TRADITIONAL WATER MANAGEMENT IN THE SEMI-ARID AREAS OF CENTRAL HIMALAYA

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ABSTRACT

In the semi-arid areas of Central Himalaya, India, people have worked out an efficient water management system. Present paper focuses on some interesting technical and ideological aspects of this system.

The technical aspect reveals Central Himalayan peoples' intimate knowledge of different watering sources that were articulated in some thirty-five local names on the basis of topographical setting and available quantity of water. Furthermore, it describes how using locally available material the people developed various sustainable and highly efficient hydraulic contrivances to tap and store water from different sources; that based on simple technology most of these devices were executed and maintained by community efforts, hence free from financial burden.

The ideological aspect shows that in Central Himalaya ideology lent sanctity to water, accordingly several important rites and ceremonies were developed around it. Furthermore, images of different divinities were installed in the watering places to sanctify them. Consequently, in semi-arid parts ideology motivated people to participate in the construction, repairs, and hygienic maintenance of the watering places, and helped society in resolving water related conflicts, and agreeable distribution of water.

Combined testimony of the archaeological record, folklores, and ethnography unfolds that in Central Himalaya these two aspects existed from very early times. Naturally therefore the efficiency of traditional water management is time-honoured.

Sadly to-day due to State control in water management the people of Central Himalaya are distancing themselves from the traditional water management system that needs to be arrested, because its efficieny is beyond doubt. Indeed in the context of ever growing global water crisis, and technical, environmental, institutional, and social issues thereof, the traditional water management in the semi-arid areas of Central Himalaya is worth examining.

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TECHNICAL ASPECT:

The people of Central Himalaya have a long tradition of utilization of different water resources based on intimate knowledge of the “science of the concrete”. It is evident not only from their classification of watering places but also in the use of simple technology to tap water in the semi-arid pockets.

Classification of watering places: The uncertain climatic conditions in Central Himalaya have made a deep impact on the lifestyle of its inhabitants. The great volume, force, and velocity of the snow fed rivers of Central Himalaya cannot be controlled by simple technology; therefore traditionally people use smaller streams originating from the forest-clad mountains having low volume and velocity. However, 80 per cent of the annual flows of these rivers occur between June and September, and during the remaining months water is always short in supply. Hence, the people of Central Himalaya explored other sources of water. Accordingly, each watering spot was given a specific technical term based on the quantity of water therein. So far the author has recorded some thirty-five odd terms referring to some or the other category of watering places. This helps considerably in water management as also unfolding the history of water.

It is interesting to note that each of the thirty-five odd terms of water under reference cannot be rendered into Sanskrit, Hindi, Hindustani (Urdu), or English precisely because of the deficiency of vocabulary of these languages concerning classified watering places. No doubt, these concepts are indicative of deep knowledge of hydrology, and bespeak a long scientific tradition.

Hydraulic devices: The Central Himalayan people have been practicing certain interesting, multipurpose hydraulic contrivances, which are very effective on account of simple and cheap technology. These are as follows:

***Khal*:** The *khal* (storage tank) used to be an extremely useful time honoured device to harvest water in the areas of water scarcity, where it has been the only source of irrigation.

The *khal*-system in some places is called “*kul jhuvamda*” (executing conduit). There are different types of *khal*-s, depending on topography and volume of the available water. The most elaborate one (example, Baugad stream, village Adigram Phuloriya, District Almora) consists of two *jamgi*-s (weirs to forming large pond) situated at two different points, the one upstream, and the other downstream from where *gul/ban* (diversion channel) takes off. The longer the distance between the weirs the larger the volume of harvested water, therefore it could stretch over a kilometre. The upstream weir, relatively more spacious, stores maximum amount of run off water of the stream at a higher elevation. In between these two weirs a series of *khal*-s (tanks) and *chupadal*-s (subsidiary tanks) are so constructed that surplus water exceeding the capacity of each tank is channelled to another, thus the entire series of *khal*-s and *chupadal*-s is filled with water. Each weir and tank is provided with an outlet at the base of its wall towards the direction of downstream, through which flow of the outgoing water is regulated. Whereas the outlets of the smaller tanks are blocked by a stone slab each that of the weirs and larger tanks have a *muni* (a stone slab with a hole). When water is released through the hole of *muni* it rushes out with great force to its destination through *gul/ban* and *kul*-s (irrigation channels). The height of a weir is about 1.5 meters or more, that of a *khal* is about a meter, and of a *chupadal* about 80 centimeters. The capacity of the tanks (both larger and smaller) varies according to availability of water and may range from roughly 500 litres to about a few thousands.

