

## Traditional system of water management in watersheds of Arunachal Pradesh

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The *Adi* tribe of Arunachal Pradesh is very rich in indigenous traditional knowledge in conserving natural resources. The *Yetbung Lingang* and *Linkum* are such traditional water conservation structures made up of locally available stones/boulders, bamboo and *tokopata* and used to divert the perennial stream of the area for *Panikheti* and winter crop cultivation. The people of the watersheds of East Siang district have their traditional clarification for construction of these types of structures. Rainfall evaporation pattern of the study area also supports prolong crop growing season for widening arable land under the watershed. Scientific rationale of the study confirms the multifaceted advantages of such traditional practices.

**Keywords:** Traditional System of Water management, Community, *Yetbung Lingang*, *Linkum*

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Water is one of the key inputs to agriculture for obtaining high crop yield. Either excess or deficit of water in plant root environment constraints optimal crop production. Northeast India, being a high rainfall area coupled with steep topography experiences excessive surface runoff and floods during monsoon period and acute water shortage for irrigation and drinking purposes during winter season. Due to hilly nature of the terrain, major and medium irrigation projects are more or less absent. As the irrigated areas lies on the terraces of hill slopes and few in valley lands proper water management is needed. However, the water management component has not been given due importance. Community based land tenure system dominates in the region. Rice is the main kharif crop grown in both lowland and upland conditions in the region. Maize, millets, soybean, groundnut, linseed, pea, tapioca, mustard, potatoes, ginger, turmeric, pineapple, cassava, vegetables, etc. are also grown in both the seasons. Mostly fields are fallow during the winter season except where irrigation facilities are available.

Traditional methods of water management consist of harnessing the hill streams during monsoon by constructing temporary check dams on stream bed for diversion and conveyance of water through split

bamboo pipe, earthen channel, etc. Boulder, timber and earthen dams are used to build across the stream to raise the level of water for diversion. There is a tradition of such irrigation practices being followed by village/community as a whole in carrying water from streams over large distances. Based on long experience under existing soil and climatic conditions as well as availability of large number of hill streams, farmers in certain areas have developed typical systems of water management, which are very effective under the existing condition of topography and terrain. Some of these systems are bamboo drip irrigation system in Meghalaya, *Zabo* system in Nagaland, *Apatani* system in Arunachal Pradesh, etc. In bamboo drip system, water from the natural stream located at a higher elevation is conveyed to the plantation sites through gravitational flow with the use of bamboo channels supported by wooden or bamboo posts. Water distribution is done with the use of bamboo channels, bamboo supports, water diversion pipes and strips. The whole system enables the distribution of 15 to 25 litres of water per minute depending on the availability of water resource and the number of plants to be irrigated<sup>4</sup>. It takes about 15 days for 2 labours to install the system in a hectare of land. Most of the materials used in installing the system last around three years. Once laid out, the

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system works round the clock if so desired. The maintenance cost is very minimal; a little care is sufficient to keep the system in good condition<sup>1,2</sup>. The Zabo (means impounding of water) system consists of a protected forestland in the top of the hill, water-harvesting tanks in the middle and paddy fields at the lower side. Paddy husk is used on shoulder bunds and puddling is done thoroughly<sup>3</sup>. In *Apatani* system terraces prepared in the main valley are quite broad, perfectly levelled and provided with strong bunds. The slope of land in the main valley ranges between 1-8%. Every stream arising from the surrounding hills is tapped, channelised at the rim of the valley and diverted to the terrace fields by a network of primary, secondary and tertiary channels<sup>4,5</sup>. Indigenous water conservation technology was investigated, studied and documented in Sumari village of Pauri district, Uttarakhand<sup>6</sup> and water distribution methods based on folk tradition and local beliefs in Ladakh, Jammu and Kashmir<sup>7</sup>. However, these practices are now degenerating slowly due to reduction in water resources and apathy of the people for participatory programmes<sup>8</sup>.

