



Manual on Species for Implementation of REDD+ Activities in Mizoram



ICIMOD

giz German Institute of
International Cooperation
and Development (GIZ) GmbH

On behalf of:



Federal Ministry
for the Environment, Nature Conservation
and Nuclear Safety

of the Federal Republic of Germany



NORWEGIAN MINISTRY
OF FOREIGN AFFAIRS

Manual on Species for Implementation of REDD+ Activities in Mizoram


2018

Indian Council of Forestry Research and Education
(An Autonomous Body of Ministry of Environment, Forest and Climate Change, Government of India)
P.O. New Forest, Dehradun - 248006 (INDIA)

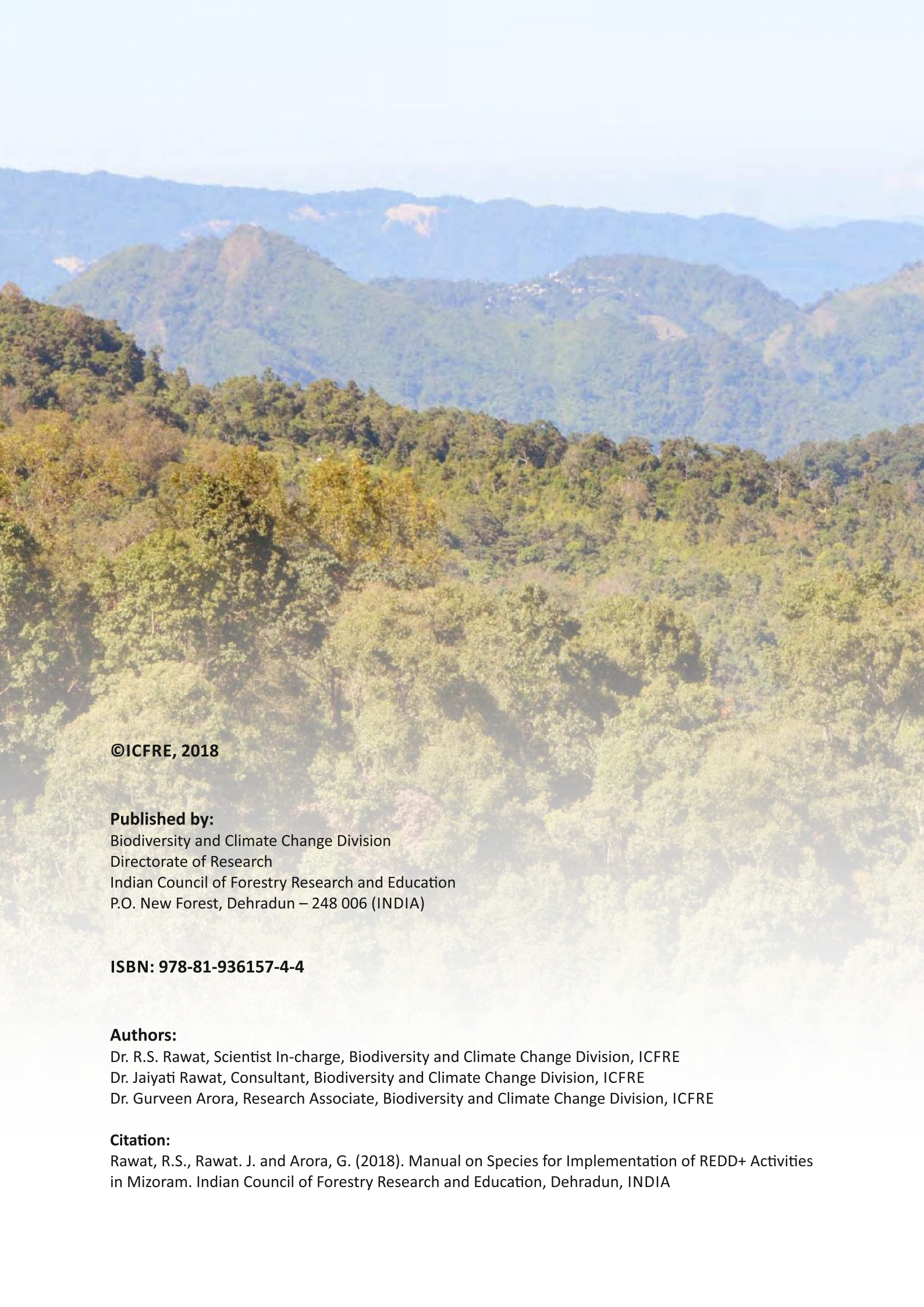


ICIMOD

giz Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH

On behalf of:
 Federal Ministry
for the Environment, Nature Conservation
and Nuclear Safety
of the Federal Republic of Germany


**NORWEGIAN MINISTRY
OF FOREIGN AFFAIRS**



©ICFRE, 2018

Published by:

Biodiversity and Climate Change Division
Directorate of Research
Indian Council of Forestry Research and Education
P.O. New Forest, Dehradun – 248 006 (INDIA)

ISBN: 978-81-936157-4-4







Authors:

Dr. R.S. Rawat, Scientist In-charge, Biodiversity and Climate Change Division, ICFRE
Dr. Jaiyati Rawat, Consultant, Biodiversity and Climate Change Division, ICFRE
Dr. Gurveen Arora, Research Associate, Biodiversity and Climate Change Division, ICFRE

Citation:

Rawat, R.S., Rawat. J. and Arora, G. (2018). Manual on Species for Implementation of REDD+ Activities in Mizoram. Indian Council of Forestry Research and Education, Dehradun, INDIA

Contents

	Executive Summary	i
	Introduction	01
	Methodology	02
	Species for REDD+ Activities	03
	Conclusion	38
	Literature Cited	40





Executive Summary

UNFCCC has identified REDD+ as one of the important climate change mitigation option and it has the potential to address the issues of climate change, combating desertification and conservation of biodiversity. ICFRE in collaboration with ICIMOD is implementing REDD+ Himalayas Project in the state of Mizoram for improving the livelihood of the local community, capacity building and knowledge sharing on different aspects of REDD+, conservation of biodiversity and climate change mitigation through REDD+. Drivers of deforestation and forest degradation have been identified for the state of Mizoram and accordingly necessary strategies have also been identified for addressing the drivers of deforestation and forest degradation.

ICFRE in collaboration with ICIMOD has also developed a State REDD+ Action Plan for addressing the drivers of deforestation and forest degradation as well as implementing the National REDD+ Strategy in the state of Mizoram. It is needed to select suitable multipurpose species for implementation of REDD+ activities in the state of Mizoram. Accordingly, fifty suitable multipurpose species which comprises of forty five tree species and five bamboo species from the state of Mizoram were selected through consultation with experts, officials of State Forest Department and representatives of the village council members. Selected species are described with their brief distribution, description, uses and planting techniques which will be helpful in raising the plantation of the selected species for implementation of REDD+ activities in the state of Mizoram.





Introduction

Mizoram is one of the forest rich states among the seven sisters of North-east with geographical area of 21081 sq. km. Forest resources of the state are being managed by the Department of Environment, Forest and Climate Change with ten forest divisions (Aizawl Forest division, Champhai Forest Division, Dariawn Forest Division, Kawrthah Forest Division, Kolasib Forest Division, Lunglei Forest Division, Mamit Forest Division, North Vaniaipha Forest Division, Thenzawl Forest Division and Tiabung Forest Division) and Autonomous District Councils with three forest divisions (Chakma Autonomous District Council Forest Division, Lai Autonomous District Council Forest Division and Mara Autonomous District Council Forest Division).

As per India State of Forest Report 2017 “Mizoram has the highest forest cover of 18,186 sq. km. which is 86.27% of the total geographical area of the state. Out of the total forest cover, it has very dense forest of 131 sq. km, moderately dense forest of 5861 sq. km. and open forest of 121994 sq. km”. Estimated tree cover of the state is 467 sq. km. which is 2.22% of the total geographical area (FSI, 2017). Thus total forest and tree cover of the state is 18,653 sq. km which is 88.48% of the total geographical area.

Total numbers of plant species recorded from the state are 2358 out of which 2141 species are of angiosperms, 6 species of gymnosperms, 211 species are of pteridophytes (Singh, 1997). Mizoram is rich in bamboo resources and 34 species of the bamboo have been reported out of which 22 species are indigenous and 12 species are introduced (Bisht and Naithani, 2010). Bamboo bearing area in the recorded forest area of the state is 3267 sq. km. (FSI, 2017).



Forest provides number of valuable goods and ecosystem services for the well-being of human population. It also plays a significant role in providing water, food and livelihood securities to the local forest dwelling communities. Bisht (2016) has estimated the total value of selected goods and services provided by forests in Mizoram to the tune of Rs. 5153 million per annum which comprises of Rs. 2721 million per annum from goods as a direct benefits and Rs. 2432 million per annum from ecosystem services as indirect benefits.

India State of Forest Report 2017 has reported the 531 sq. km. decrease in forest cover in Mizoram from the previous report of 2015 may be due to shifting cultivation (FSI, 2017). Rawat *et al.*, 2017 identified shifting cultivation, fuel

wood collection, over exploitation of non-timber forest products as direct drivers of deforestation and forest degradation whereas unemployment, lack of industries, lack of knowledge and awareness, and low connectivity of roads as indirect drivers of deforestation and forest degradation in the Mamit district of Mizoram.

Reducing emission from deforestation and forest degradation, conservation of forests, sustainable management of forests and enhancement of forest carbon stocks in developing countries is collectively known as REDD+ which is one of the important mitigation options for combating climate change. REDD+ mechanism has the potential to address the issues of climate change, combating desertification and conservation of biodiversity. It can bring the synergies among the three Rio Conventions (UNFCCC, UNCCD and CBD) for addressing the

common issues of sustainable land management.

ICFRE in collaboration with ICIMOD is implementing REDD+ Himalayas Project in the state of Mizoram for improving the livelihood of the local community, capacity building and knowledge sharing on different aspects of REDD+, conservation of biodiversity and climate change mitigation through REDD+.ICFRE has identified suitable strategies and also developed in collaboration with ICIMOD a State REDD+ Action Plan for addressing the drivers of deforestation and forest degradation as well as implementing the National REDD+ Strategy in the state of Mizoram. It is also needed to identify suitable multipurpose indigenous species for implementation of REDD+ initiatives in the state of Mizoram.

Methodology

Suitable multipurpose tree species for implementation of REDD+ activities in the state of Mizoram have been selected through consultation with experts, officials of State Forest Department and representatives of the village council members. After finalization of the

tree species, necessary information pertaining to distribution, description, uses, nursery and planting methods of the selected species were collected from the published sources viz. books, research papers, reports and trusted relevant web sites.

Species for REDD+ Activities

Following 50 species have been identified as suitable and multipurpose species for implementation of REDD+ activities in the state of Mizoram:

01. *Acrocarpus fraxinifolius* Arn.

Family: Fabaceae

Mizo Name: Ngan-bawm

English Name: Pink Cedar

Distribution: In Mizoram, it grows up to an altitude of 1500 m.

Description: It is a tall deciduous tree with dark-brown bark. It is an enormously fast growing species. It is a pioneer species with high light demander; however, the young plants can also tolerate moderate shade. Deep, substantially drained and clayey loam soils are best for its growth. It also flourishes in shallow and compressed soils. It flowers from February to March and seed setting from April to June. The seed of *A. fraxinifolius* is hard coated, thus the germination is fickle due to difficulty in imbibition. The seed remains quiescent for 0-10 months, however weeds burning and exposing the soil promotes natural seed germination.

Uses: Its wood is used as timber and fuelwood. The leaves are lopped for fodder. It also yields gum and resin.



Propagation and Planting Technique: Pods are generally collected in the month of June. Pods are dried in open or crushed such that the seed

gets separated from the pod. The seeds can be stored for a long time. The seeds have been reported to be in excellent condition after being stored in airtight tins or gunny bags for about 19 months. Seed germination is erratic due to hard seed coat. Pre-treatment of seeds is required for getting good germination percentage. It was reported that pre-treatment of seeds with concentrated sulphuric acid gives excellent germination. Pre-treated seeds are sown on

raised nursery beds. Shade is needed in the nursery beds for initial growth. Excessive watering is avoided as more moist conditions may result in damping off the seedlings. Generally, seedlings take 4-5 months of growth period for planting in the field. The species can be also raised by direct sowing in the field. Sowing is done in 3rd week of July. Seedlings planted during monsoon rains have shown better results than direct sowing.

02. *Adenanthera pavonina* Linn.

Family: Fabaceae

Mizo Name: Senmaltet / Sentet

English Name: Red wood tree / Red bead tree

Distribution: In Mizoram, it grows up to an altitude of 1,000 m altitude and found in areas of Lungsum, Ratu, Dampa Tiger Reserve, Mamit and Thenhlum, etc

Description: It is found on deep, well drained to shallow and rocky soils. It is a medium sized deciduous tree with bright scarlet lenticular-globose seeds. It flowers from May to July and fruit from August to October.

Uses: Wood is used for building, cabinet making, firewood and charcoal. Powdered wood is used as a red dye. The seeds are eaten and also used for necklaces. The grounded seeds are used for boils and inflammations. Decoction of young leaves is used against rheumatism and gout. Pulverized wood mixed with water is taken orally for migraines and headaches and dysentery, diarrhoea and tonsillitis are treated with a bark and leaf decoction.

Propagation and Planting Technique: The tree requires a moist climate to thrive well and the



seeds should be kept moist for some days before sowing. It can be easily planted through seeds as well as stem cuttings. The seed coat is extremely hard and requires scarification; otherwise germination is erratic and may take up to 12 months. Manual scarification includes immersing seeds in boiling water for 1 minute, or treatment with sulphuric acid has shown to significantly increase germination rates. Treated seeds can be directly sown in the nursery. Germination occurs within 10 days. Seedlings reach 20-30 cm in height in 2-3 months. Four or five months old seedlings can be transplanted in the field for plantation.

