many varieties of Sarawak floras and faunas; shrubs, plants and trees.
- The plants are with small leaves, as well as with really huge leaves that can be as big as the size of an umbrella.
- The huge leaves are useful and, the natives use them for wrapping food and for their disposable plates.
- The big leaves are also thatched to make roof covers for farm huts.





Snake Fruit or Buah Salak

- *Buah salak* (snake fruit) is abundant on the lower hill sides and lowland areas (mountain foothills).
- The palm-like trees are covered with sharp thins and plucking the fruits can be a tricky and lanful task.
- The ripened fruit is popular and good snack food. They can also be used to make juices, or cured and processed to make candies and light snack tit bits.



















Custard Fruit or Bikara

- The *bikara or angkara* (custard fruit) trees have been growing in the wild in Sarawak forest.
- When the demand and consumption became popular, many villagers grow the trees as shades, as well as for its fruits, in their gardens or house compounds.
- The fruit has a creamy-like texture, and its taste is like custard (thus its street name 'custard fruit').







Nipah Palm

- Nipah palm thrives naturally in swampy brackish (salty and fresh water) coastal areas of Sarawak.
- The plants are short, without trunk, but having clusters of palm leaves similar to that of sago (though smaller and shorter).
- It is commercially valuable for producing palm (brown) sugar.
- The fruits are edible, and the shoots (inside piths) are excellent for vegetables.
- The leaves are for making thatched roofing materials and brooms.
- The leaf trunks are for making baskets and other weaving artifacts.
- Besides contributing to the much needed natural system of air and water eco-filtration, nipah palm clusters and roots are important natural habitats and food sources for crabs, prawns, and fishes.











Sago Palm

- Sago palm has so many uses for good human needs and lifestyle.
- The sago flour is a staple food to some indegenious people of Sarawak.
- Other than just boiled for food, sago flour is also for making breads and biscuits, plus the many uses like for making cakes, desserts, and a variety of decorative culinary creations.
- The trunks are for household building materials.
- The leaf trunks are used to make baskets, mats, floor carpets and building walls or for roof panelling.
- Sago palm leaves are thatched to make house roofs.
- The pit (after extraction of the flour) are for animal feeds and fertilisers.
- The mid leaves are for making brooms and brushes.
- Many Sarawakians also find food delicacy in the grubs that live inside the decaying piths.
- The fruit is edible.
- Sago palm, in abundance in the coastal areas and also in the low lying areas of Sarawak, make good forest landscape scenery, and magnificient natural 'green-lung' foliage.
- The trunk can grow from 10 to 15 metres (35 to 50 feet) high.









Tarap

- *Tarap*, botanically known as *Artocarp*us *Odoratissimus*, is related to jackfruit, *(chempedak)* and breadfruit.
- Experts believe that t*arap* is native to Borneo (even though it also grows in the Philippines. Filipinos call it *Marang)*. Sabahans know it by the name of *timadang*.
- The fruit is soft, tarty, sweet and creamy, like the custard apple or sour-sop, but it is smoother, and not grainy.
- The nut is also edible.
- It can grow up to 25 metres (or 80 feet) high, and up to 25 CM girth-wide (8 feet).
- It can live in forest areas of up to 1,000 metres (3,200 feet) above sea level.
- The texture of the outer skin is soft, and once ripened it is easily peeled by hand.
- Popular dessert for locals and visitors to Sarawak.











Breadfruit



Breadfruit (*Artocarpus altilis*) is a species of flowering tree in the mulberry and jackfruit (*Artocarpus heterophyllus*) family (Moraceae) believed to be a domesticated descendant of *Artocarpus camansi* originating in New Guinea, the Maluku Islands, and the Philippines. It was initially spread to Oceania via the Austronesian expansion. It was further spread to other tropical regions of the world during the Colonial Era. British and French navigators introduced a few Polynesian seedless varieties to Caribbean islands during the late 18th century. Today it is grown in some 90 countries throughout South and Southeast Asia, the Pacific Ocean, the Caribbean, Central America and Africa. Its name is derived from the texture of the moderately ripe fruit when cooked, similar to freshly baked bread and having a potato-like flavor.



The trees have been widely planted in tropical regions, including lowland Central America, northern South America, and the Caribbean. In addition to the fruit serving as a staple food in many cultures, the light, sturdy timber of breadfruit has been used for outriggers, ships, and houses in the tropics.

Breadfruit is closely related to *Artocarpus camansi* (breadnut or seeded breadfruit) of New Guinea, the Maluku Islands, and the Philippines, *Artocarpus blancoi* (*tipolo* or *antipolo*) of the Philippines, and *Artocarpus mariannensis* (*dugdug*) of Micro.













Jack Fruit

- *Cempedak* or jackfruit (*Artocarpus heterophyllus)* has many varieties in Sarawak.
- The tree is huge with bushy branches, good for shades and ornnament. It has white sticky sap or latex, and the leaves are evergreen, glossy and leathery textured.
- It can grow from 30 ft to 70 ft (9m-21 m) tall
- Short, stout flowering twigs emerge from the trunk and large branches, or from the soil-covered base of old trees.
- Jackfruit can be 8 inches to 3 feet (20-90 cm) long; and 6 inches to 20 inches (15-50 cm) wide, weighing from 10 lbs to 60 lbs; or as much as 110 lbs (4.5-20 or 50 kg) for larger varieties.



- The rind or exterior of the fruit is green, but turned to yellow when ripe.
- The fruit consists of many hard, cone-like points attached to a thick and rubbery, pale yellow or whitish inside wall.
- The interior consists of large bulbs of yellow flesh, massed among narrow ribbons of thin, tough undeveloped perigones, with a central, pithy core.
- Each bulb encloses a smooth, oval, light-brown seed or endocarp that is covered by thin white membrane or exocarp.
- The seed is 3/4 to 1 1/2 inch (2-4 cm) long, and 1/2 to 3/4 inch (1.25-2 cm) thick.
- There could be anything from 10 to 50 seeds in a fruit, depending on the variety and size.
- Jackfruit makes good dessert, and has sweet flavour with its unique aroma and freshness.
- People can make cakes and puddings from the fruits.
- The hard seeds can be boiled and are edible, it has nutty flavour.











Tampoi

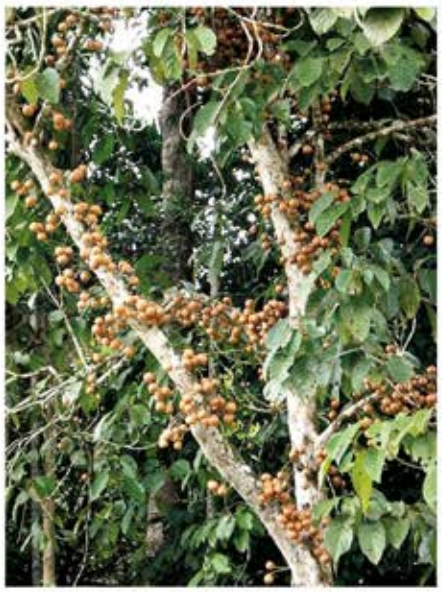






- Tampoi (botanically known as b*accaurea macrocarpa)* is a sweet fruit.
- In Kalimantan it is called *kapul* or *lara*. The local Sarawakians named them differently (*entongon* or *bitongon* for the white flesh, and *tampoi* for the yellow flesh).
- The fruit is round, like a mangosteen. The skin is brown, while the flesh can be red, white or yellow, depending on the variety.
- It is native to Borneo.
- Tampoi tree is dioecious (that is, it has either only male or only female flowers).
- It is a small, rain forest, sub-storey tropical trees.
- The female trees bear fruit directly on the trunk and on the large branches.
- The fruits are large, with delicious tangy flavour.
- Depending on conditions, the fruit can closely clothe the trunk beautifully, like the fruit of many ficus species.
- Tampoi fruits develop on long, green stems directly from the trunks and branches of the tree.
- The fruits are 5 to 7 centimetres around and flattened at both ends, with smooth-textured, brownish-orange skins. Beneath the skin lies a thick pith and a hollow cavity containing succulent red, yellowish or white and translucent, segmented flesh. Each removable segment contains large, brown, inedible seed.
- Tampoi are juicy, and have slightly earthy, sweet-sour flavor.
- Tampoi fruit is a good source of beneficial phenols and flavonoids and contain carotenoids. The flesh provides high levels of antioxidants.
- Tampoi fruits are eaten fresh.
- The flesh can be added to stews, pickled or fermented to make wine.
- Until recently, Tampoi could only be found in the wild or in home gardens.
- In 2009, the Malaysian Agricultural Research and Development Institute (MARDI) asserted for the domestication of *Tampoi* for not just economic gains, but also as effort to protect the species from extinction.
- Tampoi are native to the island of Borneo. The matured trees can grow for up to 100 feet high.
- There are at least 50 different species in the Baccaurea genus, all of which are native to the same area.
- The hard-shelled fruits are popular with the local Sarawakians. They use the fruits to make wine for their various celebrations.













Sugar or Toddy Palm Tree

- The palm, locally known as the *enyuok* or *toddy palm*, is native to Borneo.
- Its sweet juice is processed to make local raw brown sugar.
- The fruits are very popular among the wild animals foraging in the forest. Thus it is a good useful plant for both human beings and survival of animals.
- The palm trees grow and multiply in the wild, and local villagers normally do not cut them down when they clear patches of their forest land.
- The trees can grow up to 100 feet or so high.
- The trees are cut to get the sweet juice for making brown sugar. Or for the villagers to make their local natural brew.
- Felled trees can only produce raw sugar or wine brew once. So farmers or vilagers now do not cut the tree but obtain the juices by only cutting the inflorescence. The juices are obtained from cutting the flower inflorescence and the palm juices flow out from the cut. This is a better method because the same palm tree can be used for many years to obtain, and tap, the sweet juices many times and for many years throughout the lifespan of that palm tree.
- The palm leaaves are for making thatched roofings.
- The string-like hairs or fibres on matured old tree trunks can be used to make strings or ropes.
- The barks of the trunk are very hardy and durable for house decorations, wall panelling and solid flooring.
- Palm shoots (young inner piths) are very popular for vegatables.
- The grubs that live in the decayed palm woods are a delicacy dish for the local natives of Sarawak.
- The sugar or toddy palm trees are very hardy plant. It grows in lowlands and also on hilly or mountain terrain. It is very useful for shades as well as for scenic forest landscape.

Jungle Mango



- This is Jungle Mango, or assam embang or *bowang* in one local Sarawak dialect.
- Botanically it is known as *mangifera pajang*. Other names are *buah mawang, asam embang, embawang,* or *bambangan.*
- This wild forest mango is endemic to Borneo.
- The rounded canon-sized fruit is sweet with little sourish taste. The fruit can weigh more than 800gm.
- The fruit skin is brown and rather thick, while the pulp or flesh is bright yellow and very fresh to eat as dessert, or it can be made into pastries, juices, jams, salad, and even for cooking or flavouring ingredient.
- The trees grow wild and uncultivated in the past. But today many villagers like to grow them in their farms or gardens.
- The trees can grow from 50 feet to 100 feet high and has huge span of branches. It is beautiful for shades, or for farm boundaries when planted at the edges of farms. The huge trees provide scenic or picturesque forest landscape.

