

Natural resource conservation through indigenous farming systems: Wisdom alive in North East India

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Primitive agriculture like *jhuming* is widely prevalent in North East India for food production. Besides this, some potential indigenous farming systems are exist like Alder (*Alnus nepalensis*) based farming system, *Zabo* farming, *Panikheti* in hills and pond based farming system in plains of the region developed by local farmers using their ingenuity and skills over the centuries. These techniques and systems have sustainable agricultural base and practiced in isolated pockets in the North East India. While some components of farming systems has good Scientific base for resource conservation like nutrient cycling through *in-situ* residue management, green leaf manuring, soil and water conservation and maintenance of forestry. However, there are other few components like burning of biomass in *jhuming* needs a relook. The paper is aimed to document the various indigenous techniques of soil and water conservation linked with these farming systems in the North-eastern region of India.

Keywords: Indigenous farming systems, Soil and water conservation, Productivity, North-eastern region of India

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The North-eastern region of India comprises 8 states, namely Sikkim, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura. The total geographical area of the region is 2.55 lakh km² (about 8 % of the country's total area). The physiography of the region is divided into 3 divisions, namely Meghalaya Plateau, the north-eastern hills and Basin and the Brahmaputra valley. The North-eastern Hills and Basin alone account for 65 % of the total area while the Brahmaputra valley and the Meghalaya Plateau cover 22 and 13 % of the area, respectively. Rainfall occurs from May to November in North-eastern region. Annual rainfall varies from 2,000 - 4,000 mm in the area. Nearly, 90 % of the population of the region depends on agriculture as the sole source of livelihood. Among the workers of the region, 60.1 % are cultivators, 9.3 % are agricultural labourers while 7.3 % are connected with livestock, forestry, fishery and other allied activities. Shifting cultivation is prevalent in the region on a wide scale (0.88 million hectare and annual area under this

practice is 386.5 thousand ha^{1,2}). Efforts are being made to wean away the farmers from shifting cultivation. It is not easy to eliminate this practice since it is linked with socio-economic condition of the people and prevalence of complex land tenure system.

However, over the ages, tribal farmers developed some potential indigenous farming systems in the region using their ingenuity and skill. These techniques and systems have sustainable agriculture base and are practiced since centuries. These farming systems make use of locally available resources and there is need of an in-depth study to know the secrets of their success. Unfortunately, most of these technically sound practices are continued to specific location/region/tribes. Lack of proper documentation, ignorance and subsequent dissemination across similar agro-ecological zones either through farmers' participatory programme or other modes of mass media exploration are to be blamed for the current confinement. As a result, most of the resource poor farmers of this region are deprived from taking due benefits from their age old, simple, economically

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viable and environmentally safe production system. Therefore, keeping this in view, an attempt has been made to document all these technically sound indigenous technology with due consideration to Scientific pros and cons of each technology. This paper will also serve as a main media tool to various primary stakeholders for proper dissemination as the proven technology across North-eastern region of India.

Methodology

The North-eastern region of India comprising 8 states lies between 21.5° and 29.5° N latitude and 89.01° and 97.5° E longitude. The soil of the region is acidic to highly acidic in reaction, high in organic matter content, low in nitrogen, low to very low in available phosphorus and medium to high in available potassium. Soils are red lateritic to sandy clay loam. Average annual rainfall is 2450 mm with about 65% received during monsoon (June to October). Extensive field visits were made to different parts of the North-eastern Region of India to collect primary information related to farming systems (About 20 villages were visited and more than 500 farmers were consulted). Periodic visits were made under National Agricultural Innovation Project (NAIP) and Institute programmes to different sites. Simple questionnaire and other PRA tools with the help of extension workers were used to collect the information. Crop cutting methods were used to estimate the crop yield. Photographs of important activities were taken from farmers' field to characterize the systems. Farmers were asked question on nutrient recycling, water management, integration of components, pest and disease management, etc. Finally, available literatures were reviewed to fine tune the results and give explanations for the activities of farming systems.

