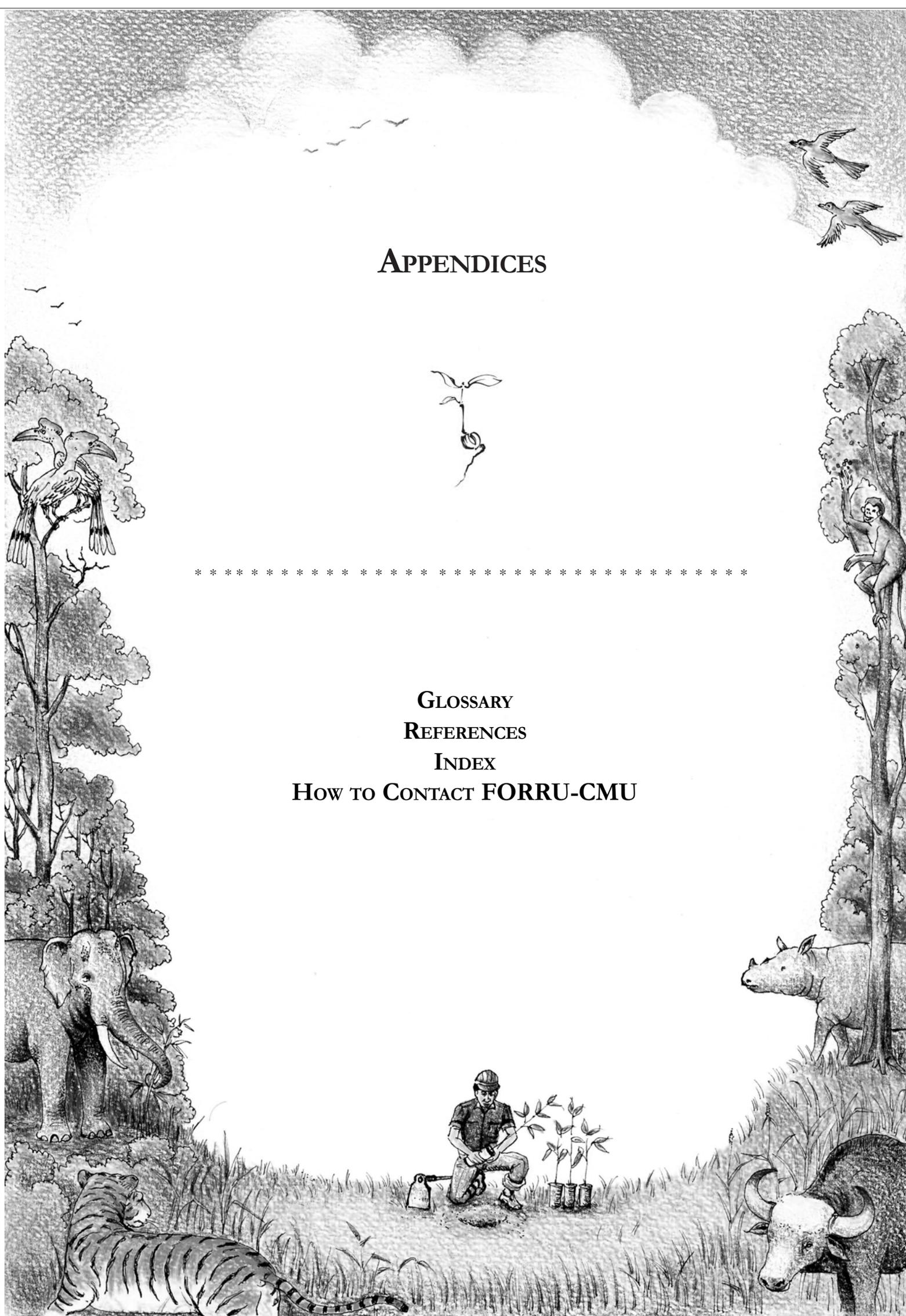


# APPENDICES

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## BIODIVERSITY CONSERVATION IS THE ULTIMATE AIM OF FOREST RESTORATION



*Indian Pied Hornbill  
- an important  
disperser of large  
tree seeds.*

*Evergreen forest at 1,300 m elevation in Doi  
Suthep-Pui National Park, part of northern  
Thailand's natural heritage*



*One of Thailand's  
many butterfly  
species - insects are  
by far the largest  
component of  
biodiversity.*