Sour Wild Apple or Konis




















Wild Ferns

- Sarawak forest has many varieties of faunas and greens or plants belonging to the fern family.
- Three of these fern types are popular among the people as local vegetables that diners find not only nutritious but fresh, and freely growing wild in the forest with no worry for chemicals or fertiliser used to grow them.
- There are however some villagers that now undertake to plant or nurture them in their garden for personal consumption, as well as for small commercial activity along with other vegetables they grow for sale.
- The three common fern types that are edible are (i) paku uban or *jiet* in the local dialect, (ii) paku biasa, and (iii) midin. Midin is a tree creeper (vine), while paku uban or *jiet* and paku biasa are growing on the ground with roots. They grow and mix with other grasses and small shrubs in lowlands and swampy areas.



Rattan

- According to many text books there are roughly 600 species of rattan with most species found in tropical forests of South East Asia. It is a climbing plant or lianas, belonging to the sub-family of Calamoideae.
- Most rattan palms are ecologically considered as lianas due to their climbing habits, unlike other palm species.
- There are species that have tree-like or shrub-like habits and like to form clusters.
- Rattan is economically important to create or produce furnitures, canes, decorative art pieces, baskets, cordage, woven floor mats, and various variety of home and garden handicrafts or artefacts. It is also for decoration of interior house walls and ceiling panels.
- Globally, rattan is a valuable non-timber forest product.
- Some species of rattan have edible scaly fruit, and the heart of rattan palm are popular as healthy vegetable dish of the local Sarawak populace.
- So far and up to today, the source and supply of almost all rattan products come from the natural-grown and wild-harvested plants, in spite of the fact that for the last 30 years in this country atempts have been made (and government encouragement) to have them grown commercially on big scale.
- It has been reported that rattan supplies today are threatened due to deforestation and over-exploitation.
- Rattans are of many sizes, from small canes used to make small furnitures and baskets or used as strings and ropes; to large canes used for household stands and support, and for legs of furnitures, chairs and tables.
- The lianas can climb and reach maturiity up to 60 feet or more in length.
- It thrives well in lowland areas where the ground is always moist and the plant reaches up to the sky for plenty of sunlight, climbing on the trees that it entwined itself to.















Miscellaneous Decorative Trees



- There are trees that are not big in size but also not too small in girth that many villagers and land owners do not destroy or cut down haphazardly. They are left to grow wild naturally in the forest.
- They do not grow bigger even after 5, 10, 15 years. But they do grow in height that can reach as high as 30 feet to 60 feet.
- Some of these miscellaneous trees are of many types and species. The more common one is known as *silumah* in a local native dialect of Sarawak.
- The forest owner may find the need to cut down and use some of these trees as poles or for use in household activities, or to construct houses or when doing maintenance work for the house; or when extending the house facade etc.
- These miscellaneous trees act as ready wood materials for the owner. It also provides values to the forest landscape restoration programme, and provide coolness and shades that is also the ';green lung' for the environment, besides the aesthetic value of fresh natural greenery.











Kepayang



- Kepayang tree grows wild in Borneo. The local dialectic name is *poyang* (in bidayuh dialect).
- Its botanic name is *pangium edule*.
- The tree can grow up to 100 feet high when fully matured.
- The fruit is shaped like a rugby ball and has brownish skin.
- The seeds are processed for side dish and is popular locally as snack food, or for spice and ingredient to cook fish or meat.
- There are medicinal values in the nutty and oil-rich seeds that are specially processed.
- Kepayang trees are grown wild, but there are now efforts to grow and cultivate them on farmlands at commercial scale.
- The trees and leaf foliages make nice natural canopy shades, and contribute to the beauty of natural forest landscape restoration initiatives that land owners embark upon with effort and support from government and NGOs.



Lipstick Palm Tree

- The palm tree is commonly found in the forest of Sarawak. It is a good ornamental plant, popular among many landscapers.
- The botanical name is *cyrtostachys renda*.
- Other names are *red sealing wax palm, red palm, rajah palm or pinang rajah*.
- This palm is native to Thailand, Malaysia, Sumatra and Borneo.
- There are many types and species, from small dwarfy variety, to huge-girded and tall sky-reaching trunks.
- It is slow growing, slender multi-stemmed and clustering palm tree. It has a scarlet to bright red colored crownshaft and leaf sheath. This makes it distinct from other palm species.
- It can grow up to 52 feet or 16 metres.
- The fruits are oval. They are green when young, and dark bluish-black when ripe.
- The lipstick palm is wild in the forest. But it is now popularly grown for its unusual foliage and bright red colour, and high in demand for gardening and environmental landscapings.
- Local people also have the traditional use like for flooring materials, roof thatching, and for making darts.
- Some villagers harvest the plant for the palm hearts to make vegetable dish.
- Propagation is by fresh seeds, but may be slow to germinate. The faster way is by dividing out the suckers.
- In the wild, the most suitable environment for lipstick palm to thrive is in lowland peat areas, and swampy forest with good soil drainage, with thin peat layer and high sand content in the soil.
- The palms grow well in full sun or shade, needing humid conditions and well-draining soil.
- Studies show that this lipstick palm tree tolerates flooding. It can grow in standing water since its native habitat is peat swamp forest. It does not stand cold temperatures or prolonged periods of drought.









Areca Palm

- Areca nut is *buah pinang* and areca palm is *pokok buah pinang* or *tongun bua baai* in the local bidayuh dialect. The other common name is *betel nut*, because the nut is part of the ingredients that people like to chew with sireh leaves.
- Botanically areca palm is *areca catechu*.
- They grow aplenty in Sarawak, both in the wild as well as nowadays they are cultivated by the villagers. It is also used as one of the plants for home and garden landscapes by many urban home owners.
- In ideal condition and in their natural habitat, the palm trees can grow up to 100 feet or more in height.







Asam Paya











Bemban





- *Bemban* is a tropical plant, and it thrives in abundance in the natural forest of Sarawak.
- Its scientific name is *donax grandis*.
- Sabahans call it *lamah*. *Bemban* belongs to the family of *marantaceae*.
- The plant grows wild on lowlands as well as throughout the hilly and mountaneous parts of Sarawak.
- It has big clean leaves. The plant produces white flowers that later turns into beautiful round white berries splendidly hanging from the branches. *Bemban* grows branches only once at the top.
- The trunk of the plant is long, blue or dark green in colour, and can grow up to 10 to 15 feet in good soils.
- Easy to grow, it is popular as ornamental plant and garden landscaping.
- But its commercial value since the old days is that the trunk is procesed into many household and office as well as personal products. The following are produced or made from the *bemban* processed trunk: Bags, wallets, mats, baskets, table top covers, slippers, wall panelling, roof panelling, souvenir items, and artwork and many handicraft decorations.
- The villagers thatch the broad leaves and use them for their farm house or garden roofs. The broad and clean leaves are also used by them to wrap foods or to serve as disposable plates.



















Belimbi or Belimbing Buluh/Wuluh

- *Belimbing Buluh* or *belimbing asam* is found in abundance in Sarawak forest.
- The scientific or botanical name is *Averrhoa bilimbi*.
- *The* fruit is sour. It is for making salad, sour fish and meat dishes, and for food garnishing.
- The tree is with evergreen leaves.
- Matured trees can reach up to 50 feet (15 metres).
- The fruit starts from the base trunk and handing out from the branches.
- It is also a good ornamental tree for the garden, as well as providing shades and contributes to the fresh and beautiful forest landscape.
- The fruit is ellipsoidal, elongated, measuring about 4–10 cm and 4-angled.
- *Belimbing buloh* or *wuluh* holds great value in complementary medicine as evidenced by the substantial amount of research on it by Indonesian and Malaysian authorities.





Crystal Fruit

- Crystal fruit tree has many names. Indonesians named it *matoa*, meaning 'crystal. Some locals call it 'crystal longan', or 'crystal lychee'. Other common names include, *taun tree, island lychee*, and *tava*. Or 'dragon eyes' (not to be confused with longan or mata kuching that has similar name).
- Its botanical name is p*ometia pinnata*.
- It is a member of the *sapindaceae* family.
- Crystal fruit tree is a large tropical hardwood and fruit tree species. It belonged to the *sapindaceae* family (maple and lychee family).
- Naturally widespread, the trees grow through south east Asia (including Sarawak Borneo) and the Pacific region.
- The tree can grow as tall canopy trees of 40 metres (130 feet) high.
- They have pinnate leaves.
- The variety of crystal tree is many, and the fruits are green, yellow, or dark red. They are 4 cm (1.6 in) long, each with three seeds, surrounded by a fleshy-like a lychee. It is a popular fruit for dessert and cocktails. Flavour wise, the flesh has a mixture taste of lychee and *rambutan*.
- Crystal tree, with its evergreen thick leaves and large foliage for shades would make good material for forest landscape restoration. Given its popular-in-demand edible fruit, this hard wood species is also ideal choice for agroforestry activities for local small holders and plantation owners.





















Illipenut

- *Engkabang* or Illipenut is a hardy tropical plant, indegenious to Borneo.
- The botanical name is *shorea stenoptera*.
- The oil from the fruit is extracted as vegetable butter or also known as Borneo tallow nut oil.
- The true illipe nut is from the species madhuca *latifolia*, *and* it is used for producing biodiesel. Mowrah Butter is from *madhuca longifolia*.
- The trees have large canopy long extended branches with evergreen broad leaves.
- The trees are found mainly growing wild in the forest of Sarawak, but nowadays since it is also a protected item, there are farmers and plantation owners that cultivate or grow them for commercial purposes.
- Besides the fruits, the big matured trees also make for excellent hard woods used to make furniture and for interior building materials.
- The trees produce resin or latex. When crystalised or dry the resin can be used for making medicinal products and also for fuel. Locally known as *damar*, these resins are used by natives of Sarawak as fuel to light up their houses and (traditional native lamps).
- Illipenut trees can grow high, up to more than 100 plus feet. They make picturesque forest landscape and the big trunk buttresses, and canopy shades from the branches make the tree unique from oither big gigantic in the forest.