03. *Albizia chinensis* (Osborne) Merr. Syn. *Albizzia stipulata* Boivin

Family: Fabaceae

Mizo Name: Vang,

English Name: Chinese Albizia,

Common Name: Siris

Distribution: It is a common tree in Mizoram and grows up to 1800 m altitude.

Description: A large deciduous fast-growing tree with moderate light-demander. The leaves either in the form of single leaflets or by whole plume begin to fall in January. The trees are generally leafless during the months of February-March and the new leaves start appearing in March or early April. At the time of flowering, yellowish-

white aromatic flowers appear which give an attractive appearance to the tree. The pods start developing early and ripening takes place during November-December, however the pods keep on hanging to the tree even when they dry out. The seeds are dispersed by the wind after the pods fall on the ground and dehisce. It is well adapted in the poor soils and flourishes on laterite and alluvial soil and sandy mining areas.

Uses: Wood is used for making drum, mortars, boxes, firewood and charcoal, etc. The bark is used as a fish poison. The leaves are used as fodder. An infusion of the bark is used as a lotion for cuts, scabies and other skin diseases.

Propagation and Planting Technique: Seeds get ripened during the months of December-March and ripened pods need to be collected in the month of January. After getting sun dried, the pods open and the seeds are stored in gunny bags. The seeds remain viable for one year. Pre-treatment of the seed is not required before



sowing. However, for getting uniform germination, seeds can be soaked in water for 24 hours before sowing. Germination begins within two months of sowing and gets completed within six months. Regular watering and weeding are required in the nursery. The seedlings are planted at a spacing of 3 x 1m for fodder production, at a spacing of 3 x 3 m for normal plantation and at a spacing of 7 x 15 m in tea and coffee plantations as a shade tree.

04. *Albizia lebbeck* (L.) Benth.

Family: Fabaceae

Mizo Name: Thing-chawk-e / Kang-tek-pa

English Name: Woman's tongue tree / Siris Tree / East Indian walnut

Common Name: Siris / Kokko

Distribution: In Mizoram, it grows up to 1800 m altitude and found in the areas of Dampui-ngaw, Dampa Tiger Reserve, Sesawng-ram, Seling-ram, Hmunpui-ram and Thenhlum-ram, etc

Description: It is a fast-growing moderate to large sized deciduous tree with spreading crown and dark grey or brownish rough bark. When it is grown in the open it tends to have a short trunk and a low spreading crown. It establishes substantially on fertile, well-drained loamy soils but inadequately on heavy clays. The leaves begin to fall in October and November and several trees get nearly leafless by the end of November in northern India. Some trees can be found leafy even during the month of December. The appearance of new leaves started in March or April. The aromatic yellowish white flowers appear from March-May. The fruits start developing rapidly, attaining full size by October



and ripening takes place by December-January. The ripened pods persist on the trees till March until they are blown down by hot winds and dehisce after reaching the ground.

Uses: Wood is used for making furniture, gun-stocks, tobacco pipe and motor bodies. Wood is also used as a fuelwood. The young shoots are eaten as a vegetable. The bark, flowers and seeds have medicinal values. The leaves are also used as a fodder.

Propagation and Planting Technique: Collection of ripe and healthy seeds should be done during January-March. The pods are dried in the sun

until they dehisce and then lightly beaten up to extract seed. Seeds remain viable for atleast one year and can be stored in polythene bags for 4-5 years. Seeds are kept for one whole year for better germination results than fresh seeds. Germination percentage can be increased by soaking the seeds in boiling water for 24 hours or in cold water for 48 hours without pre-treatment. Seedlings are either raised in sunken nursery beds of 1 m width or in the containers. Broadcast sowing, dibbling and line sowing are preferred for sowing of the pre-treated seeds in the month of March. In line sowing, seeds are sown in 2 cm distance and the distance between line to line should be 15-20cm. The sowing depth seed should be 1.5-2cm. Germination begins after five days of sowing and proceeds till one month. Highest germination percent has been reported by dibbling method of sowing. Weeding done at regular intervals not only aids in germination but also in growth and development of seedlings.

After the germination is finished, the seedlings are placed in the rows at spacing of nearly 5cm.

Direct sowings are done just earlier or at the break of the rainy season. Sowing of the seedlings may be done in well worked up patches, mounds, pits or lines. The technique which is commonly used on well loosened soil is line sowing. However, regular weedings during the initial phase may give about 70% success.

The planting material may comprise of either entire plants or stumps or seedlings raised in the containers. Whole plants are uprooted from the nursery with clumps of earth. The estimated survival percentage may be about 70-80%. Planting is favored during next monsoons when the seedlings are nearly 15 months old. Planting is done in the month of July in 30 cm³ pits with the typical spacing kept for fuelwood is 3 x 3 m and for timber is 5 x 5 m.

05. *Albizia procera* (Roxb.) Benth.

Family: Fabaceae

Mizo Name: Kang-tek

Common Name: White Siris / Koroi

Distribution: In Mizoram, it grows up to 1500 m altitude

Description: It is a large deciduous, fast growing tree. It is a large graceful tree with a clean, high-branching trunk. It grows best on moist alluvial soils, well-drained loams or clay soils.

Uses: Heartwood is used for furniture, motor bodies, drums, posts, beams, planks, tool handles, firewood, etc. The bark is boiled in water and the water is taken against pinworms / threadworms, etc. @ one or two teaspoonful once a day for 2 - 3 days. The bark is also used to poison fish and the leaves for cattle fodder. The leaves are also used as insecticide.

Propagation and Planting Technique: The tree produces large number of seeds every year which get dispersed by wind. Seeds get buried with an early spell of rain and ample moisture and loose soil which favours germination. It can be planted by direct sowing, stump planting and nursery-raised entire plants.



Seeds ripening take place during January-April. The dark brown coloured ripen pods are collected after falling on the ground. The seeds are extracted from the pods after they dehisce when dried in the sun. The seeds can be stored for one year in dry sacks placed in well ventilated shed. Sowing of seeds in line should be done during the months from April to May. Spacing of 7.5cm x 7.5cm should be kept between the lines. The depth of sowing should be kept between 10-15mm. Only light watering is required for a week. The seeds start germinating in 3-4 days and the germination lasts for three weeks. Pre-treated seeds can be directly sown in polythene bags consisting of equal proportion of sandy loam and good quality top soil. Pricking out in polythene

bags can be done when first pair of leaves appear in the nursery seedlings. Seedlings are kept under shade and watering is done atleast once every two days. Seedlings of 4-7 months are considered suitable for plantation. The plantation can either be done completely or with or without ball of earth around the roots. Plants

upto collar diameter of 1.8cm are suitable for both entire and stump planting. If frequent weeding and soil loosening are carried out, the results from direct sowing in the lines are more successful than either complete planting or stump planting.

06. *Alnus nepalensis* D. Don.

Family: Betulaceae

Mizo Name: Hriang-pui

Common Name: Alder / Utis

Distribution: In Mizoram, it grows from 500-3000 m altitude and found in areas of Champhai, Hnahlan, South Khawbung and Phuaibuang, etc.

Description: A middle-sized to large deciduous tree. It is a deciduous tree which grows relatively large and under favourable conditions, it attains a height of 30 m. It has a silver-grey bark with horizontal patterns of raised swellings. Flowering takes place during the months of September-October where the male are in large terminal drooping panicles and the female flowers are in small axillary racemes. Fruits ripening take place during December-March. It is a pioneer species which develop better in full light but it is also a shade bearer. It is mostly found in the moist vicinities in lesser elevations such as close to river areas but also have a tendency to inhabit rocky areas which get exposed due to landslides as well as deserted cultivation lands. It is commonly found near streams, ravines and in drier forests where it occurs in pure and mixed stands. It is found in moist, cool, subtropical monsoon type of climate with a dry spell of 4-8 months. It also grows in humid, cool or subtropical mountain areas in tropical zones with high rainfall. The species prefers moist, substantially drained soils such as loam and loamy sand gravel, sand and clay.



Uses: Wood is used for making tea-boxes and as a fuel wood. Bark is used for dyeing and tanning. The leaves are used as a fodder.

Propagation and Planting Technique: The seeds are sown in the month of March in germination beds where they are either broadcasted or sown in lines and germination takes place within 2-3 weeks. Frequent weeding and watering is required as well as inoculation of seed beds with nodules through mixing of soils collected from the mature trees is also suggested. After 15 months when the plants get 40-50 cm tall, they are ready to be planted out.

07. *Anogeissus acuminata* (Roxb. ex DC) Wall. ex Guilem. & Perr.

Family: Combretaceae

Mizo Name: Zai-rum

Common Name: Yon / Button tree

Distribution: Fairly common in Mizoram and found below 1,000 m altitude.

Description: It is a huge attractive deciduous tree with an upright bole, hanging branches but the crown is narrow. The tree can reach a height of 40 m, also the upright bole which is unbuttressed, can also reach a diameter of 100 cm. It is found particularly in deep, humus rich,

loamy soils, along streams or river banks. Flowering can be observed during the months of March-April and fruiting as well as ripening takes place in the month of April.

Uses: Wood is used for tool handles, fuel and charcoal. Decoction of the bark is used in stomach troubles, fever, diarrhoea and also applied on measles, chicken-pox, sprains and burns. The leaves are cooked in water and the water is taken as a remedy for high blood pressure.

Propagation and Planting Technique: The ripe fruits are collected from the trees, dried in the sun and then stored. Generally seed viability is low. Seed germination is increase if seeds are treated in hot water for 3 minutes. Seed should be stored in air tight containers. It can be



propagated by seeds and cuttings. One year old seedlings are the best planting stock in cases of propagation by stumps. The best rooting percentage was reported in hard wood cutting with a treatment of 1000 ppm of IBA (rooting hormone) within 60-70 days during April to June.

08. *Aquilaria malaccensis* Lam. Syn. *Aquilaria agallocha* Roxb. ex DC.

Family: Thymeleaceae

Mizoname: Thing-rai, Eagle wood / Aloewood

Common Name: Agarwood

Distribution: Found wild on the banks of Tuivawlriver and also cultivated in Mizoram.

Description: It is a critically endangered species. It is tall evergreen or deciduous tree with white flowers. The tree is famous for agar or gaharu (*Zeuzera conferta*) which is actually a fungus that infects the wood of the species. The tree is mostly traded for this fungus only. Agar is collected from the forests due to difficulty in getting it as well as destruction of agar plantations which were set up a long time back in 1900s. Agar (*Zeuzera conferta*) has an unusual but long-lasting odour. It enters the hard wood of the tree by the means of lesions or borers. Since it occurs naturally, thus the trials carried out to produce agar via artificial wood infestation have been failed. The fungi produce black patches and stores resinous oil which is separated during distillation of the woody chips. This oil produced by the fungi has high medicinal value as well as high importance in perfume industry. Since agar is formed due to infestation in the hard wood, thus the time of harvesting also depends on disease infestation. Appearance of black patches on the bark of the tree suggests



the infestation as well as the harvesting time of agar for business purposes. Powdered wood chips are soaked in water for 2-3 days which is then transferred to a stainless steel container for distillation in order to collect oil and water in a separator and this process continues for about 30-36 hours. Later the distilled oil and water are stored however, the ratio of oil and water in the condenser is kept small on account of the high boiling point hence the oil is kept in aluminum bottles. The agar oil which is collected from the distillation of the powdered wood chips ranges from 0.8-2.2% in fungal infested wood of 8-50 years aged tree.

Uses: Wood white, soft, scented when fresh cut,

can be used for firewood. Irregular masses which found in the wood of stem are used as incense, perfume, drugs and wood oils. Decoction of the bark is used in asthma, abdominal pain, vomiting and chronic diarrhoea. The leaves are boiled in oil and taken for removing fish spines from throat.

Propagation and Planting Technique: The seeds grow fully during July-August and since they

soon lose their feasibility, it is necessary that the seeds should be sown within a week of their collection. The seeds are raised in polybags which may result in more than 80% of seed germination. Seedlings should be transplanted to the field when the height of 30-40 cm has been attained. The transplantation should be carried out during monsoons i.e. from April-June and a spacing of 3 x 3m should be kept among the seedlings in field.

09. *Artocarpus chaplasha* Roxb. Syn. *Artocarpus chama* Buch. Ham

Family: Moraceae

Mizo Name: Tat-kawng

Common Name: Chaplash

Distribution: In Mizoram, it is found up to 1,500 m altitude.

Description: A large deciduous tree with a tall straight bole. The species has been found to be distributed in moist deciduous and evergreen forests of the sub-Himalayan tract and outer ranges from Nepal eastwards to Khasi hills. Its growth is generally favoured by the moist areas and it avoids drier sites. It is a distinctive species of *Cachar* tropical semi-evergreen forest type. The tree grows best in the moist areas such as river banks and do not get established in the dry forest types. It favours a rich deep loamy soil, however, it may also grow in clayey soil provided with a good drainage.

Uses: Wood used for building, furniture, motor bodies, mortars, plywood, boat-building, etc. The bark is used in diarrhoea, and the milky juice is applied on inflammatory disease of the glands, and sometimes used as milk in the tea. The leaves are lopped for cattle fodder. The fruits and seeds are eaten by man, wild animals like monkeys, langurs, hoolock gibbon, porcupine, bears, wild pig, squirrels, keeled box turtle, and birds.

Propagation and Planting Technique: The seedlings grow very slowly in the first year but in the second or third year, they grow very fast. The tree requires a fair amount of light for its best possible growth. However, the seedlings can bear a reasonable amount of shade. Since the seedlings are drought sensitive thus prolonged



dry period may have poor effects on plant's growth. The seed has good regenerative ability and can even regenerate without proper soil cover which can be best observed during rainy season. The plant can be raised by direct sowing, by planting out in nurseries or as container-raised seedlings or stumps.

Mature fruits should be collected during the month of June to early August. The fruits are later left for few days to rot and seeds can be separated by properly rubbing and washing the rotten fruits. The seeds are then dried in the shade. Germination rate of fresh seed has been found to be very high i.e. it shows 80-90% of germination within 7-10 days, the germination starts which takes approximately two weeks to get finished.