Results and discussion

The specific characteristics of important indigenous farming systems of North-eastern region and their place of origin as well as practice are mentioned in Table 1 and Figs 1-12. The details of each farming systems are described below:

Panikheti system of rice cultivation

Due to high rainfall in the region, weeds are main constraints for higher productivity in upland rice. Farmers in some parts of the Kohima district of Nagaland and whole of Sikkim are doing cultivation

in bench terraces from the time immemorial up to 100% slope and more and even rocky lands having hardly 10 - 15 cm depth of soil. Farmers develop terraces in the middle and lower part of the hill slopes (Fig. 1). Natural forest is kept intact in the upper portion of the hills.

In this system, the hill streams are trapped or near the source of emergence, the water is channelized to irrigate a series of terraces in such a way that water continuously flows from the upper terraces to the lower ones without any soil erosion and maintaining a desired level of standing water (5 - 8 cm) on the terraces (Fig. 1). Terrace risers are usually maintained with stones. Stubbles and residues of previous crops are burnt in terraces or incorporated into the field. The weeds and other succulent plant biomass available are allowed to decompose and then incorporated into the soil³. In the terraced field, agricultural operations start in the month of December and January by the digging of fields with the help of spades. Puddling operations start in the month of April followed by soil submergence and maintaining standing water with a level of 5-8 cm by the first week of June. In the same month, seedlings of paddy are transplanted⁴. Farmers do not use any pesticides to control insect pests and diseases. Paddy is harvested during October to November. Thus, the cultivation of rice is done on sloping lands with the help of terracing with good soil and water conservation practices. The average productivity of this system of rice cultivation is about 2.5-3.0 t/ha.

Apatani method of water management (Rice + fish systems of *Apatanis*)

It is practiced in *Apatani* inter-piedmont flat land of about 30 km² located at an altitude of about 1,525 m above mean sea level in the humid tropic climate of lower Subansiri district, Arunachal Pradesh. The area is dominated by local tribe *Apatani* who developed this system to cultivate paddy and fish together⁵. The *Apatani* plateau has a population density of 554 persons against an average of 13 persons per km² of the state. The plateau has about 21 villages in its vicinity. The farmers grow wet land rice, integrated with fish culture in terraces and finger millet on the risers. The area is surrounded by high mountain. The *Apatani* tribe has developed this system of rice cultivation along with other crops making judicious use of available water^{6,7}. Sometimes, they used red algae along with rice + fish integration to serve as a source of nitrogen (N) to rice while feeding the fishes.

Table 1—Major indigenous farming systems of the North East India and their specific characteristics

Farming systems	States	Resource conservation methods followed	Crop productivity
<i>Panikheti</i> system of rice cultivation	Nagaland, Sikkim and Manipur	Terracing, diverting water from hills to terraces, green leaf manuring, <i>in-situ</i> residue management.	2.5 - 3.0 t/ha rice
<i>Apatani</i> method of rice cultivation	<i>Apatani</i> plateau of Arunachal Pradesh	Rice + fish + red algae integration, soil and water conservation, <i>in-situ</i> residue management.	4.0 - 4.5 t/ha rice
<i>Zabo</i> farming	<i>Phek</i> district of Nagaland	Forest in the upper hills, animal shed in mid hill slopes, water harvesting tank down at the cattle shed and finally the rice/crop field. Green leaf manuring with alder litters. Paddy husk is used to plug the bunds to reduce seepage loss. Tank silts are used in crop fields.	3.0 - 3.5 t/ha rice
Alder based farming system	Nagaland	Alder tree (Non leguminous nitrogen fixing tree) is lopped to maintain a height of about 2 m. The leaves and biomass are used to manage soil fertility.	2.0 - 2.5 t/ha rice
Alder + Large cardamom system	High altitude of Sikkim	Alder and large cardamom are grown together. N fixation by alder maintains the soil fertility.	200 - 240 kg/ha large cardamom
<i>Bun</i> method (Raised beds)	Meghalaya	Dry vegetation/biomass as source of manure, legumes as companion crops	18 - 20 t/ha potato
Bamboo drip irrigation	Jaintia hills of Meghalaya	Drip irrigation using bamboo/banana pseudo stem.	Good harvest of arecanut
Cattle shed rotation in upland	Sikkim	Temporary cattle shed is made in field to harvest <i>in-situ</i> urine, cow dung and organic litters.	Organic production of ginger and cole crops
Pond based farming systems	Plains of Tripura, Assam and Manipur	Farm pond near homestead, Fish + livestock + arecanut + kitchen garden + vegetables + rice, Farmyard manure, irrigation with harvested pond water.	3.5 - 4.0 t/ha rice

Note: The pest and diseases in these systems are managed by indigenous means like crab trap, dead lizard, cow dung spay, plant extracts, wood ash, etc. In pond based farming systems in plains, low level of fertilizer (20 kg/ha) and pesticides are used.

