

# A54

## INNOVATIVE FARMING PRACTICES AND BIORESOURCE UTILIZATION PATTERNS

By tribals of Arunachal Pradesh, Northeast India

*Chowlani Manpoong and Shri Kant Tripathi\**

### Introduction

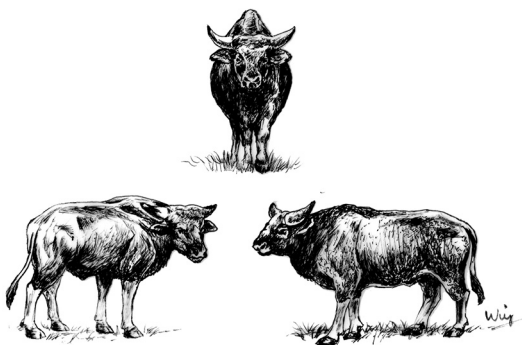
Northeast India is rich in indigenous farming practices, with a wide diversity of agroecological habitats that are inhabited by many ethnic groups. Traditional community-based farming is largely confined to hilly regions that were beyond the technology-transfer initiatives of the Green Revolution in the 1960s. The structure, organization and function of these farming systems differ significantly, depending on social, cultural, ecological and economic aspects.

The state of Arunachal Pradesh is a thinly populated hilly tract on the northeastern extremity of India, situated between 26° 28' and 29° 31' N latitudes and 91° 31' and 97° 31' E longitudes. It has international borders with Bhutan in the west, China in the north and northeast, Myanmar in the east, and interstate borders with Nagaland in the southwest and Assam in the south. It consists of 26 administrative districts and is well known for its ethno-culturally diversified population, consisting of 26 major tribes and more than 100 sub-ethnic tribes, all with unique livelihood practices. In 2012, the total population of Arunachal Pradesh was approximately 1.25 million, residing in a geographical area of 83,743 sq. km with a population density of about 17 people per sq. km. The major tribes include Adi, Apatani, Bugun, Galo, Hrusso, Singpho, Khamba, Koro, Memba, Meyor, Mishmi, Monpa, Nocte, Nyishi, Sajolang, Sartang, Sherdukpen, Tagin, Tai Khamti, Yobin, Tangshang, Tutsa and Wangcho. A demographic profile of 20 of the state's districts is shown in Table A54-1. A diversity of geographical, socio-economic, cultural and edaphic factors have endowed Arunachal Pradesh with rich natural resources and a suitability for growing tropical, sub-tropical and sub-temperate crops.

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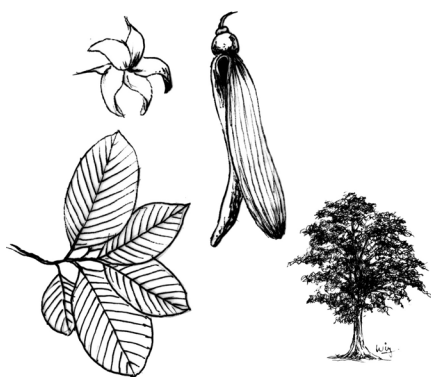
The state's diverse topographical and climatic conditions have favoured the growth of luxuriant forests. The richness of flora and fauna that occur in these forests presents a panorama of biological diversity with more than 5000 plant species, about 85 terrestrial mammals, more than 500 bird species and a large number of colourful insects and reptiles. The vegetation falls under four broad climatic categories and can be classified into five broad forest types with secondary forests as a sixth type. These are tropical forests, subtropical forests, pine forests, temperate forests and alpine forests. Degraded forests are commonly dominated by bamboos and other grasses. Within these forests, the state tree, *Dipterocarpus retusus* (commonly known as hollong) can be found, along with the state flower of Arunachal Pradesh, the foxtail orchid (*Rynchosyilis retusa*). The forests are also home to the state animal, the free-ranging mithun (*Bos frontalis*) and the state bird, the great hornbill (*Buceros bicornis*).



*Bos frontalis* [Bovidae]

Mithun, also known as *gayals*, are large, semi-domesticated bovines that inhabit the mountainous forests of northeast India, Bangladesh, Myanmar and China's Yunnan province. In northeast India they are kept by ethnic-minority groups in semi-wild herds, roaming freely in forested areas and watched over by village-appointed 'caretakers'.

These cattle are a valuable source of meat, particularly during festivals.



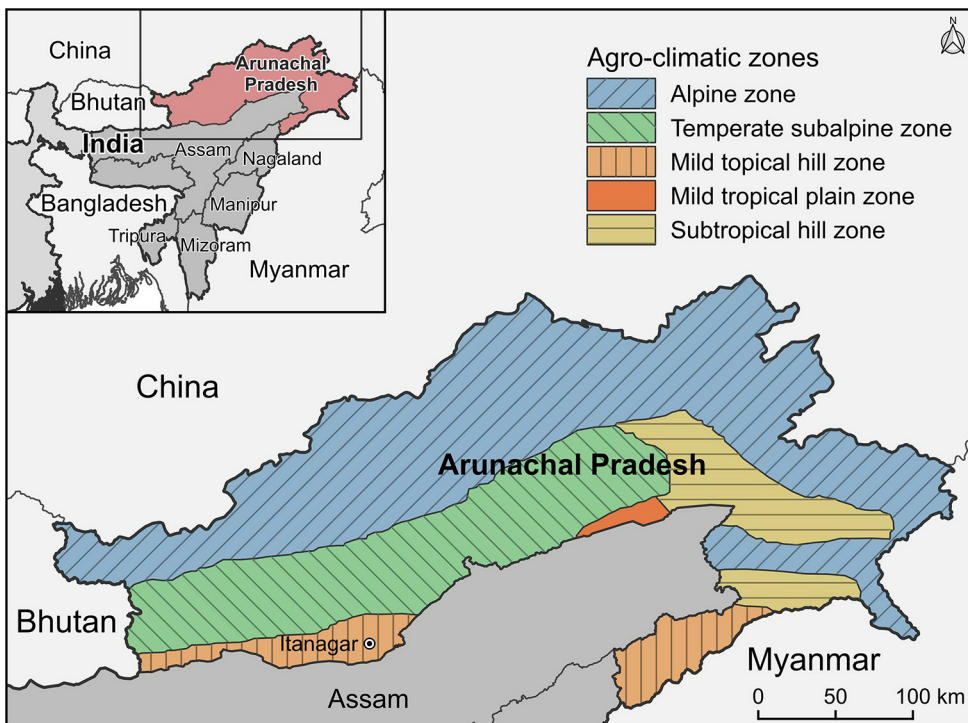
*Dipterocarpus macrocarpus* Vesque,  
a synonym of

*Dipterocarpus retusus* var.  
*macrocarpus* (Vesque) P.S.Ashton  
[Dipterocarpaceae]

Commonly known as hollong, this is the state tree of both Assam and Arunachal Pradesh. It is a large timber tree that grows to 30 m tall at altitudes from 800 to 1500 m, and is commonly harvested from the wild. It is classified as 'vulnerable' in the IUCN Red List of Threatened Species. Resin from these trees is used for torches and candles and as a dressing for wounds. The timber is used for construction and making furniture.

Agriculture is the state's main occupation and varying farming systems have been adopted to take full advantage of five climatic zones: a temperate subalpine zone, an alpine zone, a subtropical hill zone, a mild tropical plain zone and a mild tropical hill zone (see Figure A54-1). The diverse farming practices of indigenous communities range from various forms shifting cultivation to homegardens and sedentary systems such as wet-rice cultivation. Out of a net cropped area of 170,000 ha, 60% of it is used for shifting cultivation and rest is under upland or wetland terraces, or is valley land and plains. Rice accounts for a major 62.5% share of this latter area, followed by maize (16.2%), millets (12.4%), and horticultural crops including oranges, kiwifruit, apples, pineapples, bananas, tea and Areca nut.