The fresh seeds are sown in lines with a spacing of 10-15 cm and spacing between the seeds should be kept 7.5 cm. The seeds may also be sown directly into polythene bags after a week of

their collection during the months of June to July. Later when the seedlings grow enough to reach a manageable size, they are transplanted to nursery beds which are properly irrigated as well as weeded. The seedlings are then planted out naked or with balls of earth or after making stumps, during July when they are nearly one year old. The plantable stock can also be made available within first monsoonal rainfall i.e. in between the month of July, provided that the seed should be collected early and sown timely.

Sowing is preferred in polythene bags or long baskets which are filled with properly grinded soil and farmyard manure as the transplantation gets difficult to be managed due to its long delicate taproot system.

During the monsoons, one year old seedlings which are sown in containers or are naked with or without ball of earth are planted. However, it should be kept in mind that the soil column should not be broken as it may damage the roots.

10. *Artocarpus lakoocha* Roxb. Syn. *Artocarpus lacucha* Buch. - Ham.

Family: Moraceae

Mizo Name: Thei-tat

English Name: Monkey jack

Common Name: Lakooch

Distribution: In Mizoram, it is found up to 1,200 m altitude.

Description: A large deciduous tree with a spreading crown. It is a moderate size and grows upto 18 m. It is usually found along river banks in low lying areas and also in those places which are protected. However, due to its poor seed feasibility as well as extensive use, its population is gradually reducing. The tree favours light for its best development during growing phase whereas the younger trees can also bear light amount of shade. The species require good amount of moisture hence it prefers deep permeable soils and avoid poor localities as its survival gets difficult in less moisture laden soils. However, the trees can also bear a dry period lasting up to 3 months. The tree should not be planted in frosty areas as it may damage or kill the young seedlings.

Uses: Heartwood yellow, turning dark brown, durable under water, used for building, furniture, firewood, etc. The leaves are lopped for cattle fodder. The fruits are edible.

Propagation and Planting Technique: Mature fruits must be collected when they are still on trees and their collection should be done on time as they are consumed by birds and monkeys. The freshly collected seeds must be packed in bags such that proper ventilation and protection from direct sunlight can be provided



to the seeds as the freshly collected seeds have very high moisture content, thus proper care is needed before bringing the seeds for processing. To collect the seeds, the fruits are crushed or de-pulped manually with or without water. The seeds must be handled with care as the seed coat is very thin thus making the seed very fragile after extraction. The seeds collected from mature fruits have a 50-55% of moisture content thus cannot be dried at low moisture content. The seeds if being extracted before storage then slight drying of the seeds is necessary and the moisture content should be never kept below 40%. The seeds can be sown in polythene bags or in seedbeds. Normally two seeds per pot are sown and surplus seedlings pricked out into another pot. 20-25% compost should be added to the potting mixture. If sown in seedbeds, the seedbed should be raised. About 1 kg of seed used per sq. m. Sowing is done during the monsoon because of the short viability of the seed. The seedlings must remain in the nursery until the next monsoon (nearly one year later), when they attain 20-25 cm height.

11. *Bauhinia purpurea* L.

Family: Fabaceae

Mizo Name: Vau-fa-vang

English Name: Purple Bauhinia / Butterfly tree

Distribution: In Mizoram, it grows between 500-2000 m altitudes.

Description: A middle-sized evergreen, sometimes deciduous tree. It grows on a variety of sandy, loamy and gravelly soils in full sun in fertile, moisture-retentive but well-drained soils. The tree is evergreen with the old leaves falling in March and April and appearance of the new leaves take place in April-May. Flowering takes place in September-December and the flowers are purple, deep rose to lilac colored. Pollination is due to bees which get attracted on the trees because of the fragrance of flowers. Pod formation and ripening takes place within January-April. The ripened pods have coriaceous valves and greenish-purple in appearance. The pods dehisce during summer period and spread seeds to a considerable distance.

Uses: The wood is pinkish-white, turning dark brown, used for tool handles, firewood, charcoal, etc. The flower-buds and fruits are eaten as a vegetable. The leaves are lopped for cattle fodder. The root, bark and flowers are used in medicine.

Propagation and Planting Technique: It can be propagated by direct sowing method or planting out stumps or nursery raised seedlings in containers. The tree produces seeds every year and the development of the pods starts from January-April. The pods are collected from the trees, and then are covered with a muslin cloth which is later sun dried such that the seeds may be collected after the pods dehisce. The pods are then stored in air-tight containers after getting



properly cleaned. The germination percent of the seedlings vary from 80-100%. The seeds are sown in nursery in lines during April-May at a depth of 5-6 mm and are kept at 20-25 cm spacing. The seeds are soaked either in hot water for straight 12 hours or in cold water for 24 hours before they are sown. The hot water pre-treatment of the seeds is considered to give better results. It takes one whole month to finish the germination process and after which the seedlings can be planted out during onset of the first monsoon rains. The method of direct sowing in lines or patches at a depth of 5-6 mm, is considered to be useful for the growth of the species.

Seedlings should be planted out in pits along with ball of earth during the rainy season when they are 2-3 months old as older plants are difficult to handle. The plants which have attained the age of 14-15 months are best for stump planting with shoots of 5 cm length and roots of 25cm length.

Frequent watering is necessary till the plants get established. Since the root system of the seedlings is very susceptible, thus planning out should be done carefully. Thus, before planting out the seedlings, they must be pricked out into baskets or containers.

12. *Bauhinia variegata* L.

Family: Fabaceae

Mizo Name: Vau-be

English Name: Mountain Ebony / Orchid Tree

Common Name: Kachnar

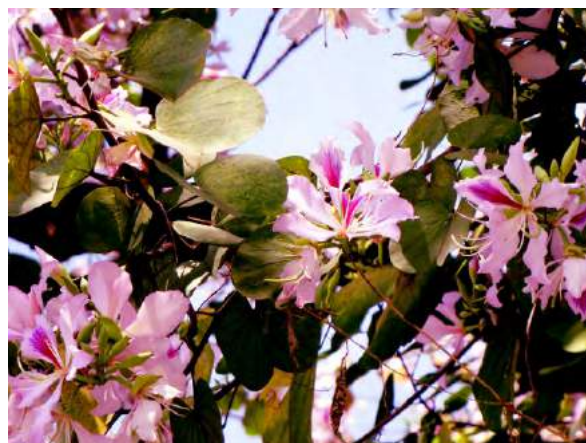
Distribution: In Mizoram, it grows up to 1800 m altitude.

Description: It is a moderate sized deciduous tree with grey coloured bark, long vertical cracks, hairy young branches with white or purple flowers. It is a heavy light-demander, drought resistant, requires good drainage but is susceptible to fire. The tree is deciduous in nature and remains leafless during December-

April. In the months of February-April, flowering takes place in which the flowers can be seen on the upper leafless branches.

Uses: The wood is greyish-brown, used for tool handles, firewood, charcoal, etc. The leaves, tender fruits, flowers and flower buds are eaten as vegetable. Decoction of the bark/ leaves is useful in menstrual disorders, intestinal worms, piles, diabetes, diarrhoea and dysentery. The leaves are also good for fodder.

Propagation and Planting Technique: Pods are rapidly formed followed by the ripening in May and June. The pods get dehisce later, scattering the seeds to a distance. The tree can be raised by direct sowing, entire planting as well as stump planting. The collection of matured pods is done before they dehisce during the months of May and June and are later dried in direct sunlight to release seeds. The fresh seeds have 95% of germination. The seeds are soaked in water for 24 hours in order to get increased as well as uniform germination. The seeds are mulched and watered till germination occurs. Proper ploughing and levelling of the soil is done after the grass and weeds are removed. Seeds are sown at 1 cm depth in drills at a spacing of 20-25cm and spacing between seeds is kept at 5cm. Planting out is done during July-August whereas sowing is done in March-April such that whole plant can be grown. Germination starts in 6-7 days and gets finished within 15 days. The seeds have fast germination which is in the range



of 95%. Frequent weeding is required as it enhances growth of seedlings to 1 m height within two months but the roots of the seedlings should not be disturbed during weeding. Farmyard manure helps in improving soil structure and provides proper medium for the growth of seedlings but it must be added at the time preparation of beds. Seedlings raised in polythene bags are filled with equal proportions of sand, soil and farmyard manure which act as growing medium. 2-3 seeds are sown in each polythene bag. Planting is done during the first rainfall in which 2-3 months old nursery raised seedlings are used. The seedlings are planted out in 30 cm³ pits covered with ball of earth at a spacing of 2.5 x 2.5 m or 3 x 3 m but it should be noticed that the roots should not be disturbed. Direct sowing method is the most successful method for artificial growth of this species. The seeds should be sown in lines with spacing of 3 m and at a depth of 5-6 cm.

13. *Betula alnoides* Buch. - Ham. ex D. Don.

Family: Betulaceae, Mizo name: Hriang, English name: Alder birch, Common name: Bhojpatra

Distribution: It is found to be growing in around 2000 m elevation in the eastern Himalayas. It can grow up to 3000m altitude. In Mizoram, it is found in Chakhang area.

Description: A moderate-sized to large deciduous tree; bark greyish-brown, silvery, papery. It grows gregariously on landslips, nearly exposed soils and along the moist narrow valleys and streams. During winter season, the tree is generally leafless and the flowers appear during March-April, and may be at other times too. The



ripening of fruits takes place in May-June after which the seed gets dispersed to a substantial distance from the seed-bearers. It is a shade,

moisture and properly drained soil demanding species. It is fast growing species and can also bear frost.

Uses: Wood grey, light brown or white, used for furniture, plywood, tool handles, etc. The tree is lopped for fodder, particularly for goats. The plant is said to be used as snake-bite remedy.

Propagation and Planting Technique: The seed can be best sown when it gets mature. The seed is covered and placed in the sun's position. The seeds sown during spring season should be surface sown and must be kept in direction of sunlight in a cold frame. Seeds are sown in September. Seeds are slightly propagated in the nursery shaded beds after mixing with ash or powdered earth in order to prevent germination in clumps. The seeds are meant to be covered with a thin layer of soil after sowing so that the seeds can be prevented from getting blown away. It takes around 2 months to complete the germination and the germination percentage is less.

After the seedlings get larger in size, they can be pricked out in individual pots and then can be grown in a cold frame such that their first winter may get passed. The seedlings can also be planted out in seedbeds when they get either matured or during early spring season. The plants should be grown in the seedbeds for at least two years before they are planted out during winter in their stable places. The seedlings are planted out during late spring or early summers.

Successful transplantation of *B. alnoides* depends on the selection of suitable size of plants. After the transplants have reached 60 cm height, they are planted out either naked or with some soil around the roots and are kept in spacing of 2 x 2m. Since the seedlings are hardy in nature, transplantation of plants up to 90cm height can be done easily. Frequent weeding and cleaning are needed for 2-3 years. Since the species grows rapidly, thinning is required as the canopy gets completed after 4 years.

14. *Bischofia javanica* Blume

Family: Euphorbiaceae

Mizo Name: Khuang-thli

English Name: Bishop wood/ Java cedar,

Common Name: Uriam

Distribution: In Mizoram, it grows up to 1800 m altitude.

Description: It is a fast-growing, large evergreen or deciduous tree with trifoliate leaves. The tree prefers deep, loose soils such as sandy, rocky or loamy soils with sufficient water content. The tree is leafless during winter for a short duration, more particularly in areas, of low rainfall. The leaves turn red before falling. Fruits are ripened during the month of February.

Uses: Wood is used for building, house posts, bridge-construction, furniture, firewood, etc. Juice of the young leaves is used for curing tonsillitis and sores. The bark, stem and leaves are also medicinal. The leaves are lopped for cattle fodder. The fruits are edible.

Nursery and Planting Methods: The best time



for seed collection is in the dry weeks of February and early March. Fruits should be collected from middle aged trees with crown exposed to the sun. They are kept in shade for a few days to rot, the pulp is washed off and the seeds are dried. The seeds should be sown soon after collection. If the circumstances do not allow immediate sowing, the dry seed may be mixed with ash and stored for short while in air-tight tin cases.

The seeds are sown in irrigated nursery beds.

About 70gm of seed will suffice for one square metre of bed area. Beds are sometimes covered with thatch grass in order to hasten germination. The sowing is done in September-October in porous soil beds and watered regularly. Germination starts within 10 days and is completed within a month. Transplanting of naked seeds is quite successful in the field, therefore, raising of polythene bag seedlings is not necessary. Germination rate is also high

between 70-90%. Weeding, hoeing and watering are done regularly. Shading during summer months is also desirable. One or two year old seedlings are taken out with ball of earth for planting in the field. Transplanting of naked seedlings is the best method of planting for this species. It can be raised successfully by root and shoot cuttings made from healthy plants raised in nursery beds.

15. *Castanopsis tribuloides* (Sm.) A. DC.

Family: Fagaceae

Mizo Name: Thing-sia

Common Name: Chestnut

Distribution: Fairly common in Mizoram and ascending to about 1,800 m.

Description: A middle-sized or large evergreen tree with lanceolate, entire leaves.

Uses: Wood grey, moderately hard, used for house posts, firewood and charcoal. Juice of the stem is recommended for infection of mouth in children. Leaves are use as fodder.

Propagation and Planting Technique: The seeds are best sown when it gets matured in a cold frame hence it requires a period of cold stratification. The seed is less feasible thus should not be allowed to dry out. If it is kept under moist and cool conditions such as putting it in a plastic bag in a fridge, it can be stored for a few months. The stored seeds should be soaked in warm water for 24-48 hours before sowing. Germination normally takes place at 15°C and



within 1-3 months. When the seedlings get large enough, they are pricked out in individual pots and planted out in mid-summer, or else the seeds may be grown in a cold frame for their first winter and then planted out in late spring season. The younger plants should be protected from cold for their first winter.

16. *Celtis tetrandra* Roxb.