So, sometimes terraces appear reddish in colour, which is an indication of red algae presence. The *Apatani* plateau is called rice-bowl of the *Apatanis*, who practice wet rice cultivation (Fig. 2).

The system integrates land, water and farming system by protecting soil erosion, conserving water for irrigation and paddy-cum-fish culture. Every stream originating from the hills is trapped soon after it emerges from forest, channelized at the rim of valley and diverted by network of primary, secondary and tertiary channels. The farmers utilize the indigenous varieties of paddy and fish. Two categories of paddy are cultivated: (a) *Mipya* (early maturing local varieties), (b) *Empo* (late maturing local varieties) ripe at different periods. *Mipya* varieties are harvested in the early part of July, whereas *Empo* varieties are harvested in the month of October. Paddy cultivation is started with sowing of the seed in the nursery in the month of February to March. The transplanting is done in the month of April-May and lasts upto July-August depending on the arrival and retrieval of monsoon. Within a month of transplantation of paddy seedlings, fingerlings are released. The common species of the fish reared

in paddy fields are: *Cyprinus carpo* (Common carp), *Cyprinus carpio* var. *communis* (Scale carp), *Cyprinus carpio* var. *specularis* (Mirror carp) and *Cyprinus carpio* var. *nudus* (Leather carp). Nutrient and soil fertility management of the terraces is done mainly through the recycling of agricultural wastes. Paddy straw is allowed to decompose in the fields and finally incorporated in the soil. Burning/incorporation of undecomposed straw is also in practice. Pig and poultry manure is added to the fields for maintenance of soil health. Thus, the farming system practiced by the *Apatani* tribe takes proper care of the soil health, surrounding forest and therefore, the forests and the environment have remained fully intact in this part of the state.

This system is eco-friendly and the rice productivity in this system is very high (4-4.5 t/ha) compared to the state average of less than 2.0 t/ha. *Apatani* farmers are well aware and extremely cautious of their environment and ecology. Apart from conserving the soil from erosion, the farmers have taken up the plantation of *Terminalia myriantha*, *Ailanthus excelsa*, *Michelia* sp., *Mangolia* sp. and bamboos. Entire surrounding hills and uplands in the



Fig. 1-9—*Panikheti* in Sikkim; 2) Rice + Fish farming of *Apatanis*; 3) Bamboo drip irrigation of *Jaintias*; 4) Alder based farming system; 5) Alder + large cardamom farming system 14; 6) *Zabo* farming in Nagaland; 7) Maize + frenchbean in *bun* cultivation; 8) Temporary cowshed in terrace. Note the vacated area behind the shed after use; 9) A typical pond based farming system of Tripura integrating fish + fruits + vegetables and agronomical crops

area are conserved as forests. These forest areas are well protected by the community. This helps in maintenance of ecological balance and continuous flow of streams. As a consequence, soil erosion, siltation of rivers and other water bodies, drying of water sources, degradation of soil health, loss of flora, fauna and forest resources are negligible in this area.

The first diversion of water from the stream takes off at a short distance above the terraces. Central irrigation channel and embankments of different sizes are constructed in the paddy field. The water into the plots are drawn from irrigation channel and has a check gate made of bamboo splits (*huburs*) at the inlet for regulation of entry and exit of water through the outlet. The farmers drain-off the water from the rice fields twice, once during flowering and finally at maturity. On an average, 10 cm water level is maintained in the plots by adjusting the height of outlet pipes. For fish culture, a vertical pit is dug in the middle of the plot, so that the water remains in these pits even when it drains away from the surrounding fields. To prevent trashes or migration of fish, a semicircular wooden/bamboo net is installed at the inlet. To reduce beating action of flowing water resulting in soil erosion; wooden strikes or planks are put at the outlet. The *huburs* are installed about 15 - 25 cm above the bed level of these fields in order to maintain proper water level. They are made of plank or pine tree trunk or bamboo stems of different diameters (Fig. 10). The water from terraces is finally drained into the river, which flows at middle of the valley.