The *jamgi, khal, and chupadal* are simple walled structures to store flowing water. The ingenuity lies in making them almost leak proof. For this pieces of *digada/jhupuk* (turf/sod) are collected from the banks of stream. A layer of these pieces is placed on the foundation of the masonry wall above which is laid the first course of boulders and pebbles, followed by another layer of turf. Thus by laying alternate courses of turf and stone the weirs and tanks are raised to required height. Sod is also placed in the gaps between the boulders and pebbles. It checks leakage and binds stone masonry firmly.

Gul and ***kul*****:** *Gul* (diversion channel) and *kul* (distributing water ditch), the time honoured irrigation devices, are constructed with great ingenuity along streams and have withstood the test of time for generations. Following points are taken into consideration for their construction:

a. An appropriate site for constructing a *ban* (weir).

b. The weir should have appropriate height to facilitate construction of network of *gul* and *kul*-s to irrigate surrounding fields. The *gul* is also used to run water-mills, hence easy and forceful flow of water is the main consideration.

c. The weir should harness maximum water throughout the year.

Ethnographic evidence suggests that construction of a *ban* (weir), *gul* and *kul* is a community affair. These used to be designed, constructed, maintained, and regulated with the approval of concerned community. As a custom each and every household using water from the *gul* and *kul* must help in the construction and repairs of the *ban*, *gul* and *kul.* Whereas able-bodied male members offered physical labour, others substituted it for cash or kind, which was used towards payment of wages to labourers employed in the construction work. Distribution of water in some deficient areas was done on the basis of *hara* system in which the farmers collectively entered into contract with one of the natives competent enough to undertake repairs of the distributing channels as well as regulate and distribute water properly. In return, at the time of each harvest he received a certain portion of the grain produced by each farmer (cf. Pande 1997).

Construction of a *ban* (weir) is done in two ways. A simple construction involves piling in row huge boulders, pebbles, and gravel, brought down by the river during heavy rains. Where necessary, it is further reinforced by loose irregular framework of wooden logs, stakes, brushwood, etc. The row is constructed across the river somewhat obliquely with a slight curve towards the direction of the flow, as a result of which the forceful flow of the stream does not easily wash it away. It is interesting to note that on the advice of a native engineer the same geometrical knowledge was applied by the British in the early 20th century to successfully raise a dam at Bhimtal (District Nainital) after repeated failures in damming the Bhimtal Lake.

Another type of weir, called *ghori bund*, is relatively advanced in technology. Its base is constructed with crates filled with boulders above which is fixed a framework of a series of tripods made of newly cut wooden logs measuring about two and a half metres. The tripods, called *ghori* (literally mare), are so fixed that they slant towards downstream; their front two legs face upstream, while the third leg towards downstream acts as a pivot. These tripods are tied with one another through front legs slightly above their base with wooden logs. The framework of these tripods is filled with boulders and pebbles together with an irregular mesh-like formation of twigs and branches of trees on the top, which in turn is packed with gravel, sand, and silt. At a certain strategic point of the weir a few tripods are left separated so that in case of heavy floods the weir is breached to allow floodwater gush, sparing the remaining part (Pande 1995: 48-50).

