

## Tribal agriculture: tradition in transition in the Indian Eastern Himalaya

The Indian Eastern Himalaya, a biodiversity hotspot<sup>1</sup>, is also home to myriads of tribes and colourful sub-tribes, who are expert bio-harvesters and managers of the agro-ecosystem. The tribes are known for their indigenous knowledge system (IKS). Despite the undulating hilly and ecological fragile terrains, one can observe the skilled utility of land for sustainable agriculture. Using self-reliance and experiential knowledge, these transformed lands enable them to obtain essential commodities and sustainable yield required to thrive in the environmental constraints of uphill agroecosystem<sup>2</sup>. Positively influencing the traditional agro-ecosystem, part of this system is intensely linked to the high levels of agro-biodiversity<sup>3</sup>.

A field survey undertaken during 2013–2015, unveiled almost similar agro-ecological management schemes amongst the Wancho, Nocte and Tutsa tribes. They have designed their terrains into productive landforms, which can be classified into six different categories: ting-nok (settlement area), chaw-mo (plantation sites), cha-wat (kitchen garden), ling (community forest), lingnu (sacred groves) and zang-mo (cultivable land). The settlement area comprises clan houses, community hall and Morung or Pa or Pang (sacred boys' dormitory). These traditional houses are usually constructed using bamboo (*Bambusa tulda* Roxb. and *Dendrocalamus giganteus* Munro), *Livistona jenkinsiana* Griff. and timber of various trees. The settlement area is always linked with the traditional homestead and kitchen gardens. Cultivable land is devoted for agricultural purposes and each of them is usually owned by individual villages, while the plantation sites are used for various socio-economically valuable plant species (*Livistona jenkinsiana*, tea, cardamom, rubber tree, plum, kiwi, orange, betel plant, etc.). Community forests are maintained for community hunting, and harvesting and gathering of non-timber forest products (NTFPs). Sacred groves, on the other hand, remains virgin and are unaffected by the outside world, because except the local priest, everyone else is forbidden from entering the site. Thus the forests conserve many plant and animal species.

The upland agro-ecology of this region is usually driven by the indigenous farming system enduring several agro-ecological (land-use pattern, nutrient recycling, integrated farming, biodiversity conservation and crop cycles) and ethno-ecological (adaptation of indigenous crop varieties, traditional cropping calendar, mixed farming, knowledge repositories and superstitions) components. This unique traditional way of farming enhances food self-sufficiency and sustainability by providing adequate foodstuff for day-to-day living. Most importantly, this practice is also responsible for the conservation of plant genetic resources *in situ* through mixed-farming (in jhum plot), traditional homegardens and other allied activities. The products of farms are vended in the local and urban markets, which in turn enhances the financial security of the households and uplifts the living status of the people as well. The knowledge they possess and that acquired during the course of the agricultural process would be further passed down to the next generation.

Jhum or swidden agriculture is the most prominent, significant and ideal indigenous farming practice, extensively performed in response to the topographic features. These diversified systems have emerged over centuries of experimentation, and represent the interaction of communities with their environment, without access to any external inputs<sup>4</sup>. The jhum culture also preserves and transfers the IKS from one generation to the next. Such fields are usually a multi-crop system with an average of 30 different plant varieties responsible for food security<sup>5</sup>. The diversity of plants in agricultural fields is contributed by cereals (*Oryza sativa* L., *Zea mays* L., *Coix lacryma-jobi* L., *Sorghum vulgare* Pers., *Triticum aestivum* L. and millets), vegetables (*Cucurbita moschata* Dutch. ex Poir, *Benincasa hispida* (Thunb.) Cogn., *Momordica charantia* L., *Lagenaria siceraria* (Molina) Standl., *Solanum melongena* L., *Solanum lycopersicum* L., *Solanum torvum* Sw., *Cucumis sativus* L., *Brassica oleracea* L., *Plantago major* L., *Spilanthes paniculata* Wall., *Clerodendrum viscosum* Vent., *Amaranthus tricolour* L., *Cardamine hirsute* L.

