

Indigenous knowledge of *Nyishi* tribes on traditional agroforestry systems

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The ethno-botanically important species in traditional agroforests of *Nyishi* community of Arunachal Pradesh was studied during the year 2004-2005. The plants used by the local people for food, medicine and other ethnobotanical purposes including the utilization and related ethnobotanical aspects were assessed during the survey. A total of 80 useful plants belonging to 45 families and 69 genera were collected from 20 randomly selected agroforestry plots. Of the plants documented under 10 major categories, 47 species are used for food, 21 species are used in medicine and 35 species are used for other purposes.

Key words: Agroforestry, *Nyishi* community, Ethnomedicine, Conservation, Arunachal Pradesh

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Agroforestry has a long tradition in Arunachal Pradesh, where trees are integrated in the crops and livestock production systems according to agro-climatic and other prevailing conditions. These systems are managed indigenously, with practices having been evolved by the farmers through trial and error over long periods of time¹. Farmers usually plant trees in their traditional agroforestry systems in pursuit of their livelihood goals of income generation, risk management, household food security and optimal use of available land, labour and capital². A great number of different traditional grain crops, rhizomatous crops, pineapple and vegetables are being grown with a number of fruits and other trees in their traditional systems, which are valuable for the farmers' everyday life.

Traditional cropping patterns also vary among the communities, since they have evolved in response to prevailing soil and climatic conditions and social and ethological preferences³. The age, gender and socio-cultural status are the most frequently used proxies for household preferences⁴. The farmers of Arunachal Pradesh are not ready to adopt modern agroforestry as

it is considerably more complex than traditional agriculture⁵. The tribesmen have also their own ways of identifying, classification and judicious uses of traditional ethnobotanical plants. Ethnobotanical uses of plants in Arunachal Pradesh have been reported⁶⁻¹⁴. Arunachal Pradesh harbours ca. 500 plant species of medicinal and pharmacological significance. A detail study of community wise survey is required as this may provide a meaningful way for the promotion of the traditional knowledge. The medicinal plants used by *Nyishi* community of Arunachal Pradesh has also been reported but the ethnobotanical plants in traditional agroforests and their indigenous uses has not yet been explored and categorized for any community of Arunachal Pradesh¹⁵⁻¹⁸. The study would sort out the ethnobotanical uses of plants on traditional agroforests by *Nyishi* tribe, which is one of the most dominant tribe of Arunachal Pradesh.

Methodology

The study was carried out in traditional agroforests maintained by *Nyishi* tribe in Nirjuli and Doimukh villages of Papumpare district in Arunachal Pradesh. More than 20 agroforestry plots (20 sq m each) from both the villages were selected for collecting the

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ethnobotanical information. Routine methods of botanical collection and herbarium techniques have been followed¹⁹. Plants were identified using relevant floras. Data on ethnomedicinal uses of plants were obtained by using questionnaires and through interviews of traditional healer and knowledgeable elderly owner of the traditional agroforests.

Results

Nyishi community and their livelihoods

The *Nyishis* are one of the major tribes of Arunachal Pradesh with a population of more than one lakh (1991 census), scattered over the mountainous terrain of the Lower Subansiri, Pauphare and East Kameng districts. These areas are influenced by sub-Himalayan climate with moderate sun shine and rainfall. Traditionally, people practice shifting cultivation (*jhum kheti*) and also a few farms under traditional agroforestry. The *Nyishis* believe in the existence of the Sun and the Moon (*Donyi-Polo* in *Nyishi* dialect). With this traditional belief, they perform festivals that are mainly agricultural-based. The major festivals include *Nyokum-Yullu* (festival for good harvest and social wellbeing) and *Sirom-Molo-Sichum*, celebrated during December is mainly related with future prosperity. The rice-millet beer (*Apong*) prepared from paddy and *Eleusine coracana* is a common drink for the community.

Traditional agroforests and their socio-economy

The *Nyishis* have tremendous traditional knowledge to use the natural resources. The community is farm-based and they have customary laws that accommodate socio-cultural patterns, land tenure system and cultivation practices. Earlier, the local people used to be collecting their day-to-day requirements from the wild, but over time, they have developed a few traditional systems that can help in meeting their livelihoods. The traditional agroforestry system is one of such system that can fulfil productivity, sustainability and adaptability criterions for the traditional farmers' of the community. A great number of different traditional crops are grown in the traditional agroforestry systems of this region, which are valuable for the farmers' everyday life, as they provide a greater diversity of food and also act as a good source of commercial outlets in addition to household consumption.