The *kul*-s (distributing channels) are usually dug in the surface soil. These channels are lined with stone only at those points where turns are provided, and their remaining part remains unlined. In these channels local variety of such grass as withstands the flow of water is allowed to grow which checks soil erosion very effectively. Sometimes, when the water is carried to longer distances through precipitous rocks or ravines aqueducts of deodar or pine, supported by huge columns of wood with masonry base or rough stone masonry pillars erected on the ravines, are used. The height of these columns is often more than 12 metres (Pant 1935: chapter XIII). Likewise, traditionally, the Rajis, a hunter-gatherer band confined to mainly Didihat *tehsil* (District Pithoragarh), used to convey water to fairly long distances using banana leaf-sheaths.

The advantage of *khal, gul* and *kul* systems is that the material required in its construction is locally available in abundance, and free of cost. They are very cheap light constructions; their design and technology are simple, and can be executed by untrained labour force under the supervision of a few experienced persons. These simple weirs are very effective and sustainable because they have negligible impact of silting, for the annual floods wash away the rough walls together with silt at the vulnerable points. This obviates silting of the weir, which is the unavoidable problem of the heavy, permanent dams constructed at high cost with cement, concrete, steel, etc. When the flood season is over these weirs are again repaired by the community labour. On account of these qualities the *khal, gul* and *kul* used to be very popular in the water deficient areas. Sadly, these days water is being drawn from distant places by diesel pumps during lean season, consequently *khal*-s are being given up.

Irrigation works are necessary for successful agricultural operations. Inscriptions reveal existence of irrigated land and water channels (*gul* and *kul*) in Central Himalaya from at least *circa* seventh century AD, as is evident from the Taleshwar Copper plate of King Vishnuvarman of Central Himalaya which mentions grant of *kedara* (line 21, Gupte 1915-16: 119), meaning 'irrigated land' (Monier-Williams 1986: 309), and *sa=kulyam* (line 20, Gupte 1915-16: 119), meaning 'together with = channels or canals' (Monier-Williams 1986: 296).

Water sealing devices: To make water channels and weirs almost leak proof plaster of *chupad/lesu-mat* (sticky fine clay), or *dhyudathamauka-mata* (clay of the anthill), preferably the latter, sometimes mixed with cow dung and natural fibres, is used. Interestingly, in many places cow dung dissolved in water is flown through the channels, consequently particles of cow dung settle in the cracks and pores of the channel, which minimize water leakage considerably.

Naul: Variously known as *nauva, nauli, naulo,* the *naul* (covered/open reservoir below ground level) is a tank in which water oozing from the ground of the earth is collected. There are two types of *naul*-s, namely, the one having a superstructure that covers the tank, and the other without a superstructure. The size and plan of these *nauls* may vary, according to the topography. The spill over water of the *naul* is used in irrigation.

A *naul* is constructed in those places where water oozes in very small amount from different spots from the earth so that it cannot be collected directly. Therefore, a spot is selected where a pit is dug to ascertain whether sufficient water oozes for collection. Having found such a place the pit is dug according to the available volume of water as well as the requirements and means of the people constructing it. It is then lined with chiselled stone slabs, thus forming a water reservoir. Its storing capacity may vary from some one thousand to five thousand litres or even more. The tank, a rectangular structure, is raised up with two parallel walls on each side which rise slightly above the ground level to prevent rainwater, mud, soil, grass, twigs, etc., falling into it. The inner walls forming tank are stepped, and the outer walls almost vertical. Stones employed in the outer walls are roughly dressed and bonded in 'English bond' style with alternate courses of headers (*thada*) and stretchers (*mudhi*). Fine clay mortar is used in bonding. The vertical walls serve as foundation to the superstructure of dressed stone masonry with a pointed sloping roof of stone slabs supported by stone beams laid in lantern pattern. The gap between the stepped and vertical walls of the tank is packed with extremely fine clay locally called *chupaud mata*. According to the masons the clay filling not only seals the water completely but also binds the entire structure remarkably. Dhaulavira (Gujrat) evidence suggests that compact clay filling was also used by the Harappans to seal water in a stone masonry tank as early as third millennium BC.