*Crocodile Sala-  
mander - one of  
many endangered  
species that benefit  
from forest restora-  
tion.*



*Sambar Deer -  
many large  
mammals are  
becoming rare  
due to hunting.*



*Unlike other forms of reforestation, forest restoration focuses on conserving as many of the species that formerly lived in the original forest ecosystem as possible. Northern Thailand's forests support at least 3,450 vascular plant species (including 1,116 trees) (CMU Herbarium Database); 383 bird species (Round, 1988) and 150 mammal species (Lekagul and McNeely, 1988), as well as many endangered species such as the Crocodile Salamander (bottom left). The number of insect species is so high (probably tens of thousands), it has yet to be properly counted, but it includes at least 500 butterflies. Forest destruction is the main threat to these species; forest restoration could be their salvation.*



## GLOSSARY

**Accelerated (assisted) natural regeneration ANR:** management actions to enhance the natural processes of forest succession.

**Achene:** a small, dry, indehiscent, one-seeded fruit with thin pericarp.

**Acorn:** fruit of oaks; a nut with a cupule.

**Acuminate:** apex with concave sides, tapering to an extended point

**Alternate:** placed singly along a stem or axis (not opposite or whorled).

**Angiosperms:** one of the main divisions of flowering plants, containing plants that have ovules enclosed in an ovary.

**ANOVA:** analysis of variance. A statistical test to determine significant differences among experimental treatments or species *etc.*

**Anther:** the part of the stamen which produces pollen.

**Apex:** the tip, *e.g.* of a leaf.

**Aril:** a fleshy, usually brightly coloured extra cover of a seed (arising from the hilum), which is free from the seed.

**Axillary:** positioned in the angle formed by the upper side of a leaf and the stem.

**Axis:** the central line of symmetry of a plant or plant part.

**Bark:** tough outer covering of woody stems or roots.

**Berry:** a simple fruit, developing from a single pistil, usually small, with several seeds within a juicy mesocarp.

**Biodiversity:** the variety of life encompassing genes, species and ecosystems.

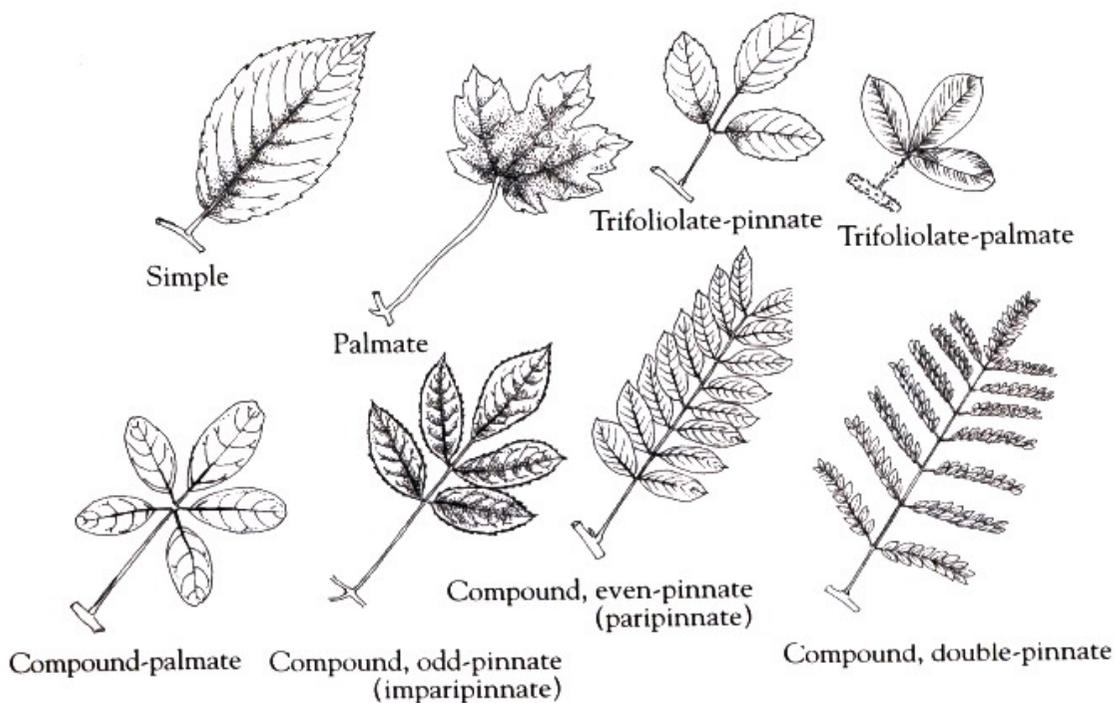
**Bimorphic:** having two forms.