Traditional agroforests of *Nyishi* community also contribute to the rural economy, employment and poverty alleviation at a local level. Most of the

traditional systems are practiced for day to day requirement and not for commercial purposes. These systems provide a mixture of market goods such as food, wood production and fodder to cattle and non market goods and services including soil conservation, water and air quality improvement, biodiversity conservation and scenic beauty. The agri-horti-silvi-pastoral system has proved to be quite beneficial in generating more income for the farmers of *Nyishi* community, especially during off-season when crops are not cultivated. The success of the system largely depends upon the proper selection of fruit tree species under different agro-climatic conditions to meet various objectives. It was also found that, more income could be generated if it is integrated with improved breed of mulch animals. Involvement of female members and low input are the important attributes of high net returns in traditional agroforestry systems. However, the *Nyishi* family size is too large (as a result of polygamy) to sustain with the yield and hence the cost-benefit ratio goes almost hand to mouth (1:1).

Structure of traditional agroforests

The studied agroforests of *Nyishi* community are multi-storied with the top storey occupied by *Livistona jenkinsiana*, *Gravellia robusta*, etc. *Artocarpus heterophyllus*, *Mangifera indica*, etc. are dominant in the sub-canopy layer. Papaya, guava and citrus are some of the commonly observed middle-storey species. Generally, fruit and timber yielding plants are common in most of the agroforests maintained by the *Nyishi* community. The predominant floor species in traditional agroforestry system is *Ananas comosus* and vegetable crops. Among the weedy species, the most extensive one are those belonging to the family Asteraceae (e.g., *Spilanthes* sp, *Ageratum conyzoides*). Interestingly *Livistona jenkinsiana* were exclusively found in the traditional agroforestry systems of Arunachal Pradesh.

Ethno-medico-botany of traditional agroforests

The detailed survey of traditional agroforestry systems recorded 80 species of ethnomedicinal importance, representing 69 genera and 45 families. There are 10 categories of ethnobotanically important plants characterized based on the products in the traditional agroforests viz., fruit plant, vegetables, cereals, medicinal, timber, thatching, broom making, house building, fuel wood and plants for the purpose of local wine preparation (Table 1). 23% of the total