Family: Ulmaceae

Mizo Name: An-ku / An-ku-hawng-tial

English Name: Eastern Nettle Tree

Distribution: Ascending to about 1,100 m. It is found in areas of Mamit and Sesawng in Mizoram.

Description: A large deciduous tree. It prefers well drained light sandy and medium loamy soils.

Uses: Wood greyish-white, moderately hard, used for firewood. The fruits are prescribed in amenorrhoea and colic. The leaves are lopped for cattle fodder.

Propagation and Planting Technique: Seeds are obtained by rubbing the flesh off fruits as they turn yellow. There are 4,000-10,000 seeds/kg. Pretreatment involves placing seeds in boiling water and then soaking for 48 hours.

Germination starts in about 10 days and is complete in 3 weeks. Germination of fresh seed is about 70 %.

The stored seeds are provided cold stratification for 2-3 months after which they are ready to be sown in February/March in a greenhouse. Germination is good, however the stored seeds might take 12 months or even more to germinate. The seed can be stored up to 5 years. As soon as the seeds get large enough to handle, seedlings should be pricked out into individual pots. Seedlings should be protected from frost.



17. *Cerasus cerasoides* (Buch. - Ham. ex D. Don) S.Y. Sokolov Syn. *Prunus cerasoides* Buch. - Ham. ex D. Don

Family: Rosaceae

Mizo Name: Tlai-zawng & Pai-vun

English Name: Wild Himalayan Cherry

Common Name: Padam

Distribution: It grows from 700 to 1,800 m altitude. It occurs in areas of Champhai, S. Khawbung, Hnahlan, Phuaibuang, N. Vanlaiphai, Lungchuan, Tawi-tlang in Mizoram

Description: It is a middle-sized or large deciduous tree. Its bark is brownish-grey, smooth and peels off in thin shining horizontal stripes exposing a shining copper colored surface. The plant prefers light sandy, medium loamy and heavy clay soils and requires well drained condition. The tree flowers in autumn or early winter October-December. Fruiting occurs between December and February.

Uses: Wood red, scented, moderately hard, durable, used for walking-sticks, gun-stock and firewood. Decoction of the bark is used in fever and the leaves as fodder. The fruits are eaten by children and birds like bulbuls, barbets, etc.

Propagation and Planting Technique: Seeds mature in the month of March-April. Fully ripened fruits are picked up from tree or fallen ones are collected from the ground. The seeds are removed from the fruits, washed free of pulp and sown. The seeds may be sown immediately after collection in April to middle of May. Seeds



remain viable for 2-4 months but germination percentage is more in freshly collected seeds. The seeds should be sown in well prepared nursery beds or polythene bags containing mixture of sand, soil and farmyard manure (1:1:1). Pre-sowing treatments like soaking the seeds in water or giving hot water treatment do have favourable effect on germination. Ripened and de-pulped seeds treated with hot water for 10 minutes have a high germination rate.

Pits of 45cm x 45cm x 45cm are dug and dry farmyard manure is added to the pits. The seedlings of about 65cm height are transplanted into the field. Seedlings are transplanted into the pits during monsoon in July. Weeding is carried out at a monthly interval in monsoon season. Plants require manuring in its initial stages of growth. Farm yard manure or compost is given in September-October. Watering at an interval of 10-15 days is favourable during summer. The lower branches are pruned in the second year in winter to avoid crowding.

18. *Chukrasia tabularis* A. Juss.

Family: Meliaceae

Mizo Name: Zawng-tei

English Name: Chittagong wood

Common Name: Chickrassy

Distribution: In Mizoram, it is found up to 1450 m altitude.

Description: A tall deciduous to semi-evergreen tree. It usually reaches a height of up to 40 m on favorable sites, with a clear straight bole measuring up to 25 m and diameter of 1.2 m. *C. tabularis* usually avoids heavy and wet soils. It is regarded as a pioneer species and common in former shifting cultivation areas.

Uses: Wood is used for furniture, gunstocks, plywood, motor bodies, house building, posts, fuelwood, etc. Decoction/ infusion of the bark or the capsule is taken against diarrhoea, dysentery and indigestion. Juice of the leaves is also applied to fresh cuts.

Propagation and Planting Technique: It regenerates naturally through seed as well as through coppice. Capsules are dried in shade until they split open, and the seeds are released



by gentle tumbling or shaking. Direct sun drying should be avoided, as it may cause overheating and desiccation of the sensitive seeds. Seeds are sown with overhead shade in light porous soil. And about 80-90% seeds germinate within in 1 to 4 weeks. Where seed is plentiful, the best method is broadcast sowing in strips 0.6 m wide and 1.8 m apart. Best results have been obtained by raising seedlings in well-drained boxes and pots before transplanting. Seedlings are pricked out and transplanted to the nursery beds when about 1 month old and 6-8 cm high. The seedlings are very sensitive to drought. After 6 months the seedlings are ready for planting in rainy season.

19. *Cinnamomum tamala* (Buch.- Ham.) T. Nees & Eberm.

Family: Lauraceae

Mizo Name: Tespata / Hnah-rimtui

English Name: Bay leaf

Common Name: Tejpat

Distribution: It grows from 300-2,400 m altitude. Found in Dampa Tiger Reserve, Thorangtlang Wildlife Sanctuary, Lunglei area, Reiek-tlang

Description: A moderate-sized evergreen tree with aromatic leaves. It is a moderate sized, aromatic, evergreen tree which reaches a height of 15 m or even more. Its bark is thin, dark brown and wrinkled.

Uses: Wood is used for firewood. The leaves are used as food flavouring, and the bark and leaves in medicine.



Propagation and Planting Technique: Direct sowing and entire planting. The seedlings are transplanted in the field at a distance of 2 m and spacing of 3-4 m. The seedlings require enough shade during the young age but the shade trees

are later removed in 8-9 years. The tree is perfect for cash crop farming due to the essential oil obtained from it. The observed age of the tree is 100 years however the tree still bears leaves at such age. Leaves are accumulated every year during dry season i.e. from October-March from robust plants whereas collected in

alternate years from old and fragile trees. However, leaves can be started harvesting from the trees when they are 10 years old. The leaves are aromatic but constant rains decrease it. The branches having leaves are sun dried for 3-4 days after which they are sold in the market. The average annual yield per tree is 40-100 kg/tree.

20. *Cinnamomum verum* J. Presl Syn. *Cinnamomum zeylanicum* Breyn.

Family: Lauraceae

Mizo Name: Thak-thing

English Name: True cinnamon

Common Name: Dalchini

Distribution: Found in Dampa Tiger Reserve, Baktawng area, Sihphar, Sawleng area, Lungchuan area and Reiak-tlang etc. between the altitude of 600-1800 m.

Description: A moderate-sized to large evergreen tree with classic red-grey bark; bark and leaves very aromatic. It is an evergreen, moderate to large sized tree, having rough and brown colored bark in older trees whereas smooth in younger trees. The continuous removing of shoots by pruning almost to ground level results in the formation of a dense bush of 2-2.5 m height with a number of leafy and coppice shoots under cultivation areas. Trees grown in the forests reach 20 m in height.

Uses: Wood light red, moderately hard, used for firewood and the bark as a spice or condiment. The leaves are also used for flavouring food. The oil extracted from the bark is used in perfumes. Decoction of the bark is useful for a remedy of cancer, asthma, diarrhoea and vomiting



Propagation and Planting Technique: It can be propagated by seed and seeds germinate within 20-25 days. The seeds may be sown in nurseries or directly in the field. Nursery beds should be of well-prepared rich sandy soil with an adequate supply of fresh water and light shading is also required in the nursery. After about 4 months, seedlings can be transplanted into containers/polythene bags and can be planted in the fields after 4 or 5 months of growth. It can also be propagated vegetatively by cuttings or layering, or by the division of old rootstocks.

21. *Ficus virens* Aiton

Family: Moraceae

Mizo Name: Zai-hri, Hmawng-ke-za

Hmawng-thir

English Name: White Fig

Distribution: In Mizoram it is found in areas of Seling and Drngwn up to about 1,500 m.

Description: It is a large widely spreading deciduous and fast growing tree, which reaches a height of 35 m. It has a huge and extended



crown as well as many roots develop on the trunk or from base of the lower limbs. Bark greenish-grey smooth bark and fruit are sessile white when ripe.

Uses: Wood moderately hard, used for firewood. The young shoots are eaten in curries, and the fibre used for making ropes.

Propagation and Planting Technique: It fruits

twice in a year. It can be propagated by seeds or stem cuttings. The seed must be collected early and should be stored in boxes in moist peat until required for sowing in the spring. Seed sowing should be done in early spring in the nursery beds. Leave the beds open for a week and then cover with the frames. The seedlings should remain in these beds until the autumn, 18 months later. During the rainy season, seedlings can be transplanted in the fields.

22. *Fraxinus floribunda* Wall.

Family: Oleaceae

Mizo Name: Zo-zih-nghal

English Name: Indian Ash

Distribution: In Mizoram, it is found in areas of Hualtu, Tawizo and Reiek-tlang etc. between 1,200 - 1,500 m altitude.

Description: It is a moderate to large sized deciduous tree having a rounded crown and is found in shady conditions on rich moist soils. The young trees have grey and smooth bark which becomes rough and intensely cracked longitudinally with age.

Uses: A wood is used as fuel wood.

Propagation and Planting Technique: Flowers appear during the months of April-May and ripening of the fruits can be observed in September-October. For a whole year, mature and dried seeds lie dormant in the ground. Germination of seeds takes place in next spring



season. Mature seeds remain viable for 1-2 years if stored properly. It can be raised by planting seedlings with good success. The seeds are sown in the nursery beds during autumn or in the spring. After sowing, germination takes place during spring season. For planting purposes, two year old seedlings which are nearly 60cm tall, are used. The seedling growth is however slow during the first year but picks up from the second growing season. Weeding and cleanings for atleast two years are required.

23. *Gmelina arborea* Roxb.

Family: Verbenaceae

Mizo Name: Thlan-vawng

English Name: Beech Wood/ Gmelina/ White Teak

Common Name: Gamari/ Gomari/ Gamhar

Distribution: Found up to 1,300 m altitude in Mizoram.

Description: It is a moderate sized, deciduous tree, and under favourable conditions may reach a height of 25 m. The species occurs in a variety of forest habitats, including tropical semi-



evergreen, sub-montane, very moist teak forests, deciduous, sal and dry teak forests. The tree is a strong light demander, although it can stand some shade. The bark of older trees peels off in large flakes leaving lighter patches, giving the tree a rather characteristic appearance. It has suitable characteristics for agroforestry, with fast growth, ease of establishment, and relative freedom from pests outside its natural range. It is an especially promising fuelwood species because it can be established easily, regenerates well from both sprouts and seeds, and is fast growing. It coppices well with vigorous shoot growth. Leaves are shed in February-April and the new foliage appears in April-May. The fruits ripen from the end of April-June or July. Flowering and fruiting occurs normally in abundance every year. Flowering generally starts during the dry season when the trees are leafless i.e., from February onwards. Fruits mature from April onwards and both continue well into July. Mature fruits would develop around 1.5 months after the appearance of the white flower buds. Green fruits to some extent contain immature seeds, while the yellow contain more of mature seeds.

Uses: Wood greyish or yellowish-white, does not warp, durable under water, used for planking, paneling, furniture, drums, boxes, matches, pulpwood, house posts, boat-building, etc. The flowers are eaten cooked as a vegetable and the leaves are lopped for cattle fodder. The roots, leaves, flowers and fruits are medicinal. Because of its high light demanding character, it regenerates naturally only in the open and on the edge of the forests. It is thus an ideal choice for large scale afforestation and plantations.

Propagation and Planting Technique: The coppice shoots grow vigorously and also produces root-suckers. It can be planted either by direct sowing, stump planting and entire transplanting. Direct sowing is the easiest method. It can be propagated by cuttings, budding and grafting also. Under suitable conditions, stump planting gives better height growth.

The fruits are collected preferably from the forest floor previously clean swept or by plucking the ripened fruits from the tree. In seed stands,

high quality of site maintenance, weed cleaning is necessary to facilitate high seed collection and can be continued for 4-9 months. The colour of the fruits indicate the maturity of seeds, which shows that only green, green yellow or yellow stones should be collected to ensure seed quality. Fruits that have started to turn black should in any case be discarded. In order to avoid fermentation, fruits should be cleaned within 24 hours. It is especially important for fully ripe fruits.

Seed collected in the beginning of the season can be used for raising planting stock on same planting season. The time of sowing depends upon the climate of the locality, availability of seed and also the type of planting stock to be produced. Sowing is generally done in March for production of entire plants, for planting out June-July is the best time, and for production of stumps sowing should be done in June-July. Sowing should be done in well drained raised and unshaded nursery beds at a spacing of 2cm between the seeds and 5cm between the rows. The depth of sowing is normally 1-2.5 cm. Seeds start germinating within 2 weeks and completed within 6 weeks. Germination percentage varies from about 50-85, depending upon the quality of the seed and the nursery conditions.

Beds are watered once every day till the germination is complete. The seed can also be dibbled in polythene bags. Two to three seedlings may arise from one stone. Surplus seedlings are pricked out and transplanted in separate beds. Weeding is carried out as and when required. The seedlings grow fairly fast and become fit for planting out when they are about 15cm high.

For direct sowing, hoeing is done in patches or in lines. Lines are cleaned at a spacing of about 3m by cutting bushes and weeds. The soil is worked in about 30 cm wide strips and upto 15cm depth. Sowing is done in June-July with the onset of rains. The lines are seeded regularly and bushes which may shade the seedlings are removed. After about one month, seedlings are spaced 10-15cm apart and after one year to about 1m apart.

24. *Haldina cordifolia* (Roxb.) Ridsdale Syn. *Adina cordifolia* (Roxb.) Hook. f.

Family: Rubiaceae

Mizo Name: Lung-khup

English Name: Yellow Teak

Common Name: Haldu

Distribution: It is distributed up to 1000 m altitude in Mizoram.