Shifting cultivation is the predominant land use on the hill slopes of Arunachal Pradesh (Ramakrishnan et al., 1994). The dependency of tribal communities on age-old traditional slash-and-burn farming has been a prominent part of their livelihood system for many generations. However, the tribal communities are also involved in different farming practices. The Singphos and Tai Khamtis have been practising settled agriculture for many years, since they settled on suitable terrain in river valleys and on plateaux. Most of the Monpa, Miji, Sherdukpen, Aka, and Bugun peoples of West Kameng district manage temperate fruit orchards due to the climatic suitability of their area. Wet-rice-cum-fish cultivation, as practised by the Apatani tribe, is the



**FIGURE A54-1:** The agroclimatic zones of Arunachal Pradesh.

*Source:* Mishra et al., 2008.

**TABLE A54-1:** District-by-district demographic profile of Arunachal Pradesh.

<i>Districts</i>	<i>Area (sq. km<sup>2</sup>)</i>	<i>Population</i>	<i>Major tribes</i>
Anjaw	6190	21,167	Mishmi
Changlang	4662	148,226	Tangsa, Singpho, Tutsa, Nocte, Lisu
Dibang Valley	9129	8004	Idu Mishmi
East Kameng	4134	78,690	Nyishi, Akas, Miji, Puroik
East Siang	2703	74,100	Adi
Kra Daadi	2025	22,290	Nyishi
Kurung Kumey	4015	92,076	Nyishi, Puroik
Lohit	3625	110,313	Mishmi
Longding	1192	56,953	Wangcho, Nocte, Konyak
Lower Dibang Valley	3900	54,080	Idu Mishmi, Adi, Mising, Galo
Lower Subansiri	3508	83,030	Nyishi, Apatani
Namsai	1587	14,246	Tai Khamti, Singpho
Papumpare	3462	176,573	Nyishi, Adi, Apatani
Siang	2045	45,586	Adi
Tawang	2172	49,977	Monpa
Tirap	1170	111,975	Nocte, Wancho, Tutsa
Upper Siang	6590	35,320	Adi, Memba, Khamba, Idu Mishmi
Upper Subansiri	7032	83,448	Tagin, Nyishi, Galo
West Kameng	7180	91,802	Galo, Minyong, Bori, Bokar, Pailibo, Ramos, Memba
West Siang	7180	91,802	Galo, Minyong, Bori, Bokar, Pailibo, Ramos, Memba

most popular farming system in Lower Subansiri district. Tree-based farming is another widely practised farming system in most parts of the state. Homegardens are also a widespread means of boosting subsistence diets, with the choice of crops varying, both from region to region and tribe to tribe.

In addition to their diverse farming systems, the indigenous communities are also well known as hunters and gatherers. The rich bioresources of surrounding forests have resulted in non-timber forest products – wild plants – contributing more than half of family diets. Exploring the benefits of this biodiversity, members of the Tai Khamti tribe residing in the mild tropical plain zone, have learned to use wild plants as traditional medicines to treat various ailments. These activities and practices demonstrate the importance of conserving the indigenous knowledge of the tribal communities of Arunachal Pradesh. The farming systems are an essential aspect of indigenous communities and are linked to their traditions, rituals and cultural identities. Although times have changed, their agricultural practices have long remained unchanged.

## Traditional Houses

The people of Arunachal Pradesh are well known for their houses made from bamboo, which is the most economical and easily accessible construction material in the region. Each tribal group has its own traditional dwelling style with distinctly different designs and interiors (Figure A54-2). The houses are designed according to local needs, cultural traditions and availability of construction materials, and their size reflects the family customs of each tribal group. As well as bamboo, building materials include locally sourced timber, canes and leaves, and the houses are usually raised well above the ground on stilts tied with wooden beams. Roofs are made with rice straw, dried leaves of the fan palm locally called *toko* (*Livistona jenkinsiana*), or thatch grass. Life for villagers is tough, so the houses are designed to meet the challenges of nature.



*Livistona jenkinsiana* Griff.  
[Arecaceae]

These endangered fan palms, known locally as *toko*, are highly valued as a source of thatching for houses and other buildings. Their broad fan-like leaves are also used for making hats, fans, brooms and raincoats, and their edible metallic-blue fruit are reputed to have many health benefits. The slow-growing palms reach 15 m tall with a four-metre-wide crown, and the tribal people of Arunachal Pradesh are credited with playing a vital role in their conservation.

## Farming practices of various tribes of Arunachal Pradesh

### Shifting cultivation

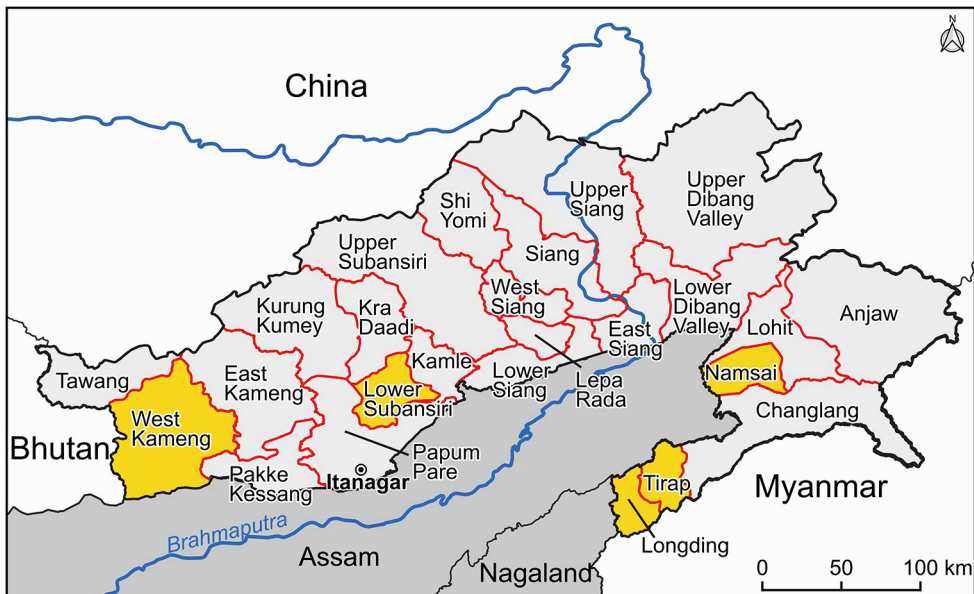
Shifting cultivation is the traditional slash-and-burn farming system locally known as *jhum kheti*, which has been a large part of tribal livelihood options over many generations. It is practised mostly on hill slopes (Wangpan et al., 2012; Wangpan and Tanjang, 2012). This is by far the most dominant farming system in the districts of Tirap and Longding, in the southeastern part of Arunachal Pradesh (see Figure A54-3). It is part of traditional culture and has evolved over many years – from long before Arunachal Pradesh was declared a state of India. The two districts are situated near Nagaland, to the south, and the area is influenced by the Naga way of life. Thus, most of the people in these two districts are Christians and the Naga influence extends to their practice of shifting cultivation. Basically, there are two major tribes, the Noctes and the Wangchos, involved in *jhum kheti*. Several decades ago, these tribes specialized in clearing forests, and they were hired by tribes in adjoining districts to exercise this expertise.





**FIGURE A54-2:** Traditional houses in Arunachal Pradesh: Houses in a Nocte village (top left); Nocte houses hugging a slope (top right); A house of the Adi tribe (bottom left); an Apatani house (bottom right).

*Photos: Chowlani Manpoong.*



**FIGURE A54-3:** The administrative districts of Arunachal Pradesh, with districts discussed in this chapter highlighted.

The Tirap and Longding districts are situated in a mild tropical hill zone (Figures A54-1 and A54-3) and its inhabitants, the Noctes and the Wangchos, are well known for their practice of shifting cultivation, community hunting, fishing and gathering forest products (Tanjung, 2009). Tirap is situated within the periphery of the Himalayan Patkai range and is bounded by Changlang district to the east, Longding district to the west, Assam to the north and Myanmar to the south. Longding district is bounded by Tirap district to the east, Nagaland to the west, Assam to the north and Myanmar to the south (Figure A54-3).