In the *Adi* tribe dominated East Siang district of Arunachal Pradesh, people in community basis usually constructs traditional water conservation structures such as *Yetbung Lingang*, *Linkum* for diverting water of the streams for *Panikheti* (irrigation in bench terraces and valley) also known as *Asiarik* in *Adi* dialect. In this system, the hill streams are tapped at or near the source of emergence and the water is channelised to irrigate a series of terraces and paddy fields in valley lands in such a manner that water continuously flows from the upper terraces to the lower ones, without soil erosion. The perennial streams are blocked by the *Yetbung Lingang*, *Linkum* structures and water is diverted to the adjoining command areas for low land paddy cultivation in *kharif* season and highly remunerative vegetable crops in following *rabi* season. There is a need to analyse these practices scientifically and socio-economic stand point to popularize them for cost effective, eco-friendly and sustainable management of water resources. Present investigation was carried out to document the indigenous traditional water management technique of the *Adi* community in Debing Sigo Korong and Riga watersheds of East Siang district for irrigation purposes.

### Methodology

The study was carried out in East Siang district of Arunachal Pradesh. Two potential underdeveloped watersheds were selected namely Debing Sigo

Korong (27°51'N and 95°07'E) and Riga (28°16' N and 95°03'E). Two villages in each of the watershed were visited and 20 % of the existing households were considered for the study. As such, 25 representative informants from Debing Sigo Korong and 30 from Riga were consulted with Prior Informed Consent (PIC) from the presidents of respective watershed associations. The *Yetbung Lingang* structure was found in the Debing Sigo Korong watershed and the *Linkum* was found on the way to Riga. The Debing Sigo Korong watershed is a micro-watershed of 543 hectares. The watershed has 127 households and a population of 790. No commercial craft and rural industry is seen in the watershed. However, women practice village craft such as weaving cloths (*Galuk*) for their own uses. About 15 % of the total population have migrated from the watershed mostly for government services and about 60 % practice farming. The farmers practice *Panikheti* for which they frequently make *Yetbung Lingang* structure.

The data collection was made through rapport building with the village head man (*Gaon-burha*), primary school teachers, extension workers, village priests and members of local committees. A transect walk with the help of village elders was made. Family heads/elders from the selected households were interviewed with the help of questionnaire approved by the Central Agricultural University, Imphal. Questionnaire related to ecosystems and the traditional methods of land and water management was translated to *Adi* dialect for better understanding of the respondents. The Focus Group Discussions (FGDs) were followed to discuss the location specific suitable natural resource management practices so that a consensus score can be derived for the further analysis and interpretation of data.

### Results and discussion

From this study, it was observed that out of many ways of water conservation techniques used by the individual/community, construction of *Yetbung Lingang* and *Linkum* are the most common in Debing watershed. Most of the respondents have expressed their experience in managing the water in different ways of making bunds but the base technique of constructing and maintaining those structures are broadly similar. These constructions are made by using locally available *eling* (stones), *dibang* (bamboo), *tak* (tokopata) and *jeing* (canes) with human skill since time immemorial. In all these practices there is strong community participation for

the construction, repair and maintenance of these structures and ethnical rules for sharing the water. The area is mostly under sole crop of paddy in *kharif* season, if the stream is seasonal whereas, farmers grow winter vegetables, in case the stream is perennial.

**Scientific rationality**

Uneven weekly distribution of rainfall is typical characteristic of the study area. It has been observed that the district is receiving sufficient rainfall during the rainy season with weekly variation from 67 mm to 253 mm; while during post rainy season, weekly receipt of rainfall varies from as low as 0.3 mm to as high as 119 mm. On the contrary, weekly evaporation of the study area found to be more static in its behaviour with 13 mm to 28 mm during the rainy season and 20 mm to 33 mm during the post rainy season (Fig. 1). It can be noted that there is sufficient surplus of water receipt over its loss through evaporation during the period of May thru December (week number 18 to 44). Moreover, the soil of this region is highly porous with very less water holding capacity. There lies the opportunity to raise a rainfed crop of low land paddy and any second crop including vegetable in the post rainy season with the help of construction of traditional *Yetbung Lingang* structure.