**Bivalved:** with two valves.

**Blade:** the expanded part of a leaf or petal.

**Bole:** stem or trunk of a tree.

### Leaf Types



**Bud:** an undeveloped (or dormant) leaf, flower or shoot protected by scales (bracts).

**Buttress:** a vertical projection at the base of a tree trunk, originating from a lateral root.

**Calyx:** united sepals of a flower.

**Capsule:** a one- to many-seeded, dry fruit, which splits into valves when ripe.

**Carpel:** the ovary, stigma and style.

**Climax forest:** undisturbed, stable, forest at maximum development in terms of structure and species composition, determined by soil and climatic conditions.

**Community forest:** a forest that is managed collectively by local people.

**Compound:** with more than one similar parts in one organ e.g. leaves.

**Coppicing:** with many shoots growing out from tree stumps.

**Corolla:** united petals of a flower.

**Cotyledon:** seed leaf; part of the embryo of a seed plant.

**Cupule:** enclosing structure, originating from the base of nuts formed of dry, enlarged bracts e.g. around nuts of *Quercus* and *Lithocarpus* species.

**Cyme (adjective cymose):** a type of branching inflorescence, in which the central and terminal flower opens first.

**Damping-off:** various fungal diseases, which attack young seedlings, causing stem collapse and death.

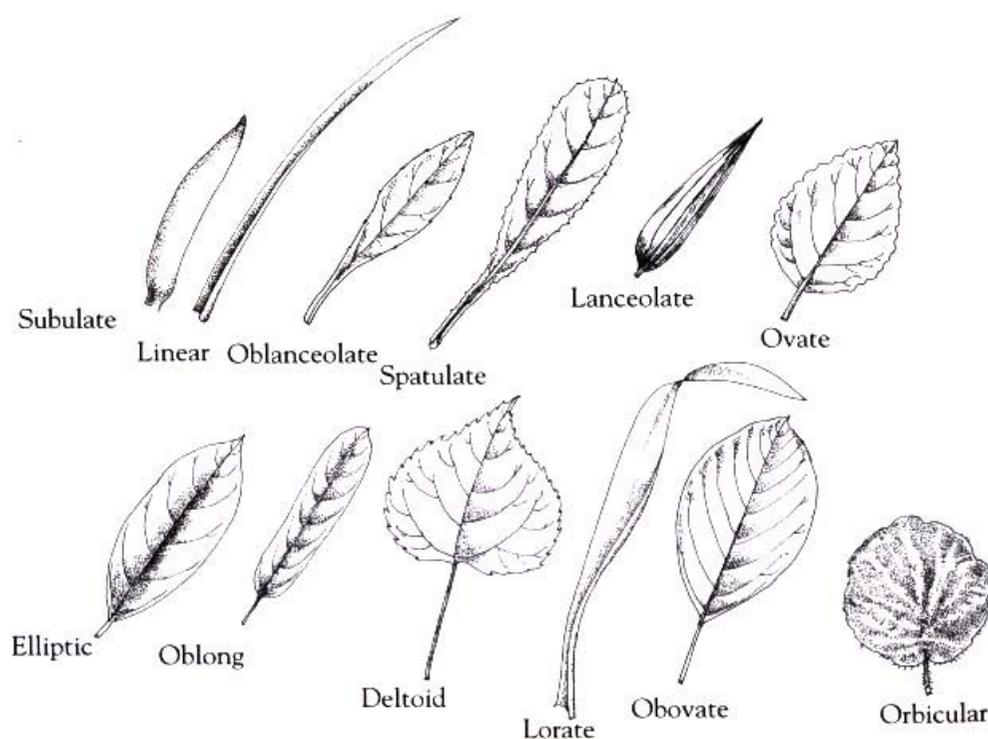
**Deciduous:** shedding leaves annually or periodically; not evergreen.