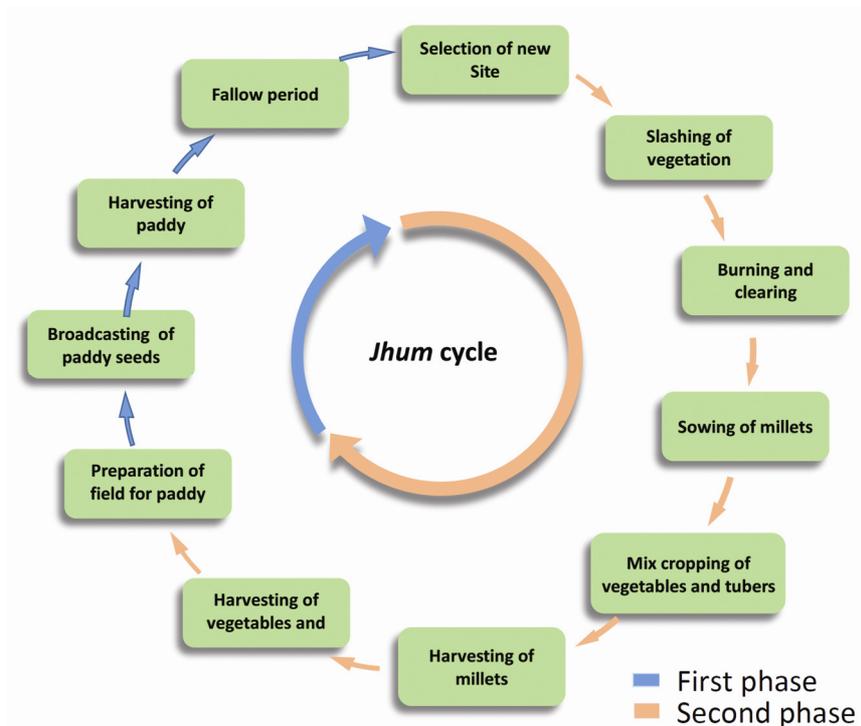
and *Clerodendrum colebrookianum* Walp.), tuberous plants (*Colocasia esculenta* L., *Dioscorea esculenta* L., *Dioscorea bulbifera* L., *Dioscorea allata* L., *Manihot esculenta* Crantz., *Ipomoea batatas* (L.) Lam.), oilseeds (*Sesamum indicum* L., *Linum usitatissimum* L., *Perilla frutescens* (L.) Britt. and *Sesamum orientale* L.), legumes (*Phaseolus vulgaris* L., *Vigna unguiculata* (L.) Walp., *Glycine max* (L.) Merr., *Vigna umbellata* (Thunb. Ohwi & Ohashi), *Psophocarpus tetragonolobus* (L.) D.C., *Lablab purpureus* (L.) Sweet), and spices and condiments (*Capsicum annum* L., *C. frutescens* L., *Amaranthus viridis* L., *Amaranthus spinosus* L., *Eryngium foetidum* L., *Houttuynia cordata* Thunb., *Zanthoxylum alatum* Roxb., *Zanthoxylum rhetsa* (Roxb.) DC., *Allium cepa* L., *Allium sativum* L., *Allium hookeri* Thwaites, *Foeniculum vulgare* Mill., *Trigonella foenum-graecum* L., *Piper longum* L., *Piper nigrum* L., *Curcuma longa* L. and *Zingiber officinale* Rosc.). More than 50 indigenous rice varieties and over a 100 accessions of plant species are cultivated extensively in the jhum-based agricultural field, kitchen gardens and traditional homestead gardens. Both men and women actively participate in the entire process; however, the contribution of women is often more than that of the men.

The cropping cycle in traditional farming involves several stages, starting from slashing and burning of vegetation to fallow period (Figure 1). Based on local cropping calendar, it is further divided into a two-year cycle, i.e. new field (*zim* in Wancho; Chepu in Nocte and Tutsa) and old field (*kap* in Wancho; *kop* in Nocte and Tutsa) (Figure 2). The new field (first phase) signifies the newly selected area where mix-farming is done. The old field signifies the second phase of cropping (in the same field), where the mono-culturing of rice is done.

