Traditional land and water management systems of North-East hill region

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The tribal societies of different states of NEH regions with long history and traditions have developed ingenious indigenous land and water management systems which have built-in eco-friendly systems of conservation, preservation, and utilization of natural resources. The systems described include ‘zabo’ farming system, agriculture with Alder Tree and ‘Panikheti’ of terraced rice fields of Nagaland, water management in Apatani Plateau of Arunachal Pradesh, rice-cum-fish culture of Arunachal Pradesh and Nagaland, and bamboo drip irrigation system of Jaintia and Khasi Hills of Meghalaya. All these systems are in vogue for centuries and they are still sustainable.

These tribal indigenous systems of land and water management are mostly community managed and with locally available materials. Generally monocropping of rice is done using traditional methods of crop cultivation, which are labour intensive, using small amounts of organic manure and manual hand tools. The productivity is generally low. However, due to increasing population, decreasing community participation, and local forest products, deforestation, and land degradation due to shifting cultivation, productivity of some of these systems is not enough to fulfil the needs of the farmers.

Use of low cost synthetic materials, appropriate farming tools and implements, improved package of practices for crop cultivation, and subsidiary land based practices like scientific fish culture, cattle management and growing of horticultural crops, grasses and legumes, etc will improve the productivity and income of the farmers and these eco-friendly systems will again become economically viable.

Keywords: Traditional land and water management, Zabo or ‘Ruza’ system, Alnus nepalensis, Panikheti, Rice-cum-fish culture, Bamboo drip irrigation.

The North Eastern Hill (NEH) Region of India comprising the states of Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura lies between 21.5°N to 29.5°N latitude and 85.5°E to 97.5°E longitude. The total area of the region is 18,375 thousand hectares of which about 9,729 thousand ha (52.95%) was estimated to be under various types of forest including fallow land under regeneration in the shifting cultivation cycle. The region falls under high rainfall zone and the climate varies from sub-tropical zone to alpine. It is characterized by difficult hilly terrain, wide
variations in slopes and altitude, land tenure systems, and cultivation practices.

The environment, local conditions, socio-economic and socio-cultural life of the people and also the festivals, functions, and rituals associated with agricultural practices vary in different states of the region. There are a number of tribes inhabiting the NEH region. These tribal societies with long history and traditions have developed ingenious indigenous farming systems, which have built-in eco-friendly systems for conservation, preservation, and utilization of natural resources. Some of these practices have been briefly described hereunder.

**Zabo or 'Ruza' system**

'Zabo' system is an indigenous farming system practiced by Chakhesang tribes of Kikruma village situated at an altitude of 1270 m above mean sea level on a flat ridge bound on the south by Seidzu river and on the north by Khuzha river in Phek district of Nagaland. The village is situated few hundred metres above the two rivers. The water from the two rivers cannot be used for irrigation or household purposes. This situation might have compelled the tribal farmers to evolve a system to impound and store runoff water from hilltops for domestic and irrigational use. The zabo system has been in vogue for centuries and has remained sustainable.

Zabo means “impounding of water”. Zabo system has a combination of forest, agriculture, and animal husbandry with conservation base, soil erosion control, water management and its utilization, and management and protection of environment. Only organic manure is used for raising crops.

The system—The system comprises protected forest land on hill top, well planned water harvesting pond(s) at the middle, and the livestock yard and paddy field towards the foot hills at the lower elevations (Fig. 1). In case, a suitable location for water storage is not available, the runoff water from the catchments is taken directly to paddy fields for water storage. Water harvesting ponds are dug below the forest area with formation of earthen embankments. The size of the pond depends upon the serving area and amount of water harvested. Silt retention tanks are constructed at some points before the runoff water is taken to the main pond. The siltation tanks are desilted every year and the silt is used as soil amendment in lighter soils. At the time of construction of the ponds, the inner surface and side bunds are rammed and compacted thoroughly to reduce seepage losses of water. Down blow is cattle enclosure. Further down below are paddy fields which are well terraced, puddled and compacted for uniform distribution of water and for reducing infiltration and percolation losses and reduced weed infestation. Before applying the water from the main pond to paddy fields, it is passed through the cattle enclosures so that it carries the dung and urine of animals to the paddy fields. Paddy cultivation is done by following the traditional practices.