**Dehiscent:** splitting open (see capsule)

**Dicotyledon:** one of the two great divisions of Angiosperms, having embryos with two seed leaves or cotyledons.

**Dormancy:** the period between seed dispersal and germination, during which germination is delayed, despite suitable conditions prevailing.

## Leaf Form



## Leaf Shapes - Quick Definitions

Length/width	Widest at the:		
	Apex	Middle	Base
+/- 1		Orbicular	
1-2	Obovate	Elliptic	Ovate
2-3	Obovate-oblong	Oblong	Ovate-oblong
3-5	Obovate-lanceolate	Lanceolate	Ovate-lanceolate
5-10		Linear-lanceolate	
10+		Linear-subulate	

J. F. Maxwell

**DNP:** The Thailand Government's Department of National Parks, Wildlife and Plant Conservation.

**Drupe:** a fleshy fruit, in which one or more seeds are enclosed within a stony inner layer (endocarp).

**Ecology:** the scientific study of the factors determining the distribution and abundance of plants and animals.

**Ecosystem:** any area or space, within which living organisms and the non-living environment interact to bring about an exchange of materials between the living and non-living parts of the system.

**Elliptic:** refers to a shape (usually a leaf) that is widest in the middle and tapers towards both ends.

**Embryo:** rudimentary shoot and root within the seed.

**Emergent:** arising above the soil, becoming visible; or describing a tree with a crown rising above the main forest canopy.

**EMR:** East Malling Research, U.K., FORRU's Darwin Project Partner (formerly HRI).

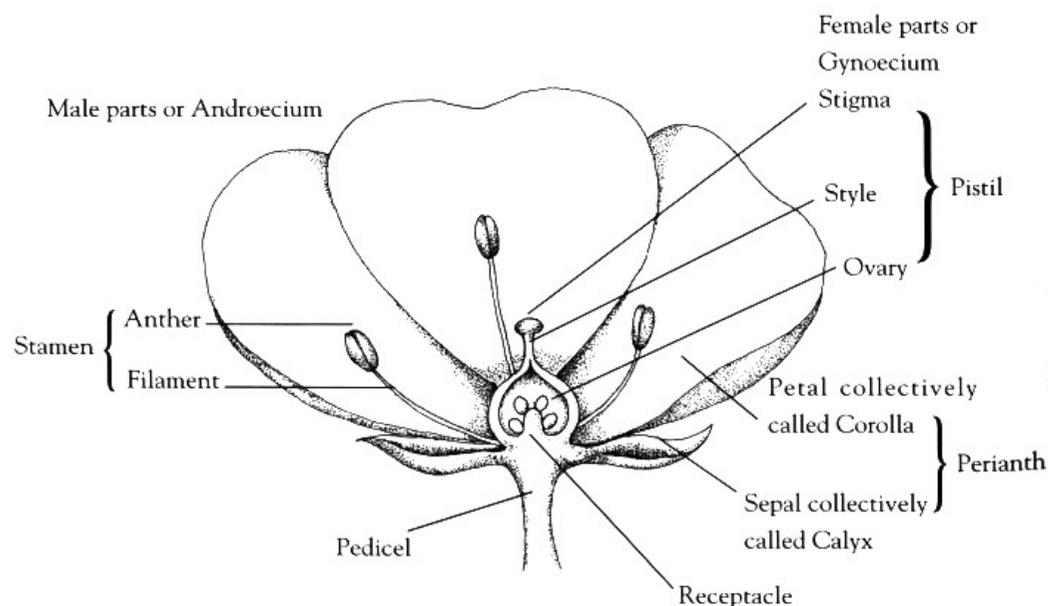
**Endemic:** indigenous to and confined to a particular area.

**Endocarp:** the inner layer of the pericarp or fruit wall.

**Endosperm:** tissue formed from the embryo sac, which stores nutritive material in seeds.

**Entire:** of leaf margins - not toothed or divided in any way.

## Flower Parts



**Epicotyl:** the part of a seedling above the cotyledons that gives rise to the stem and leaves.

**Epiphyte:** (adjective **epiphytic**): a plant growing upon, but not nourished by, another plant.

**Epilithic:** growing on rocks.

**Evergreen:** a plant that retains green foliage throughout the year.

**Exocarp:** the outer layer of the pericarp or fruit wall.

**Exotic:** of species - introduced, not native.

**Extirpation:** the disappearance of a species from a local area.

**Extinction:** the complete loss of a species globally; when no more individuals of a species exist.

**Fire break:** a strip of land cleared of vegetation, to prevent the spread of wild fires.

**Fissure:** longitudinal splits or cracks.

**Flower:** the structure for sexual reproduction in the Angiosperms, usually consisting of male organs (comprising the stamens) and female organs (comprising the pistils).