Traditionally, the Nocte worship nature, and their principal cosmic power is known as *jauban*. Their Animist beliefs are akin to those of native Americans, including a lore which says that after death, the spirit of a mighty chief becomes *laa* – a majestic eagle. Other malevolent and benevolent deities are also worshipped, and offerings of food and water are given to the gods in order to appease them. The principal harvest festival of the Noctes is *chalo loku*, in late November. *Loku* means ‘chasing out the old season’. The festival recalls timeless cultural traditions of the Nocte and is promoted as the best opportunity to see the tribe at its colourful best.

The Wangcho and Nocte tribes are ethnically related; their language belongs to the Tibeto-Burman family and both tribes retain animistic beliefs. The prime festival of the Wangchos is called *oriah*, and is held in March and April. For six to 12 days, the villages are alive with song, dance and prayer. Villagers exchange bamboo tubes filled with rice beer as a gesture of greeting and goodwill and pork skin is offered to the village chief as a mark of respect. The festival marks the sowing of *jhum* rice. Pigs, buffaloes and *nithun* are sacrificed and feasts are arranged in every dormitory (*murung*). Boys and girls, wearing ceremonial costumes, sing and are joined by others from the village to dance around a *jangban*, a tall ceremonial pole erected for *Oriah*.

*Jhum kheti* is closely linked to the ecological, socio-economic and cultural life of the tribal people and is closely connected to the rituals and festivals that revolve around the *jhum* fields and the events of the cultivation calendar (Table A54-2).

*Jhum*-based traditional farming in Tirap and Longding districts is considered to be a farming system with potential for sustainability and improving livelihoods. Traditionally, farmers of the Nocte tribe maintain a fallow period of between 8 to 10 years after the *jhum* crops have been harvested, so the forest can recover to secondary succession. The decomposition of litter is augmented, organic matter is deposited and soil nutrients are recycled. The tribal *jhumias* believe that shorter fallow periods and rapid crop rotations increase the threats of soil erosion and land degradation. After a fallow period of sufficient length, the slashing and subsequent burning – preconditions for shifting cultivation usually start near the end of November. Once the vegetation is slashed it is allowed to dry in the sun for three to four weeks and is then burnt *in situ* around the end of December.

The agrobiodiversity of *jhum* farming is another factor that leads *jhumias* to believe that their traditional *jhum kheti* is sustainable. The diversity of crops in *jhum* fields provides food security for the farming communities throughout the year. More than 20 crop species are cultivated, comprising cereals (*Oryza sativa*, *Zea mays*),

**TABLE A54-2:** Monthly calendar of events linked to upland-rice cultivation in shifting cultivation.

<i>Months</i>	<i>Cultural linkages</i>	<i>Agricultural activities</i>
Mid-November	Beginning of agriculture cycle.	Gifts offered to elders and relatives.
Late November	Relates to field preparation.	Slashing of vegetation.
Mid-December	Relates to field preparation.	Burning of slashed vegetation.
Early January	Relates to crop protection.	A shaman predicts the fate of the agricultural season.
Mid-January	Relates to sowing.	Festival prior to burning and planting for shifting cultivation.
Early February	Relates to crop germination.	Fields inspected to check for germination.
Late March	Relates to crop health.	Prayers offered to the spirits for a healthy crop.
Early April	Relates to crop health.	Evil spirits are warded off to ensure a healthy crop.
Early May	Relates to weeding.	Weeding of <i>jhum</i> field.
Mid-May	Relates to pests.	Prayers offered to spirits and pest-infected crops removed.
Early June	Relates to harvest.	Stones tied to a few crops to symbolize strength and prayers offered to spirits.
Late June	Relates to harvest.	Some newly ripened rice is harvested, prepared and eaten.
Mid-July	Relates to harvest.	Full harvest of crops.



*Eleusine coracana* (L.)  
Gaertn. [Poaceae]

Finger millet, which is native to the highlands of Uganda and Ethiopia, has three big advantages as a cereal crop for shifting cultivators: it can be grown at altitudes up to 2500 m; it is highly drought tolerant; and the unhusked grain can be kept for up to 10 years or more in good storage conditions, making it an important famine crop. High-level efforts are being made to expand finger millet cultivation to improve the nutrition of farming communities.



tuberous crops (*Manihot esculenta*, *Dioscorea* spp., *Ipomoea batatas*), vegetables (*Solanum melongena*, *Luffa cylindrica*, *Cucurbita moschata*) and spices (*Zingiber officinale*, *Coriandrum sativum*, *Capsicum* spp.) (see Table A54-3). Upland rice is the main crop and is grown in association with maize, finger millet, beans, cassava, yams, bananas, sweet potatoes, ginger, chillies, sesame and vegetables. Most of the field crops and vegetables are grown in a mixed cropping system. In the first year of cultivation on a *jhum* plot, upland rice, millets and maize are grown with cassava, taro (*Colocasia esculenta*) and vegetables. In the following second year of cultivation, upland rice is sown along with a few vegetable crops. After these crops are harvested, the plot is left fallow for about nine years. Many indigenous rice cultivars are cultivated in a single *jhum* plot. Each of them has a different traditional use in making various foods and beverages during festivals.

Shifting cultivation, as practised by the Nocte and Wangcho tribes, follows an ages-old procedure. A single large *jhum* plot is divided among the *jhumias*, with the borders of individual plots marked by carefully placed stones. The tasks of cultivation and involvement in cultural events are carried out together, as a whole. These farming practices indicate a unique spirit of togetherness and harmony among the *jhumias* throughout the year.

Encroachment of wild animals to plunder ripening crops has long been a problem for farming communities in Tirap district. A traditional technique for controlling this damage is the construction of fields huts giving a broad view of the *jhums* so that wild animals, including elephants, wild boars, birds and other wildlife can be driven away by loud noises (Figure A54-5, top right). In this case, the field hut is made of bamboo and rests on top of a truncated clump of bamboo culms. The structure is not only used to ward off unwanted wildlife, but is also a base from which the *jhumias* can hunt wild animals and gather non-timber forest products and a refuge of rest for busy farmers. The pursuit of sustenance is thus a constant preoccupation.



**FIGURE A54-4:** A shifting cultivation landscape (left) showing a recently cropped plot in the foreground, a newly burnt plot ready for planting beyond it, and a fallow plot targeted for future cultivation behind that. And (right) fire engulfs dry slashed vegetation as a newly opened plot is prepared for cultivation.

*Photos:* Chowlani Manpoong (left) and Cacap Lamma (right).



**FIGURE A54-5:** Shifting cultivation in Tirap district, Arunachal Pradesh. Women weeding a crop of upland rice (top left); a field hut built on a bamboo clump gives a clear view of marauding wildlife – including wild elephants – in a field of upland rice (top right); rice crops ready for harvest in a group of *jhums* viewed from above (bottom left); and the harvest leaves a bare patch between field huts (bottom right).

*Photos:* Chowhani Manpoong.

### ***Paddy-cum-fish cultivation of the Apatani tribe***

The Ziro valley is located in Lower Subansiri district and covers an area of 10,135 sq. km in what is the sub-Himalayan climatic zone (Figures A54-1 and A54-3). The area is mainly occupied by members of the Apatani tribe – a peaceful people with inquiring minds and a liking for inventing new things. They practise sedentary agriculture, involving wet-rice cultivation with fish, when shifting cultivation is the dominant agricultural system all around them. In 2014 the United Nations Educational, Scientific and Cultural Organization (UNESCO) recognized the cultural landscape of the Apatani as a World Heritage site, describing it as a living cultural landscape where man and environment have long existed together in a state of interdependence. Some cultural practices, however, were extraordinary. Apatani women became known for tattoos and stuffing large plugs of material into their noses to make them less attractive to invaders. Younger Apatanis have now largely rejected these practices. The staple foods of the Apatanis are rice, fish and pork, and this led to the development of their extensive wet-rice-and-fish cultivation practice. In addition, they have developed systems for cultivation of the abundant pine and bamboo in their region.