**Agriculture with Alder (Alnus nepalensis D. Don)**

The farming system with alder proba-
Fig. 1—'Zabo' farming system of Nagaland

bly started in the 16th century and this time-tested method of cultivation is still prevalent among the farmers of Angami, Chang, Chakhesang, Yimchunger and Konyak tribes of Nagaland. The place of origin of this farming system is Khonoma village in Kohima district of Nagaland. With alder trees, farmers grow mostly maize, millets, job’s tears (Coix lacryma-jobi Linn.), wheat, potato and taro (Colocasia esculenta (Linn.) Schott) using alder leaves and tender twigs.

Ability of the alder tree in enhancing soil fertility has been fully exploited by the farmers of Nagaland. Studies have shown that on an average about 100 to 125 kg N/ha is added to the soil by a well developed alder tree which is a non-leguminous tree that fixes large quantities of atmospheric nitrogen through nodules on the roots. The amount of N added to the soil varies according to the population of alder trees. High population may exert shading effect on crops. Nodules give a biomass of 150 to 370 kg N/ha. Roots of alder tree do not grow very deep in the soil but spread side ways and develop nodules quickly. The alder tree is pollarded from November to January. Leaves and tender twigs are separated, burnt and mixed in the soil and branches are used as firewood. After pollarding, new shoots known as coppices sprout. Alder trees sprout coppices quickly and profusely. The pollarding is done every four to five years on rotation basis. The crops are grown along with alder trees during regenerative phase as well as in the year of pollarding.
Panikheti

Due to high rainfall in NEH region, weeds infestation is a serious problem in upland rice cultivation. Since only hills and runoff water from the hills were available for rice cultivation, terracing became necessary for keeping the rain water standing in the field. The tribal farmers acquired skill and ingenuity for construction of terraces to keep the water standing in the field which is known as “Panikheti”.

Angami and Chakhesang tribes of Nagaland have developed irrigation system for terraced rice fields through which almost all fields can be irrigated properly and judiciously. The system is more prevalent in Nagaland, Manipur and Sikkim, as far as use of harvested water for need-based, uniform irrigation of all the terraced rice fields is concerned.

The system—Depending upon the slope of the hill, terraces of different sizes are constructed, supported by bunds of 0.5 to 1.3 m width and 0.2 to 1.4 m height. The levelling of terraces is done by cut and fill method and the topsoil removed is again spread uniformly on the surface. Perfect levelling of terraces and well managed irrigation-cum-drainage system controls soil erosion and loss of soil fertility. Big clods of clay/silt soils are spread randomly over the field which disintegrate due to rainwater and the soil spreads in the field and checks percolation of water appreciably. Runoff water coming from hill tops and slopes is used to irrigate the terraced fields and the excess water is safely guided through well pitched drainage channels to the lower reaches in the storage tanks. Locally available stones of various sizes and clayey/silty soils are used carefully for pitching the channels. Leaves of trees, forest litter, crop residues, and weeds etc are decomposed alongwith cattle dung or burnt and incorporated in terraced fields to maintain the soil fertility for rice cultivation.

Water Management in Apatani Plateau

The Apatani plateau is spread over an area of 26 sq km in Subansiri district of Arunachal Pradesh and is inhabited by Apatani tribes. The valley is surrounded by high hills having an elevation of 2438 m above mean sea level and lies between Panior and Kamla rivers at an altitude of 1524 m.

The system—The Apatani tribal people have developed an efficient system of water management for rice and fish culture that has remained sustainable for centuries. The system involves people’s participation for common works and the available water of natural streams is used judiciously in a planned manner for crop production.