**Forest landscape restoration (FLR):** integrated management of all landscape functions in deforested or degraded areas to regain ecological integrity and enhance human well-being; usually including some forest restoration.

**Forest restoration:** any activity aimed at re-establishing the forest ecosystem originally present on a deforested site before deforestation occurred; one particular kind of reforestation.

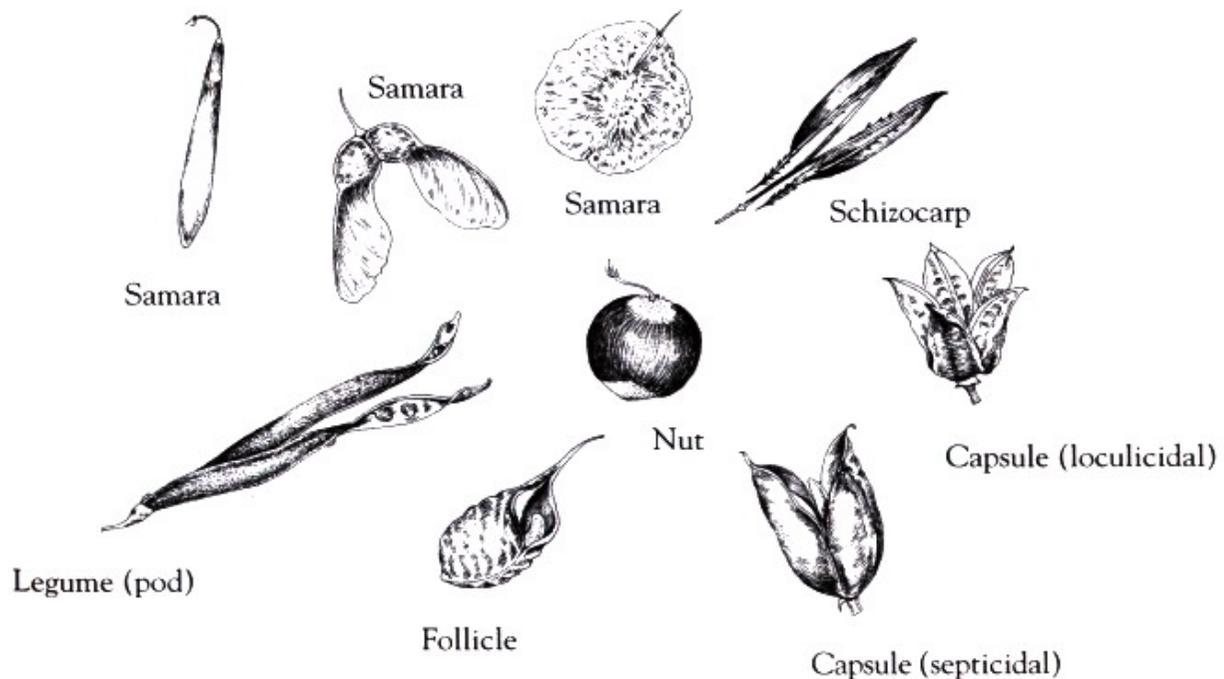
**Framework species method:** planting indigenous forest tree species, which can rapidly re-establish canopy cover and attract seed-dispersing wildlife, to accelerate forest regeneration and biodiversity recovery.

**Fruit:** the ripened ovary bearing the seeds.

**Funicle:** the connection between an ovule and its placenta.

**GBH = girth at breast height:** the circumference of a tree trunk measured 1.3 m above the ground.

## Dry Fruit Types



**Genus:** a group of closely related species.

**Glabrous:** not hairy.

**Gland:** a secreting organ, often dot or wart-like, either on the surface of or embedded in tissue.

**Glaucous:** with a waxy, greyish-blue bloom.

**Globose:** spherical, round.

**Glomerule** (adjective **glomerulate**): a dense cluster of short-stalked flowers.

**GP = germination percent:** the number of seeds which germinate divided by the number sown, multiplied by 100.

**ha (Hectare):** an area of land equal to 10,000 square metres.

**Habit:** the characteristic growth form of a plant species *e.g.* as a tree, shrub, herb *etc.*

**Hardening-off:** the process of gradually acclimatizing seedlings in the nursery to the conditions they will be subject to after planting out.