Description: It is a large deciduous tree, with a tall crown, upright trunk along with cordate leaves. The trunk/ bole is nearly 18 m in height and has nearly 7 m girth and above, however the bole is much buttressed and fluted at the base and sometimes the shapes of the buttresses can be uneven but extraordinary. The bark is grey in colour with exfoliating patches leaving pinkish serrations. Shedding of old leaves take place in February and appearance of the new leaves can be observed in during May to June. The trees remain leafless in March-April, depending upon the climatic conditions and moisture supply.

Uses: Wood is used for planking, house-posts, door, window-frames shutters, drums, furnitures, plywood, bobbins, firewood, etc. The leaves are good for fodder. The bark is prescribed for fever, strangury, ulcers, skin diseases, and the roots for diarrhoea and dysentery.

Propagation and Planting Technique: Natural regeneration from the seed is fairly well under favourable conditions. Seed is dispersed by wind to considerable distances. Germination takes place early in the rainy season. Although, seed production is high, the proportion of saplings which survive and establish is relatively very small. The success of natural regeneration depends on number of factors like suitable seed bed in the form of clean, loose, preferably fairly porous soil; protection from flooding and being washed away, for the seed and young seedlings which grow very slow in the first season; complete freedom from weeds, under natural forest, this can be obtained only through a good burning; adequate drainage at the site; absolute protection from grazing and browsing against domestic cattle and wild animals and optimum light requirements.

The actual period of ripening varies depending



upon the locality and climatic conditions. The best time for collection of seeds is February. However local observations are more important before seed collection. The heads are dried in the sun, broken up and immersed in water to separate the seed. The heavier seed settles down to the bottom while the husk and infertile seeds float and can be removed by decantation. The seed can also be obtained by drying the heads, beating and then winnowing. The dried seed is stored in sealed tins or gunny bags. Sometimes, it is not desired necessary to separate the seed from husk and can be sown without detriment, but it may give to irregular sowing.

For raising seedlings in the nursery, sowing should preferably be done in boxes so as to ensure proper depth of sowing which is important because of minute seeds. The boxes should be filled with well pulverized soil, sandy loam is preferred and stiff clayey soil is avoided. Before sowing, the seed can be mixed with powdered charcoal, or sterilized sand or ash to ensure uniform sowing. The seeds are covered lightly with finely powdered soil. Watering is carried out with fine sprinkler carefully as the tiny seeds may be washed away. Deep sowing gives poor results. The boxes are kept under cover. 2-3 month old seedlings are pricked in the nursery or bags. The seedlings become ready for planting out when about one year old after sowing during the rains.

Planting stock can also be raised from plantation of direct sowing where unwanted seedlings can be planted out elsewhere during the second weeding. Care however be taken that root system is not damaged during transplanting,

preferably a ball of earth root system is advisable. It has been reported that plants with ball of earth give better results than naked plants both in respect of survival rate and height

growth. Planting out seedlings is usually done when they are about one year old and 20-25 cm in height, smaller seedlings can be kept for the next year or for winter planting.

25. *Juglans regia* Linn.

Family: Juglandaceae

Mizo Name: Khaw-kherh

English Name: Walnut tree

Distribution: Found above 900 m areas of Buhban, Mualpheng, Lamchhip, S. Vanlaiphai, Darzo, Lamherh, Sihfa and Durtlang in Mizoram.

Description: It is a large deciduous fruit tree with long fragrant leaves. When grown as a fruit tree in the open, it has a spreading crown and a comparatively short-bole, but in the forest it is a tall tree with a long clean stem, attaining a height of 24-30 m or even more.

Uses: Wood is used for furniture, cabinet-making, carving, gunstocks, etc. The rind of the unripe fruit and young leaves are used to intoxicate fish, and the nuts for tanning and dyeing. The leaves are used for cattle-fodder. The bark, leaves and fruits are used in medicine. The nuts are eaten. The walnut is one of the first species to lose its leaves, trees becoming leafless from September to October. The new leaves appear in March-April, when generally the flowering takes place. The fruits ripen in September-October, sometimes as early as July

Propagation and Planting Technique: Seeds are collected in September-October. Seed is dried in sun, after removing the fleshy cover. The nuts



should be carefully stored from the time of ripening to the time of sowing, in order to protect them from vermin. The seeds are soaked in lukewarm water for 24 to 48 hours or kept in cow dung for a couple of days before sowing for better germination. Germination takes place in early spring and is completed within a month or so. Germination percentage is 70-80. Watering is also done frequently depending upon the site. 1.5-3 year old seedlings are planted in the field. Transplanting is done entire with or without ball of earth in the first cold winter when the plants are leafless. Walnut requires to be planted closely in order to prevent branching.

The growth of the seedlings grown by direct sowing is very slow as compared to nursery grown transplants. Moreover, this method is successful only where the nuts are not liable to be destroyed by vermin.

26. *Lagerstroemia speciosa* (L.) Pers. Syn. *Lagerstroemia flos-reginae* Retz.

Family: Lythraceae

Mizo Name: Thla-do / Chawn-pui

English Name: Queen's flower/ Queen crape myrtle/ Pride of India

Common Name: Jarul

Distribution: In Mizoram it is found up to about 1,200 m.

Description: A medium sized or large deciduous tree with large handsome flowers. The leaves

turn copper-coloured during February-March and fall off gradually. The new foliage appears in April-May. Flowering takes place during April-June. The tree looks extremely beautiful in the flowering stage. Most of the flowers fall off during the second or third day, and only the later ones set fruit. Fruits ripen from November-June.

Uses: Wood is used for building, furniture, gunstock, boat-building, posts, firewood, etc. Decoction of the bark is useful for diabetes,

heart diseases, diarrhoea and dysentery

Propagation and Planting Technique: The tree starts seeding at the age of 3 years, but fertile seeds are produced above 15 years. Fruits are collected by lopping branches as soon as the capsules start to open; care being taken that only ripe fruits are collected. Best time of collection of seed is from December-February. The fruits are spread on the mat in the sun for a few days for the capsules to open when the seeds are extracted by hand. They are dried and stored in the gunny bags until required for sowing. Although seed stored for one or two years in gunny bags keep well, but the stored seed do not give good germination.

Generally, no pre-treatment of seed is required; however, soaking the seeds in water for 12 hours immediately before sowing is reported to hasten germination. The seed is broadcasted in the leveled and shaded beds in February-March and a layer of soil is spread over it. Watering is done till the germination is complete. Germination takes place between 10-30 days.



Planting of 10-15 cm entire plants or even taller with or without ball of earth in June of the first year can be done successfully. In plantations, dense planting of the species is useful as the species has the property of low branching. The plants are weeded and protected against frost. In the low lying areas, entire planting can be done on mounds.

27. *Lannea coromandelica* (Houtt.) Merr.

Family: Anacardiaceae

Mizo Name: Tawi-taw-suak/ Zawng-tawi-taw

English Name: Wodier

Common Name: Jhingan

Distribution: Distributed up to 1,200 m altitude in Mizoram.

Description: It is a moderate to large-sized deciduous tree with spreading crown generally attaining height of 20 m or more. The tree is deciduous for about six months from November-May, but the seedlings keep their leaves longer. It is one of the earliest trees to lose and one of the last to regain one of its foliage. The leaves turn yellow before fall. The tree becomes entirely leafless by the end of December or January and remains bare till late February when small greenish white flowers start appearing in numerous spikes from the tips of small branches mainly during March-April. The handsome foliage appears not until May or June when last of the flowers have fallen. The development of fruits (berries) takes immediately thereafter



which ripen from May-July by the time the leaves appear. The small green berries are borne in large numbers on the female trees or female branches. They are oblong and about 1-1.5 cm long with a hard stone. Fruits turn red or brownish when ripe.

Uses: The wood is used for paper pulp, drums, house posts, furniture, firewood, etc. Tender leaves are eaten as a vegetable. The bark is used for tanning and the leaves for cattle fodder. The bark and leaves are medicinal.

Propagation and Planting Technique: Natural reproduction through seed is generally inadequate because of low viability of seed and loss of seed by birds. It can be raised by direct sowing, planting entire seedlings, stump planting and from cuttings. The seed can be collected from May to June. The seeds are cleaned and dried before storage, but they lose viability quickly, thereby, necessitating sowing of freshly collected seeds. Fresh seed is sown in lines 20-30 cm apart and lightly covered with soil. Sowing is

done in the month of May-June. Germination starts within a week and takes about four weeks to complete. Watering is done until the germination completes and afterwards it is required sparingly. Weeding of nursery beds is necessary to save the seedlings from suppression. One year old seedlings are generally planted out. Planting can be done in the month of July-August with one year old entire transplants or with one year old stumps.

28. *Magnolia champaca* (L.) Bail. ex Pierre Syn. *Michelia champaca* Linn.

Family: Magnoliaceae

Mizo Name: Ngiau-hnah-hlai

English Name: Golden champa/ Champac/
Michelia

Common Name: Champa

Distribution: Found between the altitudes of 600-2000 m in Mizoram.

Description: It is an evergreen or semi-deciduous, medium-tall sized emergent canopy tree up to 50 m tall and 200 cm in diameter. It is found scattered in primary lowland to montane evergreen rain forest, up to 2100 m altitude. It flowers from June-July and September-October. It is described as a remarkable tree, worshipped for its great antiquity.

Uses: Wood light olive-brown, very durable, used for furniture, house building, paneling, drums, plywood, firewood, etc. The leaves are also good



for fodder. The bark, roots, leaves, flowers and fruits are used in medicine. The tree is also good for windbreak.

Nursery and Planting Methods: Trees propagated from seed take 8-10 years to flower whereas vegetatively propagated trees flower in 2-3 years. It is planted at 3 m x 2.5-3m but the open canopy makes weed control necessary.

29. *Melia azedarach* Linn.

Family: Meliaceae

Mizo Name: Nim-suak

English Name: Persian Lilac/ Bead tree

Common Name: Ghoola-Neem

Distribution: Introduced in Mizoram and ascending to about 1,500 m altitude

Description: It is a deciduous tree, grows up to a moderate size, having short trunk and spreading crown. The tree grows very fast and coppices extremely well. The leaves are compound, first pair opposite, subsequent leaves alternate, once



or twice pinnate, 3-5 or 7-foliate. The tree is usually leafless from December to March-April. The new leaves appear in February-March. The lilac colored and honey scented flowers appear from March-May covering the whole tree and giving a delightful appearance. The flowers are replaced by bunches of drupes soon after which are first bright green in color and then ripen to yellow, appeared by gradual shrinking and drying in the cold season, when the fruits appear conspicuous due to leaf shedding. It takes one year for the seed to ripen. The fruits remain on the tree in yellow clusters during the next flowering season and may still be seen on the trees till July.

Uses: Heartwood red, soft, durable, used for house construction, boat building, furniture, packing cases, firewood, etc. The leaves are lopped for fodder. The bark, leaves and fruits are medicinal.

Propagation and Planting Technique: The tree

seeds profusely every year. Ripe fruits attaining yellow color continue hanging on the trees till April-May, when they can be collected by shaking the trees or collected from the floor shortly after the wind blow. Sowing of whole fruits is done during February-March. One to four seedlings may emerge from a single fruit. The fruits/seeds filled in gunny bags and then kept in running water for 2-3 days also enhance the germination. The nursery beds are shaded from February to April-May. Watering is done regularly after sowing until germination is complete. Germination starts in about three weeks and may take about two months to complete. Seedlings are retained in the nursery beds for one year and then uprooted for planting out in the field. Two year old seedlings are fit for planting out in the field.

The seedlings are planted either in July or during winter months when they are leafless, using ball of earth around plants in both cases. The species can also be raised by direct sowing.

30. *Melia dubia* Cav.

Family: Meliaceae

Mizo Name: Sa-khi-thei/ Kel-thel-ret

Common Name: Malabar Neem

Distribution: Ascending to about 1,500 m. It occurs in areas of Keifang, Seling, Lungpher, Darlawn, S.Khawbung, N. Vanlaiphai, Ngopa in Mizoram.

Description: A middle-sized deciduous tree with white flowers. A large handsome deciduous perennial tree growing from 6-30 m in height. It is a tree of moist localities and tropical forests. It remains leafless for a short time detracts from its value as a roadside tree. The tree has a rapid growth. The fruits are of ovoid shape and ripen in the cold season. Melia is a good agroforestry species and supports a variety of crops throughout its cultivation period. Groundnut, chilli, turmeric, drumstick, blackgram, greengram, papaya, banana, melon, sugarcane, mango orchards as inter crops are being successfully cultivated. The species can also support cultivation of tomato underneath. It is also grown as a shade tree in coffee and tree plantations. The species performs exceedingly



well when planted on bunds, attaining the harvestable size within four years.

Uses: Heartwood reddish-white, soft, used for planking, ceilings, shingles, pencils, match boxes, tea-boxes, plyboard, building purposes, fence-posts, firewood, etc. 'The fruit is bitter and nauseous; good for abdominal colic; useful as a cholagogue in malarial fevers' (Ayurveda).

Propagation and Planting Technique: The juvenile stem cuttings respond well to 1000-2000 ppm rooting hormone (IBA in liquid formulation).

Vegetative multiplication through mini cuttings has been standardized for mass production of propagules. The size of the cutting and season of rooting plays a major role in the rooting of cuttings.

After collection the fruits can be transported to the place of processing in gunny bags or bamboo baskets. Ripe yellow fruits can be decupled easily if the fruits undergo fermentation and heating as the pulp is difficult to remove. The drupes thus extracted have to be dried for ten days in shade.

Cleaned and dried drupes can then be stored in gunny bags or sealed tins for one to two years without losing viability. The drupes stored for over a year show improved germination over fresh ones.

Cleaned and dried drupes should be sown in the open raised nursery beds, in drilled lines, 5 cm apart. About 6-7 kg of dried drupes containing about 1500 numbers are required for one standard nursery bed (10m x 1m). The drupes sown need to be watered regularly.