Bamboo drip irrigation

Water application on hill slopes for irrigation of plantation crops poses a serious problem.

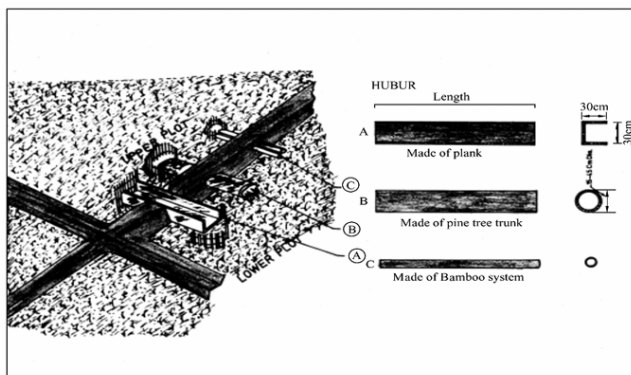


Fig. 10—Apatani water management system⁵

The tribal farmers in Muktapur, Jaintia hills district of Meghalaya have developed the indigenous technique of bamboo drip irrigation for irrigating crops in hill slopes³. Betalvines planted with arecanut as the supporting tree are irrigated with this system, in which water trickles or drips at the base of the crop. Water from the natural streams located at higher elevation is conveyed with the use of bamboo channels, supports to the site of plantation through gravity flow (Fig. 11). Discharge of water up to 25 L/minute at main channel can be easily managed by manipulating the distribution systems.

This system is very useful in water scarcity areas, soils with poor water holding capacity and the rocky and undulating topography. Bamboo drip irrigation system is an excellent example of man's skill and ingenuity and glaring example in the evolution of agricultural systems⁸. Water is carried with the help of different sizes/forms of bamboo pipes and further distributed into different bamboo water channels for application at the desired site. The special feature of the system is to convey water to the site of actual use without leakage and loss on the way. As a result, conveyance as well as application losses are negligible and irrigation efficiency is very high. Flow of the water from bamboo pipes can be controlled as per the requirement. The tribal farmers of Jaintia hills have the necessary skill to lay-out the bamboo network with proficiency so that the whole unit works

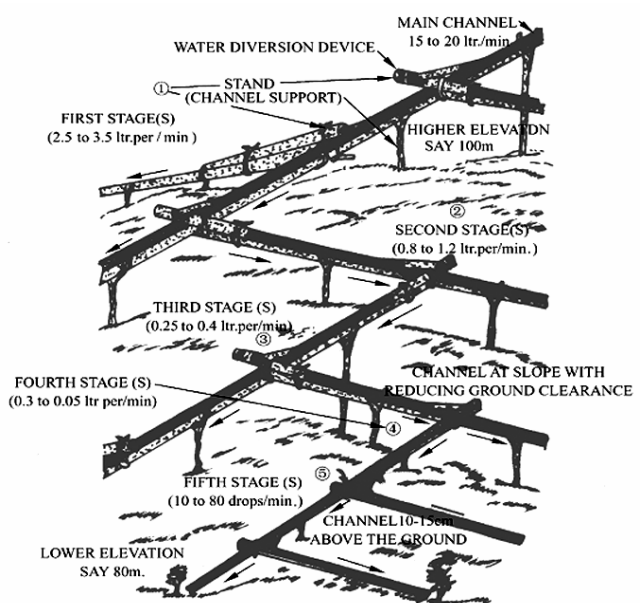


Fig. 11—A sketch of water distribution in Bamboo drip irrigation system (Shown in five stages)¹

efficiently and perfectly. Water trickles down from the holes in bamboo pipes to the plant root system (Fig. 3). Plantation crops, betel-vines, black pepper, etc. are irrigated by this system.