Table 1—Ethnobotanical plants of traditional agroforestry systems

Category	Plant species
Fruit plants	<i>Ananus comosus</i> Merr., <i>Areca catechu</i> Linn., <i>Artocarpus heterophyllus</i> Lam., <i>Callicarpa macrophylla</i> Vahl., <i>Carica papaya</i> Linn., <i>Castanopsis indica</i> (Roxb.) A. DC., <i>Citrus reticulata</i> Blanco., <i>Citrus limon</i> (L) Burm., <i>Dillenia indica</i> Linn., <i>Elaeocarpus floribundus</i> Blume., <i>Litsea cubeba</i> (Lour) Pers., <i>Mangifera indica</i> Linn., <i>Morus alba</i> Linn., <i>Musa sapientum</i> Linn., <i>Prunus</i> sp, <i>Psidium guajava</i> Linn., <i>Rubus ellipticus</i> Smith., <i>Syzgium fruticosum</i> DC., <i>Terminalia</i> sp, <i>Zizyphus jujuba</i> Lamk.
Vegetables	<i>Abelmoschus esculentus</i> (Linn) Moench., <i>Alocasia indica</i> (Roxb.) Schott., <i>Amaranthus</i> sp, <i>Brassica oleracea</i> Linn., <i>Capsicum annum</i> Linn., <i>Clerodendron viscosum</i> Vent., <i>Colocasia</i> sp, <i>Cucurbita moschata</i> Poir., <i>Cucurmis sativus</i> Linn., <i>Dioscorea</i> sp, <i>Ipomoea batatas</i> (L) Laurk., <i>Lycopersicum esculentum</i> Linn., <i>Manihot esculenta</i> Crantz., <i>Momordica charantia</i> Linn, <i>Moringa oleifera</i> Cam., <i>Phaseolus vulgaris</i> Linn., <i>Polygonum</i> sp, <i>Pouzolzia</i> sp, <i>Solanum torvum</i> Swartz., <i>S. melongena</i> Linn., <i>S. nigrum</i> Linn., <i>S. kurzii</i> Brace ex Prain., <i>Zanthoxylum armatum</i> DC.
Cereals	<i>Eleusine coracana</i> (L) Gaertn., <i>Oryza sativa</i> Linn., <i>Zea mays</i> Linn.
Medicinal	<i>Areca catechu</i> Linn, <i>Ageratum conyzoides</i> L, <i>Alstonia scholaris</i> (L.) R. Br, <i>Artemesia nilagirica</i> Pamp., <i>Bauhinia variegata</i> Linn., <i>Cassia alata</i> L., <i>Centella asiatica</i> (L), Urban, <i>Clerodendron viscosum</i> Vent., <i>Cocos nucifera</i> Linn, <i>Colocasia esculenta</i> (L) Merr., <i>Curcuma longa</i> L., <i>Dillenia indica</i> L., <i>Diplazium esculentum</i> , <i>Erythrina indica</i> , <i>Moringa oleifera</i> Cam., <i>Musa sapientum</i> . Linn, <i>Piper betel</i> Linn., <i>Solanum khasianum</i> Cl., <i>Spilanthes acmella</i> Merr., <i>Terminalia myriocarpa</i> Heurek & Muell, <i>Zingiber officinale</i> Rosc.
Timber	<i>Duabanga sonneratiodes</i> Buch., <i>Gmelina arborea</i> Linn., <i>Mesua ferrea</i> ., <i>Michelia champaca</i> ., <i>Terminalia myriocarpa</i> Heurek. & Muell.
Thatching	<i>Areca catechu</i> Linn, <i>Imperata cylindrica</i> Linn., <i>Livistona jenkinsiana</i> Griff, <i>Wallichia</i> sp
Broom making	<i>Calamus</i> sp, <i>Dendrocalamus</i> sp, <i>Imperata cylindrica</i> Linn., <i>Livistona jenkinsiana</i> Griff., <i>Saccharum spontaneum</i> Linn., <i>Sida acuta</i> Burm f.
House building	<i>Altingia excelsa</i> , <i>Bambusa tulda</i> Roxb., <i>B. pallida</i> Munro., <i>Calamus</i> sp, <i>Dendrocalamus hamiltonii</i> Nees et Arn., <i>Dipterocarpus</i> sp, <i>Gmelina arborea</i> , <i>Livistona jenkinsiana</i> Griff., <i>Mesua ferrea</i> Linn
Fuel wood	<i>Acacia nilotica</i> (L) Delile, <i>Albizia lebbeck</i> Benth, <i>Albizia procera</i> Benth, <i>Bauhinia variegata</i> Linn., <i>Morus alba</i> Linn.
Local wine	<i>Colocasia</i> sp, <i>Dioscorea</i> sp, <i>Eleusine coracana</i> (L) Gaertn, <i>Manihot esculenta</i> Crantz, <i>Saccharum officinarum</i> Linn, <i>Zea mays</i> Linn.

ethnobotanical plants were found to be used for vegetable purposes, whereas 20% are medicinal and 19% are fruit yielding plants in the traditional agroforestry systems. Though the numbers of plant species used as cereals (eg, *Eleusine coracana*, *Oryza sativa*, *Zea mays*, etc.) are very less, these species are planted extensively in the agroforestry ground.

The family Poaceae recorded the highest (9) species contribution followed by Solanaceae (7), Verbanaceae (4), Zingiberaceae, Rutaceae, Mimosaceae, Cucurbitaceae (3 species each). Four families were represented by 2 species and 34 families represented by 1 species. The plants from Poaceae and Verbanaceae family were found to be utilized in most of the categories like cereals, broom making, house building and wine preparation purpose, whereas maximum Solanaceae plants were found to

be used as vegetables and Mimosaceae for fire wood purposes. Herbs represented the maximum percentage (43%) of ethnobotanical uses, whereas trees and shrubs represent 35% and 22%, respectively of the total ethno-botanical uses of traditional agroforestry systems. 23 plants collected from agroforestry systems were found to be used by Nyishi community for different medicinal purposes (Table 2). Leaves are the most widely used plant part (24%) of the reported medicinal plant uses, followed by fruit and bark (14% each). Some other parts such as root, seed, nut, inflorescence, latex, rhizome are also used, which account for 48% of the total uses of the plant parts. A majority of the remedies are prepared in the form of juice from freshly collected plant parts of single species or mixing with other species according to needs by crushing or squeezing.