**Construction and design of *Yetbung Lingang* and *Linkum* structure**

The *Yetbung Lingang* and *Linkum* structure are constructed and maintained by the local community under the leadership of *Gaon Burha* without any assistance from the Government sector.

The *Yetbung Lingang* structure is constructed at suitable location across the stream during winter when

the flow is minimal. Usually upstream side of the stream is preferred for construction of such structure so that stored water can be diverted to the command area of adjoining paddy fields. Locally available stones from the same stream bed are collected. Raw bamboo is cut from the nearby jungles and gathered near to the location of construction. Bamboo variety *Dendrocalamus hamiltonii* Nees & Arn. ex Munro is used for straight pieces and *Bambusa pallida* Munro for making rings and for tying purposes (Fig. 2). The design of the structure has two parts hydrologic and hydraulic. In hydrologic design how much discharge has to be handled by the structure is determined. The villagers however, do this by increasing the number of structure in series in case the flow of the stream is high based on previous record (Fig. 3). Hydraulic design explains the safe dimension of the structure. Villagers do not increase the size of the structure, but increase the number. The diameter of the structure is

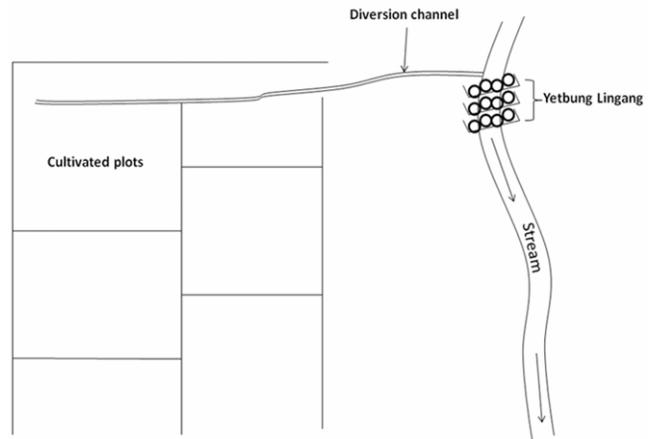


Fig. 2—Construction of the frame of *Yetbung Lingang*

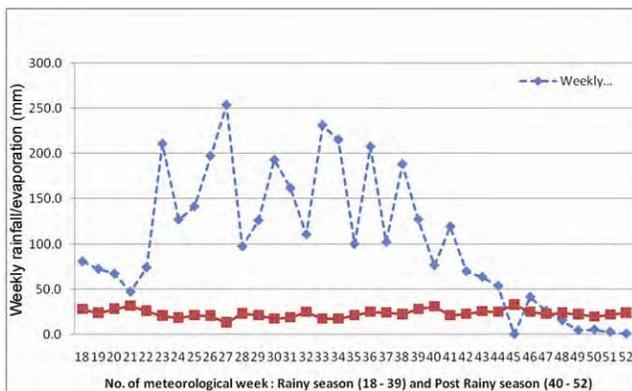


Fig. 1—Mean weekly rainfall / evaporation at Pasighat, East Siang District, Arunachal Pradesh during rainy season (May - September) and post-rainy season (October - December)

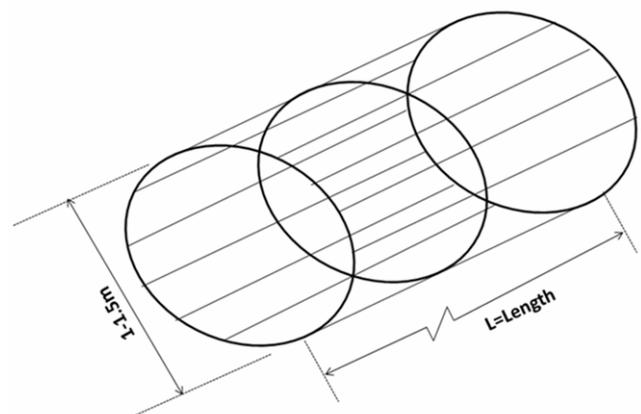


Fig. 3—Construction of series of *Yetbung Lingang* to counteract the heavy flow during rainy season