Since, the water is carried through bamboo pipes, the system indirectly helps in conserving the forest area on hills. No cutting of trees and shrubs is required to clear the land for making irrigation channels through the forest area on hills. Another benefit to forest area is that the farmers can go for settled cultivation when bamboo drip irrigation system is followed and do not resort to shifting cultivation which involve heavy deforestation. The bamboo drip irrigation system has helped in conserving forests and natural resources and thus can become a viable alternative to arrest the further degradation by shifting cultivation.

Alder based farming system

The ability of the alder trees (*Alnus nepalensis*) to develop and retain fertility of the soil has been fully utilized by farmers in *Angami*, *Chakhesang*, *Chang*, *Yimchunger* and *Konyak* areas in Nagaland at varying altitudes^{3, 4}. Alder is a deciduous or semi-deciduous tree and it does not require high soil fertility but prefers permeable soils. The root nodules (colonies of *Frankia*) of alder responsible for fertilizing the soil (through atmospheric N fixation) whereas, the spreading nature of the roots helps in preventing soil erosion in slopes.

In this system of cultivation the *Alnus nepalensis* seedlings are planted on the sloppy land intended for cultivation and the alder grows fast till first 6-10 yrs. At this stage, initially the trees are pollarded, the leaves and twigs are burnt and ash is mixed into the soil to prepare it for raising crops (Fig. 4). Subsequently, pollarding is done once every 4-6 yrs. Under this process coppice are cut except 5-6 on top of the main trunk and crop schedule is followed including fallow period of 2-4 yrs. The bigger branches stripped-off leaves are used as fire wood, while the root of the tree develop nodules (colonies of *Frankia*) responsible for fertilizing the soil through nitrogen (N) fixation. Nitrogen fixation in *A. nepalensis* takes place through a symbiotic relationship between *Alnus* with nitrogen-fixing actinomycetes of the genus *Frankia* and is, therefore, able to improve degraded jhumlands. Symbiotic microorganism *Frankia* (actinomycetes) are located in specialized structures, or nodules, along the root system of the host plants. The root nodules are

analogous to those induced by *Rhizobium* in legumes, and they provide an environment where *Frankia* can grow and prosper, while providing the host-plant with fixed atmospheric nitrogen. Unlike the *Rhizobium*-legume symbiosis, where most of the host plants belong to a single large family, *Frankia* can form root nodules in symbiosis with actinorhizal plants^{9,10}. Total litter yield depend on the number of plants and amount of N fixed varied between 48.3 kg/ha (60 trees/ha) to 184.8 kg/ha (625 trees/ha). Besides fixing atmospheric N, the litter added to the soil provides phosphorus, potassium, calcium and other nutrients through the addition of biomass^{11,12}. Agricultural crops, together with alder trees forms a very remunerative agro-forestry system and ability of the tree to develop and retain soil fertility has been fully utilized by the tribal farmers of *Angami*, *Chakhasang*, *Chang*, *Yimchaunger* and *Konyak* tribes¹³.

In *Khonoma* village, Nagaland the Alder-based system is an outstanding model of sustainable land-use evolved through numerous years of testing within the community. Most of the farmers cultivate *jhum* fields for 2 yrs within a 10 yrs cycle (1:4 ratio of cropping to fallow), while Alder-based system allows crop harvests in two out of every 4 yrs (1:1 ratio of cropping to fallow). As high as 57 different edible crops produced along with primary crops of rice, maize and potato. In first year *jhum*, primary crop grown is rice. Along with rice, numbers of secondary crops are also grown (tapioca, chili, potato, amaranthus, colocasia, etc.). During second year, jobstear and other secondary crops are grown. Alder-based *jhum* fields are managed typically in a four-year cycle, with two years of cropping between the alder trees followed by two years of fallow where the soil is rested and the coppices allowed to grow. In Sikkim, alder based farming system is very popular where farmers grows large cardamom in understory of alder trees.

Alder + Large cardamom farming system of Sikkim

In this system, large cardamom (*Badi eliachi*) is grown as intercrop in the under storey of alder tree (*Alnus nepalensis*) plantation (about 400 trees/ha). Large cardamom thrives well in the association with the alder trees (Fig. 5). This is the age old farming system followed in the high altitude areas of Sikkim. Sikkim is known throughout the world for producing quality large cardamom. Nearly, 45% of world's large cardamom comes from Sikkim which is one of the major sources of revenue generation of the state.