All streams coming out of surrounding hills are tapped at the beginning of the valley, channelised and diverted through a network of primary, secondary and tertiary channels to rice fields. At a short distance above the terraces, some water is allowed to flow in the first feeder channel through a diversion, while the stream continues on its course. The feeder channel branches off at angles to lead water to any terraced rice field which can be flooded
or drained as per need by blocking or opening of connecting ducts known as “Huburs” (Fig. 2). The cross sections of main and sub-channels vary in depth and width as per load of water. These channels are pitched with locally available stones and boulders especially at the entry point for checking erosion due to flow of water. By adjusting the height of the outlet pipes, the water level in the rice field is maintained. The excess water from the fields is drained into the Kale river which flows through the middle of the valley.

Although, rice-cum-fish culture is practiced to some extent in low-land rice areas of the country, special indigenous techniques are being used for rice-cum-fish culture in NEH region.

Fig. 2—Water management in Apatani plateau of Arunachal Pradesh for rice-cum-fish culture
Rice-cum-Fish Culture

Sometimes, farmers practice rice-cum-fish culture by making a little deeper fish-channels at suitable intervals in the fields so that even if water from the rice field is drained out, sufficient water remains in the fish channel.\(^1\)

In Nagaland also rice-cum-fish culture is practiced in terraced rice fields. In this system, a small pit is dug in each terrace in a series of terraces where rice is grown. Fingerlings are put in water in these pits. When water supply is sufficient in monsoon season, the whole rice field is kept under shallow submergence of 5 to 10 cm and fishes come out of the pits and move around the whole submerged area of the terraced field. During water scarcity period, when water remains only in the pits, fishes run back to the pits and grow. In this system, fishes get better nutrition due to manuring of rice fields and their growth is better due to availability of larger surface area during full submergence of rice fields. Thus, both rice and fishes are produced together by proper management of rainwater.

Bamboo drip irrigation

Bamboo drip irrigation is widely adopted by tribal farmers of Jaintia and Khasi hills of Meghalaya. This is a good irrigation system for growing crops in areas where water becomes scarce in lean periods as the topography is undulating and hilly, and the soils have poor water holding capacity.

In Jaintia and Khasi Hill areas, the hill slopes are quite steep with less soil depth and preponderance of bouldery soils at several places. Even in such type of poor land, good plantation crops of arecanut, and betel vine are grown using water from bamboo drip irrigation. Since bamboo is available locally, this system does not require any outside material assistance and capital investment by the farmers is very small.\(^1\)

The system—In this system, a meager quantity of hill stream’s water coming from hill top is diverted into split bamboo line in such a way that it acts as a prefabricated open channel. Such pipelines run about 1 to 2 m above the ground surface supported by bamboo or wood stands. The length of the line depends on the distance between water source and the field.

Water is brought to the field through these bamboo channels by gravitational flow and then distributed to the individual plants of arecanut and betel vines all over the orchard. Distribution of water in the orchard is done by installing secondary, tertiary, or even more branches of bamboo pipeline with a typical water diversion system at the points of each branch (Fig. 3). Ultimately, water drips to the base of individual plants ranging from 10 to 100 drops per minute at the terminals of these branches. Sometimes water is taken to distant places in the hills through this system for household use.\(^6\)

Conclusion

The tribal indigenous systems of land and water management are basically community managed and to a small extent self managed using locally available forest raw materials such as bamboo, wood, stones and boulders, etc. All operations including agricultural operations...
Fig. 3—Bamboo drip irrigation system of Meghalaya
are done manually using hand tools and wooden sticks. Mostly bamboo is used for fencing, making pegs and water channels to take water across bunds or on hilly terrains.

However, due to increasing population pressure on natural resources, deforestation and reduced shifting cultivation cycle, decreasing availability of forest products, decreasing community participation, short life of materials used in some of these systems, use of small hand tools which are time consuming and labour intensive, and use of a meagre amount of undecomposed cattle dung for growing only rice, these systems are gradually turning into uneconomical in spite of the fact that these are eco-friendly systems of conservation, preservation, and utilization of natural resources.

Integration of modern scientific knowledge and proven eco-friendly techniques of conservation and utilization of natural resources using low cost synthetic materials and area specific tools, implements and agricultural practices as well as scientific management of cattle and fish, these traditional systems can again be made economically viable. The added advantages will include reduction in shifting cultivation and misuse of natural resources.

References