The stone employed in lining the tank is fine-grained, impervious, and can be chiselled smoothly without using much force. The hammer used in chiselling the stone has a pointed end on one side and the other side has a flat end. Sometimes when the chisel is not used the pointed end of hammer is employed in dressing the stone. Whereas the exposed parts of the stone slabs are finely hewn, the covered ones used in bonding are so chiselled that they bear fine chisel marks forming intricate widthwise rows of grooves (directionally from the side of walls towards the centre of the tank). According to the masons, the stone slabs are so laid one above another in the masonry that the grooves could serve the purpose of tenon and mortise, and that the fine stone powder produced in the course of chiselling is spread all over the grooves to fill in the gaps as a result of which the water gets sealed in the tank. However, in some examples where water trickles into the tank from the side-walls (usually opposite outlet) the stone powder is not used; in that case the grooves provide a smooth passage to the flow of trickling water. Significantly, the bottom of the tank in some examples is provided with a *pati* (stone slab) bearing a hole from where water oozes from the ground. Obviously, this hole as well as the base of the stepped tank reveals that the masons are aware of the potentials of hydraulic pressure. Nevertheless, it may also be noted that the design of the tank may vary according to the flow of water. Thus where water trickles from rocky surface the inner walls of tank are provided with steep steps, or walls, in the latter steps are provided only at the entrance of the *naul,* which also being the outlet for the overflowing water.

Uncovered *naul* is a simple structure, and may consist of a single course of lining to four or more, the depth ranging from about 50 to 70 centimetres. In most cases it is made with stone slabs. To construct such a *naul,* a 60 to 80 centimetre deep and 100 to 150 centimetre square pit is dug. Having a stone slab floor it is lined with finely chiselled stone slabs of equal size so as to look like a cistern. The ends of all of these stone slabs are proportionately perforated at equal points; subsequently copper wires are passed through the perforations for bonding the stone slabs with one another securely.

The *naul* is indeed a marvel of hydraulic technology, and has survived the vagaries of nature for centuries. Significantly, the storing part of the *naul*, constructed below the ground level, has never been found in ruinous condition, nor anyone has ever heard of its restoration, even though it has dried out or else its superstructure has fallen. The only maintenance required by some of these *naul*-s is that of cleaning, that too sparingly. Before the introduction of the iron and steel pipes *naul* was the main source of potable water supply in Central Himalaya. So far, the epigraphic evidence indicates existence of a *paniya samgraha* (water reservoir, *naul*?) in Uttarakhand Himalaya from *circa* sixth century AD (Gai 1971). However, there are a few extant *naul*-s (water reservoirs) in Kumaon, still in use, containing inscriptions in Nagari characters bearing dates between Samvatsara 1329 and Saka 1391 (AD 1272 and 1477). One can still see extant *naul*-s in almost every old settlement which continued to be built up to the first half of the 20th century AD.

Ceramic pipes: An interesting early device of conveying water to distant waterless locations without seepage was the use of ceramic pipes which have been unearthed at several places in Central Himalaya, notably, Silor Mahadev, Champawat, Lohaghat, Chandpurgarhi, etc. These pipes are about 40 centimetres long with an inner diametre of 8 to 10 centimetres. The top end (inlet) of the pipe is wider and the bottom end (outlet) narrower so that the latter of one pipe is inserted into the top of another, thus forming a line. Using gravitational pull water through these pipes used to be carried to its destination through uneven terrain that was otherwise impossible before the introduction of steel pipes.

IDEOLOGICAL ASPECT:

Combined testimony of the archaeological, archival, and ethnographic sources clearly shows that in Central Himalaya people held water as a sacred element. Therefore, watering places used to be adorned with images of some or the other deities. The most frequently represented image found in the old watering places is that of Seshasayi-Vishnu, because traditionally it is believed that water becomes scarce only in those places with which god Vishnu is unhappy. The other deities whose images are installed in the watering places in different parts of Uttarakhand Himalaya are Siva, Uma-Mahesvara, Ganesa, the river goddess Ganga, etc. Among these, Ganesa is the most popular deity next to Seshasayi-Vishnu. All these deities belong to the great tradition of Hinduism. However, local deities representing little tradition associated with waters are also not wanting. Thus, in the northern fringe of Uttarakhand bordering western Tibet (China) Pancha-Naga, Gabla, Bhumiya, Dharmua and Hardyul are associated with water.