◀ Abundant *durian* fruits in deep forest

Durian Tree

- **Durian** is the edible fruit of several tree species belonging to the *genus durio*.
- There are some 30 recognised *durio* species, (at least nine of which produce edible fruit).
- Research showed that as of 1987 there are over 100 named varieties in Malaysia, and about 300 in Thailand.
- *Durio zibethinus* is the only species available in the international market: other species are sold in their local regions.
- Durian is native to Borneo and Sumatra. It is labelled as the 'king of fruits'. It is distinctive for its large size, strong odour, and thorn-covered rind.
- The fruit can be from a small cannon-ball size (5 inch) to big (12 inches or 30 cm) in diameter. And from a short 6 inch fruit to 15 inches long. Fruits weigh from 400 grams to 4 kilos.
- Depending on the species, the colour of the rind or skin is anything from green to pale yellow or brown, while the flesh is white or pale yellow to red.
- Besides the flesh, the seeds can also be eaten when cooked.
- *Durio sensu lato* has 30 recognised species. And d*urio sensu stricto* comprises 24 of these species. The 6 additional species included in *Durio s.l.* are now considered by some to comprise their own genus, and they are b*oschia*, d*urio s.s*, and b*oschia*.
- Durian trees are large, growing from 25 m to 50 metres (80 feet to 165 feet) in height, depending on the species.
- The leaves are ever green.The flowers are produced in three to thirty clusters together on large branches or even directly on the trunk with each flower having a calyx or sepal, and four to six petals.
- Durian trees have one or two flowering and fruiting periods annually, although the timing varies depending on the species, cultivars, and localities.
- A typical durian tree can bear fruit after four or five years. The durian fruits hang from any branch, and matures roughly three months after pollination.
- Among the 30 known species of d*urio*, 9 of them are identified as producing edible fruits: they are (i) *D. zibethinus*, (ii) *D. dulcis*, (iii) *D. grandiflorus*, (iv) *D. graveolens*, (v) *D. kutejensis*, (vi) *Durio lowianus*, (vii) *D. macrantha*, and (viii) *D. oxleyanus* and (ix) *D. testudinarius*
- The fruit of many species has never been collected or properly examined, however, so other species may have edible fruit too and only the local villagers may be able to share the experience.
- Durian trees, though growing

▶ Durian trees

wild initially, has seen its extensive cultivation nowadays. Thus it may not be defined as 'agroforestry' activity to cultivate them, and would be recognised as normal agricultural activity and grown for subsistent consumption as well as for commercial purposes. However due to its massive size that dominate the landscape, the large foliage and early association as wild 'forest' material, growing them in big farm fields or sporadically around the fringes of farms and gardens can be construed as 'agroforestry' in practice, and forest landscape restoration in essence, knowing the fact that durian trees look like forest trees in the farms and forest fringes.

- Durian trees therefore make excellent material for forestry, and forest landscape restoration, giving people and the community two values: (i) aesthetics and scenic sights of the forest and the (ii) commercial values the trees avail in the form of (a) flowers and fruits for consumption and sale, and the much (b) sought after hard durable wood with fine grains for planks used as interior decorations for houses and buildings, as well as for making attractive handricrafts, carvings, furnitures, and household utensils.







Lianas and Jungle Vines

The concept of agroforestry is to preserve the forest or jungle, selecting, preserving and maintaining plants and trees (not necessary only cultivated crops). The plants and trees are used by human beings for food sources or for other personal and household needs, or for commercial revenue.

Nurturing the forest and maintainng its original or near-to-original landscape is the objective strategy for forest landscape restoration.

In the forest, besides natural vegetation, trees, plants, floras and faunas, there are also creepers, vines and lianas. These are natural to the virgin equatorial forest like that found in Sarawak. Since the ancient days, the local inhabitants are finding great values and needs for these vines and lianas. They do not indiscriminately destroy or cut them, but leave them to thrive naturally in the forest. Now and then they will 'harvest' the old matured ones. They use these vines and lianas for strings and ropes, to make baskets, mats, house building materials, rope bridges, and some of the vines' leaves and fruits are edible or have traditional medicinal values.



Vines

- Vines give rainforest its characteristically dense appearance. Apart from their structural role, they are essential food and 'highways' for tropical wildlife.
- Vines comprise variety of plants (lianas included). They start or germinate from the soil, but hang from treetops. They are bole climbers, and can ascend to as high as the trees that they entwine themselves to. They wrap themselves around trees and sometimes could even choke them.
- Vines are present in both disturbed areas exposed to light, and in the undisturbed forest interiors. Rregardless of soil type they can thrive comfortably.
- People have long used vines for food, medicine, art and handicraft, hallucinogens, poisons, ropes and construction materials.

Lianas

- Liana is a woody, long-stemmed vine rooted in the soil at ground level. It uses trees, as well as other means of vertical support, climbing up to the tree top canopy, searching for direct sunlight.
- The word *liana* does not refer to a botanical or taxonomic grouping. The word refers to a habit of plant growth, just like tree or shrub.
- Lianas are characteristic of damp or moist deciduous tropical forest.
- Lianas form bridges amidst a forest canopy. It provides arboreal animals with paths across the forest. Arboreal creatures include ants, invertebrates, lizards, rodents, sloths, squirrels, lemurs, monkeys, etc.
- The so called 'bridge' can also protect weaker trees from falling or getting uprooted due to strong winds.
- Lianas compete with forest trees for sunlight, water, and nutrients from the soil.
- Natural lianas and vines make good representation of plants and materials for forest landscape restoration. Prseserving or nurturing them in their natural habitat or in reconstructed forest also benefit people as they have human uses and commercial values.







Mangosteen



- Mangosteen or *buah manggis* is commonly found in Sarawak forest. Today many of those that we see around are grown and cultivated for personal consumption and income sale.
- Its botanical name is *garcinia mangostana*, and is also known as the purple mangosteen.
- It is a tropical evergreen tree with edible (sweet) fruit, native to tropical lands surrounding the Indian Ocean.
- The tree grows from 6 metres to 25 metres (20 feet to 82 feet) high.
- Besides the delicious fruit, and medical extracts researchers do with the skin,mangosteen trees make excellent garden shades and picturesque environmental forest landscape.
- The white- flesh fruit is rich in vitamin C, deliciously sweet, juicy, and low in calorie. Its high nutritional value makes good addition to human diet.





















Longan or *Mata Kuching*

- Longan is commonly known as *buah mata kuching* in Sarawak.
- It is native to tropical Asia (including Borneo) and China.
- Its botanical name is *imocarpus longan*.
- Longan is a member of the soapberry family *sapindaceae*, to which *rambutan* and lychee also belonged.
- Longan is a tropical tree, producing edible fruit. The tree is similar to lychee, though the fruit is less aromatic in taste.
- Other name for longan is *dragon's eye*. The longan (from Cantonese word *lùhng-ngáah*, literally mean 'dragon eye'). It is so named because it resembles an eyeball when the fruit is shelled (the black seed shows through the translucent juicy sweet flesh, like a pupil/iris).
- The seed is round, small, and hard. It is lacquered black or enamel-like. The fully ripened fruit has bark-like shell, firm and thin, making the fruit easy to peel by just squeezing the pulp out.
- The trees can grow up to 40 metres (120 feet) in the wild, though the cultivated ones are shorter but have bushy foliage that is splendid for shades. Its trunk is about 1 metre (3 to 4 feet) in girth. They make great material for forest landscape restoration, and agroforestry activities too, given the commercial demand for the juicy sweet fruits packed with vitamins and other nutrients.











Jering and Petai

Jering

- *Jering*, botanically is classified as *archidendron jiringa*.
- *It* is a tropical tree found in abundance in Sarawak forest.
- Other given names of jering are: dog fruit, blackbead, jinkol, jarung, krakos, and ngapi nut.
- *Jering* fruit is round to oval with a squat, flattened shape and average 3 centimeters in diameter.
- The pods grow in clusters and are thick, hard, and dark brown to purple. The bean inside the pod is pale green to cream-coloured. When it is raw it is bitter and firm in texture. When cooked, *Jering* beans lose their bitter flavour and develop a mild, starchy texture.
- *Jering* beans are edible.
- In addition to its medicinal and other culinary purposes, the bean pods and the bark of the *Jering* tree are also used to make purple and black dyes in local villages.
- *Jering* seeds contains vitamin C, vitamin A, fiber, calcium, and oils containing sulfur and alkaloids.
- The leaves of the *Jering* are used in traditional medicine in Southeast Asia. The leaves are used to help reduce symptoms of chest pain, toothaches, and skin problems.
- The leaves can also be ground into a powder and used to heal cuts and wounds.
- Villagers also use the young leaves for salads.
- *Jering* is native to Southeast Asia (and Sarawak). It likes humid climate.
- Originally grown naturally wild in lowlands and some highland areas of Sarawak, today the plant is cultvated and farmers grow them for the fruits as well as to create shades for their gardens.
- It also provides nice views as it blends well with any forest landscape restoration programme.
- The trees can grow up to 100 feet high when in full maturity.



Petai

- *Petai* is also known as bitter bean, twisted cluster bean, stink bean, or *petai*, *pete* in Indonesia.
- Its botanical name is *arkia speciosa*.
- The trees are also natural to Sarawak.
- The tree bears long, flat edible beans with bright green seeds, with the size and shape of plump almonds.
- The seeds have a peculiar smell, due to sulfur-containing compounds which can also be found in shiitake mushrom, truffles, and cabbage.
- The *petai* tree can grow up to 30 metres (around 100 feet high).
- The flowers are bulb-shaped mass at the end of long stalks. The flowers secrete nectar that attracts bats and other pollinators. The fruits emerge as long, twisted, translucent pods in a cluster of seven or eight pods. When those pods mature, within them will reside the *petai* beans or seeds.
- Like *jering* seeds, *petai* seeds are great for medicinal and culinary values.
- Many farmers and plantation owners today cultivate *petai* on small to large commercial scale. Before this all the trees were natural to the forest and farmers did not cultivate them.



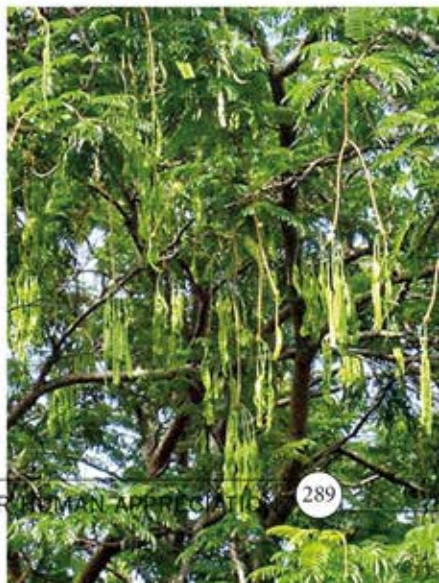




















Medicinal & Edible Mushroom and Fungi

- A **fungus** is any member of the group of eukaryotic organisms that includes microorganisms such as yeasts and molds, as well as mushrooms.
- What characterises fungus in a different kingdom from plants, bacteria, and protists is the chitin in its cell walls. Fungus, like animals, is heterotroph. It acquires food by absorbing dissolved molecules, typically by secreting digestive enzymes into its environment.
- Unlike plants, fungus does not photosynthesize. Growth is its means of mobility, except for spores (a few of which are flagellated), that can travel through the air or water.
- Fungi are the principal decomposers in our ecological systems.
- The study of fungi is known as mycology. In the past, mycology was regarded as a branch of botany, although it is now known that fungi are genetically more closely related to animals than to plants.
- Mushroom is a fungus. It is also known as toadstool. It is fleshy, spore-bearing fruiting body of a fungus, typically produced above ground, on the soil, or on its food source (rotten or dead wood, saw dust, tree barks, etc).
- Mushroom has a stem (*stipe*), a cap (*pileus*), and gills (*lamellae*, *sing. lamella*) on the underside of the cap. 'Mushroom' also mean a variety of other gilled fungi, with or without stems, so the term is used to describe the fleshy fruiting bodies of some *ascomycota*. The *gills* produce microscopic spores that help the fungus spread across the ground or its occupant surface.
- In Sarawak there are many kinds of fungus (wild forest mushrooms). Some are edible, and there are varieties that are poisionous.
- The many varieties of wild mushrooms found in Sarawak forest provide great food choices for human. Many good and exotic cuisines can be prepared from these mushrooms gathered from the wild.
- Mushrooms have long been valued as delicious and nutritious foods in many countries. They are appreciated, not only for texture and flavour, but for their chemical and nutritional characteristics.
- Mushrooms are attractive as functional foods. In Malaysia, many species, including *grifola frondosa* (maitake), *morchella esculenta* (morel), and





termitomyces spp. (*termite mushrooms* or also known as *cendawan busut*) have become highly valued, partially due to their rareness and difficulty in cultivation. *Termitomyces spp* remains elusive. Laboratory trials to culture and cultivate them are ongoing. *Termitomyces spp* are called *termite mushrooms* for they are only able to survive and continue their progeny while in symbiotic growth together with termites in their hills. These highly palatable fungi with high *umami* have close association with termites.