**Herbarium:** a collect of dried plant specimens for scientific study.

**Hemiparasitic:** partially parasitic; plants that absorb nutriment from other plants, but retain green tissues that carry out photosynthesis.

**Hilum:** a scar left on a seed where it was previously attached to the funicle.

**HRI:** Horticulture Research International; the former name of EMR.

**Hypocotyl:** the axis of an embryo below the cotyledons, which, on germination, produces the radicle.

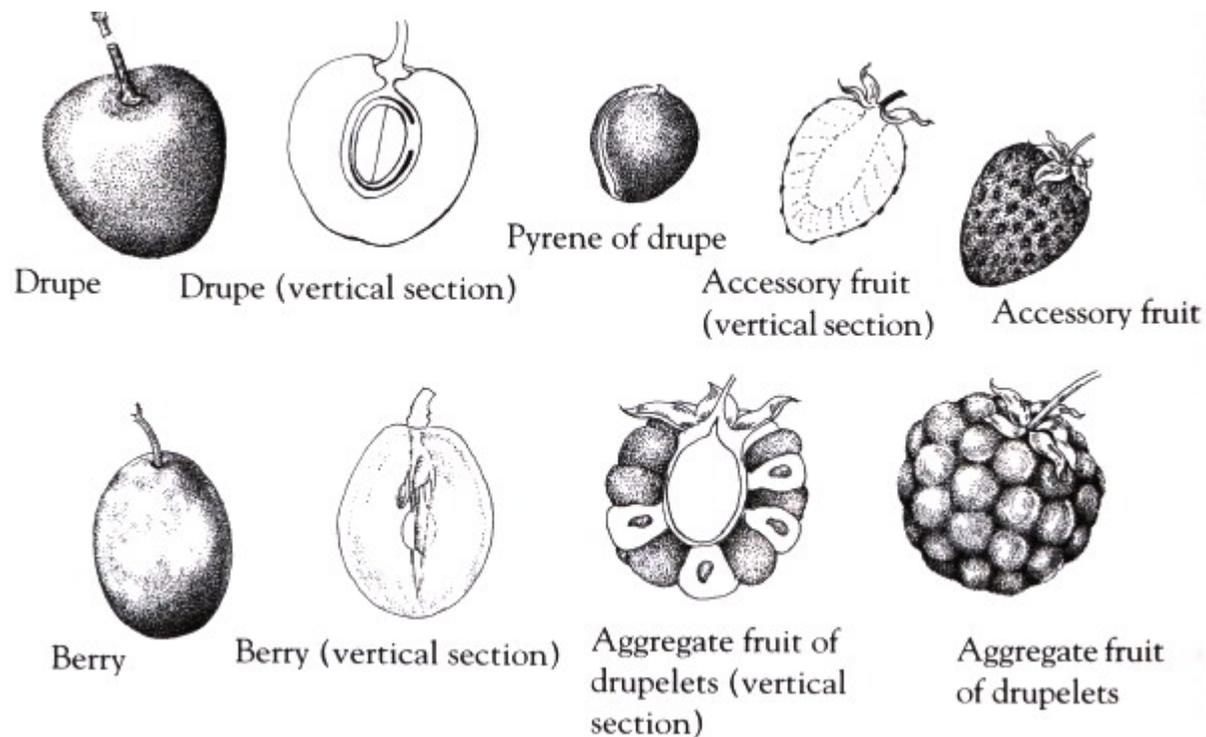
**Imparipinnate:** odd-pinnate; with an unequal number of leaflets.