about 1-1.5 m (Figs 4 & 5) while the length of the structure is kept 1 m more than the width of the stream so that about 50 cm enters into the stream bank on both the sides for better grip of the structure. Foundation of the structure is kept below the base of the stream by removing stones from the bottom at the section. Gap between the longitudinal bamboo pieces is kept in such a manner that the stones which are packed inside should not come out under the flow of water. Once the frame is prepared, stones of suitable sizes are filled in it (Fig. 6). Series of 3-4 such structures are laid across the stream. The structure acts like a filtered check dam and raises the water level in the upstream side. A wall made up of tokopata (*Livistona jenkinsiana* Griff) and bamboo is provided at the upstream side for reducing the seepage of water flow to downstream side and raises the water level in the upstream side. Around 50 % of the water requirement of crops is met through the water supplied from the *Yetbung Lingang* during the prolong dry spell of the monsoon as well as in post rainy season. Scheduling of irrigation is decided by the farmers based on the feel and appearance method. This increases the cropping intensity and supplies the need based grains and vegetables to the people of the village.

'Linkum' in Adi dialect is any temporary structure that uses locally available stones with or without the structures made up of bamboo for varied purposes as

shown in the Fig. 7. In case only stones are arranged to check stream bank erosion, then the *Linkum* of about 1-2 m width is constructed with the height upto top of the embankment (Fig. 8). Whereas, if the *Linkum* is made of stones and GI wire, it is referred to as *Linkum-Gabion* structure. *Linkum-Gabion* structure is constructed for multiple purposes, viz. filtered check dam to check gully erosion and prevent stream bank erosion (Fig. 9). The *Gabion* structure is constructed by the villagers widely under government projects in watersheds (Fig. 10). Galvanised iron wire of No. 8 or No. 10 gauge is used for fabricating mesh with triple twist. The wire net has mesh size varies from 7.5-15 cm. For every 10 m wire mesh, 13 m of wire is used. Then, boxes of wire net are prepared and stones are filled in these boxes. Lastly the opening ends of wire meshes are tied with the help of iron rods. This design is made by the engineers and detail dimension of the structure is given to the villagers for its construction.

#### Economics and durability of *Yetbung Lingang* and *Linkum* structures

For the construction of *Yetbung Lingang* structure no effective cost is involved as all the materials are collected from the villages and labours are contributed by the community in holistic approach. The average life of these structures is 3 yrs.



Fig. (4-10) – Fig. 4—Panikheti based on *Yetbung Lingang* structure; Fig. 5—Schematic diagram of *Yetbung Lingang*; Fig. 6—Filling of stones in the frame *Yetbung Lingang*; Fig. 7—*Linkum* as a support for laying pipeline across the small river/stream; Fig. 8—Stream bank erosion is prevented by *Linkum*; Fig. 9—*Linkum* as filtered check dam prevents gully erosion; Fig. 10—Community making *Gabion-Linkum* structure for protecting the stream banks

In case *Linkum* is constructed by locally available bamboo and stones, the cost incurred is minimum. However, cost involved in constructing *Linkum-Gabion* structure is mainly the cost of GI wire mesh (15 m × 3 m size wire net with mesh size 10 cm × 10 cm) which is about Rs. 1100/-. The average life of the *Linkum-Gabion* structure is around 10 yrs.

### Conclusion

Indigenous water management practices with *Yetbung Lingang* and *Linkum* are widely used in East Siang district of Arunachal Pradesh since long back. There are abundance of stones, boulders, bamboo and *tokopata* which are meticulously utilised for raising these two structures used for storing of water, irrigating the crop, laying of pipe, checking erosion loss, erecting a temporary small bridge, etc. Local *Adi* tribe have their traditional wisdom for constructing and using them. Torrential rainfall coupled with erosive nature of light textured soil of undulating topography requires such constructions to conserve and utilise the natural resources like soil and water. Generally financial assistance for erecting and maintaining such structures are not provided by the Government and other organised sectors. In this situation, *Yetbung Lingang* and *Linkum* created in holistic way has become the lifeline of the local people in the remote area of Arunachal Pradesh.

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