The system is purely organic in nature. The fertility in this system is maintained by biological nitrogen fixation through *Frankia sp.* in association with alder trees.

In contrast to alder based farming system in Nagaland where periodical lopping is done to maintain height of two meter, this system follow no such practice and alder trees are allowed to grow and later on used for timber purposes.

Zabo system

Zabo is an indigenous farming system of Nagaland. This system has its origin in *Kikrumba* village of *Phek* district of Nagaland, located at an altitude of 1,270 m above mean sea level. The area under this practice is 958 ha. The word *Zabo* means impounding of water. It has a combination of forest, agriculture and animal husbandry practices with well founded soil and water conservation base. Water resource development, water management and protection of environment are inherent aspects of the system^{3,15}.

The *Zabo*, farming system has protected forest land at top of the hill, water harvesting tanks in the middle and cattle yard and paddy fields at the lower side (Fig. 12). Some times it becomes difficult to get a suitable location for construction of the water storage tanks then the runoff from the catchment area is taken directly to paddy fields for storage as well as for irrigation during the crop growth period. Special techniques for seepage control in the paddy plots are followed. Paddy husk is used on shoulder bunds and puddling is done thoroughly. The catchment area, which is generally 1.5 ha or more, is kept under forest cover to serve as water source to the tank. The area is not disturbed by cutting and burning of trees. The cattle, pig, poultry birds, etc. are sometimes let loose in the forest area. The slope of catchment area is up to 100 per cent or even more.

The open cattle yard is fenced with local wood and bamboo. This is managed by group of farmers and they keep their cattle inside these enclosures on

rotation basis. These cattle enclosures are constructed on a little lower side of the water harvesting pond. In *Kikrumba* village, buffaloes and pigs are the common domesticated animals. The water from the pond is allowed to pass through the cattle yard before taking it to rice field for irrigation. The water carries with it the dung and urine of the animals to the field through split bamboo channels, just like present day fertigation system. This serves as good source of nutrition to crop. The farmers also add leaf litter of *Alnus nepalensis* (Alder) into the soil for managing soil health including fertility. The soils under *Zabo* system of cultivation are very rich in organic matter (1.79 - 2.87% SOC) and available nutrient contents (N: P₂O₅:K₂O = 209-370: 6.7-18.8: 60-160 kg/ha)¹⁵. This makes a good yield of rice even in the absence of inorganic fertilizers.

Below the catchment area (mid-hill), silt retention and water harvesting tanks are dugout with the formation of earthen embankments (Fig. 12). The size of pond depends on the size of the catchment area. Silt retention tanks are constructed at two or more points before the runoff water enters into the main tank. The silt retention tanks are cleaned annually for proper maintenance of the water harvesting system. The bottom surface of water harvesting tank is properly packed and side walls are plastered with paddy husk to minimize the seepage loss.

Majority of the farmers practice paddy-cum-fish culture. A small pit is dug in the middle of rice field to serve as shelter for fish during dry period. When the water is drained out from the fields before harvesting of paddy crop, the fish remain in the pit in the fields. Through this technique, farmers generally harvest about 60-75 kg of fish per hectare as an additional output.

Paddy fields of varying size are located at lower elevations (Fig. 6). Long duration (170-180 days) local rice varieties are grown and transplanting is done in June. The farmers get a rice productivity of about 3-3.5 t/ha.