**Indehiscent:** not splitting open (*e.g.* of fruits).

**Indigenous:** native to an area, not introduced: the opposite of exotic.

**Inflorescence:** the arrangement of flowers along a floral axis; a cluster of flowers.

## Fleshy Fruit Types



- Infructescence:** a cluster of fruits derived from an inflorescence.
- Internode:** a length of stem between two adjacent nodes.
- Lanceolate:** shaped like the head of a spear or lance, with the widest part at the middle.
- Lateral:** on or at the side.
- Leaf-exchanging:** young leaves flushing more or less at the same time as senescent leaves are shed.
- Leaflet:** lateral axis of a compound leaf.
- Legume:** a dry fruit of one carpel, often splitting along one or both sides.
- Lenticel:** a pore in a stem, often surrounded by a raised corky margin, for gaseous exchange.
- Lenticellate:** bearing lenticels.
- Lignified:** becoming woody, due to thickening of cell walls by deposition of lignin.
- Lobe:** any curved or rounded part or segment of any organ; specifically a part of a petal; calyx or leaf blade.
- Locule:** ovary chamber, containing the ovules or anther chamber containing the pollen.
- Longitudinal:** along the vertical axis of an organ.
- Margin:** the outer edge of *e.g.* a leaf blade or petal.
- Masting:** mass fruiting erratically, once every several years, a common fruiting pattern amongst species of the family Fagaceae.
- Mesocarp:** the middle layer of the fruit wall or pericarp.
- Midrib/mid-vein:** the primary vein of *e.g.* of a leaf blade.
- MLD median length of dormancy:** the number of days between sowing seeds and germination of half the seeds that eventually germinate.
- Monocarpic:** flowering and fruiting once only, followed by death.
- Monocotyledon:** one of the two great divisions of angiosperms; embryos with one cotyledon.
- Monopodial:** with a simple main stem, growing from the apex and having lateral branches.
- Mychorrhiza:** a mutualistic association between vascular plant roots and fungi.
- Nectar:** a sugary solution, secreted by many flowers, which attracts animal pollinators.
- Node:** the point on an axis where leaves, flowers *etc.* are borne.
- Nut:** a simple, dry, one-seeded fruit with a hard pericarp.
- Oblong:** longer than broad, widest in the middle.
- Obovate:** the inverse of ovate, with the broadest part towards the top.
- Obovoid:** of *e.g.* a fruit, egg-shaped, with the base as the narrower end.
- Opposite:** leaf arrangement, in which the leaves arise opposite to each other at a node.
- Ovary:** the part of the flower containing the ovules and later the seeds, usually with one or more styles and stigmas.
- Ovate:** with an oval outline, broader towards the base than the apex and round-ended.
- Ovoid:** ovate in 3 dimensions, egg-shaped, attached at the broad end.
- Panicle:** a type of inflorescence with the main axis divided into branches, each bearing several flowers.
- Paniculate:** arranged in a panicle.



**Paripinnate:** a compound leaf divided into pairs of leaflets, with no terminal leaflet, *i.e.* an even number.

**Pectinate:** having tooth-like projections, like those of a comb.

**Pedicel:** the stalk of a single flower.

**Peduncle:** the stalk of an inflorescence.

**Peltate:** (of leaves) circular with petiole attached to the centre of the under-surface.

**Perianth:** collective term for the outer, non-reproductive parts of flowers (often differentiated into corolla and calyx).

**Pericarp:** the wall of a fruit, developed from the ovary wall, usually with three layers: exocarp, mesocarp and endocarp.

**Petal:** free parts of the second whorl of a flower.

**Petiolate:** having a petiole.

**Petiole:** stalk of a leaf.

**Petiolule:** stalk of a leaflet.

**Phenology:** the study of seasonal cycles of biological phenomena *e.g.* the periodic flowering and fruiting of trees.

**Pinnate:** compound leaf with leaflets along each side of a primary axis.

**Pistil:** the female parts of a flower, comprised of ovary; style and stigma.

**Pod:** the fruit of legumes, often splitting open along one valve.

**Pollen:** minute grains, containing the male reproductive cells of flowering plants.

**Pricking-out:** lifting seedlings from germination trays and potting them into containers.

**Primary forest:** undisturbed forest at maximum development in terms of structure and species composition (=climax forest).

**Pyrene:** a structure including the hard endocarp of a drupe and the seed(s) enclosed within.

**Raceme** (adjective **racemose**): an inflorescence with stalked flowers that are borne along an unbranched axis.

**Rai:** the standard unit of land area measurement in Thailand; equal to 1,600 square metres.

**Receptacle:** the enlarged extremity of an axis, bearing the flower. The walls of figs are receptacles.

**Reforestation:** planting trees to re-establish tree cover of any kind; includes plantation forestry, agroforestry, community forestry and forest restoration.

**RCD = root collar diameter:** the diameter of the root collar, usually measured with callipers, using a Vernier scale. The root collar is the point at which the above-ground parts of a plant meet the tap-root.