- Some mushrooms and fungi are found to have medicinal values like one variety known as lingzhi.
- Lingzhi, with the scientific name of *ganoderma lingzhi*, is also known as *reishi*. It is a polypore fungus (bracket fungus). It belongs to the genus *ganoderma*.
- Its black or red-varnished, kidney-shaped cap and peripherally inserted stem gives it the distinct fan-like appearance.



- When it is fresh, lingzhi is flat, soft, and cork-like. It has no gills on its underside, so it releases its spores via fine pores.
- Depending on the age, the underside pores can be white or brown.
- Lingzhi mushroom is used in traditional Chinese medicine. It is said to have curative effects on cancer, and other metabolic and cardiovascular diseases.
- Linghzi mushrooms grow at the base, stumps or barks of living or decayed trees.



- With research done, today lingzhi can be be cultivated on hardwood logs, sawdust or woodchips
- In the wild, linghzi mushrooms are found on dead logs, tree stumps, tree buttreses, as well as on the barks of lower trunks of certain types of big tropical trees like the illipenut, rubber, *tapang*, jackfruit, *durian* trees, etc.
- With agroforestry and forest landscape restoration activities, (a) edible mushroom like termite mushroom, and (b) medicinal mushrooms like linghzi, can thrive naturally on their conducive habitat or man-induced environment.

Rambai





- *Rambai* is a wild, tropicl plant fruit tree, growing in abundance in Sarawak.
- Its botanical name is b*accaurea motleyana*.
- It can grow from 9 metres to 12 metres (20 feet to 40 feet) high.
- It has good foliage, and evergreen leaves, thus making it an excellent material for forest landscape restoration; and agroforestry (since its fruits are popular among locals as well as those outside Sarawak).
- *Rambai* leaves are 33 centimetre long, and 15 centimetre wide.
- A tree has either male or female flowers (dioecious). The flowers are sweet scented, and have yellow petals.
- The fruit bunch can be as big or wide as 15 centimetres, and the bunch (pisillate inflorescences) as long as 75 centimetres in length.
- The fruit is sweet and juicy, and rich in vitamin C and other nutrients.
- The tree trunk usually is straight up with few branches at the top. It is a hardy wood, making it popular among villagers as materials for their traditional house decorations and artcrafts (making parang heads, etc).
- Growing wild originally in Sarawak forest, today many farmers and villagers grow or cultivate them for garden and farm shades (forest landscape restoration), as well as sources of income from sales of the fruits (agroforestry).















Pandan

- *Pandan* is a plant, found widely throughout Southeast Asia (including Sarawak).

  The botanical name is p*andanus amaryllifolius.*
- It is a tropical plant in the *pandanus* or screwpine family.
- *Pandan* is a true cultigen. What is cultigen?

  A cultigen (from the Latin *cultus* – cultivated, and *gens* – kind) is a cultivated plant. It is a plant that has been deliberately altered or selected by humans; a result of artificial selection. Cultigens have commercial value in horticulture, agriculture or forestry. Cultigens are defined by their mode of origin, and not by where they are growing. Plants like *pandan* that meets this definition remain cultigens, whether they are naturalised in the wild, growing in cultivation or deliberately planted in the wild.
- *Pandan* is believed to have been domesticated in ancient times. It is sterile, and can only reproduce vegetatively through suckers or cuttings.
- *It was first described from specimens from the Maluku Islands, and the rare presence of male flowers in these specimens may indicate that it is the origin of the species. However, as no other wild specimens have been found, this is still conjecture. It has also been introduced to South Asia via Malaysia and Indonesia, where they are grown extensively* (information extracted from Wikipedia).
- It has fragrant leaves, used widely for flavouring in many local cuisines (fish and meat dish, snacks, desserts,cakes,etc).
- *Pandan* is green in colour, it grows upright,with fan-shaped sprays of long, narrow, blade-like leaves and woody aerial roots.
- For both aesthetic (scenic) value and also commercial, p*andan* plants are great to add variety to the other plants, trees and grasses grown or kept for any forest landscape restoration programme, or for agroforestry activities.







Pulasan and Rambutan

Pulasan

- The botanical name for *pulasan* is *nephelium ramboutan-ake.* It is a tropical fruit in the *soapberry* family of *sapindaceae.*
- It is closely related to the rambutan (sometimes confused with it).
- *Pulasan* is sweeter than *rambutan.*
- *It* is common in the forest of Sarawak, but very rare outside Southeast Asia.
- Pulasan fruit has health benefits: it reduces body fat, so it is good for weight-loss and maintaining healthy body. It is high in Vitamin C, giving great boost to the immune system. It can quicken the healing of wounds, also repairing and maintaining teeth and bones.
- Traditionally, the villagers use the leaves and roots of the *pulasan* tree as 'mesh' or poultice to apply on the skin to treat various ailments.
- *Pulasan* tree is an ornamental, and handy for forest or garden landscape, apart from the fact that the fruits are edible and of commercial value.
- It can grow to a height of 10 metres to 15 metres. It has short trunk, of 30cm to 40 cm thick. The branchlets are brown and hairy when young. The alternate leaves, pinnate or odd-pinnate, are 17cm to 45 cm long, with 2 to 5 pairs of opposite or nearly opposite leaflets, are oblong or elliptic-lanceolate, slightly wavy, dark-green and barely glossy on the upper surface.
- For flowers and fruits, *pulasan* has small, greenish and petalless flowers with 4 to 5 hairy sepals. The flowers are borne singly or in clusters on the branches.
- Unlike rambutan that is widely cultivated now, pulasan is not that popular yet among gardeners. However the tree and foliage make good material for forest landscape restoration and agroforestry.





Rambutan

- Like *pulasan*, *rambutan* is very common in Borneo. Though initially existed as wild plant, today it is popularly cultivared for garden shades, as well as for fruits that has commercial value.
- What is *rambutan?* It is is a type of fruit, akin to lychee. The tree is medium-sized tropical tree, in the family of *sapindaceae.*
- The botanical or taxonomic name is *nephelium lappaceum.*
- *Rambutan* fruit has a gummy textute, with pleasant and sweet taste, resembling that of a lychee. It is high in iron, vitamin C, copper, and antioxidants. The fruits can be eaten fresh, or made into juice, or canned for uninterrupted supply for consumers.
- Its name '*rambutan*' refers to its very distinctive hairy appearance, and '*rambut*' means 'hair' in the local language. *Rambutan* fruit trees bear fruit that is indeed hairy in appearance.
- The fruit, or berry, is oval-shaped with a single seed. The outer peel is reddish or sometimes orange or yellow, and covered with malleable, fleshy spines. The interior flesh is white to pale pink, with a flavour similar to grape and lychee.
- The seed can be cooked and eaten, or the entire fruit with seed can be consumed.
- *Rambutan* fruit trees are male, female, or hermaphrodite.
- The trees are evergreens, growing up from 50 feet to 80 feet high (15m-24 m) and With dense, spreading crown.
- Foliage is alternate, 2 to 12 inches (5-31 cm.) long with hairy red rachis when young, and 1 to 4 pairs of leaflets that are elliptic to oblong in shape.
- Compared to pulasan, rambutan is widely cultivated nowadays.
- The beautiful evergreen tree and foliage of both *pulasan* and *rambutan* however make great material for agroforestry and forest landscape restoration.







Pitcher Plant



- Pitcher plant or *periok kera* (Malay name meaning literally 'monkey cup') or *tiramuo* (in local bidayuh dialect) is common in the wild forest of Borneo.
- Its botanical name is *nepenthes*. It is a carnivorous plant, a pitfall trap that drowns insects in its cup and absorp it for food as the insect decays inside.



- Pitcher plants grow in damp tropical forests in the lowland and up to 2,100 metres altitude.
- It is a vine or creeper type of plant, climbing onto trees to a height of up to 50 feet or more.
- The vine is very useful for the villagers to make into (i) ropes, (ii) baskets, fish traps, mats, and for other local ornamental crafts.



- Growing wild in the Sarawak forest, pitcher plants make good plant materials for forest landscape restoration, and also agroforestry (the plant has commercial values as stated in above).
- The plant, with its unique long leaves and many beautiful and attractive looking cups are very popular among garderners to grow as ornamental plants for their home gardens.



- When the cups are still small with the lids not yet opened, there are natural clear viscious liquid inside them. The liquid is manufactured or produced naturally by the plant. Villagers use this liquid as eye freshener or natural eye drops to clear off dirty eyes or to clean the eyes from some infections. The liquid is very refreshing and has cooling effect to the eyes, making it to be known as the free 'natural eye drop' for the villagers.
- The cups are also a novelty, used by villagers to cook food (cake, rice and meat).





Wild Watercress Vegetable

- There are many varieties of local or native watercress or types of watercress found in the natural habitats in Sarawak swamp forest. They thrive on the edges of streams in swampy areas, on the ponds, and along natural as well as man-made water canals or ducts.
- Some are edible and make tasty and healthy vegetable dishes.
- One of such local watercress is known in the bidayuh dialect as *sigomouk*.
- It is a popular local vegetable, and in demand just like *kangkong*, *midin* and ferns. It is on sale in many local *tamu* or the rural wet market.
- *Sigomouk* generally grows wild, and healthy in pond-swamps, muddy or mulky water ducts, and along the sides of streams where other water hyacinths thrive.
- In agroforesty practice, where ponds are built for aquaculture *sigomouk* can make very good decoration to the pond areas. It has beautiful flowers and pods that attract insects especially dragon flies and birds. It also helps to filter the water, and local water snails find the roots and clusters to be perfect homes. The clusters are also nesting and dwelling places for fishes.
- For use in agroforestry, and also material for forest landscape restoration, *sigomouk* indeed not only beautifies the area, but it also provides vegetables for human consumption, and home to fishes and snails. The farmers also use sigomouk as feed for chicken, pig, cow/ bufallo and duck rearing.



