Traditional Irrigation System: A Case of Apatani Tribe in Arunachal Himalaya, North East India

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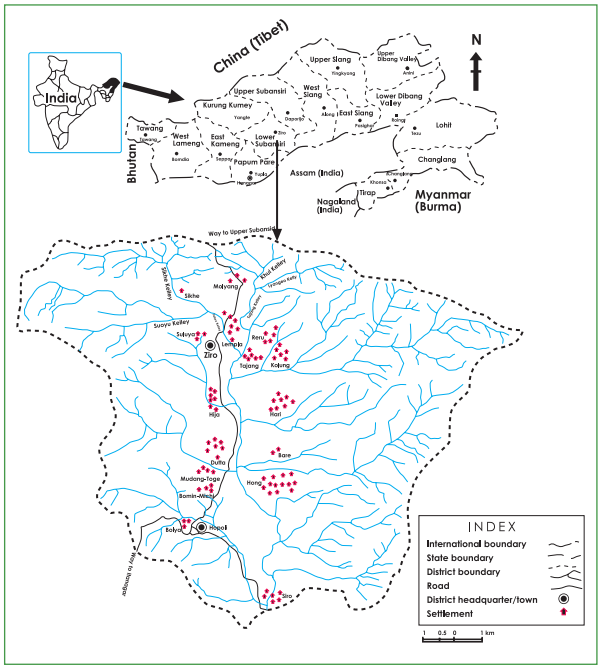

Figure 1: Map of Apatani plateau watershed.

The post-World War II era has witnessed a drastic increase in irrigation activities that have contributed substantially to the massive growth in agricultural production that enables humanity to feed its doubling population. Worldwide, irrigated land has increased from 50 mha (million hectares) in 1900 to 466 mha today. Much of this increase has been in developing countries. For example, in 1950 India had an irrigation potential of 22.6 mha which today has risen to 105 mha. However, in many cases, water resources have been overdeveloped. There has been overspending on capital and significant cost in terms of loss of ecosystems, extinction of fish species and contamination of water sources. This has happened due to underestimated or neglect of economical and ecologically viable traditional irrigation technologies which are time-tested and location specific. Documentation and validation as well as valuing of traditional irrigation practices may have a pivotal role particularly in fragile mountain ecosystems.

Arunachal Pradesh, a state in the extreme north-east of India (bordering Bhutan to the west, Tibet to the north and Myanmar to the east), has great ethno-cultural diversity, with 26 major and 110 minor sub-tribes. The region is well-known for its rich eco-cultural heritage, as well as the wealth of traditional ecological knowledge amongst farmers. As agriculture is the main livelihood activity in the region, it is vital that the production systems are managed efficiently. The Apatani tribe in the Apatani plateau situated in the central western part of Arunachal Himalaya, through traditional irrigation systems locally called as Bogo, has been successfully managing their agro-ecosystem for many years

Plate 1: Landscape view of Apatani plateau. Plate 2: Paddy-cum-fish culture by the Apatani tribe. Plate 3: Traditional erosion control system in irrigation canal by using locally available resources. Plate 4: Modern erosion control in irrigation canal by using concrete. Plate 5: Traditional check dam for irrigation. Plate 6: Modern check dam for irrigation. Photos: Mihin Dolla.

(Figure 1 and Plate 1). However, in recent times, with the youth migrating in search of jobs and other labourers coming in, many of these traditions, practices and knowledge are in danger of being diluted or lost.

When traditional knowledge and practices developed over centuries are shared within the tribe who work on the land together, it clearly supports sustainable agro-ecosystem management in this region. The Apatani are known for their system of rice and fish cultivation (Aji-ngyii) in the valley, which produces enough rice to export from the region after meeting local needs (Plate 2). This is a highly evolved indigenous farming system, the energy and economic efficiency of which is very high partly due to effective irrigation practices.

As part of a wider research effort into this little studied region, the G.B. Pant Institute of Himalayan Environment and Development set out to document traditional knowledge in relation to sustainable agriculture across the Arunachal Himalaya. The main objectives of the study carried out between March 2006 and February 2008, were to examine the traditional irrigation practices used by the farmers in the Apatani plateau, the nature of community participation and the changes they are facing. Group discussions among different age groups of the Apatani were held, involving both men and women. Special attention was paid to older farmers in order to understand the exact nature of traditional irrigation system and its transition.

Traditional system

The Apatani system of irrigation is more than a century old. The practice has been worked on and perfected through community involvement and equitable sharing of water resources. In this system, water is tapped near the forest in the foothills of the valley and is channelled through to major canals on either side of the valley to supply the agricultural land. The water is distributed via numerous small canals so that every plot of land is well supplied with irrigated water for rice cultivation and fish culture. This also ensures that any surplus water is drained back to the main canal without the loss of any organic matter or soil.

Terraces made along the gradient are connected using bamboo pipes of small circumference (10–15 cm) at the higher elevations where water intake is lower. In the lower valley where the volume of water is greater, pine pipes of larger circumference (15-25 cm) are used. These pipes are made from pine trunks split vertically, hollowed out and then the two parts put back together. Water from the bamboo and pine pipes is not allowed to cascade from one plot to another; bamboo barriers are fixed on the upper elevations where the volume of water is smaller, with pine blocks at lower elevations where the volume of water is greater. Further, to contain losses of organic matter or fish from the plots, bamboo traps or straw bedding have been introduced into all plots. In addition, the outflow pipes are placed five to eight inches above the surface of the lower plots so that water from lower plots cannot flow back to the upper plots. The dimensions of the dykes or bunds change from higher elevations towards the valley floor. At higher elevations, the plots are wider, whereas at lower levels the bunds are narrower.