**RFD:** the Royal Thai Forest Department.

**RGR = relative growth rate:** Incremental growth, proportional to the average size of the plant during the measurement period. Allows growth to be compared amongst plants of different sizes.

**Root trainers:** containers with vertical ridges to direct root growth downwards and prevent root spiralling.

**Sapling:** a young tree, larger than a seedling, but not yet mature,

**Saponins:** a group of toxic soapy chemicals (glucosides).

**Saprophytic:** obtaining carbon and energy from the decomposition of organic matter.

**Sarcotesta:** a fleshy outer seed coat.

**Scarious:** membranous, dry parts that are not green.

**Seed:** the unit of sexual reproduction developed from a fertilised ovule, consisting of an embryo



enclosed within a testa, potentially capable of germination.

**Seed coat:** outer, protective covering of seed (testa).

**Seed predator:** any animal, which destroys seeds without successfully dispersing them.

**Seedling:** a very young plant, just after germination, which is still dependent on food reserves from the seed.

**Sepal:** free part of the outer envelope of a flower.

**Septum** (plural **septa**): wall between locules of an ovary.

**Septicidal:** dehiscence longitudinally through septa so that carpels are separated.

**Serrate:** toothed, like a saw, with teeth pointing forwards.

**Sheath:** the base of a leaf or leaf stalk that embraces the stem.

**Simple:** a leaf with one blade.

**Sinuous/sinuate:** (of margins) wavy.

**Spicate:** spike-like.

**Spike:** a simple unbranched inflorescence, bearing stalk-less flowers.

**Spiral:** with parts arranged in spirals.

**Stalk:** the 'stem' of any organ *e.g.* petiole, peduncle; pedicel; filament.

**Stamen:** the male reproductive organ of a flower, composed of a filament and anther, the latter producing pollen.

**Stem:** the main axis of a plant; leaf bearing and flower bearing, as distinguished from the root-bearing axis.

**Stigma:** the receptive part of the female reproductive organs, at the top of the ovary, on which pollen grains germinate.

**Stipule:** a leaf-like or scale-like outgrowth at the base of a petiole.

**Striations:** parallel longitudinal lines or grooves, *e.g.* on bark.

**Style:** the elongated apical part of a carpel or ovary, bearing the stigma at its tip.

**Subglobose:** nearly globose.

**Subopposite:** nearly opposite.

**Suborbicular:** nearly orbicular.

**Sympodial:** growth pattern, in which shoots cease to grow and one or more lateral buds, next to the apical bud, grow repeating the pattern.

**Syconium:** a type of fleshy multiple fruit, enclosed by a receptacle (*i.e.* a fig).

**Tannins:** a group of astringent chemicals in the bark and leaves of some tree species.

**Tepal:** a flower segment that is not clearly differentiated into a sepal or petal.

**Terminal:** at the tip or apex of an axis.

**Testa:** outer coat of a seed (developed from the integument).

**Thyrse** (adjective **thyrsoid**): densely branched inflorescence, broadest in the middle and in which the mode of branching is cymose.

**Toothed:** bearing small projections around the edge, as in the margin of some leaf blades.

**TNT = total nursery time:** the number of months required to grow saplings from seed sowing until optimal planting time (not including seed storage time).

**Treelet:** a small tree <5 m tall at maturity.

**Trifoliate:** a compound leaf having three leaflets.

**Tubercle:** small rounded protuberance.

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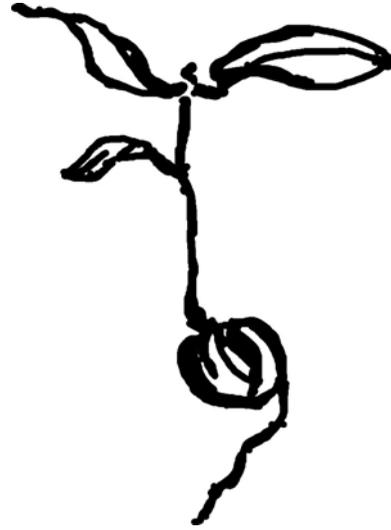
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*Above - Forest restoration is no longer a fantasy but a realistically achievable goal.*

*Back Cover - Children of Ban Mae Sa Mai proudly hold saplings of framework tree species, which they have helped to grow in their community tree nursery.*