**TABLE A54-3:** Dominant plants in the shifting cultivation fields of Arunachal Pradesh.

<i>Botanical name</i>	<i>Local name*</i>	<i>Common name</i>	<i>Family</i>
<i>Oryza sativa</i>	<i>khau</i>	rice	Poaceae
<i>Zea mays</i>	<i>khaupha</i>	maize	Poaceae
<i>Triticum</i> spp.	<i>khaukehu</i>	wheat	Poaceae
<i>Setaria italica</i>	<i>khau hang ma</i>	foxtail millet	Poaceae
<i>Eleusine corocana</i>	<i>khau hang ma</i>	finger millet	Poaceae
<i>Cajanus cajan</i>	<i>tholeang</i>	pigeon pea	Leguminosae
<i>Manihot esculenta</i>	<i>maanhak leu</i>	cassava	Euphorbiaceae
<i>Dioscorea</i> spp.	<i>maan long</i>	yams	Dioscoreaceae
<i>Colocasia</i> spp.	<i>mon</i>	taro	Araceae
<i>Solanum tuberosum</i>	<i>maan kala</i>	potato	Solanaceae
<i>Ipomoea batatas</i>	<i>Maan sangpho</i>	sweet potato	Convolvulaceae
<i>Daucus carota</i>	<i>gajol</i>	wild carrot	Apiaceae
<i>Zingiber officinale</i>	<i>khieng</i>	ginger	Zingiberaceae
<i>Solanum nigrum</i>	<i>piten</i>	black nightshade	Solanaceae
<i>Capsicum annuum</i>	<i>emphit</i>	chilli	Solanaceae
<i>Coriandrum sativum</i>	<i>piki</i>	coriander	Apiaceae
<i>Allium sativum</i>	<i>ploching</i>	garlic	Amaryllidaceae
<i>Luffa cylindrica</i>	<i>moloei</i>	sponge gourd	Cucurbitaceae
<i>Cucurbita moschata</i>	<i>umpakham</i>	butternut squash	Cucurbitaceae
<i>Momordica charantia</i>	<i>makhaekhum</i>	bitter melon	Cucurbitaceae
<i>Cucumis sativus</i>	<i>teng</i>	cucumber	Cucurbitaceae
<i>Lycopersicum esculentum</i>	<i>maek</i>	tomato	Solanaceae
<i>Glycine max</i>	<i>thonao</i>	soybean	Leguminosae
<i>Sesamum indicum</i>	<i>nga khao</i>	sesame	Pedaliaceae

Note: \*Local names in the Tai Khamti language.

The Apatani cultural landscape is well known for the unique agricultural techniques practised within the community. Since time immemorial, the Apatanis residing in the Ziro valley have been cultivating wet rice (Tanjang and Nair, 2015). Their extensive wet-rice fields, surrounded by hills and mountains cloaked in pines, bamboos and other trees, are the source of two ‘crops’ of fish, keeping pace with the growing rice. The wet-rice-cum-fish cultivation is locally known as *ajii-nguyi* (Figure A54-6). The first batch of fish is usually introduced to the flooded fields before the rice seedlings are transplanted in late February or early March. Between 50 and 1000 fingerlings are introduced to each field, with the numbers depending on the size of the field, its location, water supply and freedom from the threat of flooding. The main fish species are common carp (*Cyprinus carpio*), grass carp (*Ctenopharyngodon idella*), silver carp (*Hypophthalmichthys rodepix*), rohu (*Labeo rohita*), catla (*Labeo catla*) and mrigal (*Cirrhinus mrigala*). The first batch of fish is usually harvested in mid-June and July, about the same time as a second batch is introduced to the ricefields. In the



second batch, the farmers use small fish from fish nurseries as well as half-grown fish from the first harvest, which are returned to the fields to grow to full size. The second batch of fish is reared for three to four months and harvested in September and early October, before the rice crop is harvested.

The wet-rice-cum-fish system is the primary occupation of the Apatani, providing a basic livelihood for the villagers. It is considered to be an economically viable farming practice that is highly efficient and helps to preserve the biodiversity of the area, which is closely linked to stability of the ecosystem. Their highly developed valley cultivation of rice, which has been perfected over centuries, has often led to the Apatani being regarded as a relatively advanced tribal society in the northeast Indian region.



**FIGURE A54-6:** Apatani farmers harvesting fish from their wet-rice-cum-fish cultivation system.

Source: Saikia and Das (2008).



### **Bamboo, pine and wet-rice agroforestry system**

Forests surrounding the Ziro valley are dominated by bamboo (*Phyllostachys reticulata*) and pine (*Pinus wallichiana*) trees. The abundance of these two species has led the Apatanis to develop an innovative cultivation system that combines bamboo, pine and wet rice. The pine forest is a human-managed system that occurs as privately owned, clan, or community forest. The monopodial bamboo species *Phyllostachys reticulata* is

*Phyllostachys bambusoides* Siebold & Zucc., a synonym of *Phyllostachys reticulata* (Rupr.) K. Koch [Poaceae]

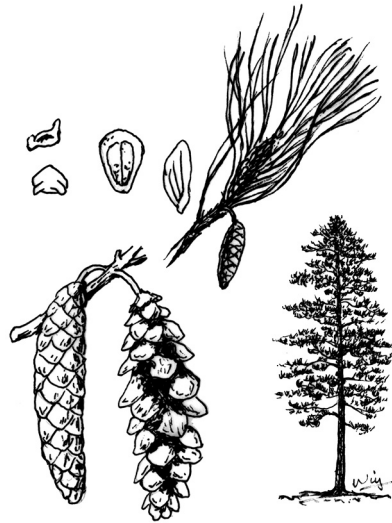
This species, known as timber bamboo, is preferred for construction and making furniture. It has very straight culms, reaching 20 m in height and 10 cm in diameter at the base. Plantations in China produce very large quantities of culms that are converted into board products and laminated flooring. The timber has long fibres and is highly flexible, even when split finely. This species flowers only once every 120 years, and then it dies. The last flowering was reported in the 1960s.

planted among young *Pinus wallichiana* trees that have been grown from seed. The resulting stand lives up to the observation that no trees other than pine could survive successfully in a bamboo grove, and similarly, no shrubs or small trees other than *Phyllostachys reticulata* could grow and survive alongside the pine trees. This belief led the indigenous farmers to conclude that bamboo and pine could be grown together as a sustainable land-use system.

In the bamboo, pine and wet rice system, the farmers begin by incorporating bamboo and pine with the utmost care (Tanjung and Nair, 2016). Pine saplings with soil attached to their roots are collected from nearby plantations and are planted at a spacing of about 4 m by 4 m. During the early years of growth, the lower branches are pruned regularly to promote upward growth and formation of straight poles that are required for construction purposes. The bamboo, locally called taniibije, is interplanted about four years later, when the pine trees are well established and about two meters high. The bamboo culms, about two years old and with rhizomes exposed, are selected and dug from an established bamboo garden with machetes during January and February and planted among the pines at a spacing of about 1.5 m by 1.5 m.

The bamboo matures in three years, which is often indicated by the shedding of leaves and the color around the nodes turning from green to yellow. Traditionally, it is recommended that three-year-old bamboo culms should be harvested every year in the months from October to February to ensure proper growth of new stems. An established plantation regenerates on its own and can be continuously harvested for a number of years. A mature bamboo clump survives for approximately ten years, after which it dies.

The management of bamboo and pine within wet-rice cultivation helps to enrich the soil with organic matter, bringing a long-term benefit to rice crops. The diverse microbial communities in the rhizosphere of both bamboo and pine play a vital role in enhancing soil fertility and productivity, thereby increasing rice-crop yields.