To curtail soil erosion from the main canal, bio-fencing measures such as planting with *Phragmites sp.*, *Ligustrum sp.*, etc. have been carried out and wooden barriers of *Pinus wallichiana A. B. Jacks*, *Castanopsis spp.* or bamboo species have been installed to limit the flow of water (Plate 3). Weeding of *Houttuynia cordata Thunb.* is not done, as it is considered good for soil binding and stabilization of the bunds. Bamboo is also used to support the wider bunds. The bunds are repaired every year before rice planting. Ploughing is not done in the rice plots so as to avoid soil loss, but spades may be used to till the land before irrigation.

Equitable sharing

The Apatani traditional community has evolved using diverse management tactics. For example, they have set a group called Bogo, which is seen as the most important group as

there are limited water sources for irrigation in the Apatani valley and good water management is essential for efficient production in the rice-fish system. These irrigation systems are managed by the traditional farmers' group led by Bogo Ahtoh. The Bogo Ahtoh is mainly headed by a male member as it requires heavy work. The group manager leads all the activities, although in some cases the financial transactions are made by the Finance Secretary or Passer Binee. The Bogo Ahtoh post can be held for one to three years and is selected from within the group. Organisation size normally ranges between as low as three and a high of nearly 600 households depending on village size and irrigation canal length. The main task of the organisation is construction and maintenance of the water supply system and regulation of the efficient sharing of water among the group. The vision of this group is reflected in the management and sharing of water in the community, which recognises that water is the common concern which binds the group. The farmers know that traditional practices are very important for maintaining sustainable production systems and that farmers' associations are the foundations of these practices. Most farmers recognise that without farmers' organisations, agro-ecosystem management will easily weaken and the technical ecological knowledge which supports it will quickly erode.

Since water is most important for rice cultivation, the entire community has a stake in it and its equal distribution ensures collective survival and social cohesiveness within the community. The proper distribution of water is regulated by a few nominated members of the community who ensure its equitable distribution and are empowered to resolve any conflicts that arise. Each year, repairing of the canal is carried out by collective participation, whereby one person from each household provides their labour. Some villages within the community have a small grant for the upkeep and maintenance of the canals. Each plot owner is bound to provide equal supplies of water to the neighbouring plots and violation of such regulations is dealt with by the community institution called Buliyang. The division of labour is such that men repair the bunds and canals, whilst women manage the plantations and weeding through to harvest. Harvesting is done jointly by both, with women cutting the spikes and men doing the threshing.

Irrigation and soil fertility

The canal draining the village wastewater, which carries organic material, particularly the biodegradable waste from the homesteads that comprises of vegetable waste, poultry and piggery manure, is a good source of fertiliser and is also connected to the irrigation canal, which is further draining into the agricultural fields. In addition, the organic material (decomposed leave litter) leaching from the forest floor is collected in separate pipes connected to the main canal so that whenever the additional forest run-off reaches the canal, it goes on to the plots. Plots not connected to the main canal collect any organic material from the forest through the normal bamboo pipe connected to the plots above them. The extra organic material accumulating near the inlet pipe is spread by hand on other parts of the plot. The traditional perception is that the run-off from forest with trees such as *Ficus spp.* are more fertile compared to forest with *Quercus spp.*, *Castanopsis spp.* etc. This traditional perception may be correlated with the decomposition of leaf litters as the litter of Ficus spp. decomposes faster that of *Quercus spp.* and *Castanopsis spp.*

Transition and future options

Traditional irrigation systems are now in a transitional phase, mainly due to outside intervention. It has been quite evident that the traditional check dam and irrigation canal are slowly and steadily transformed by the use of concrete and iron materials from outside sources (Plate 4). This transition not only endangers Apatani's ecological knowledge but also risks the future survival of the fish population, as the concrete reduces the movement of fishes from down to upstream and it also lacks a breeding centre. In the traditional system there is enough space for breeding as the channels are made of wood and bamboo, which is not common in concrete construction. Though the Apatani are believed to be a very conservative community, now some of the traditional irrigation management systems are on the verge of extinction due to the integration of outside technologies. It is common for the youth to leave the communities in search of jobs, which creates shortages of traditional labour. In addition, outside labour forces are increasingly coming to the area for timber sawing, stone mining and the harvesting of non-timber forest products. Due to sociocultural, climatic and physiographic differences, these people have different management techniques which often dilute the Apatani traditional practices. The Apatani will still need labour from outside, but now they are trying to cope with the emerging situation by being aware that their system is very efficient yet delicate, and realising the need to preserve their time-tested knowledge by documenting it for future generations.

Except for financial support, particularly for erosion control, fencing and drainage maintenance, the farmers do not receive or seek any technological interventions or other help from any outside agencies. Outside experts have highlighted the Apatani rice-fish culture system as one of the most efficient crop production systems, encouraging the Apatani farmers to continue their traditional practices. The ingenuity of the Apatani community is well reflected in its traditional water management systems and in the sharing of resources for optimum utilization. The traditional system of wet-rice cultivation, which is a purely organic farming system, is functional even today and is modified by the community as and when required. There is optimum utilization of available natural resources such as bamboo, cane, pine, *Phragmites sp.*, *Ligustrum sp.* and *Castanopsis sp.* in order to check soil erosion, conserve soil fertility and raise fish in an integrated manner along with the cultivation of the many available rice varieties. The Apatani irrigation system offers environmental implications in sustainable resource management and may be replicated in similar micro-ecological conditions.

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