31. *Mesua ferrea* Linn.

Family: Clusiaceae

Mizo Name: Herh-se

English Name: Iron-wood tree/ Ceylon ironwood

Common Name: Mesua/ Nag kesar/ Nahor

Distribution: It is a State Tree of Mizoram and found up to 1,200 m.

Description: A moderate sized, handsome, evergreen tree which has a rather bushy, sometimes conical crown. It requires a good drainage, fairly rich, well drained as well as deep moist fertile soil. The old leaves are shed during the cold season and new flush of leaves appears towards the end of the season. The flowers generally appear from March-April.

Uses: Wood is used for railway sleepers, bridges, posts, tool handles, gunstock, rice-pestle, firewood and charcoal. The bark, flowers, unripe fruit and seed oil are medicinal. The seed oil is also used for burning, lubricating and soap-making.

Propagation and Planting Technique: Seedlings are planted in the field after one year when they are about 30 cm tall or after two years when



they are about 75 cm tall. Seed collection time varies from the middle of July to the beginning of September in different places. Mature fruits are collected from the ground, spread out in the sun till they dehisce and then dried in the shade. Due to oily nature, seeds lose viability within a few days of collection. Freshly collected seeds are sown in the shaded beds of nurseries to avoid damage from drip and splash from the young tender leaves. Germination commences in about 14 days and is complete within and is complete within 2 months or less. Planting of seedlings with naked roots or with ball of earth or in containers are all successful. The seedlings are planted in the second rains in pits of 30cm³.

32. *Morus alba* Linn.

Family: Moraceae

Mizo Name: Thing-thei-hmu

English Name: White mulberry/ Tut/ Mulberry

Distribution: Ascending up to about 1,200 m altitude in Mizoram.

Description: A small or middle-sized deciduous

tree with short spikes. It is usually a middle-sized deciduous tree, with pubescent shoots and has a rather straggly appearance, losing its leaves in winter. The bark on young trees is light colored and smooth, but with age becomes darker and vertically fissured. The tree remains deciduous in winter months, shedding its leaves in November-December. The new leaves appear depending

upon the climate of the locality from March-April. Flowering takes place at about the same time and fruits ripen from April-June. Trees of about five years age start producing viable seed.

Uses: Heartwood yellow or yellowish-brown, darkening on exposure, used for boat building, house construction, furniture, hockey sticks, drums, tool handles, firewood, etc. Silkworms are fed on its leaves. The fruits and bark are used in medicine. The leaves are sometimes boiled with meats and eaten as curry. Young leaves and twigs are good fodder for cattle, goats and poultry. The fruits are edible.

Propagation and Planting Technique: It regenerates profusely in nature through seed. The seed is dispersed by water, birds, jackals and human beings. In the irrigated tracts, the spread of mulberry is fairly rapid. Seedlings establish under light shade of thin crowned trees. Moisture availability is also an important factor, as the regeneration gets killed, if the soil dries up and continues to be so for some period. Trampling and browsing also destroy young regeneration.

Mulberry is an early seed producer, trees of about 5 years' age start producing viable seed. All the fruits on a tree do not ripe at one time and only ripe fruits should be collected from the trees, fruits should also not be collected from the ground, as they are generally insect attacked. The fruits are heaped in the shade, rubbed or kneaded in successive washing of water to separate out the seed which is then dried in the sun for a few days, and rubbed by hand before storage. The fruits may be pressed in a cloth to



extract the juice; the pulp is dried in the sun, rubbed by hand and winnowed to separate out the seed.

Sowing is done in May-June soon after collection in lines about 20 cm apart in the irrigated and raised beds. The fine seed is mixed with ash or saw dust or sand to ensure uniform sowing and covered lightly with fine soil. Watering after sowing and regularly thereafter is necessary till the completion of germination. Germination starts in about a week and completes in another ten days. The nursery beds are kept shaded and clean of weeds.

Transplanting of the seedlings is normally not required and they are planted in the next July-August with balls of earth around their roots.

Entire seedlings can be planted when 15-30 cm tall during monsoon, though winter planting is also successful. They are invariably planted with a ball of earth around the roots in pits of 30cm³.

33. *Morus macroura* Miq. Syn. *Morus laevigata* Wall. ex Brandis

Family: Moraceae

Mizo Name: Lung-li

English Name: Himalayan Mulberry

Common Name: Bola

Distribution: Ascending to about 1,300 m. It is found at Nausel, W. Phaileng, Mualpheng in Mizoram.

Description: A middle-sized or large deciduous tree with long-cylindrical fruit. It is a very



adaptable species and can be grown in the warm temperate zone. Trees can be very cold tolerant. The plants can be slow to come into fruiting when grown from seed, often taking several years. The fruit is white or purple and sweet when quite ripe.

Uses: Wood is used for house building, furniture, gunstocks, posts, oars, etc. The leaves are cooked with meats and eaten as curry. The milky

juice is applied to fresh cuts, scabies and sores. The leaves are lopped for cattle fodder.

Propagation and Planting Technique: The seed usually gemminates in the first spring, though it sometimes takes another 12 months. It is planted in degraded woodland and open areas in a mix with various other species that all have the ability to grow fast, produce dense, weed-suppressing crowns.

34. *Myrica esculenta* Buch.- Ham. ex D. Don

Family: Myricaceae

Mizo Name: Kei-fang

English Name: Box myrtle / Bay-berry

Distribution: It is found in areas of S. Khawbung, Hmuifang, Phuaibuang, Murlen, Hnahlan and Hualtu areas of Mizoram between 900 - 1,800 m altitudes.

Description: It is a medium to large, dioecious, evergreen aromatic tree which can reach 12-15 m in height. The bark is light brown to black, rough and vertically fissured.

Uses: Wood used for firewood and charcoal. The bark is used to poison fish. Decoction of the bark is effective for cough, fevers, asthma, bronchitis, sore throat, diarrhoea and dysentery. The bark is also chewed for toothache. The leaves are used as fodder, and the ripe fruits are eaten by man and birds.

Propagation and Planting Technique: Its seeds exhibit dormancy that hampers rapid and uniform germination. The germination capacity of the seeds of most of the wild edible plants in natural conditions is very low compared to other forest species, therefore multiplication through vegetative propagation, by application of auxins to stem cuttings and air layering are considered an important means for mass scale multiplication of these tree species. Physical dormancy due to the hard seed coat might be responsible for poor regeneration. The germination of *M. esculenta* can be significantly improved by subjecting seeds to different pre treatments such as acid scarification, mechanical scarification, growth hormone (GA_3) treatment on scarified seeds and pre-chilling treatment which proved superior



over water soaking and hot water treatments.

Mature ripened fruits are collected from lower branches. Collected fruits are sun dried for seven days and pulp is removed using coarse sand paper. Seeds are kept in open plastic containers at room temperature until the start of germination trials. Seeds are sown in 0.5 cm deep in seedling trays filled with equal volume of farmyard manure, nursery soil and sand (1:1:1). Increase in time duration of soaking reduces the germination percentage. The germination response as well as germination ability on GA_3 application on scarified seeds is generally higher as compared to its application on non-scarified seeds.

35. *Neolamarckia cadamba* (Roxb.) Bosser Syn. *Anthocephalus cadamba* (Roxb.) Miq.

Family: Rubiaceae

Mizo Name: Ban-phar

English Name: Bur flower Tree

Common Name: Kadam

Distribution: Found up to 900 m altitude in Mizoram

Description: A large deciduous or evergreen tree with horizontal branches. It is an early-succession species which grows best on deep, moist, alluvial sites, often in secondary forests along riverbanks and in the transitional zone between swampy, permanently flooded and periodically flooded areas.

Uses: The wood is white with a yellowish tinge, non-durable, used for planks, furniture, boxes, matches, plywood, pulpwood, firewood, etc. and the leaves are lopped for fodder. A spirit is distilled from the flowers. The bark and leaves are also medicinal.



Propagation and Planting Technique: The epigeous germination begins in about 10-14 days in the rainy season. Successful extraction of seed from ripe fruits involves air drying, crushing, and sieving through standard sieve to separate seed from chaff. Fruits are soaked in the open until rotted, ground by hand into a thick slurry, air dried, and passed through a series of sieves. This procedure improves seed purity up to 98%, and brings successful germination.

36. *Oroxylum indicum* (L.) Kurz

Family: Bignoniaceae

Mizo Name: Ar-chang-kawm

English Name: Trumpet Flower / Broken Bones Tree

Common Name: Pharra

Distribution: Below 1,000 m.

Description: It is a small, deciduous tree with few branches and an open crown. The bark is thin, light brown and corky. Flowers are large, fleshy, purplish with an unpleasant smell. It attains a height of 10-16 m, stem bark is dull in color. The plant prefers tropical areas that receive well-distributed rainfall.

Uses: Wood used for firewood and charcoal. The bark and fruits are used for tanning and dyeing. The young leaves and green pods are used as a vegetable and the leaves as fodder. The pods are roasted over the fire and eaten against goitre. Decoction of the root-bark is used in fevers, colic, stomach ulcer, constipation, indigestion, intestinal worms, strangury, asthma, cough, hiccough, diarrhoea, dysentery, etc. Poultice of



the bark is applied to rheumatism, sprains, inflammations and skin diseases. Decoction of the leaves is also useful in headache, flatulence, ulcers, etc. and the fruits for colic, cough, diseases of the heart, bronchitis, dyspepsia, leucoderma, piles, etc.

Propagation and Planting Technique: Seed is the best propagation material and should be collected before splitting of pods during February-March. Seed germination percentage is 80-90% without any pretreatment. Before field preparation, a nursery of plants is raised in polythene bags during second half of March for seedling establishment. The polybags should be filled with sandy-loam soil with good quality, well

decomposed farmyard manure added to it in the ratio 2:1. After the emergence of seedlings, the plants are watered regularly to maintain optimum moisture level. In all, 250 gm of seeds are sufficient to raise stock for plantation on 1 ha of land. The seeds should be soaked in water for atleast 12 hours before sowing to ensure good germination.

37. *Parkia timoriana* (DC.) Merr. Syn. *Parkia roxburghii* G. Don

Family: Mimosaceae

Mizo Name: Zawng-tah

English Name: Tree Bean

Distribution: Ascending to about 1,200 m.

Description: A middle-sized to large deciduous tree. It prefers growing in humid forests with spreading branches and reaches a height of 25-30 m. The trees are usually grown under condition or in homestead backyard gardens. The forest area provides a number of tree bean plants whose pod make an important contribution to the diet of local people.

Uses: Wood used for firewood. The unmaturred pods and tender leaves are eaten as a vegetable. The young leaves and seeds are useful against food allergy, colic, diarrhoea and dysentery. The bark and fruits are prescribed to check excessive bleeding during menstruation. Juice of the green rind of the pod is applied to fresh cuts, scabies and itching

Propagation and Planting Technique: Tree bean is commonly propagated by seed. Mature pods are collected from healthy, productive and disease free mother plants during the month of



March-April. Nursery may also be raised under the open field conditions, however, the seed will take comparatively longer duration to germinate. The ideal sowing time ranges from last week of April to first week of June. One month old seedlings should be transferred to a naturally ventilated polyhouse or agro-shade net for about 6 months for hardening. Planting can be done after receipt of pre-monsoon shower (June) or post monsoon period (September) if sufficient soil moisture is available. A light watering is required after planting.

38. *Prunus nepalensis* Ser. (Steud)

Family: Rosaceae

Mizo Name: Lum-ler

Distribution: It is found in areas of Mualpheng, Phuaibuang, Khuangleng, Sialsuk, Hmuifang, Chamring, Lengteng, N. Vanlaiphai, Murlen, Hnahlan and Ngopa between the altitudes of 1,200-1,800 m in Mizoram.

Description: A middle-sized to large deciduous

tree with. It is a moderate sized deciduous tree attaining a height of 12-18 m. The tree branches in verticillate fashion. Flowers are white.

Uses: Wood used for firewood.

Propagation and Planting Technique: The fruits are collected off the trees when the outer coat becomes black. The pulp of the fruit should be washed off immediately after collection and the

seeds extracted and dried in the sun for a few days. The dried seeds stored in gunny bags in well ventilated sheds store for about six months. The species can be raised by direct sowing in March-April in lines 2 m apart or at 2m x 2m spacing in prepared patches, two seeds per patch are sown, about 2.8 kg of seeds are required per ha for sowing in patches. The seeds are dibbled in the shaded nursery beds at 10cm x 10cm spacing. Germination takes place in a fortnight and completes in about 6 weeks. The shading is done to prevent hail damage. Planting of entire seedlings with or without a handful of earth round the roots is done in June, during the rains. Winter planting, when the seedlings are leafless and just before the new shoots appear, is also successful. Natural seedlings about 20 cm high, planted out



in July show moderate success. The weeding and cleaning is required up to third year of planting.

39. *Quercus serrata* Murray.

Family: Fagaceae

Mizo Name: Sa-sua / Sa-saw-thing

English Name: Red Oak

Distribution: In Mizoram, it is found in areas of Champhai and Hnahlan between 800 - 1,600 m altitudes.

Description: A moderate-sized or large deciduous tree with sharply serrated leaves. A moderate-sized or large handsome deciduous tree with straight stem, forming a full rounded crown when grown in the open and a straight clean bole when grown in a close crop. A fast growing tree suitable for plantations and for ornamental and shade purposes. It reaches fairly large dimensions. The leaves turn yellow and brown and commence falling in November, and by January it becomes leafless. The new delicate green leaves appear in February. The male catkins are first visible in October or early November, and are to be seen, up to 1 inches in length, at the end of the leafless branches in January; with the sprouting of the new shoots in February they elongate rapidly, attaining the length of 4-6 inches. Pollination takes place in February or March. Ripening and falling occurs in September and October.

Uses: Wood is used for building, firewood, charcoal, etc. Any galls produced on the tree are



strongly astringent, and can be used for treating diarrhoea, dysentery, haemorrhages, etc.