*Pinus wallichiana* (Wall.  
ex D. Don) A.B. Jacks.  
[Pinaceae]

Sometimes known as Bhutan pine, this species is native to the Himalaya, Karakoram and Hindu Kush mountains, growing to 60 m in height at altitudes ranging from 1800 to 4300 m. The wood is hard, durable and highly resinous, and is widely used in construction and joinery. It makes good firewood, but gives off thick, pungent smoke. Turpentine obtained from the resin is used to treat kidney and bladder complaints, respiratory and rheumatic ailments.



Both species – bamboo and pine – have proven to be economically and ecologically viable and capable of supplying a variety of basic rural needs, including timber, planks, poles, firewood and medicine. The bamboo poles are used for construction scaffolding and furniture making, as firewood and in religious and social activities. The pine timber is used mostly for construction and making furniture and a variety of handicrafts. Pine

timber is also split into fine thin sheets that are used as roofing material for traditional houses. Pine-tree products also have medicinal applications. Locally tapped pine oil or resin is used as a mosquito repellent and as an ointment for curing cracked heels. Local farmers also use pine needles as mulching material to reduce weed infestations in their crops.



**FIGURE A54-7:** The bamboo, pine and wet-rice agroforestry system.

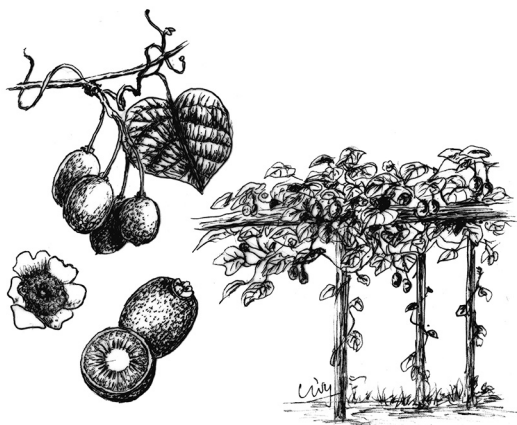
Photo: Oka Kuru.

### Fruit-based farming system

West Kameng district has a mountain ecosystem with steep hilly terrain. It is in the west of Arunachal Pradesh, and accounts for 8.86% of the state's total area. It is part of the temperate subalpine zone (Figures A54-1 and A54-3). With its lowest elevation of 213 metres above sea level (masl) on its southern border with the state of Assam, the district rises steeply to a maximum elevation of 7090 masl. The district is home to the Eagle's Nest Wildlife Sanctuary, covering 217 sq. km, and the Sessa Orchid Wildlife Sanctuary, covering 100 sq. km.

The inhabitants are Tibeto-Mongoloid people comprising six major tribes: the Monpas, Mijis, Akas, Sherdukpens, Thangras and Khawas. The economy is primarily dependent on agriculture and horticulture. The Monpas prefer permanent cultivation of selected crops, while the Akas, Mijis and Khawas live in lower elevations and practise shifting cultivation. The district is well known for its horticultural crops, including apples (*Malus domestica*), kiwifruit (*Actinidia chinensis* var. *deliciosa*), pears (*Pyrus communis*), peaches (*Prunus persica*), plums (*Prunus salicina*), oranges (*Citrus aurantium*) and walnuts (*Juglans regia*), because of its suitable climate. Horticulture helps to utilize wasteland, reduces the area used for shifting cultivation, prevents soil erosion along slopes and improves the socio-economic conditions of the people.

Kiwifruit are grown mainly in parts of Dirang and Bomdila administrative circles in the district's hilly tracts (Figure A54-8). Production has been boosted by implementation of scientific technology, selection of suitable sites and favourable



*Actinidia deliciosa* (A.Chev.)  
C.F.Liang & A.R.Ferguson, a  
synonym of  
*Actinidia chinensis* var.  
*deliciosa* (A.Chev.) A.Chev.  
[Actinidiaceae]

In the early 1900s, a New Zealand school principal returned from a trip to China with a handful of seeds. The vines that grew from them were known for more than 50 years as Chinese gooseberry. But one of the country's leading fruit merchants gave the increasingly popular fruit a new name: kiwifruit, after New Zealand's national bird. China, Italy and New Zealand are now its main producers, and the vigorous, woody vines with their succulent fruit are grown in the temperate subalpine zones of Arunachal Pradesh.

agroclimatic conditions. Apples are cultivated in high reaches, mostly in the administrative circles of Shergaon and Dirang (Figure A54-8). The farmers have developed locally innovative ideas to produce high-quality apples, including the use of good-quality germplasm. As a result, apples from Shergaon have gained wide popularity and the government of Arunachal Pradesh has adopted measures to improve the farmers' income. The fruit crops are mainly consumed by the local people, but are also sold in other parts of the country to generate food security in the communities of growers. As well as agriculture and horticulture, the local people also keep cattle, yaks, *mithun*,



**FIGURE A54-8:** Horticulture in West Kameng district, Arunachal Pradesh. Kiwifruit (left) and an apple orchard (right).

*Photos:* Netan.

sheep, goats, pigs and poultry, although commercial livestock farming is rare.

### Tree-based farming systems

A prominent farming system in Arunachal Pradesh involves the conservation of forest trees and bamboo in and around *jhum* land. The trees not only provide shade and support for understorey crops, but also system resilience at landscape level. Dominant trees include *Trema orientalis*, *Macaranga peltata*, *Alnus nepalensis*, *Castanopsis tribuloides*, *Dendrocalamus hookeri*, *Magnolia hodgsonii*, *Magnolia insignis*, *Gynocardia odorata*, *Quercus lancifolia* and *Bauhinia* spp. The main crops grown in tree-based farming systems are large cardamom, maize, mustard and ginger (Figure A54-9). An innovative step towards the avoidance of soil-moisture stress in these systems during dry seasons is rainwater harvesting using low-cost, easily available materials. The availability of trees and bamboos in *jhum* land and nearby forest ensures raw materials for house construction and firewood.

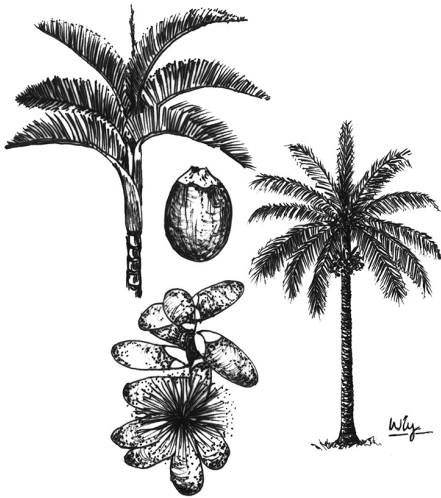
Homegardens with complex vegetation patterns and a high diversity of local plant species act as a sustainable agroforestry system supporting the livelihood options of the local people. Traditional homegardens are maintained for the survival of the rural people and to provide economic support (Figure A54-9). The structure and composition of homegardens depend on both their position in the overall farming system and on a family's livelihood strategies. Crop diversification is of the utmost significance. A wide range of species of differing strata and life forms adds to their ecological efficiency in terms of the use of water, sunlight and nutrients. Traditionally, the homegardens produce vegetables, fruit, medicinal plants and other cash crops to supplement the staple-food crops produced in open fields (Tanjung and Arunachalam, 2009). The size of traditional homegardens ranges from 0.05 to 0.27 ha, with four vertical strata of canopy species, understorey, shrubs and herbs. The canopy may consist of bamboos and timber species along with some fruit trees like *Mangifera indica*, *Cocos nucifera*, *Areca catechu*, *Artocarpus heterophyllus* and *Carica papaya*,



*Trema orientalis* (L.) Blume  
[Cannabaceae]

This fast-growing shrub or small tree grows to 18 m and is a common fallow species in shifting cultivation. It is valued as a shade tree, a pioneer species and a timber producer. It also produces animal fodder and a decoction of its bark and leaves is used to treat coughs, sore throat, asthma, bronchitis and gonorrhoea. The wood also produces fine quality charcoal, suitable for making gunpowder and fireworks.