Plants for Decoration

- Sarawak equatorial rainforest is endowered with great varieties of plants, trees, floras, lianas, creepers, vines, epiphytes, mosses,faunas, shrubs, ferns and grasses. One species of grass is fern like. It grows low on the ground, usually acting as under-covers and mixing well with other grasses and shrubs.
- The local land dayak dialect for this plant is *dowon giruguoh*.
- It is very popular for dedorating meeting places, ceremonial halls, and houses for festival gatherings or celebrations and parties.
- The grass is green when fresh and alive, turning yellow or brown when it is dry or has been cut for few days. The great thing about this grass is that even when it is dead or dry it still provides good decorative pieces to the spaces or buildings.
- *Dowon giruguoh* is found in abundance along roadsides or footpaths, and exist both in the primary and secondary jungles.
- In the practice of agroforestry, dowon giruguoh can make good material or plant to nurture to restore the forest landscape, besides just enjoying its unique and beautiful natural structure.













Wild Star Fruit or Belimbing Dayak

- Wild star fruit or *belimbing hutan*, is indegenious or endemic to Borneo (and Sarawak) forest.
- Its scientific or botanical name is *baccaurea angulata*.
- Other names are *belimbing darah, belimbing hutan, belimbing api, belimbing merah*, and *uchong*. It belong to the family of *phyllanthaceae*.
- It is related to the species of *rambai*.
- Indonesians call it *asem ketiak, pidau, umbing, umbung*, and *bonit*. Brunei people call it *belimbing hutan*. Sabah dusun call it *embaling, embaling bobou;* while the Ibans call it *ujung, uchong. belimbing uchong, pelawak, popotong, tampoi hutan*.
- B*elimbing dayak or belimbing merah* used to be part of the jungle produce since ancient time or not long ago. But today many villagers and farmers grow it to meet the commercial market demand for indigenous fruits.
- *Belimbing merah* got its local name from the colour and shape of the fruit. This oval red star-shaped fruit is also called 'red raspberry'.
- The whitish content of the fruit is the same colour and taste as the *rambai* fruit. The fruit is about 3 centimetres in diameter, and 6 centimetres in length. The bright red skin is thick, leathery, and spongy with angular panels. The white to translucent flesh is divided into 1-3 segments, with a thin membrane. There are several flat, light brown seeds adhered tightly in the centre of the flesh.
- *Belimbing merah* is sweet, tangy and juicy. It has tropical flavours similar to mangosteen.
- The fruit grows on the trunk, and branches, of a tree. It is a prolific-growing perrenial plant. It can have hundreds of tightly clustered fruits on a single tree.
- Due to its unique shape and red colour, the fruits are often used ornamentally as a vibrant table decoration.
- Studies reveal that the fruit is fibrous, and contains vitamin C, potassium, magnesium, and calcium. It is eaten fresh or made into juice and sour relish. It can also be pickled, cooked as a vegetable,or boiled and made into jam. When pickled, the sour skin becomes edible. It is commonly preserved with sweet syrups to add flavour.
- In addition to the fruit, the hard wood from the tree trunk is used for local handicrafts, for making furnitures, and for beams and posts for construction.
- The *belimbing merah* or *belimbing dayak* or *tampoi belimbing* tree grows up from 6 metres to 28 metres high. The girth of its trunk can be as big as from 60cm to 2 metres.
- It can thrive on lowland as well as on hilly and mountainous areas.
- It makes good material for forest landscape restoration, as well as for agro-forestry.







Cotton Tree or Kapok



- Cotton tree or *kapok* is a giant in the rainforest.

  It is also known as *ceiba tree*. Other names are Java *kapok*, silk-cotton or *samauma*.

  This tropical tree is native to Mexico. It was introduced to South and Southeast Asia (including Sarawak Borneo), where it is cultivated. Today it is common to see cotton trees in many gardens and secondary forests in Borneo. It is in the family order of *malvaceae*.

- The botanical name is *ceiba pentandra*.

- It can reach up to 252 feet (77 metres) in height. It towers over the other rainforest vegetation.

- Some varieties of the ceiba tree are characterised by spines or conical thorns, giving the tree a menacing appearance. The trunk's girth is big and can be up to 19 feet (5.8 metres) in diameter.



- Cotton tree is deciduous, and it sheds all of its leaves during dry season.

- Its seeds are easily blown into open areas, so it is not a wonder to see that it is one of the first trees to colonise open areas in a forest.

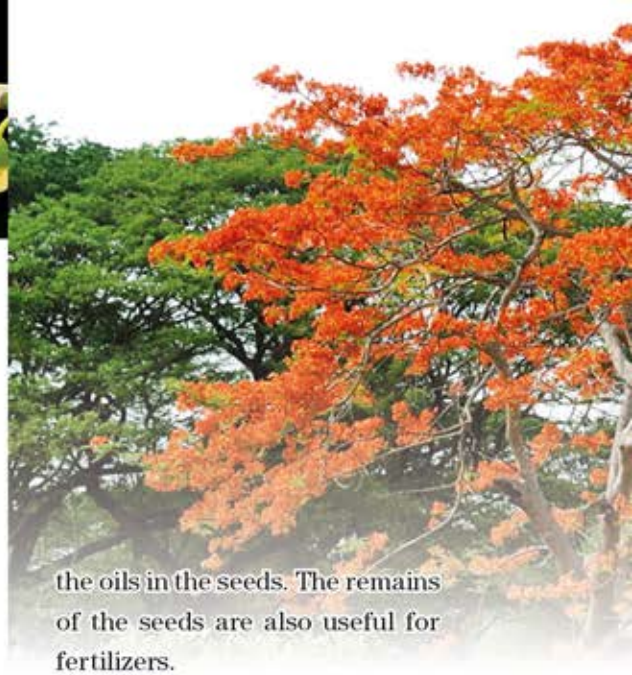
- The white and pink flowers emit odour that attracts bats that facilitate pollination.

- The tree produces between 500 and 4,000 fruits at one time, with each fruit containing about 200 seeds. When the fruits burst opened, silky fibres spread the many seeds all over the forest.

- There are many values and uses of cotton tree.

- Its wood is lightweight and porous, so it is ideal for making carvings, ornamental handicrafts, and dugout canoes.

- The silky fibres that disperse the seeds are great natural soft stuffing materials for beddings, car seats and chair cushions, and life preservers. Soaps and paint products are made from the oils in the seeds. The remains of the seeds are also useful for fertilizers.



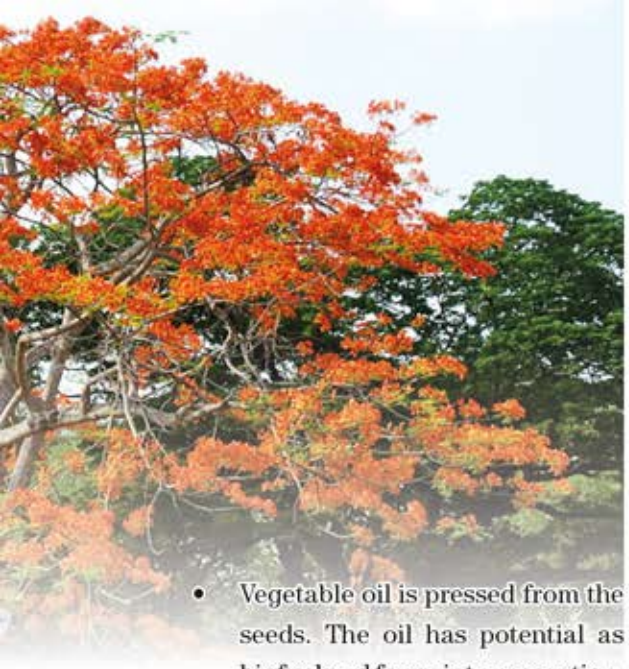
The bark of the tree is used as traditional medicines (diuretic, aphrodisiac, treating headache, as well as type II diabetes.











- Vegetable oil is pressed from the seeds. The oil has potential as biofuel and for paint preparation.

  Cotton trees are planted in parks and on roadsides because of its beautiful red flowers. Flowers are dried and cooked.

  The white fluffy fibres are carded into thread and woven into textiles.

  The dried flowers can be for food garnishing and flavouring ingredient, a spice as well as used for herbal medicine, tea or soup.

- Birds, Honey bees, and bumble bees are attracted to the flowers to collect pollen and nectar.

- Cotton trees or *kapok*, because of their spectacular size and unique canopy, and with their attractive blooms, plus uses in its flowers, seeds, and wood, make very good choice for agroforestry and forest landscape restoration.



Keranji

- *Keranji* is indigenous or native to Malaya, Sumatra and Borneo (Sarawak included).

- Its scientific or botanical name is *dialium procerum (Van Steenis)*.

- It can grow up to 50 metres or 150 feet high, and has huge evergreen canopy.

- Its wood is hardy, and can be used for housing and construction, or for local handicrafts. *Keranji* grows wild in the forest, although now there are people who grow them in their gardens and at the fringes of their farms, mainly for shades and decoration of the surrounding (forest landscape). It prefers lowland to mid-hilly areas to thrive.

- Besides its wood, the trees bear edible fruits that are popular among the locals.

- Today attempts are made to commercial use its cultivation. It is a good choice for forest landscape restoration, and agroforestry.









Kemayau

- *Kemayau* or wild Borneo olive, is a similar species or family of *dabai*.
- It is native of (or indigenous to) Borneo. Loosely, Brunei and Sabahan called it *kembayau*, while Sarawakians call it *dabai*. Despite that similarity and intention to recognise a similar fruit but with different name, there is in fact slight difference between *dabai* and *kemayau*. It is in the fruit's length, and the shape of its seed or kernel.
- *Dabai* fruit is a bit short or 'blunt', while *kembayau* is 'longish'. The inner seed or kernel of *dabai* is hard and 'star shape' and short; while that of *kemayau* is rather soft and a long oval.
- The taste (olive oil taste) is common to both.
- In the market, *dabai* is a bit pricey compared to *kemayau*.
- The skin colour of ripe *dabai* and ripe *kembayau* is the same; that is, deep dark purple or glossy black.
- *The botanical name for kemayau (*and *dabai)* is *canarium odontophyllum*, belonging to genus of the *Pili nut canarium ovatum* in the family *burseraceae*.
- *Kembayau* can grow up to a height of 50 metres (160 feet).
- Its fruit is seasonal, and a popular delicacy in Sarawak.
- The flesh is yellow, with an elongated seed. The fruit flesh is hard, and has to be soaked in warm water before eating.
- It tastes of avocado.
- The inner seeds or kernels are also edible, and similar to almonds or pistachio.













Chestnut

- Chestnut trees or *pokok berangan* grow wild in the forest of Malaysia (Sarawak included) and other Asian countries. This is the evergreen tropical chestnut species, while there is also the temperate decidious type found in cooler countries.
- Its scientific name is *castanopsis motleyana*.