Propagation and Planting Technique: For forestry plantation purposes, direct sowing is usually preferable to transplanting, owing to the length of the taproot. The seed should be sown in February, the beds being regularly watered and weeded, and by July or August the seedlings will attain a height of 1-2 feet with a taproot up to 2 feet or more in length.

40. *Rhododendron arboreum* Sm.

Family: Ericaceae

Mizo Name: Chhawk-hlei-par-sen

English Name: Rose Tree / Tree Rhododendron

Common Name: Chalan/ Burans

Distribution: It is found in Champhai, Phawngpui, Pamchung in Mizoram

Description: It is a moderate sized evergreen tree, though it is sometimes shrub-like with a crooked stem. The bark is soft, reddish-brown (older bark tends to be grey) and it peels off in long irregular strips, exposing smooth, pink colored new bark underneath. Flowers are red and usually deep crimson in colour.

Uses: Wood used for tool-handles, firewood and charcoal. The flowers which are sour to taste are eaten by children and also used in diarrhoea and dysentery. They are also medicinal, and applied to the forehead during headache.

Propagation and Planting Technique: Seedlings may be raised artificially by sowing seed in March or April in boxes or pots filled with fine sand or powdered brick previously soaked with water, the seeds should not be covered. The



boxes or pots should be sheltered from rain and sun and watered regularly. The seedlings may be pricked out, if not large enough and then kept in nursery for second season until sufficiently large to plant out. A more satisfactory method of planting is to dig up seedlings from the banks and cuttings on which they spring up naturally and transfer them to the nursery, keeping them there until large enough to plant out.

41. *Salix tetrasperma* Roxb.

Family: Salicaceae

Mizo Name: Tui-pui-sut-hlah / Tui-pui-su-hlah

English Name: Indian Willow

Distribution: It is distributed throughout the Mizoram.

Description: It is small to moderate sized, fast growing, deciduous tree, sometimes reaching to a height up to 24 m and girth up to 3 m. It is an indigenous willow, found growing gregariously along the banks of rivers, streams and in wet, swampy and moist places.

Uses: Wood is used for planking, posts, bent-wood furniture, tool handles, match industry, firewood and gunpowder charcoal. The twigs are used for making baskets. The bark is used as a febrifuge. The leaves are lopped for cattle-fodder.



Nursery and Planting Methods: *Salix tetrasperma* grows well from cuttings planted in the moist places and withstands flooding often sending out small rootlets near the base of the stem when subject to inundation. The species has been put out in swamps with marked success. Branch cuttings 2-8 cm girth and 90-120

cm long from older plantations directly struck 30 cm deep into the mud give 90% rooting and survival percentage. In other cases, one year rooted cuttings raised from branch cuttings in the nursery or by planting sets may be done.

In case of nursery, branch cuttings of about 20-25 cm length and 10-20 cm diameter at the base are planted at a spacing of about 60cm x 30cm. However, smaller cuttings of 5-8 cm in girth and 5 cm in length give better sprouting and survival. Planting of cuttings is done when the plants are leafless and before growth of the season is to start. Under northern Indian conditions, it is normally done in the first half of the January. The cuttings are inserted in the ground vertically leaving only one bud above the ground. Thorough ramming of the soil is done around the

cuttings. Regular irrigation of the nursery beds is done. Addition of the manure in adequate quantity is also necessary to ensure good growth of the plants. Nursery plants attain plantable size by the following winter when these are planted out. Planting should be done when the plants are leafless and the buds have not commenced sprouting.

The plants are uprooted and the roots are pruned before planting. Only as much taproot and lateral roots are left as it can be obtained in the planting holes. Generally planting is done in the crow-bar holes or wherever, soils are heavy, pits of the size 45 x 45 x 45 cm³ are used. The soil is properly rammed round the plants. High weeds are cut around the plants. The spacing adopted depends upon the object of planting.

42. *Schima wallichii* Choisy

Family: Theaceae

Mizo Name: Khiang

English Name: Needle wood / Schima/ Chinese guger tree

Common Name: Chilauni

Distribution: It is distributed between 600-1500 m altitudes in Mizoram.

Description: A large evergreen tree with a tall straight bole. It is an evergreen, medium-sized to large tree up to about 47 m in height, bark surface ruggedly cracked into small, thick, angular pieces, red-brown to dark grey; inner bark with skin-irritating fibres, bright red in colour. Leaves spiral, oblong to broadly elliptic, 6-13 x 3-5 cm; base wedge shaped. Flowers solitary in axils at the apices of twigs, fruits woody subglobose capsule and seeds winged. It bears flowers in April-June, and fruits are observed from May to July. The seeds are shed in next January to March of the following year. Seeds are light and are dispersed by wind.

Uses: Wood used for railway sleepers, building, planking, scantling, cabinet work, plywood and firewood. The powdered fruit is used for an application in scorpion-sting, bites of centipede and large black spider, etc. and the juice of the bark for chronic ulcer and fresh cuts. The tender leaves are eaten. Saw-dust of the timber is used



for poisoning fish. The leaves are also lopped for fodder.

Nursery and Planting Methods: It can be propagated through seeds. Ripened seeds germinate easily and seeds soaked in warm water for about 12 hours in warm water germinate better than the untreated seeds. Fresh seeds give about 90% germination in 10 - 12 days. Seeds are sown under shade and only lightly covered with soil. Seedlings of 6 - 8 months old can be transplanted in the field for plantation. Survival of seedlings was reported almost 100% in the plantation. The tree has been used as a shade tree in coffee plantations. It is a suitable tree for reforestation and planting for water conservation in catchment areas.

43. *Terminalia bellirica* (Gaertn.) Roxb.

Family: Combretaceae

Mizo Name: Thing-van-dawt / Tuikuk-re-raw

English Name: Belleric Myrobalan

Common Name: Bahera

Distribution: It is very common in tropical forests of Mizoram.

Description: A tall deciduous tree with It is a large deciduous tree with a characteristic bluish or ash-grey bark, which is furrowed vertically in an uneven fashion. Fruits are grey velvety globose.

Uses: Wood yellowish-grey, hard, durable under water, used in petty construction, tea chests, plywood, etc. Kernel of the seed is edible. The fruit is used in medicine.

Nursery and Planting Methods: The seedlings stand fairly dense shade during the first year or two but very heavy shade suppresses and kills them afterwards. Frost often affects the leaves, but ordinary frosts do not kill back the seedlings, particularly in grass. The nuts or the whole fruits



should be sown in the nursery in March or April, covered with earth and watered regularly.

Germination usually takes place about one or two months after sowing. Transplanting should be done in wet weather, and may be carried out either after pruning the stem and roots or with stem and roots intact. The latter gives the best results, the former checking the growth considerably.

44. *Terminalia chebula* Retz.

Family: Combretaceae

Mizo Name: Re-raw

English Name: Chebulicmyrobalan/ True Myrobalan **Common Name:** Myrobalan / Haritaki/ Harad

Distribution: A middle-sized deciduous tree with ellipsoid or obovoid 5 ribbed fruits.

Description: It is a moderate to large sized tree with spreading branches, a rounded crown and a short trunk. The bark is dark brown with vertical cracks, and young parts of the tree are covered with rust-colored hairs. The old leaves commence falling in February-March in North India, but somewhat earlier in South India. The new leaves appear from March to May along with flowers. The spikes of greenish-white flowers appear from April-June. In areas receiving enough north-east monsoons, flowering may take place in July-August also. The fruits ripen from October-March, depending upon the locality and fall soon after ripening.



Uses: Its wood used for house building, furniture, tool handles, etc. The fruit is used in treatment of diabetes, diarrhoea and dysentery. A fruit, coarsely powdered and smoked in a pipe, affords relief in a fit of asthma.

Propagation and Planting Technique: The seeds can be collected from the ground as soon as it falls, dried under shade and can be stored in gunny bags for one year. However, fresh seed is better for germination than that stored. Owing to hard seed cover, pretreatment of seed is

generally recommended. The most commonly followed treatment is the fermentation of seeds. In this process, after removal of pulp of the fruits, the seeds are laced in between layers of straw in a tray having perforations at its bottom. In another method, seed is clipped at its broad end in such a way that the embryo is not damaged. Such seeds are soaked in cold water for about 36 hours and sown in nursery beds under shade. This gives about 80% germination.

The pre treated seed is sown in the shaded nursery beds. Seed is covered and regularly

watered. Germination commences within 15 days and is completed within 3-5 weeks. No manuring is needed in the beds. The young plants may require watering during the first hot weather. Plants suitable for planting out are obtained in the second rains.

Planting out of one year old seedlings is most advantageous than stump-planting and direct sowing. One year old seedlings are better than two year old ones, as it is difficult to manage the long tap root in the latter.

45. *Terminalia myriocarpa* Van Heurck & Mull. Arg.

Family: Combretaceae

Mizo Name: Char

Common Name: Hollock

Distribution: It is found in tropical moist forests in Mizoram.

Description: A very large evergreen or semi-deciduous tree. It is a large tree with buttresses at the base, spreading crown and pendulous branches, reaching 30-48 m height and 4-6 m in girth, with a clear bole of 15-18 m. It is a tree of Northern tropical semi-evergreen forests and North Indian moist deciduous forests. The panicles of small pink flowers appear in October-November. The fruits ripen from March-June. The color of large panicles changes from pinkish-brown to brown and then to blackish-grey as the panicles mature giving the tree a shady appearance from a distance.

Uses: Heartwood dark brown, beautifully mottled with dark streaks, fairly durable, used for cheap furniture, plywood, house-building, doors, windows, motor bodies, firewood and charcoal. The leaves are good for fodder.

Propagation and Planting Technique: The proper time for collection of seed is when the capsules turn yellow. The seeds are separated from the branches and twigs, dried in the sun for a day or two before storage. The seeds can be stored for two to three months in a dry well-ventilated shed.

The fresh seeds are sown in the shaded beds at



the rate of 5-7 g per square metre. The seeds are lightly covered with fine silt and watered with a fine rose. The bed should be carefully weeded just after germination. Germination starts in two weeks and is generally complete within three weeks. If the seeds germinate in clumps, pricking out should be done at a spacing of 7.5 x 7.5 cm² in shaded beds in May.

The tree is rather sensitive to entire transplanting. Small sized seedlings about 10cm high are planted with a handful of earth round the root system taking care to ensure that the roots are not doubled up. Ball planting is usually safer and should be done during droughts. The small seedlings can be planted along with taungya crop of paddy.

46. *Bambusa tulda* Roxb. Syn. *Dendrocalamus tulda* Voigt

Family: Poaceae

Mizo Name: Rawhling

Common Name: Bengal Bamboo

Distribution: Common throughout the state of Mizoram. It is frequent on flat alluvial and along stream in mixed deciduous forests along the banks of dry water courses.

Description: An evergreen or deciduous, arboreous bamboos. Culms are 6-20 m tall, branching freely from nearly all the nodes, the branches from the lower nodes being thin and more or less horizontal. It often flowers sporadically or in small groups, while occasional gregarious flowering takes place. About one month after germination a seedling produces its first stem and at this stage the rhizome also starts to develop. After 9 months 4-5 young culms have been formed. *B. tulda* normally flowers gregariously for a period of 2 years in a cycle of 25-40 years, and produces viable seed. Young shoots to be used as a vegetable should preferably be harvested while they are still underground. In plantations, selective felling of older culms may start 5-7 years after planting. Normally 3-4-year-old culms are harvested, retaining at least 3-6 evenly spaced culms per clump. A 4-year felling cycle is often adopted.

Uses: Basket work, Building poles, Construction, Furniture, Handicraft, Paper pulp, Timber, Wind break

Propagation and Planting Technique: *B. tulda* can be propagated by seed, rhizome cuttings,



culm cuttings and by tissue culture. Under ambient conditions, seed remains viable for about 1 month only; when stored dry (in a desiccator over silica gel) viability can be extended to up to 1.5 years. Propagation by rhizome cuttings with direct planting in the field is very successful and average height of shoots is 1.35 m after 2.5 months of planting. Rhizome parts can best be taken at the beginning of the rainy season from 1-2 year-old culms and planted in pits of 60 cm³ at a spacing of 8 m × 8 m.

Propagation by tissue culture is very promising and is already at nursery stage but is still experimental.

47. *Dendrocalamus hamiltonii* (Nees & Arn ex Munro) Syn. *Sinocalamus hamiltonii* (Nees & Arn ex. Munro) T.Q. Nguyen

Family: Poaceae

Mizo Name: Phulrua

Distribution: Common throughout the state of Mizoram. Occurs in moist places along streams and valleys and forms dense thickets.

Description: A large tufted bamboo, with culms sometimes erect but often overhanging and almost horizontal, with large branches. The

culms sometimes attain a length of 12-25 m and a diameter of 1-18 cm. They are thin-walled, rather soft and grey in color. The flowering cycle for this species is 30 - 40 years. Harvesting may start 3 - 4 years after a clump has begun to produce culms of maximum size. Only culms older than 3 years are harvestable and harvesting should never be done during the growing season. It is recommended to cut the culms lower than 30cm above the ground level,

but not below the second node.

Uses: It is used for walling of native huts, construction, basket making and mats etc. It is also used for checking soil erosion.

Propagation and Planting Technique: Seeds have a short viability and should be sown within 2 - 3 months of harvest. Sow in containers in a lightly shaded position and only just cover. Germination usually takes place readily. Prick out into individual pots as soon as the plants are large enough to handle. Plant out into permanent positions when 20cm tall. Plants may remain in their low-growing juvenile state for several years. Cutting the culms to the ground level can stimulate taller adult growth. Rhizome, culm and branch cutting is done. The propagules are raised in the nursery and after they have produced roots they are planted out in the field before or during the first half of the rainy season.



48. *Dendrocalamus longispathus* (Kurz) Syn. *Bambusa longispatha* Kurz

Family: Poaceae

Mizo Name: Rawnal

Distribution: Common throughout the state of Mizoram and occurs moist slopes and along streams in the moist fertile loamy soil and particularly shaded fringes of the forests.