A festival known as 'Laodan' is celebrated in September, which commences with rituals and sacrificial offerings to gratify God before selection of the new jhum plot. Slashing of vegetation is usually preferred during winter season, which allows drying of slashed vegetation in open sunlight. The burning of



**Figure 1.** Indigenous farming system in Arunachal Himalaya. *a*, Slashing of vegetation and burning of dried and slashed materials. *b*, Clearing and preparation of field after burning. *c*, Construction of hut (taap) for rest after hard work. *d*, Mix cropping. *e*, Rice monoculture (old field). *f*, Harvesting of rice. *g*, Manual threshing inside the hut. *h*, Jhum fallow after harvest of paddy rice.



**Figure 2.** Jhum cycle followed by the indigenous Wancho, Nocte and Tutsa tribes of Arunachal Himalaya. It comprises two different fields (zim and kap) or two different phases, and cumulatively takes about two years to complete. Farmers usually simultaneously maintain both fields separately.

dried vegetation begins in the last week of December. After 14–20 days of the burning process, the field is cleared and prepared with the help of local tools such as dao (traditional knife) and spade. A traditional hut called taap (traditional shelter house) is also constructed in the newly prepared field. When the field is ready by the end of February, millet, as a pioneer crop is manually broadcasted, followed by the introduction of several

crops, including *Colocasia esculenta* L., *Zea mays* L., *Manihot esculenta* Crantz. and other vegetables. The harvesting of vegetables and tuberous crops of the first cycle continues till December. The rainfed cropping system of this region, depends mostly on monsoon rainfall for irrigation. Thus, the sowing and cultivation of crops usually commence in early March. At the end of the first cycle, the next phase of the jhum cycle starts with

the mono-culturing of rice. The harvesting of rice starts in September, but may vary slightly with altitude gradation. Soon after harvest, the kap is left fallow (8–10 years) for regeneration of vegetation and re-accumulation of nutrients. During the fallow period the land undergoes a secondary succession, soil fertility status is restored and physical properties such as soil aggregation and water-holding capacity are improved through

litter decomposition<sup>6</sup>. Weeding is done manually using a traditional hoe called 'zohun'. Sequential weeding is strictly followed in both fields to save the newly emerging crops from suppression and competition<sup>7</sup>.

Sowing and harvesting of the crops are most crucial in traditional cropping, and are always accompanied by rituals and major festivals. Such gatherings also help in better bonding among the people. As a result, they help each other in the field to reduce the time and energy. Such practices are called as 'ai-tho-ai' (in Wancho) or 'bilit' in Nocte and Tutsa (Figure 1f).

With an average production of 3500 kg/ha, the productivity of rice in jhum fields is fairly promising. The entire process requires constant manual labour, without intervention of any sort of modern technology, which consequently decreases the size of the farmland. Therefore, the small size of agricultural plots (jhum patches) may be the reason for unavailability of sufficient rice to meet the requirements for a year. Fortunately, this problem is usually overcome by the subsidiary food source, to provide the people enough food to sustain during the dry period (in the absence of rice). Consequently, farmers actually spend many more years growing trees and crops than burning them – protecting the soil, restoring nutrients, fallowing and resting<sup>8</sup>. Application of pesticides or any other chemicals, however, was not reported among these ethnic groups, which makes this system more exquisite. The flexibility of the indigenous farming system contributes to sustainability, even in the regions with higher elevation by sub-

stituting rice with other crops for survival. Likewise, apart from agricultural products, timber is also fetched from the agricultural field.

The region is still isolated and facing constant glitches of communication and transportation; inaccessible light, potable water, primary health care, shops, etc. which further increases the gap between tradition and scientific development. Thus, preservation of traditional knowledge in conservation perspectives is a big challenge and the need of the hour in this region, which needs to be understood by the researchers and scientists of the current era. Moreover, economically viable and environmentally sound agriculture will be the result of coordinated action of social movements in the remote hamlets in alliance with civil society<sup>9</sup>. Thus, the balanced intervention of scientifically suggested sustainable approaches is needed to cover both conservation of available resources as well as improvement in agro-ecology. Besides, the agro-ecology of this region may be assumed as an assortment of inherited ideas, techniques and knowledge that make us more aware about the predominant and successful journey of tribal communities in the Indian Eastern Himalaya.

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