Table 2—Plants used for different diseases

Plants name	Local name	Uses
<i>Ageratum conyzoides</i> L.	<i>Pashpaya</i>	Fresh leaf paste is applied on wounds and eczema to check bleeding; juice is used as antithetic
<i>Alstonia scholaris</i> (L.) R. Br.	<i>Taye Sangne</i>	2-3 drops of latex is given with water during abdominal pain after delivery; root decoction mixed with <i>Melia azadiracha</i> root bark is given in ulcer; ginger seed paste is applied on swelling
<i>Areca catechu</i> Linn	<i>Tamul</i>	Paste of nut after rubbing in water is applied on leucoderma patches
<i>Artemesia nilagirica</i> Pamp	<i>Tipin tarin</i>	Fresh juice is taken to get relief in headache and stomachache; boiled leaves are used as vegetable and to get relief from asthma
<i>Cassia alata</i> L.	<i>Kra-Pat</i>	Leaf juice is applied eczema and itching
<i>Centella asiatica</i> (L.) Urban	<i>Barang</i>	Fresh plant juice with honey is given in stomach ulcers
<i>Clerodendron glandulosum</i> Coleb.	<i>Pattoi</i>	Tender leaves as vegetables and in high pressure and bowel troubles
<i>Cocos nucifera</i> Linn.		Unripe fruit juice in urinary disorder
<i>Colocasia esculenta</i> (Linn.) Schott.	<i>Yaksar</i>	Inflorescence extract is used in fever and cough; petiole juice is used as styptic and stimulant
<i>Curcuma longa</i> L.	<i>Longobom</i>	Crushed rhizome paste is used in bone fracture and wound
<i>Dillenia indica</i> L.	<i>Ahutenga</i>	Fruit decoction is applied to scalp for curing dandruff
<i>Diplazium esculentum</i>	<i>Hoka Padma</i>	Leaf as vegetable and during indigestion
<i>Erythrina indica</i>	--	Poultice made from bark of <i>Euphorbia hirta</i> and root of <i>Diplazium esculentum</i> , <i>Musa balbisiana</i> and <i>Sida cordifolia</i> once a day for three week is used in jaundice; drop of latex is used in treating conjunctivitis
<i>Moringa oleifera</i> Lam.	<i>Sajana</i>	Leaf as vegetable and in liver disorder
<i>Musa sapientum</i> Linn.	<i>Nyoro -Kopa</i>	Boiled unripe fruits are given orally after boiling during dysentery and diabetes
<i>Piper betel</i> Linn.	<i>Ritik-Rhinik</i>	Leaf Lamina after rubbing with mustard oil and warming over burning charcoal is applied to belly during stomachache of children
<i>Solanum khasianum</i> Cl.	<i>Thitbya-ke</i>	Root decoction is used to treat malaria
<i>Spilanthus acmella</i> Merr	<i>Mershang</i>	Flowers are chewed during toothache
<i>Swerta chirayita</i> Kast.	<i>Chirata</i>	Plant decoction is taken in fever
<i>Terminalia myriocarpa</i> Muell	<i>Hilika</i>	Bark Extract is given in chest pain, and as cardiac stimulant
<i>Zanthoxylum armatum</i> D.C.	<i>Honyur</i>	Mixture of an equal amount of its dry fruits, black salt along with a little quantity of chilli and common salts is given during stomach disorder. Seed & bark are used as aromatic tonic during fever and cholera
<i>Zingiber officinale</i> Rosc.	<i>Kekir</i>	Rhizome juice mixed with honey is used for cough; powder mixed with hot water is given for stomach pain

Discussion

A large number of different traditional crops (trees, shrubs, herbs) are grown in the agro-forestry systems practiced by *Nyishi* community of Arunachal Pradesh, which are valuable for the farmers' everyday life, as they provide a greater diversity of food and also act as a good source of commercial outlets in addition to household consumption. Plant species such as *Zizyphus jujuba*, *Dillenia indica*, *Elaeocarpus floribundus*, *Prunus* sp, *Syzgium fruticosum*, *Callicarpa macrophylla*, *Litsea cubeba*, *Morus alba*,

Castanopsis indica are edible fruits that provide supplementary food especially during drought. *Nyishi* tribes of Arunachal Pradesh also been reported to use wild plants such as *Alpinia malaccensis*, *Angiopteris evecta*, *Calamus tenuis*, *Cyathea gigantea*, *Dendrocalamus hamiltonii*, *Dioscorea bulbifera* and *Wallichia densiflora* as food and supplements²⁰. It is also reported that *Wallichia densiflora*, *Cyathea gigantea* and *Angiopteris densiflora* are the three main substitutes for the staple food in Lower Subansiri district of Arunachal Pradesh²¹. Some fruit

plants like *Bambusa* sp, *Livistona* sp, etc. are multipurpose and play an important role during festival and rituals^{22, 23}.