Description: It is an evergreen clump forming large tufted bamboo. The culms are about 20 m tall with a diameter of about 1 cm. The internodes covered by long papery sheaths with irritant black hairs. As a high yielding species, it has been recommended for large scale planting. Bamboos have an interesting method of growth. Each plant produces a number of new stems annually - these stems grow to their maximum height in their first year of growth, subsequent growth in the stem being limited to the production of new side branches and leaves. Bamboos in general are usually monocarpic, living for many years before flowering, then flowering and seeding profusely for a period of 1 - 3 years before usually dying. Harvesting may start 3 - 4 years after a clump has begun to produce culms of maximum size. Only culms older than 3 years are harvestable and harvesting should never be done during the



growing season. It is recommended to cut the culms lower than 30cm above the ground level, but not below the second node. Debris and cut branches should always be removed completely.

Uses: It is used for thatching, construction, basket, mat and furniture makings.

Propagation and Planting Technique: Seeds have a short viability and should be sown within 2 - 3

months of harvest. Sow in containers in a lightly shaded position and only just cover. Germination rates of 33 - 50% have been achieved in trials, with the seed starting to sprout within 2 - 8 days. Prick out into individual pots as soon as the plants are large enough to handle. Plant out into permanent positions when 20cm tall. Plants may remain in their low-growing juvenile state for

several years - cutting the culms to the ground level can stimulate taller adult growth. Rhizome, culm and branch cuttings are done. The propagules are raised in the nursery and after they have produced roots they are planted out in the field before or during the first half of the rainy season. Culm cuttings with two nodes are taken.

49. *Melocanna baccifera* (Roxb.) Kurz Syn. *Bambusa baccifera* Roxb.

Family: Poaceae

Mizo Name: Mautak

Common Name: Muli Bamboo

Distribution: Common throughout the state of Mizoram. It occurs on dry sandy slopes of hills. It occupies extensive tracts in the shifting cultivation areas.

Description: It is an evergreen arborescent bamboo. It is a sympodial bamboo growing to about 20 m in height. Unlike other sympodial bamboos, the rhizomes are long and so rather than growing as compact clumps, *M. baccifera* produces groves of widely spaced culms, more akin to those of large monopodial bamboos. It is an aggressive colonizer and often forms the dominant vegetation on the tropical and subtropical hill slopes on which it grows. It is an aggressive bamboo, easily occupying large open areas, due to its vigorous long rhizomes. It flowers gregariously, with a flowering cycle of 30-45 years. In the season before flowering no new shoots are produced. Flowering is in December or January and may continue for about 10 years over a tract that is sometimes called a flowering wave. Harvesting may start 5-6 years after planting. Young shoots are harvested in the rainy season.

Uses: It is for building houses, thatching, hats, basket, food grain containers and cages for hen.

Propagation and Planting Technique: It can be propagated by seed, single-culm clump division and rhizome and culm cuttings. When seeds are available they are the best means of propagation. They are sown in a nursery and seedlings are transplanted to the field in the rainy season or directly sown in the field. Normally seed remains viable for about 35 days.



Storage in air-conditioned rooms increases its lifespan up to 45 days, and when stored with dry sand in gunny bags, up to 60 days. Germination starts within 10 days after sowing and rhizome development begins 30-40 days after germination. Due to its tall and soft stem, the seedling gets easily damaged during handling and transportation. Therefore chopping the seedling stem tips at 3-5 nodes is recommended. Most convenient for the propagation of *M. baccifera* is a single-culm clump division. These should be made from the youngest culms, while the lateral buds of the rhizome are still dormant, or before they have pushed more than 5.0-7.5 cm. Propagation with rhizome cuttings is easy and successful. In fact the rhizomes are very vital and start growing easily. Due to this, eradication of *M. baccifera* from cleared bamboo forest is very difficult because every rhizome part left in the ground quickly develops into a new plant.

M. baccifera can be propagated by seed (fruit), single-culm clump division, and rhizome and culm/branch cuttings. When seeds are available they afford the best means of propagation. Germination starts within 10 days after sowing and rhizome development begin 30-40 days after germination. Seed usually germinates very promptly upon maturing, even while the fruit is still on the mother plant, procurement of fruits

from a distance presents special problems. Germination percentage is higher (80%) in shade than in sunlight (33%). Early produced seeds (May-June) germinate better than later ones (September). Normally seed remains viable for about 35 days. Seeds are gradually sown in a nursery and seedlings are transplanted to the field in the rainy season or directly sown in the field.

50. *Schizostachyum dullooa* (Gamble) R. B. Majumdar

Family: Poaceae

Mizo Name: Rawthlaw

Common Name: Dolu bamboo

Distribution: It is found in Thingbuultlong near Kolasib, Buangouui near Thenzawl, Serchhip, bank of river Tuuichange, Longtlei, Phaipeng area, Saiha, Sunchluumuual, Sialsuuk forest, Dampa tiger Reserve and Damperengpui. It generally occurs along river side and nallahs in moist shady places at an altitude up to 1000 m in Mizoram.

Description: It is a medium sized bamboo, tufted, sometimes more or less scandent. The culms, which can be erect, leaning, or scandent, are 4-9 metres long; 2.5-7.5 cm in diameter. Young shoots sheaths purple towards the margin, black or blackish-green.

Uses: It is used for making kites, Mizo looms, quivers, mats, baskets, umbrellas, small boxes and construction of houses. It's also used for cooking of glutinous rice by the Mizo. It's young shoots are eaten and cooked as vegetables.



Propagation and Planting Technique:

Propagation is through culm cutting, ground layering and seedling macropropagation.

Conclusion

Fifty suitable multipurpose forestry tree species of Mizoram were identified for developing a manual describing the nursery and plantation practices. These identified species can be used for enrichment plantation, agroforestry and other afforestation programmes for the implementation of REDD+ activities. In this manual, out of the total selected species about thirty six selected species have medicinal value which are used by the local communities for cure of various disorders.

Detail information provided in this manual on nursery & plantation practices can be used by the different stakeholders (frontline staff of State Forest Department, field practitioners and local communities) for raising planting stock of selected species of Mizoram. The identified tree and bamboo species can play an important role in the implementation of REDD+ forestry plantation and agroforestry related activities in the state of Mizoram.

Literature Cited

- Arun, R. Silambarasan, S., Senthil, K. and Jacob, J.P. (2016). Sap Feeders and their Management in Multiplication Garden of *MeliaDubia*. *My Forest* (March-December), Volume 52, Issue 1-4: 57-62.
- Bargali, K. (2011). Actinorhizal plants of Kumaun Himalaya and their Ecological Significance. *African Journal of Plant Science*, Volume 5(7): 401-406.
- Bhatt, I.D., Rawal, R.S. and Dhar, U. (2000a). Improvement in seed germination of *Myricaesculenta* Buch.- Ham. Ex D. Don- a high value tree species of Kumaun Himalaya, India. *Seed Science and Technology*, Volume 28: 597-606.
- Bhatt, I.D., Rawal, R.S. and Dhar, U. (2000b). The Availability, Fruit Yield, and Harvest of *Myricaesculenta* in Kumaun (West Himalaya), India. *Mountain Research and Development*, Volume 20(2): 146-153.
- Blatter, E. and Millard, W.S. (1997). *Some Beautiful Indian Trees*. Second Edition. Bombay Natural History Society. Oxford University Press, Great Clarendon Street, Oxford, 160 pp.
- Brandis, D. (1874). *The Forest Flora of North-West and Central India: A Handbook of the Indigenous Trees and Shrubs of those countries*. W.M. H. Allen & CO., 13 Waterloo Place, S.W., London.
- Brandis, D. (1906). *Indian Trees: An Account of Trees, Shrubs, Woody Climbers, Bamboos and Palms Indigenous or Commonly Cultivated in the British Indian Empire*. London, Archibald Constable & CO Ltd., 16 James Street Haymarket S.W.
- CABI. (2013). *The CABI Encyclopedia of Forest Trees*. UK.
- Champion, H.G. & Seth, S.K. (1968). *A revised survey of the forest types of India*. Delhi: Government of India Press, 404pp.
- Chandra M (2010) *Feasibility Study on Establishing of Short Rotation Plantation (SRP) for Sustainable Biomass & Bioenergy Supply in Forest and Hilly Areas in Bangladesh*. Bangladesh Agricultural University, Mymensingh, Bangladesh. 146 pp.
- Das, M.C., Nath, A.J. and Das, A.K. (2015). Mensurational studies on *Schizostachyumdullooa* - a thin walled tropical clump forming bamboo. *Journal of Bamboo and Rattan*, Vol. 14 (1-4), 63-73.
- Devi, M., Darlong, L. and Bhattacharyya, D. (2014). *Dendrocalamuslongispatus* (Poaceae: Bambusoideae) in sporadic bloom in Tripura, India. *NeBIO I, An International Journal of*
- Kanjilal, U. (1928). *Forest Flora of the Chakrata, Dehradun and Saharanpur Forest Division, United Provinces: Being Revised and Enlarged Edition of the Forest Flora of the Siwalik and Jaunsar Forest Divisions, U.P., Third Edition*, Govt. of India, Calcutta, 558 pp.
- Kumar, R.K., Channarayappa, Prasanna, K.T. and Gowda, B. (2012). Evaluation of *Aphanamixispolystachya* (Wall.) R. Parker as a potential source of biodiesel. *Journal of Biochemical Technology*, Volume 3 (5): S128-S133.
- Lee S.H., Ng, A.B.C., Lim, R.C.J., Francisco, R., Ng, W.Q., Ng, X.Y., Neo, L., Yee, A.T.K., Chong, K.Y. and Tan, H.T.W. (2013). Status and Distribution in Singapore of *Ficusvirens* Aiton (Moraceae). *Nature in Singapore*, Volume 6: 223-227.
- Luna, R.K. (2005). *Plantation Trees*. International Book Distributors, Dehradun, Uttarakhand. 1-975 p.
- Lutzow-Felling, C.J., Gardner, D.E., Markin, G.P. and Smith, C.W. (1995). *Myricaefaya: Review of the Biology, Ecology, Distribution, and Control, Including an Annotated Bibliography*. Cooperative National Park Resources Studies Unit, University of Hawaii at Manoa, Honolulu, Technical Report 94: 1-114pp.
- Negi, S.S. and Naithani, H.B. (1995). *Oaks of India, Nepal and Bhutan*. International Book

- Distributors, Dehradun, India. 266pp.
- Pundir, S., Tomar, S., Upadhyay, N. and Sharma, V. (2015). Antioxidant, Anti-Inflammatory and Analgesic Activity of Bioactive Fraction of Leaves of *Myricaesculenta* Buch.-Ham along with its Pharmacognostic and Chromatographic Evaluation. *International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)*, Volume 4(12), 6509-6524.
- Rai, Y. (2014). Growth and Development of Medicinal Endangered Tree Species *Aphanamixis polystachya* (Wall.) Parker in District Meerut, (U.P.) India. *International Journal of Multidisciplinary and Current Research*, Volume 2: 755-758.
- Rawat, V.R.S., Rawat R.S. and Verma, N. (2017). Drivers of Deforestation and Forest Degradation in Mizoram. *Indian Council of Forestry Research and Education (INDIA)*.
- Regupathy, A. and Ayyasamy, R. (2013). Occurrence of Insects in Great Neem, *Meliadubia* Cav. - Pest Risk Assessment. *Forest Health Management, Insect Pests, Diseases and Invasives*, 354-361.
- Risdale, C.E. (1978). A Revision of *Mitragyna* and *Uncaria* (Rubiaceae). *Blumea*, Volume 24: 43-100.
- Roy, S.S., Kumar, S., Sharma, S.K., Devi, A.R., Singh, N.A., Prakash, N. and Ngachan, S.V. (2016). Tree Bean (*Parkia roxburghii*): A Potential Multipurpose Tree Legume of North East India. *National Symposium on Vegetable Legumes for Soil and Human Health*, 201-208.
- Sahni, K.C. (1998). *The Book of Indian Trees*. Bombay Natural History Society. Oxford University Press, Oxford House, Mumbai.
- Sawmliana, M. (2013). *The Book of Mizoram Plants (Includes Wild Animals, Birds, etc.)*. Second Edition (Revised & Enlarged). Lois Bet, Print & Publication, Aizawl. 1- 472 p.
- Shah, S. (2005). *Regeneration and Nursery Technique of Myricaesculenta*. Ph.D. Thesis Submitted to Kumaun University, Nainital. 146pp.
- Storrs, A. and Storrs, J. (1998). *Trees and Shrubs of Nepal and the Himalayas*. Book Faith India, Delhi, 367 pp.
- Troup, R.S. (1921). *The Silviculture of Indian Trees*. 3 Volumes. Clarendon Press, London.
- Warrier, R.R. (2011). *Meliadubia* Cav. Synonyms: *Meliacomposita* Willd., *Meliasuperb* Roxb. *Money Spinning Trees 2*. Institute of Forest Genetics and Tree Breeding (Indian Council of Forestry Research and Education), Coimbatore, Tamil Nadu.

Acknowledgement

International Centre for Integrated Mountain Development (ICIMOD), Kathmandu, Nepal
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Germany
Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, Germany
Forest Research Centre for Bamboo and Rattan (FRCBR), Aizawl, Mizoram
Department of Environment, Forest and Climate Change, Mizoram

Guidance and Support

Dr. Suresh Gairola, Director General, ICFRE
Mr. S.D. Sharma, Dy. Director General (Research), ICFRE
Mr. V.R.S. Rawat, Expert Consultant, ICFRE
Dr. H.B. Naithani, Taxonomist, FRI, Dehradun
Mr. K. Kire, APCCF, Department of Environment, Forest and Climate Change, Mizoram
Mr. M.Z. Singson, Head, FRCBR, Aizawl, Mizoram
Local communities of project area of Mamit District, Mizoram
Photo Credit : Dr. H.B. Naithani, FRI