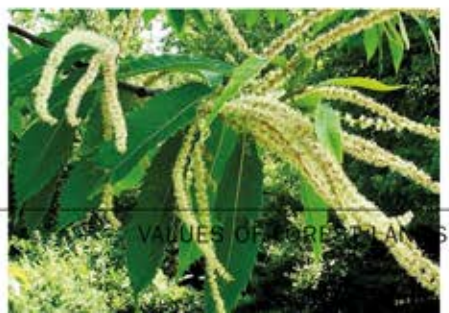
- In other parts of the world, chestnut is a group of eight or nine species of deciduous trees and shrubs in the *genus castanea*.
- Chestnut type is categorised into American, European, Japanese and Chinese type.
- The unrelated horse chestnuts (*genus aesculus*) are not true chestnuts, but are named for producing nuts of similar appearance that are mildly poisonous to humans.
- Tree chestnuts should not be confused with water chestnuts, which are tubers of aquatic herbaceous plant in the sedge *cyperaceae* family.
- Other species commonly mistaken for chestnut trees are the chestnut oak (*quercus prinus*) and the American beech (*fagus grandifolia*), both of which are in the *fagaceae* family.
- Chestnut trees vary from the smallest species of shrubby chinkapins (about 30 feet), to the giant of American forests that is the *C. dentata* variety which could reach up to 60 metres or 160 feet. Between these extremes are found the Japanese chestnut (*C. crenata*) at 10 m (35 feet) average; followed by the Chinese chestnut (*C. mollissima*) at about 15 m (60 feet), then the European chestnut (*C. sativa*) around 30 m (100 feet).

  The Chinese and more so the Japanese chestnuts are both often multi-leadered and wide-spreading, whereas European and American species tend to grow very erect when planted among others, with little tapering of their columnar trunks that are firmly set and massive. When standing on their own, they spread on the sides and develop broad, rounded, dense crowns at maturity.
- The temperate climate type of chestnuts are decideous and shed leaves in autumn when the foliage transforms to very striking yellow autumn colouring.
- For tropical climate chestnuts like those in Malaysia, the trees do not shed the evergreen leaves. Found wild in the Sarawak forest, the trees thrive on upper lowland to hilly areas, and more sporadic on the higher parts of mountains.
- The wood is hard, and the trees can grow to heights from 50 feet to 100 feet.
- It bears fruits once yearly. The fruit's skin or rind is covered with small spiky or prickly thorns, green in colour but turned brown when the fruits ripened.
- Besides the edible nuts, chestnut trees are also sought for its hard wood with good grains, and used for decorative local arts and crafts, carvings, or for making attractive furnitures.
- Its lovely foliage and unique canopy shades make good choice for garden and environmental landscaping.



- Because it is not often cultivated by farmers but people let them grow naturally in their forest habitat, chestnut tree is also good choice for agroforestry activities for its nuts (food product) and its matured wood (commercial product).







OTHER AGROFORESTRY (WILD FOREST) BY-PRODUCTS





Below are also useful forest trees or plants with good by-products (edible fruits, flowerrs and leaves for food), or useful parts and woods for household needs and appliances (materials). They are commonly found in the Sarawak forest, from the lowland areas up to the mid regional mountainous terrains. These 14 plants or tropical Sarawak trees make great choice or materials for agroforestry and forest landscape restoration. They are listed here, using local villagers' dialectic names:

1. Pokok Ngijorin

This is an evergreen tree that can grow up to more than 100 feet high, with big long branches and large foliage canopy. The wood is hard and is in demand among the villagers for carvings and handicrafts, as well as for light house construction. The tree produces edible sweet fruit. It grows on the lowland and hilly areas. The fruit is round (the size of baseball), is green in colour but turned yellow when it is ripe. The skin or rind of the fruit is used for making traditional shampoo and soap.

2. Tongun Sikuruom

This is a liana or creeper plant. The plant entwines itself on big tall trees, but without strangling the host tree, unlike the strangling fig that eventually kill-off its host. The *sikuruom* fruit is edible. It has a brown thick rind or skin that shapes and looks like an oversized ground nut. It is a popular food for the local villagers. The fruit can be cooked and eaten on its own like eating tapioca or sweet potatoes and it is starchy. Somertimes it is meshed and made into cakes or eaten together with (as a supplement) rice. The creeper or vine is thick and can reach to as high as the host tree as it competes for the sunlight.

3. Pokok Sittu

This tree is commonly available in many primary and secondary forests of Sarawak. It grows wild and to heights of up to 120 feet. The big branches and broad leaves form big foliage and canopy. From afar, the tree looks splendid and outstanding from other trees. It sheds its leaves and is a lovely sight to see the brown and red hues of fallen dead leaves. It bears edible round fruit, the size of a cricket ball. The fruit is green when young, but turned into golden yellow when it is ripe. The skin or rind is quite thick and sour. Villagers like to make salad and *sambal* out of the sour skin, or for making sweet sour fish dish. The flesh of the fruit is white and sweet with that seeds. *Sittu* tree can grow up to more than 100 feet high and it has girth size of up to 6 feet in diameter. The wood is hard and good for making local handicrafts and other light building materials.



4. Pokok Sidumang

The tree of *sidumang* fruit is often found growing wild in the forest. Because it is not properly nurtured or maintained nowadays it is rather rare to come across one. The fruit is akin to the crystal fruit, with similar skin (except that *sidumang's* skin is softer compared to the crystal fruit). The flesh is similar to crystal fruit and taste like *rambutan*. The unripe green fruit is oblong (like the shape of *dabai*) and turned deep purple when ripe. As it is rare to find it nowadays, the fruit itself is already a beauty to admire even before one consumes it. The tree can grow up to 70 feet high and has lovely foliage with nice canopy. It is a good item to keep or grow for any agroforestry and forest landscape restoration activity.



5. Tongun Siriatt

This small shrubby tree, growing up to 10 feet, has nice foliage with light creamy yellow leaf (when young) to glossy green (matured leaf). It bears edible small oblong fruit (yellowish green when young, and golden red when ripe). The leaves are used for making salad, or cooked as vegetables together with the young unripened fruits. The ripened fruits are harvested and fried or roasted to be eaten. They taste like fresh nuts. Some villagers also pound the nuts into powder or flour to make cake.

The trees are small in girth (up to 6 inches). Besides the edible leaves and fruits, the trees form lovely shrubs to decorate the garden fringes and forest landscapes.

6. Tongun Bah

This tree like to grow along river banks or streams. It prefers lowland that is wet. The leaves are evergreen, good foliage and with large canopy that is ideal for shades. It bears small fruit, white in colour and popular with the birds but the fruits are also edible to human. The tree can grow up to 60 feet high and its girth is from 2 feet to 6 feet in diameter.

7. Tongun Koron

Koron tree has hard wood, with rough leaves that villagers use to polish their wood carvings to make them smooth. The tree can reach up to 80 feet in height when fully grown. It likes to thrive on lowland areas that are well drained. The woods are used for building materials and for arts and handicrafts. Koron fruit has brown skin, covered with fine hairs. It is the size of a tennis ball. The inside flesh is deep yellow to red, and is sweet. Koron trees grow wild in the primary and secondary forest, and the saplings or young trees grow easily, germinated from the fallen fruits.

8. Pokok Bua Puduh

Puduh tree is similar to that of jackfruit tree, or very like the pokok boyuh, though smaller to boyuh in terms of tree and fruit size. The fruit is small, between 2 inches to 6 inches long and 1 inch to 2 inches wide. It is edible, and tastes very sweet but it has a peculiar smell. The trees produce latex, similar to latex produces by jackfruit. Besides the edible fruit, the hard wood makes the trees popular for making furniture, house panelling and also for local carvings and decorative materials.

9. Tongun Boyuh

Pokok or *tongun boyuh* is the larger sized version of *pokok bua puduh*. The tree has large coarse leaves. Like the jackfruit trees this tree also has sticky latex. It likes to grow on lowlands as well as on hilly and mountaineous areas. The matured trees can reach up to 200 feet tall. Old trees have huge buttress, and the smaller variety of honey bees often like to build their hives at the foot of the trees.







The girth of the tree is anything from four feet to eight feet in diameter. *Boyuh* fruits are similar to *buah terap* (same species family), but it is not as popular to humans compared to *buah terap*. The seeds, like *buah terap*'s seed, are also edible and has nutty flavour when roasted.

10. Tongun Simayih

Simanyih tree is similar to *rambutan* tree, The trees grow on lowland areas. Tree size is anything from 2 feet to 6 feet wide, and the trunk can grow up to 80 feet high. It has good canopy with its evergreen foliage of leaves. The fruits are edible. This wild tree is good selection for agroforesty amd forest landscape restoration.

11. Pokok Kidunong

Originally *pokok kidunong* was found mostly wild in the forest fringes. But today many farmers plant them. The wood of *kidunong* tree is soft, making it simpler for wood carvers and timber people to work on. Trees can grow up to 70 feet above ground, with the girth's width from 2 feet to 4 feet girth-width. The fruits are in clusters and sour if eaten on its own. Apart ftom the fruits, *kidunong* leaves are also edible for salad. Today villagers and gardeners like to cultivate them, growing the trees as wind-breaker, border-lines check-points, and for shades and ornament for the garden scenery. The sweet to sour fruits are for salad, desserts, or just eaten fresh.



12. Pokok Dooh

Dooh trees are labelled as the king of trees, due to its sheer massive size and huge canopy, while the tree trunk can be as high as 250 feet above sea level. The tree-girth is from 6 feet to 10 feet wide. The buttresses are many and huge; and just the sight of the tree itself can give one the feeling of awe and marvel as one wonders at such magnificient huge tree. The large canopy and long outreached branches give *pokok dooh* that majestic feature and it can be seen from far away, dwarfing the other nearby trees. The fruits of *pokok dooh* is light and 'floating' in the air. It is edible, and when roasted, would taste like a local nut packed with good minerals and vitamins.





13. Pokok Ripaung

The tree of *ripaung* is short, mostly 10 feet to 15 feet high, and the girth is from 2 feet to 4 feet in diameter. The wood is soft. Leaves are medium sized, oblong, and quite thick. The tree resembles the characteristic of wild starfruit or *belimbing*. *Ripaung's* fruits are small and round (the size of a softball ball). It has thick rind which is very sour. The fruits are sour. People use *ripaung* seeds to clean their hands and their cooking utensils. Or for making salad, and ingredient for sour dishes of fish and or meat. *Ripaung* tees are mostly in lowland areas.

14. Pokok buah Ropi

This tropical fruit tree is local to Sarawak. It is a hardy, and evergreen tree, with nice canopy; ideal for fruit crop as well as forest landscape. It can grow up to 80 feet in height. It bears nut fruits that are edible and popular among the local populace.