### *Areca catechu* L. [Arecaceae]

This medium-sized palm tree, a native of the Philippines, is widely cultivated for its fruit – so-called betel nuts. The nuts are wrapped in a leaf of the Piperaceae vine *Piper betle*, along with slaked lime, and are chewed for their stimulant and narcotic effects. The ingredients, which are then spat out, pose a significant risk of cancer and numerous other health problems. It is estimated that 600 million people worldwide chew betel.

with an understorey of various *Citrus* species to provide fruit for daily household consumption, or medicinal species. Shrubs like *Clerodendrum infortunatum*, *Capsicum annuum* and *Hibiscus rosa-sinensis* are the most frequent components of the shrub stratum, whereas the herb stratum may be dominated by species like *Ageratum conyzoides*, *Achyranthes aspera* and *Centella asiatica*.



**FIGURE A54-9:** Tree-based farming systems in Arunachal Pradesh. Large cardamom under a canopy of *Trema orientalis* trees (top left); maize in a natural forest (top right); a traditional homegarden (bottom left); and tea growing beneath *Areca catechu* (betel-nut) palms (bottom right).

Photos: Chowlangi Manpoong.

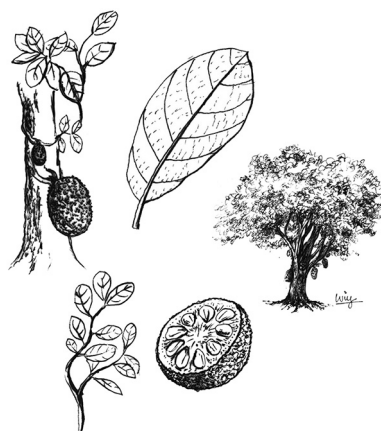
**TABLE A54-4:** Plant diversity in traditional homegardens.

<i>Tree species</i>	<i>Family</i>	<i>Shrub species</i>	<i>Family</i>
<i>Areca catechu</i>	Arecaceae	<i>Capsicum annuum</i>	Solanaceae
<i>Bambusa balcooa</i>	Poaceae	<i>Capsicum chinense</i>	Solanaceae
<i>Bambusa nutans</i>	Poaceae	<i>Chromolaena odorata</i>	Asteraceae
<i>Bambusa pallida</i>	Poaceae	<i>Clerodendrum</i>	Lamiaceae
<i>Bambusa tulda</i>	Poaceae	<i>colebrookianum</i>	Euphorbiaceae
<i>Musa acuminata</i>	Musaceae	<i>Codiaeum variegatum</i>	Celastraceae
<i>Musa balbisiana</i>	Musaceae	<i>Euonymus japonicus</i>	Rubiaceae
<i>Ensete glaucum</i> var. <i>glaucum</i>	Musaceae	<i>Gardenia jasminoides</i>	Lamiaceae
<i>Herb species</i>	<i>Family</i>	<i>Ocimum tenuiflorum</i>	Solanaceae
<i>Ageratum conyzoides</i>	Asteraceae	<i>Solanum melongena</i>	Solanaceae
<i>Brassica juncea</i>	Brassicaceae	<i>Solanum torvum</i>	Solanaceae
<i>Centella asiatica</i>	Apiaceae		
<i>Cynodon dactylon</i>	Poaceae		
<i>Houttuynia cordata</i>	Saururaceae		
<i>Hydrocotyle rotundifolia</i>	Araliaceae		
<i>Oxalis corniculata</i>	Oxalidaceae		

Some of the plants widely adopted in traditional homegardens include *Cinnamomum* spp., bananas, Areca nut palms, betel vines, fruit trees, spices and various medicinal herbs. Boundary planting of *Bauhinia* spp. around homegardens provides nitrogen fixation, fencing and beautification, as well as improving the ecosystem. Homegardens also have important social functions by providing gifts in the form of fruit, leaves or products for religious or medicinal purposes.

### Dependence on natural forests for non-timber forest products

Wild natural bioresources play a significant role in the livelihoods of tribespeople in Arunachal Pradesh. The exploitation and management of these resources enhance conservation of the state's biodiversity. The people depend on nature to meet their basic needs, and traditional practices are involved in relation to wild forest products.



*Artocarpus heterophyllus*  
Lam. [Moraceae]

The widely cultivated jackfruit produces the largest known tree-borne fruits, each up to 55 kg in weight. A mature tree may produce between 200 and 500 such fruit in a year. Both ripe and unripe fruit are eaten, the latter as a meat substitute, and both play a prominent role in many cuisines. The golden-yellow timber is said to be superior to teak for making furniture, and is also used in making musical instruments.



The Tai Khamti tribe, residing in Namsai district (Figure A54-3), is considered to be one of the most knowledgeable groups in the field of herbal medicines in Arunachal Pradesh. The Tai Khamtis' very rich plant-based medicinal knowledge has mostly been passed down from one generation to another through Thai Buddhist literature, accompanied by various magico-religious beliefs and practices. While the preparation of remedies and the doses of medicines to deal with different ailments is mostly crude and subject to approximation, the practitioners claim, among other things, to have a highly developed approach to the field of orthopaedics, or conditions involving the musculoskeletal system. Local bone healers claim to be able to heal a patient within a few weeks. Their preparation and application of medicines are commonly accompanied by chanted mantras. Plants used in herbal preparations are mostly collected from the wild. However, some expert practitioners have their own herbal gardens. Most of the Tai Khamti herbal practitioners are marginal farmers with very little income from their farm produce.

Non-timber forest products (NTFPs) are an integral part of day-to-day life for villagers in Arunachal Pradesh (Figure A54-10). In addition to wild plants having medicinal value, these plants are also consumed as fruit, seeds, spices and vegetables.



**FIGURE A54-10:** Harvesting wild vegetables in Namsai district, Arunachal Pradesh. Tai Khamti women harvesting non-timber forest products from the forest (top left); Women carrying wild vegetables back to their village (top right); and wild vegetables offered in a local market (bottom).

*Photos: Nang Rini Longkeng.*

The plant parts consumed are from both aboveground (young shoots, petioles, leaves, stem, seeds, fruits, barks) and below-ground (rhizomes and roots) and recipes vary from tribe to tribe. Examples of the wild plants are listed in Table A54-5.

Arunachal Pradesh has a vast collection of diverse fruits, with each of them claiming its own value as an important source of nutrition or as a medicine. Some of the wild fruits have cultural importance in the traditions of indigenous groups, and are known to be effective in combatting certain diseases. Fruits such as *Averrhoa carambola*, *Elaeocarpus floribundus*, *Myrica esculenta* and *Ziziphus mauritiana* are processed and preserved into pickles and consumed as appetizers. Some fruit juices, such as those from *Pyrus communis*, *Prunus cerasoides*, *Prunus salicina* and *Docynia indica* are also prepared as local alcoholic beverages. It has also been noted that the tree species *Mahonia nepalensis*, *Prunus persica* and *Quercus* spp., are important trees in sacred groves.

**TABLE A54-5:** Wild plants used as medicines, or as fruit, vegetables and spices, by the indigenous communities of Arunachal Pradesh.