During scarcity, the inhabitants also use some plants as food after cooking rhizome/flour of *Angiopteris evecta*, tubers of *Discorea* stem (except bark), etc. On the other hand *Abelmoschus esculentus*, *Alocasia indica*, *Amaranthus* sp, *Brassica oleracea*, *Capsicum annum*, *Clerodendron viscosum*, *Colocasia* sp, *Cucurbita moschata*, *Cucumis sativus*, *Dioscorea* sp, *Solanum* sp are common vegetables grown in all agroforestry systems. Local inhabitants also sell some vegetables from their garden in the market places.

Medicinal plants grown in the traditional agroforestry systems bear ecological as well as social values. Even though the cultivation of these medicinal plants has a greater potential and commercial value in the local climatic conditions, farmers are still not giving adequate efforts to cultivate medicinal plants in their lands. There are 27 medicinal plants reported out of 168 plant species grown in Peruvian Amazon home-gardens²⁴. The medicinal plants were also found less in home gardens of Assam²⁵. But the study indicates that one of the largest group made up of medicinal plants thrives in the garden space and grown close to the house with an overall representation of about 20% from both cultivated and the wild species. The tribal people of the state are dependent upon folklore medicine and also consume leaves of many medicinal plants as the most imperative boiled food, which results greater proportion of medicinal plants in their agroforestry systems.

The tradition of using plants for different treatments is one of the indigenous cultural habits widely practiced in the study area. The *Nyishi* people recognize that some diseases are due to natural causes. They also believe that other diseases are the result of bad spirit or the breaking of the traditional rule. Many of the treatments are effective and many more are harmless while some are believed to be dangerous. The plants used and the methods of preparation are often closely guarded secrets, usually only passed from father to eldest son as the death of the former approaches. The healers in the area protect and keep their ethnomedicinal knowledge confidential for several reasons. Some believe that sharing their knowledge with others will result in the loss of the healing powers of the medicine. Others believe that medicines are owned by supernatural power of God.

Though, herbal medicine continues to play a great role in the curing system of certain diseases and ailments, there is acculturation due to the widespread substitution of western medicine for native traditional healings. This has caused a decline in the herbs and herbalists. For example, the taxa that were used as sources of medicine in the past generations though still cultivated and protected or tolerated, have lost their original uses and have become shade and ornamental plants (*Cathranthus roseus*). Other plants traditionally cultivated for medicinal use now grow in marginal situation in the garden and are occasionally used, but have lost their original importance (*Artemisia* sp and *Acorus calamus*). Some of the medicinal plants that were no longer cultivated are ruderal, continue growing around the garden and are easily accessible (*Ageratium conyzoides*, *Spilanthus acmella*, etc.) weed species.

Among other useful plants encountered in the study area like different bamboo species, *Areca catechu* and *Livistona jenkinsiana* have diverse functions. These are used for fence, crafts making, house construction and valued for traditional worship as they are associated with ancestral sacrifices and they are protected by such beliefs. The specified fuel wood plants are only 5% of the total ethnobotanical species. Many of the fruit trees and timber are also used for the purpose of fuel wood consumption. In Bangladesh, trees are mainly planted by farmers in their home garden to generate income and for the purpose of house hold consumption in the form of fruits, firewood, etc²⁶. The *Manihot esculenta* tuber is widely used in traditional agroforests; the plant that yields steroids is used for the preparation of local wine usually meant for a female folk. The tuber is also used during famine. *Bauhinia variegata*, *Gmelina arborea* and *Erythrina indica* despite their soil fertilizing properties are also used as shade trees; *Gmelina arborea* is valued for its timber production. Live plants of *Areca catechu*, *Imperata cylindrica*, *Euphorbia* sp, *Withania somnifera* and *Jatropha* sp are used for making the fence. The respect and consequent preservation of the plant species for various purposes indicates that some indigenous practices have an impact in terms of conservation.

The structure of the traditional agroforests and the farming practice allowed a considerable number and variety of useful species actively by cultivation or passively by encouraging the local farmer. The *Nyishis* of Arunachal Pradesh has used this

agroforestry components i.e. ethnomedicinal and other ethnobotanical plants antiquity and is passed on verbal tradition to the younger generation. Many of these plants used by the tribes are unconventional and not known by the people outside. The interest in the traditional wisdom of usage of plants is slowly fading away from younger generation. The number of medicinal plants cultivated and used has also dramatically decreased. Both species richness and plant uses have decreased through migration of young people from rural to urban areas and the modernization of agriculture, which had the most impact on biological diversity and indigenous knowledge, practices and skills. Accordingly, there is an urgent need to capture the local knowledge; practice related management and utilization of plants before these are lost forever.

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