VALUE AND WEALTH IN FOREST LANDSCAPE RESTORATION



▲ Wild plant-herb for food-seasoning, found at Bung Bratak and other mountain areas of Sarawak



▲ Elegant fully matured forest trees



▲ Human activity on mountain forest













▲ Mountain forest waterfall





▲ Mountain trail for eco-tourism

▼ Cultivating mountain herbs



COSY RURAL DWELLING HOMES IN HARMONY WITH FOREST LANDSCAPE RESTORATION



▲ Bamboos are common on lowland areas





Human activity on mountain forest



Typical modern rural dwelling in a forest environment today







FOREST LANDSCAPE RESTORATION AND GARDEN HOMES



▶ Forest leafy plants for domestic use



▲ Planting mixed fruit trees for forest landscape restoration



▲ Forest landscaped in a rural dwelling



▲ Human activity around the forest fringe (cash crop pepper and mixed fruit trees cultivated)

FOREST LANDSCAPE RESTORATION & HOMESTAYS







Homestay

▼ Homestay







Another homestay





HARMONY WITH THE ENVIRONMENT OF NATURAL FOREST LANDSCAPE



▲ Wild forest flower



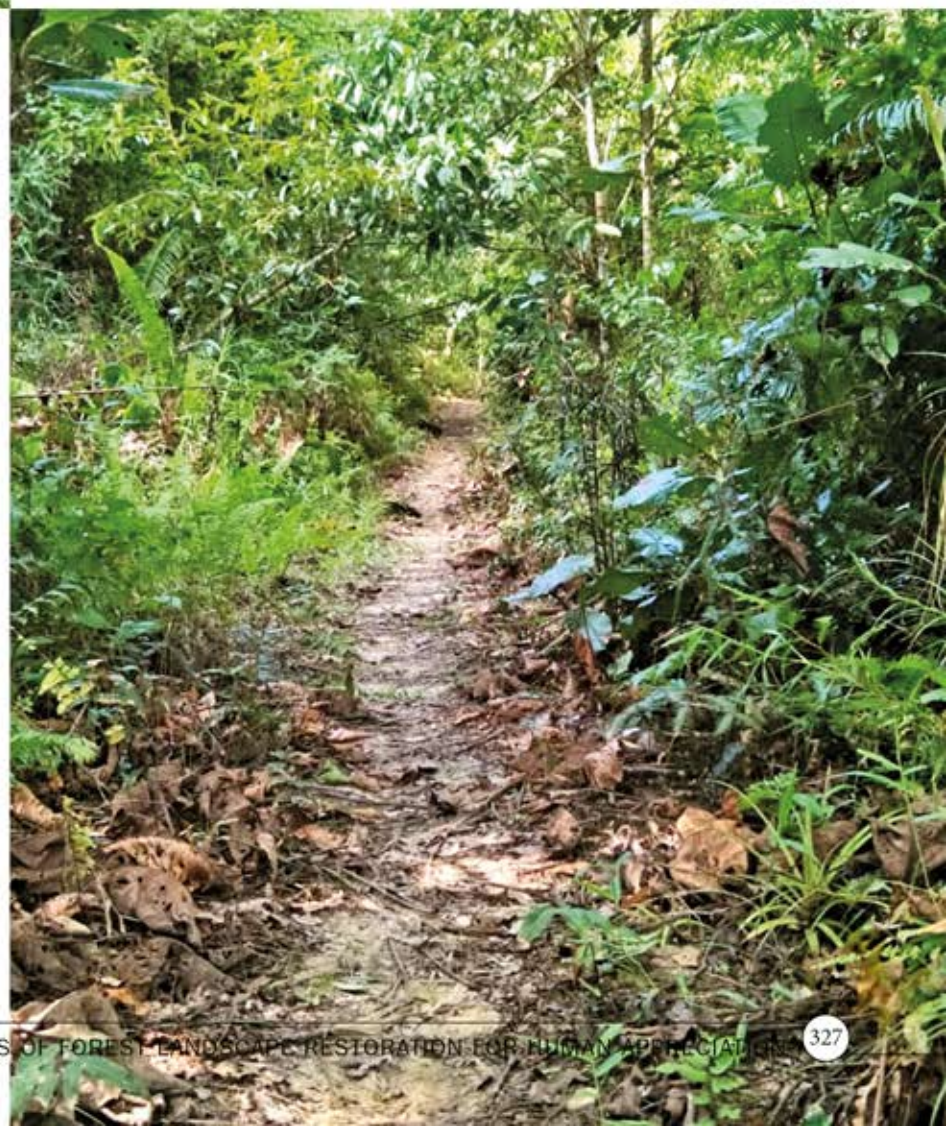
▲ Wild forest mushroom





▼ Forest foot path







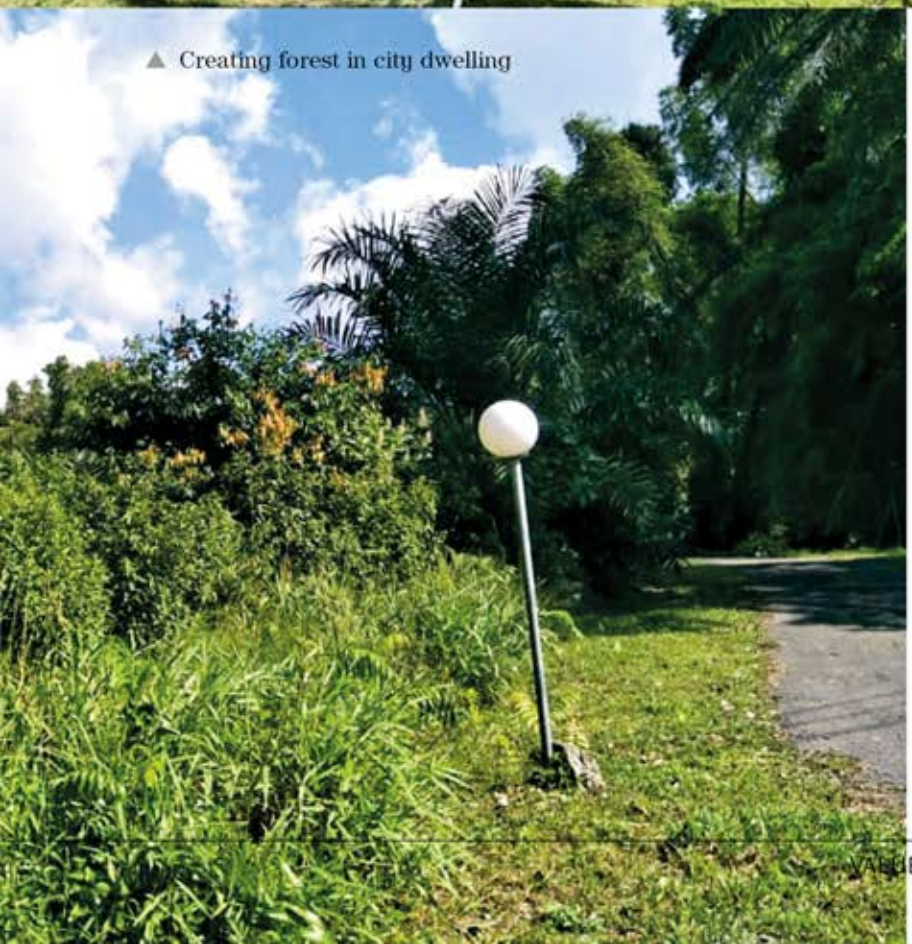
▼ Mountain forest

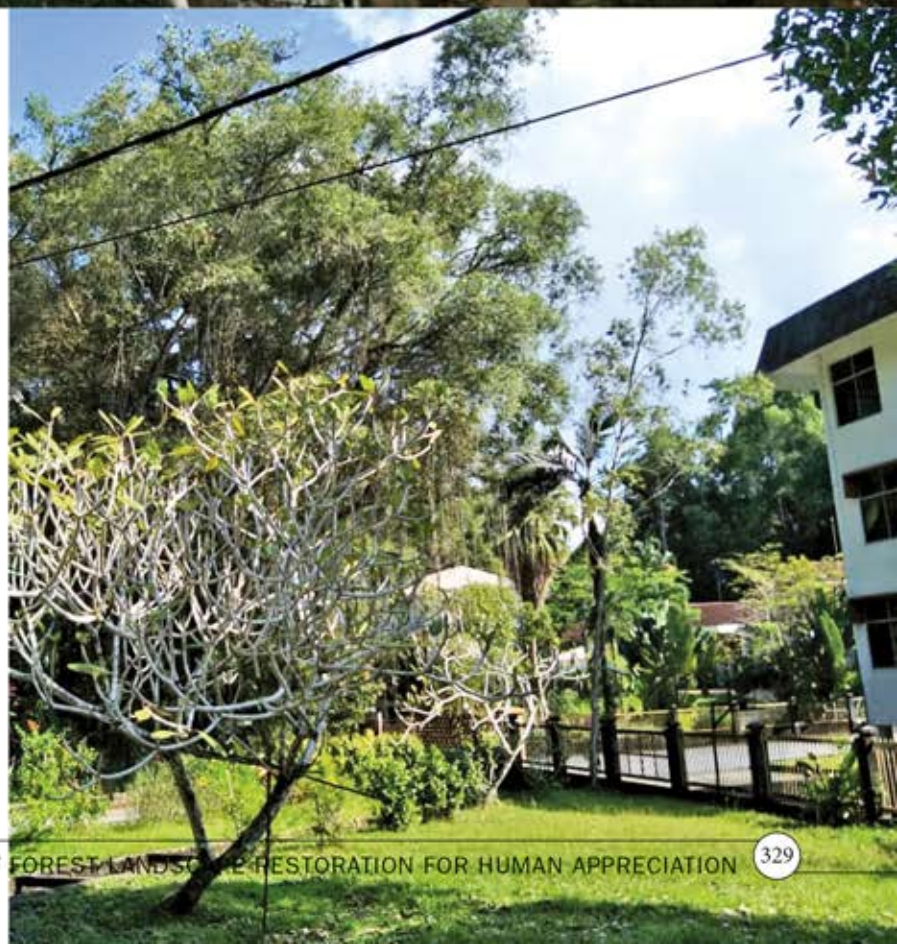






▲ Creating forest in city dwelling





AGROFORESTY LANDSCAPE OVERVIEWS IN SARAWAK

... Graphic panoramic visualisation

The broad picture

The symbiotic relationship between Man and Nature is obvious. Relationship involves two parties, Nature and Man or People and Environment. Men or People, (being the party that can think, plan, act, and monitor or manage situations) are entrusted with the duty of care and, custodian to safeguard the fragile biodiversity in our natural surroundings. When we look at the harmony human beings have with the natural forest environment, graphic presentations are effective, for us to visualize that symbiotic relationship.

Forest landscape graphics

The four graphics shown here depict various scenarios that explain how and why humans care, as they endeavour to utilise land spaces and catchments as they achieve developments and go on their civilization journey. Examples here are taken from a broad or aerial perspective, within the basins or catchments of Sarawak River Kanan and Kiri.