Watering places in Central Himalaya form an important part of several rites, which are performed at certain exclusive spots having perennial water. Thus, one of the concluding parts of several ceremonies is *naul seuna* (laying paraphernalia at the watering place), performed exclusively by women. For example, in a marriage ceremony, the women of husband's household lead his bride to the *naul* (watering place) to which place she carries an anointed pitcher containing water and several other auspicious items, including a wisp of *kusa* (Panicum Dactylon) grass. She empties (*seuna*) these items at a fixed spot of the watering place where she also performs certain rituals. Finally, she fills water in the same pitcher and carries it back to her husband's house. Another interesting ceremony is the *jala-yatra* (water journey). It is performed in several places in Garhwal by women, who, forming a row, carry on their heads pitchers filled with water from a watering place to its destination. A long sheet of white cloth is thrown over the pitchers as if forming a stream. Initially it seems to have symbolised bringing water to the needy place, but now it is also associated with the descent of the Ganges from heaven.

Interestingly, the Uttarakhand Himalayan customs recognize twelve forms of marriages, one of which is termed '*Panidhara* marriage'. It takes place 'when the husband is unavoidably absent, or astrological considerations render his actual marriage with the person of the bride undesirable... the bride is taken to some sacred place on a river, occasionally even to an ordinary spring, she is publicly "married", and declared to be the wife of the bridegroom. Absentee soldiers are often married in this way' (Lall 193: 7). Significantly, rites concerning death are also performed exclusively in the watering place of the concerned settlement. Naturally therefore, these rites and ceremonies lent sanctity to the watering places and inhabitants of every settlement collectively maintained them (Joshi 2005).

Ideology not only played vital role in managing watering places in Central Himalaya, but it also inspired people to generously participate in their construction and maintenance to earn spiritual merit. So much so that inspired by ideology Madho Simha Bhandari, the legendary General of King Prithvipati Saha (AD 1631-1667) of Garhwal, is said to have sacrificed his son Gaje Singh to seek divine favour to cause water flow through "a nearly 100 meter long tunnel about 350 meters from the diversion head" (Pande 1995: 57), which event is still remembered by holding an annual fair by the villagers.

Thus, ideology lent sanctity to the watering places, and in semi-arid parts it helped considerably in resolving water related conflicts in society. Water was not held as an item of contention, rather being offered water entailed obligation for the recipient to remain indebted to the giver. Hence the popular saying "*anjal"* (*anna* = grain, i.e., food, and *jala* = water) is used as destiny of a person.

CONCLUSION:

In Central Himalaya during the pre-British times the State encouraged community/private involvement in the control and management of water. People held water as a divine element, and traditionally all watering places were considered as the abode of some or the other deities, particularly Vishnu in the form of Narayana (he who reclines in the water). Therefore, construction and maintenance of watering places were considered pious acts and socio-religious obligations. People, by and large, willingly involved themselves in such activities. The driving force behind these activities was that if the concerned spot remained pure, sanctified, God Vishnu would be pleased to have it as his abode; hence it would remain full of water by his presence, for he reclines in water.

The deep-rootedness of the sanctity of water in Central Himalaya can be assessed from the fact that whenever and wherever scarcity of water was felt tradition-bound people used to say “God Vishnu is angry”. They did not blame the government authorities who supervised and controlled water resources. This ideology is dying out sooner than later, because nowadays water is controlled by the government agencies (see, Water Rules of 1975). It is purchased as a commodity. Therefore, water is losing its sanctity, and traditional hydraulic technology is fast disappearing.

In recent years considerable data have been collected from different parts of India showing the ingenuity and effectiveness of the traditional water harvesting and management system (see, Agarwal and Narain 1999). For a sustainable water managemnt the Third World will have to revert to traditional knowledge system.

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