<i>Botanical name</i>	<i>Local name*</i>	<i>Common name</i>	<i>Family</i>
<i>Medicinal plants</i>			
<i>Abroma augustum</i>	<i>mainai</i>	Malvaceae	Bark, root
<i>Abrus precatorius</i>	<i>mikiakuiang</i>	Leguminosae	Seed
<i>Justicia adhatoda</i>	<i>bogabahog</i>	Acanthaceae	Leaf, bark, root
<i>Alpinia galanga</i>	<i>king pang</i>	Zingiberaceae	Rhizome
<i>Andrographis paniculata</i>	<i>hirota</i>	Acanthaceae	Seed, leaf
<i>Arenaria orbiculata</i>	<i>lajaibori</i>	Caryophyllaceae	Whole plant
<i>Argyreia nervosa</i>	<i>motaimon</i>	Convolvulaceae	Leaf, white fluid
<i>Asparagus racemosus</i>	<i>sottish sora</i>	Asparagaceae	Tuber
<i>Asplenium nidus</i>	<i>yaahanka</i>	Aspleniaceae	Leaf
<i>Blechnum orientale</i>	<i>kalasona</i>	Blechnaceae	Leaf
<i>Blumea balsamifera</i>	<i>yaanang</i>	Asteraceae	Leaf
<i>Bonnaya ciliata</i>	<i>yaakio</i>	Linderniaceae	Leaf, root
<i>Senna hirsuta</i>	<i>kungu</i>	Leguminosae	Bark
<i>Chloranthus erectus</i>	<i>yaasinha</i>	Chloranthaceae	Leaf
<i>Cissampelos mucronata</i>	<i>tonabi</i>	Menispermaceae	Tender leaf, stem
<i>Citrus limon</i>	<i>hatta</i>	Rutaceae	Fruit
<i>Coleus forskohlii</i>	<i>moyamuksii</i>	Lamiaceae	Leaf, stem
<i>Croton persinilis</i>	<i>hongki</i>	Euphorbiaceae	Root
<i>Croton tiglium</i>	<i>saklang</i>	Euphorbiaceae	Leaf, flower
<i>Cyperus alternifolius</i> subsp. <i>flabelliformis</i>	<i>yaahukom</i>	Cyperaceae	Root
<i>Datura innoxia</i>	<i>pukumii</i>	Solanaceae	Leaf
<i>Pseuderanthemum</i> <i>latifolium</i>	<i>murmuchi</i>	Acanthaceae	Leaf
<i>Euphorbia hirta</i>	<i>dudboon</i>	Euphorbiaceae	Leaf, root

**TABLE A54-5 (cont.):** Wild plants used as medicines, or as fruit, vegetables and spices, by the indigenous communities of Arunachal Pradesh.

<i>Botanical name</i>	<i>Local name*</i>	<i>Common name</i>	<i>Family</i>
<i>Euphorbia neriifolia</i>	<i>sepak</i>	Euphorbiaceae	Leaf, stem
<i>Ficus hispida</i>	<i>mukonpong</i>	Moraceae	Bark, root
<i>Houttuynia cordata</i>	<i>punkyo</i>	Saururaceae	Leaf
<i>Ipomoea aquatica</i>	<i>humen</i>	Convolvulaceae	Leaf
<i>Kaempferia galanga</i>	<i>banhom</i>	Zingiberaceae	Rhizome
<i>Leucas aspera</i>	<i>dulonbon</i>	Lamiaceae	Leaf
<i>Mentha x piperita</i>	<i>balasen</i>	Lamiaceae	Leaf
<i>Millingtonia hortensis</i>	<i>meteka</i>	Bignoniaceae	Leaf, flower
<i>Mollugo pentaphylla</i>	<i>jaluk boon</i>	Molluginaceae	Leaf, stem
<i>Mosla dianthera</i>	<i>ngakai</i>	Lamiaceae	Leaf
<i>Oxalis corniculata</i>	<i>yaasompi</i>	Oxalidaceae	Leaf
<i>Cenchrus elegans</i>	<i>hakka</i>	Poaceae	Leaf, root
<i>Pilea wollastonii</i>	<i>rambodusak</i>	Urticaceae	Leaf, bark
<i>Piper mullesua</i>	<i>pipli</i>	Piperaceae	Leaf, seed
<i>Plumbago indica</i>	<i>kensumi</i>	Plumbaginaceae	Whole plant
<i>Sida acuta</i>	<i>pairangri</i>	Malvaceae	Leaf, root
<i>Solanum torvum</i>	<i>mehengchang</i>	Solanaceae	Fruit
<i>Solanum virginianum</i>	<i>mopu</i>	Solanaceae	Fruit, seed
<i>Stachytarpheta cayennensis</i>	<i>yaahangeng</i>	Verbenaceae	Leaf, bark
<i>Stephania japonica</i>	<i>bhinraj</i>	Menispermaceae	Tuber
<i>Terminalia chebula</i>	<i>hellica</i>	Combretaceae	Fruit
<i>Zanthoxylum acanthopodium</i>	<i>makat</i>	Rutaceae	Leaf, bark
<i>Fruit</i>			
<i>Actinidia callosa</i>	<i>anti tari</i>	Actinidiaceae	Mesocarp
<i>Actinidia chinensis</i> var. <i>deliciosa</i>	<i>kiwifruit</i>	Actinidiaceae	Mesocarp
<i>Averrhoa carambola</i>	<i>star fruit</i>	Oxalidaceae	Whole fruit
<i>Baccaurea ramiflora</i>	<i>khiju</i>	Phyllanthaceae	Mesocarp
<i>Calamus floribundus</i>	<i>geying</i>	Arecaceae	Whole fruit
<i>Citrus maxima</i>	<i>rubub ape</i>	Rutaceae	Mesocarp
<i>Coccinia grandis</i>	<i>jojuru</i>	Cucurbitaceae	Mesocarp
<i>Coix lacryma-jobi</i>	<i>anayat</i>	Poaceae	Mesocarp
<i>Diospyros kaki</i>	<i>jenggong</i>	Ebenaceae	Whole fruit
<i>Docynia indica</i>	<i>pecha</i>	Rosaceae	Whole fruit
<i>Dysoxylum excelsum</i>	<i>ruuh</i>	Meliaceae	Endocarp
<i>Elaeocarpus floribundus</i>	<i>jolpai</i>	Elaeocarpaceae	Pericarp and mesocarp
<i>Ficus auriculata</i>	<i>taking</i>	Moraceae	Mesocarp

**TABLE A54-5 (cont.):** Wild plants used as medicines, or as fruit, vegetables and spices, by the indigenous communities of Arunachal Pradesh.

<i>Botanical name</i>	<i>Local name*</i>	<i>Common name</i>	<i>Family</i>
<i>Ficus hispida</i>	<i>taku</i>	Moraceae	Mesocarp
<i>Ficus semicordata</i>	<i>takop</i>	Moraceae	Mesocarp
<i>Ficus subulata</i>	<i>siirehmaloh</i>	Moraceae	Mesocarp
<i>Potentilla indica</i>	<i>aki tayin</i>	Rosaceae	Whole fruit
<i>Fragaria vesca</i>	<i>sahmrep</i>	Rosaceae	Whole fruit
<i>Garcinia lanceifolia</i>	<i>taktar</i>	Clusiaceae	Pericarp and mesocarp
<i>Gaultheria fragrantissima</i>	<i>shegshingmrep</i>	Ericaceae	Pericarp and mesocarp
<i>Stauntonia latifolia</i>	<i>shulumba</i>	Lardizabalaceae	Mesocarp
<i>Livistona jenkinsiana</i>	<i>toko</i>	Arecaceae	Mesocarp
<i>Mahonia nepalensis</i>	<i>thaming</i>	Berberidaceae	Whole fruit
<i>Melastoma malabathricum</i>	<i>daidasa</i>	Melastomataceae	Endocarp
<i>Miliusa macrocarpa</i>	<i>shyamroma</i>	Annonaceae	Mesocarp
<i>Myrica esculenta</i>	<i>baching</i>	Myricaceae	Mesocarp
<i>Passiflora edulis</i>	<i>bhelrhi</i>	Passifloraceae	Endocarp
<i>Pegia nitida</i>	<i>eyidorge</i>	Anacardiaceae	Whole fruit
<i>Phyllanthus emblica</i>	<i>amla</i>	Phyllanthaceae	Pericarp and mesocarp
<i>Pinanga gracilis</i>	<i>tachar</i>	Arecaceae	Pericarp and mesocarp
<i>Prunus cerasoides</i>	<i>sembo</i>	Rosaceae	Pericarp and mesocarp
<i>Prunus bracteopadis</i>	<i>chod rhi</i>	Rosaceae	Pericarp and mesocarp
<i>Prunus persica</i>	<i>takung</i>	Rosaceae	Mesocarp
<i>Prunus salicina</i>	<i>plum</i>	Rosaceae	Pericarp and mesocarp
<i>Pyrus communis</i>	<i>naspati</i>	Rosaceae	Pericarp and mesocarp
<i>Pyrus pashia</i>	<i>jaatoh</i>	Rosaceae	Endocarp
<i>Quercus lamellosa</i>	<i>santih</i>	Leguminosae	Endocarp
<i>Quercus semecarpifolia</i>	<i>pah sheng grabo</i>	Leguminosae	Endocarp
<i>Lithocarpus elegans</i>	<i>tibeh</i>	Leguminosae	Endocarp
<i>Rhus chinensis</i>	<i>taam ahi</i>	Anacardiaceae	Whole fruit
<i>Rosa sericea</i>	<i>jamkhuyu</i>	Rosaceae	Thalamus
<i>Rosa suaveolens</i>	<i>rokpu tong</i>	Rosaceae	Mesocarp
<i>Rubus calycinus</i>	<i>wild strawberry</i>	Rosaceae	Whole fruit
<i>Rubus ellipticus</i>	<i>mipyajilyung</i>	Rosaceae	Whole fruit
<i>Rubus fairholmianus</i>	<i>mipyayoyu</i>	Rosaceae	Whole fruit