ESG

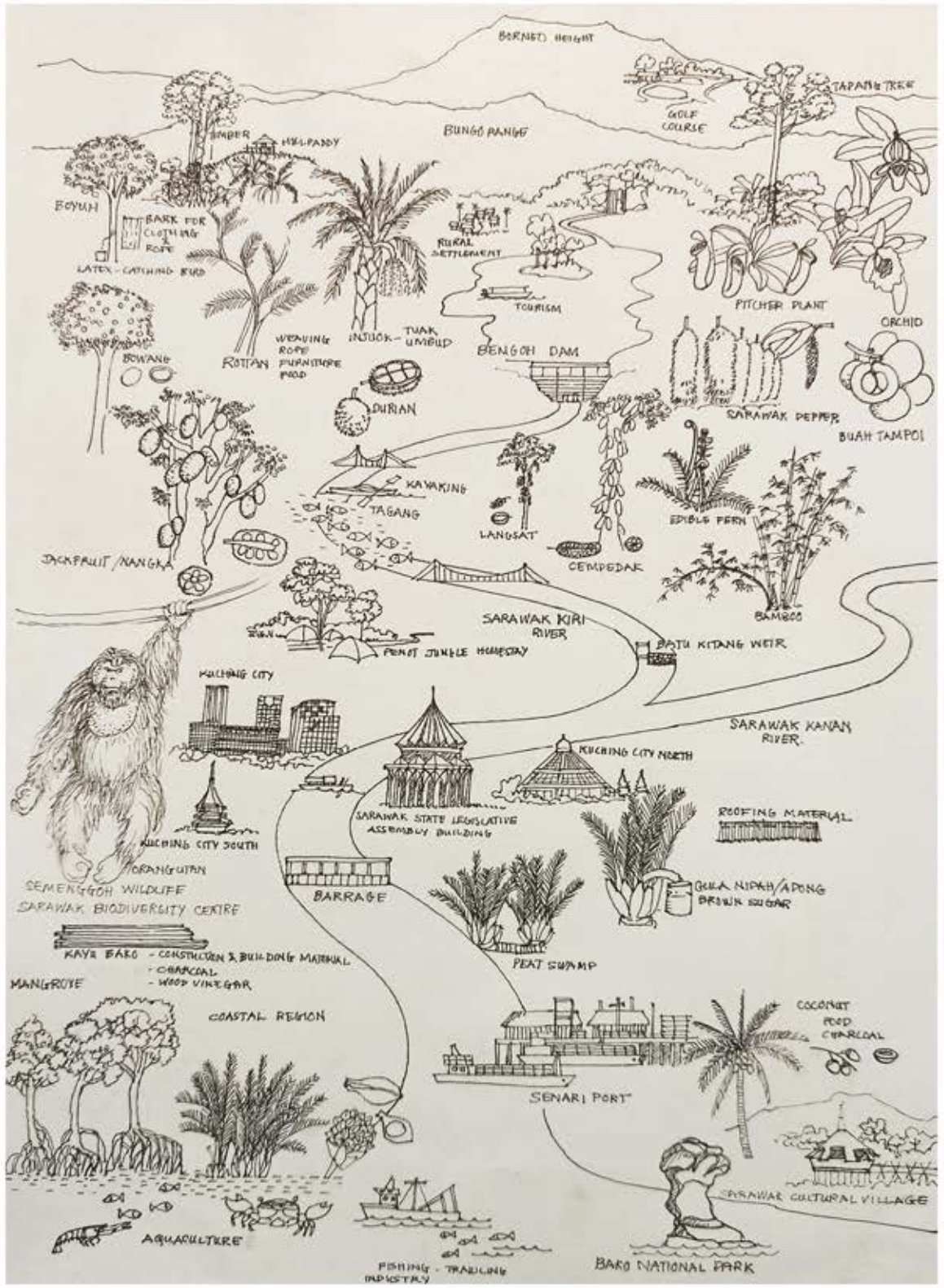
As we move along the ground, we are able to witness many undisturbed natural habitats and plants, floras and faunas in the vicinities. Human values, and natural values, move on hand in hand; in the spirit of good ESG (environmental social governance) that now become increasingly relevant for all countries on this planet Earth.



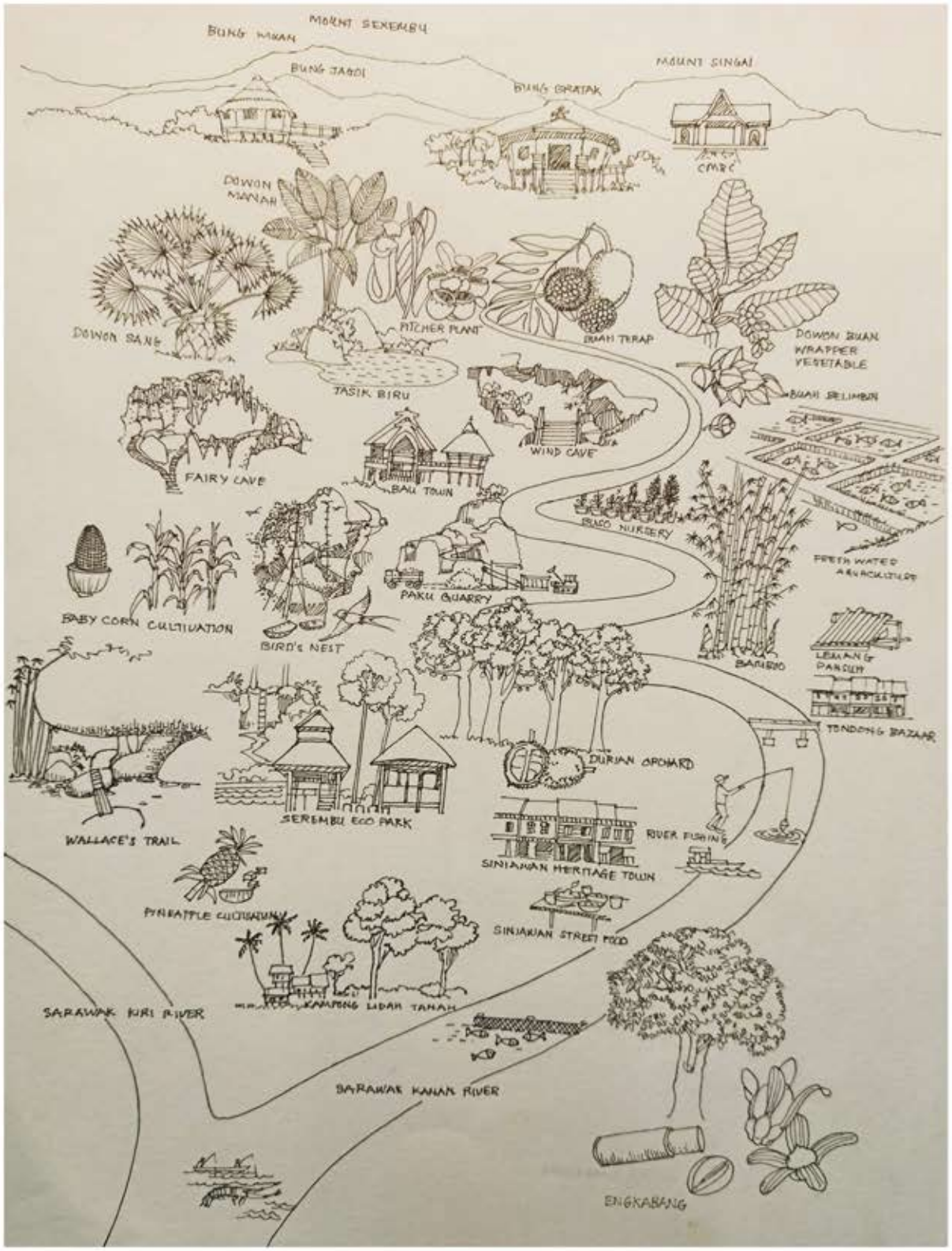
▲ Floristic Diversity and Stratafication of Tropical Rainforest in Sarawak



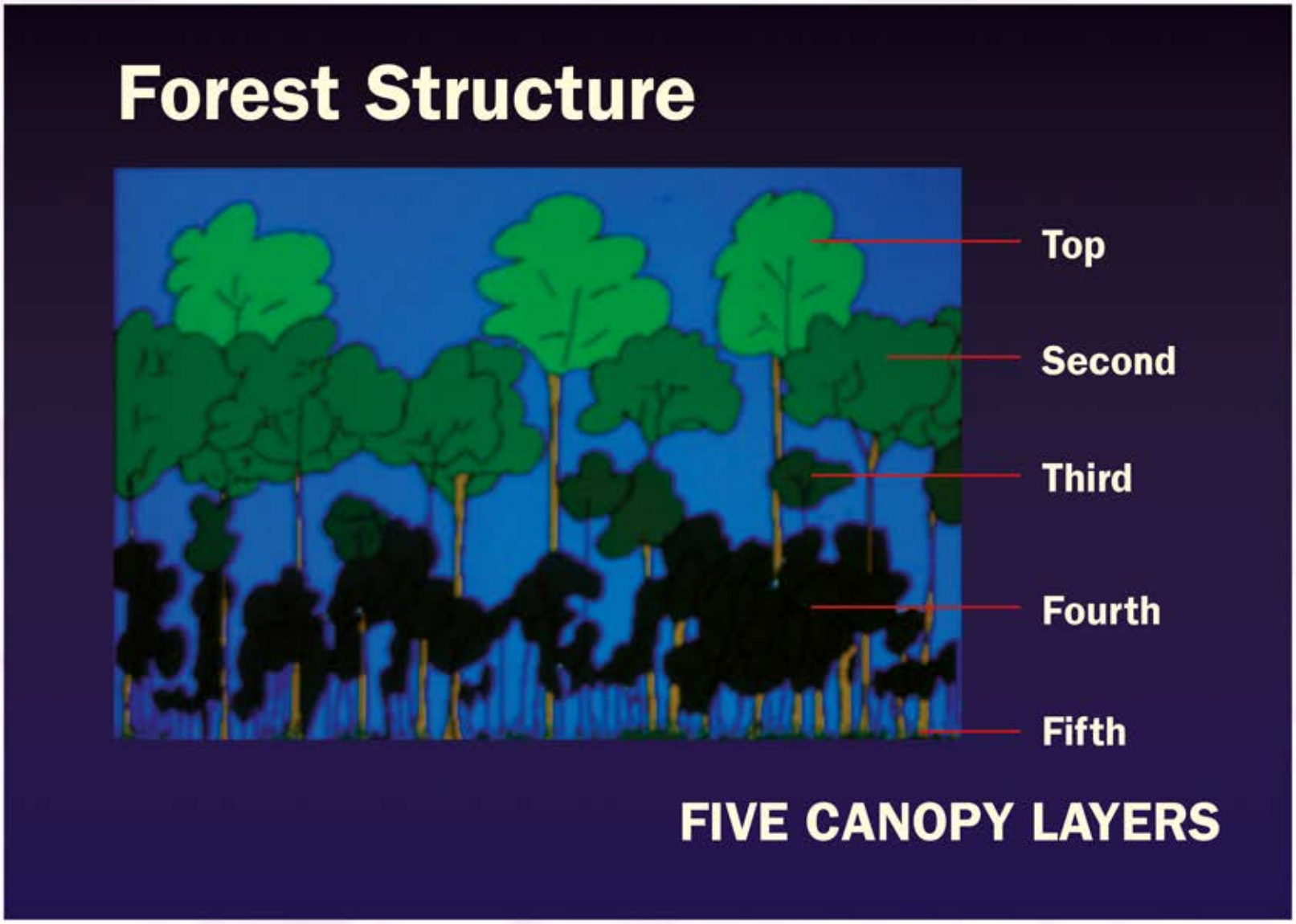
▲ Schematic illustration of forest and landscape progression within part of Sarawak River Basin



◀ Existing Iconic Landuse Along Sarawak River Basin… as Practised within Sarawak Kiri Catchment Area



◀ Harmonisation With Natural Forest Landscape … an Example From Sarawak Kanan Catchment Area



▲ Forest structure… five canopy layers



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