Bun system of cultivation

This method of cultivation is followed in Meghalaya. The crops are grown on a series of raised beds locally referred as *bun* formed along the slope of the hills and in low lands after rice. The phytomass available in and around are placed on the ground @ 15-20 t/ha and covered with soil. Locally available weeds, shrubs, crop residues, tree leaves, etc. are used as phytomass. The bed width varies from 75-150 cm

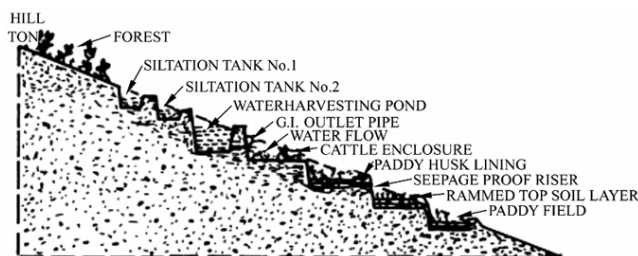


Fig. 12—Land management in *Zabo* farming system¹⁵

and the width of sunken beds/furrow varies from 50-100 cm with bed height of 15-45cm as per moisture condition and soil depth. The phytomass are either burnt or allowed for decomposition inside the soil to meet the nutritional requirements of the crops. It is a modified shifting cultivation, since here also the biomass are burnt and fields are left fallow after about 2 yrs of cultivation. In most of the cases, the bun method is practiced in the mild to steep hill slopes, which allows drainage during heavy rains. Crops like maize, ginger, turmeric, potato, sweet potato, cole crops and vegetables are grown in this method and high yields are obtained. In jaintia hills and some other parts, maize and leguminous crops like soybean and frenchbean are grown together where maize provides supports to climbing frenchbean (Fig. 7).

However, it allows a huge soil loss since the buns are formed along the hill slopes to allow better drainage. The bun method of cultivation has been refined to develop raised and sunken bed method of cultivation where rice and fish is grown in sunken beds and vegetables/maize/oilseeds, etc. are grown on raised beds¹⁶. In upland, this systems conserves moisture whereas, in lowland it facilitates the drainage. Now, introduction of vegetative barriers across the slope in the original bun system is on progress to check runoff and soil erosion.

Rotating cowshed in vegetable fields (North Sikkim)

In this system, a temporary cattle shed (made of bamboo poles and GI sheet/thatch grass roof) is made (Fig. 8) in the terrace before cultivation of vegetables like cole crops, ginger, turmeric, etc. The cattle/cows are allowed to stay in each shed for 2-3 days and thereafter, the shed is shifted to nearby new place and the process is continued until the whole field is covered. The main idea of such system is to collect the urine *in-situ* in the field itself, which is very rich in nitrogen (0.40%) and potassium (1.35%)¹⁷. The field is immediately ploughed to mix and incorporate the urine, cow dung, litter, etc. into the soil for early decomposition as measure for fertility management.

Pond based integrated farming systems of plains

Farmers in plains of Tripura, Assam, Manipur, South Garo Hills of Meghalaya, etc. follow intensive integrated farming system to meet their demand for food and earn livelihood. It is almost common to have a farm pond in each household. Around the

pond/water bodies, fruit crops like banana, arecanut, vegetable garden, etc. are maintained in embankments and nearby uplands (Fig. 9). Most of the households would have at least one animal component like cow, buffalo, pig or goat, etc. or their combinations. Local poultry/duck is also integrated to use the resources effectively. Compost pit is maintained in the corner of the field and also in backyard. Pond is used for pisciculture and during the lean season, pond water is used for life saving irrigation to crops and fruit trees. Pond is also maintained in the middle of farm especially for life saving irrigation of vegetables and for fish culture. The vegetable wastes are added to pond as feed for fishes like grass carps, etc. Rice is cultivated in lowland and wastes of farming system are recycled in rice/vegetable fields. Some farmers maintain a small pond in the corner of the rice field for fish rearing as well as for irrigation. The significant aspect of this system is that almost all the components are maintained organically except for vegetables and rice where a low amount of fertilizer is applied along with farmyard manure.

Conclusion

The indigenous farming systems of North East India have rich traditional base of water harvesting, soil fertility management, inclusion of fish and animal component along with forestry in a sustainable diversified way. However, these farming systems have either remained confined to their place of origin or are on the course of extinction due to the introduction of new technologies and farming systems which are more food grain production oriented and have little scope for environment. These traditional systems were sustainable as long as the population pressure was low. With the increase in population, pressure on land and other natural resources increased and farmers started intensive cultivation leaving hardly any time for building soil resilience. Judicious management and care of soil, water, plant and animal resources are necessary for pollution free environment and save the region from further degradation of natural resources.

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