**TABLE A54-5 (cont.):** Wild plants used as medicines, or as fruit, vegetables and spices, by the indigenous communities of Arunachal Pradesh.

<i>Botanical name</i>	<i>Local name*</i>	<i>Common name</i>	<i>Family</i>
<i>Rubus niveus</i>	<i>yikhejilyung</i>	Rosaceae	Whole fruit
<i>Saurauia armata</i>	<i>pupururu</i>	Actinidiaceae	Whole fruit
<i>Saurauia napaulensis</i>	<i>hinch</i>	Actinidiaceae	Endosperm
<i>Sterculia lanceifolia</i>	<i>taklam</i>	Malvaceae	Endocarp
<i>Syzygium jambos</i>	<i>adi jamun</i>	Myrtaceae	Mesocarp
<i>Ziziphus mauritiana</i>	<i>bogori</i>	Rhamnaceae	Pericarp and mesocarp
<i>Vegetables and spices</i>			
<i>Justicia adhatoda</i>	<i>ya paang</i>	Acanthaceae	Leaf, stem
<i>Alpinia nigra</i>	<i>moon heuo</i>	Zingiberaceae	Stem
<i>Amaranthus viridis</i>	<i>pulome</i>	Amaranthaceae	Leaf, root
<i>Amaranthus spinosus</i>	<i>pulome</i>	Amaranthaceae	Leaf, root
<i>Artocarpus chama</i>	<i>malaang</i>	Moraceae	Endosperm
<i>Bacopa monnieri</i>	<i>phakbrami</i>	Plantaginaceae	Leaf
<i>Bambusa balcooa</i>	<i>noh on</i>	Poaceae	Shoot
<i>Bauhinia purpurea</i>	<i>phakk</i>	Leguminosae	Leaf
<i>Senna occidentalis</i>	<i>putumshom</i>	Leguminosae	Leaf
<i>Centella asiatica</i>	<i>panang</i>	Apiaceae	Leaf
<i>Chenopodium album</i>	<i>jhilmil</i>	Amaranthaceae	Leaf
<i>Colocasia esculenta</i>	<i>mon</i>	Araceae	Stem, leaf
<i>Calamus erectus</i>	<i>raidang</i>	Arecaceae	Stem
<i>Rohdea nepalensis</i>	<i>plom tai</i>	Asparagaceae	Leaf
<i>Clerodendrum colebrookianum</i>	<i>patakhæi</i>	Lamiaceae	Leaf
<i>Dichrocephala integrifolia</i>	<i>phakmaein</i>	Asteraceae	Leaf
<i>Diplazium esculentum</i>	<i>pukut</i>	Athyriaceae	Leaf, stem
<i>Dendrocalamus hamiltonii</i>	<i>noh</i>	Poaceae	Shoot
<i>Dillenia indica</i>	<i>maksan</i>	Dilleniaceae	Fruit
<i>Elatostema platyphyllum</i>	<i>pushin</i>	Urticaceae	Leave
<i>Ensete superbum</i>	<i>pikoeii</i>	Musaceae	Flower
<i>Crassocephalum crepidioides</i>	<i>phuyamaein</i>	Asteraceae	Leaf
<i>Gynocardia odorata</i>	<i>makmahao neng</i>	Achariaceae	Whole plant
<i>Houttuynia cordata</i>	<i>pukhoei</i>	Saururaceae	Leaf, stem
<i>Ipomoea aquatica</i>	<i>pukum</i>	Convolvulaceae	Tuber
<i>Ipomoea batatas</i>	<i>maan</i>	Convolvulaceae	Tuber



**TABLE A54-5 (cont.):** Wild plants used as medicines, or as fruit, vegetables and spices, by the indigenous communities of Arunachal Pradesh.

<i>Botanical name</i>	<i>Local name*</i>	<i>Common name</i>	<i>Family</i>
<i>Merremia umbellata</i>	<i>thaw maan</i>	Convolvulaceae	Tuber
<i>Maranta arundinacea</i>	<i>mun heuo</i>	Marantaceae	Stem
<i>Momordica cochinchinensis</i>	<i>makhaekhae</i>	Cucurbitaceae	Leaf, stem
<i>Musa balbisiana</i>	<i>pi koeii</i>	Musaceae	Endosperm
<i>Musa x paradisiaca</i>	<i>pikoeii</i>	Musaceae	Endosperm
<i>Oxalis griffithii</i>	<i>yasom</i>	Oxalidaceae	Leaf
<i>Oenanthe javanica</i>	<i>phakkhohom</i>	Apiaceae	Leaf
<i>Pouzolzia sanguinea</i> var. <i>sanguinea</i>	<i>oeik</i>	Urticaceae	Leaf
<i>Persicaria chinensis</i>	<i>yashom</i>	Polygonaceae	Leaf, seed
<i>Polygonum perfoliatum</i>	<i>pan khula</i>	Polygonaceae	Leaf
<i>Solanum violaceum</i>	<i>mehengchang</i>	Solanaceae	Leaf
<i>Solanum nigrum</i>	<i>pitenn</i>	Solanaceae	Fruit
<i>Zanthoxylum nitidum</i>	<i>makat</i>	Rutaceae	Leaf
<i>Zanthoxylum oxyphyllum</i>	<i>mezenga</i>	Rutaceae	Leaf, stem

Note: \*Local names are from the Tai Khamti language.

Sources: Singh and Hage, 2017; Tag et al., 2007; Das and Tag, 2006.

## Conclusion

Arunachal Pradesh is blessed with an abundance of natural resources. The state has a high land area per capita, water availability and a wide variety of plants and animals. In order to boost their livelihoods, tribal farmers have domesticated both crop plants and animals. Seeds of superior species have been collected over many generations and cultivated in a variety of ways, according to the utility of the crops and the topography of the habitat. This has resulted in a great diversity in the cultivation of various crops by different tribes, due to their differing socio-ecological situations over the course of many years. The majority of farmers still follow the indigenous farming practices that have long formed the basis of their livelihoods and sustenance. Traditional festivals and lifestyles showcase the uniqueness and identity of these indigenous communities, most of which still depend upon shifting cultivation for their subsistence. However, there is a growing need to redevelop these traditional agricultural systems. Moreover, such redevelopment must proceed incrementally, rather than attempting quantum change, and it must be based on traditional ecological knowledge so as to ensure the acceptance of indigenous communities. A holistic approach to forest management and agricultural redevelopment – with emphasis on biodiversity conservation – is crucial for sustainable management of bioresources so that the benefits of development can be provided to local communities in Arunachal Pradesh on a basis of equity and social justice.

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