

Water Sharing and Human Solidarity in Ladakh

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ABSTRACT The present paper deals with water sharing among Ladakhis who inhabit the cold desert in the State of Jammu and Kashmir. The division and partition of land is common everywhere, but in Ladakh, water rather than the land is the subject of careful distribution. Water is divided according to the inheritance-fraction which each holder represents by virtue of his position in his genealogical tree. The Ladakh region has an extensive surface water system which cannot be tapped due to topographical problems. Water has historically been a critical limiting factor affecting agricultural development throughout Ladakh. Surface water sources through ingenious system of water distribution enabled local agricultural communities to overcome the limitations of lack of ground water sources and insufficient rain. Once the irrigated food producing base was established and satisfactorily maintained, further social development were necessarily associated with irrigation. In Ladakh, a social system characterised by the bond of community and work ethics helps in maintaining the system.

Water is a vital resource for human life and an essential part of economy. Water, for drinking or for irrigation, is an essential input for all-round development of any region and the hilly and arid regions of India are no exception. Uneven topography in these areas makes transportation of water by gravity flow methods extremely difficult. Traditional sources of irrigation in these areas are perennial streams and tanks, having a limited irrigation potential because most agricultural lands are situated above the reach of the diversion. *Khuls* and consequently the water flows down the valley in abundance. Conventional methods of lifting water by engine or electric motor operated pump-sets also have their own limitations because of uneven topography, difficulties in transportation and consequently, low access to support and maintenance facilities.

Among agricultural communities the effec-

tive use of water relies on collective effort. The co-operative labour and community management of water is fundamental in arid socio-economic systems. The analysis of technology as well as social organisation of water management are important for development. The construction of artificial catchments and channels depends on a skilful use of terrain, and traditionally their management is undertaken through a division of responsibilities. In a society where agriculture depends on irrigation, the social organisation of distribution of water is very important. There is a set of technical tasks relating to planning, construction and maintenance of irrigation system. Necessary set of rules for allocation of water among the users; meeting the cost and labours required in carrying out technical works; for resolving conflicts; and organization of required rituals and taboos etc. Karl Wittfogel (1957) had made generalised statements that the irrigation works in traditional irrigated societies were centrally organised requiring complete control over labour power. Bureaucratic management gave rise to bureaucratic state power, despotic in its nature. Thereby, a state stronger than the society originated where social relations were determined according to the needs of the despotic state and were delegated to social classes by the state power. However, various studies indicate that the social organisations in such irrigated societies are not as strongly modelled as suggested by Wittfogel. Various aspects of social relations which arise because of the irrigation related works deserve special attention. Subtleties in irrigation strategies are of equal, if not greater importance than the obvious function of simply providing water in arid environments. For example, the necessity for collective regulation of water-supply in the case of rice-cultivation.

Like India, in Japan and Java, rice cultivation has encouraged a good deal of flood communalism and association of labour and maintained the compact village communities for the common interests of agriculture. There are numerous irrigation societies and association for readjustments of fields etc. which had their origin long back. Where floods or droughts are of frequent occurrence, construction of dams and dykes is undertaken co-operatively.

This paper deals with the water sharing among Ladakhis who inhabit cold desert in state of Jammu and Kashmir. The division and partition of land is common everywhere, but in Ladakh, water rather the land is the subject of careful distribution. Water is a precious commodity in Ladakh. Water is divided according to the inheritance-fraction which each holder represents in virtue of his position in genealogical tree. If any one wants to cultivate land, he has to depend on the natural water from the glacial melt for cultivation, because of scanty rainfall and low water holding capacity of the soil. Water for irrigation is catered from glacial melt *Nallahs* to the fields through small irrigation channels, usually constructed along the contours of steep, rocky slopes. For this Ladakhis have to submit to that effective solidarity which water often imposes upon them. Ladakhis have accepted, the necessity of collective union of individual interests.

CLIMATE AND TOPOGRAPHICAL CONDITIONS

Ladakh is a remote and rugged mountainous region of Jammu and Kashmir State, India. Ladakh is a model of human adaptation to an extreme environment. Ladakh is among a rare places in the world where a highly developed and consistent traditional culture has come down intact into modern times, and still function in harmony with the nature.

Ladakh is a cold desert. Both southerly and westerly winds prevail in summer and winter making climate of Ladakh extremely dry and

cold. The excessive dryness of Ladakh's climate is chiefly due to elevation, by which the air is rarefied as to be incapable of holding moisture in suspension. Ladakh experience almost arctic cold during winter when the temperature goes down as low as -23°C . The Leh and Kargil districts of Ladakh are situated at about 3,800 metre and 3,000 metre, respectively above the mean sea level and therefore, experience the extremes of hot and cold. The average rainfall per year does not exceed 96.4 mm in the east and 600 mm in the west. Similarly snow fall in the valley of Ladakh is scanty, inspite of high altitude. The spring, summer and autumn together has little more than five months, after which the snowfall closes all the approaches to the area. To all intent and purpose, there are only two seasons in Ladakh, a short torrid summer and a long icy winter.

The soils of Ladakh are neutral to slightly alkaline. The soils vary from sandy to sandy loam and pure clay beds are found at some places. The textures of the soils are coarse. The range of sand in the soils varies from 20 per cent to 68 per cent. The sands are of loose type and lack capacity to absorb and hold sufficient moisture and nutrients.

Rivers have special importance in Ladakh, as these are the life line of the people here. The drainage system of the Ladakh division consists entirely of the three great mountain feeders of the Indus, the Singgechu or Indus proper, the Shyok and the Zaskar rivers. The Indus has no major cities or industries, nor a single dam or bridge on the main stream. Developing an international river is a complicated business. These rivers traverse Ladakh without creating the required scope for assured irrigation schemes. This is because the rivers flow along the bottom of the high mountain ranges. The region has an extensive surface water system but cannot be tapped due to topographical problems. Water has historically been a critical limiting factor affecting agricultural development throughout Ladakh. Dry farming is not possible in this area because of range of high and low

temperature, loose sandy soil and low range of precipitation. Food production is possible in Ladakh with regional irrigation system. Surface water sources through ingenious system of water distribution enabled local agricultural communities to overcome the limitation of lack of ground water sources and insufficient rain. Once the irrigated food producing base was established and satisfactorily maintained, further social development were necessarily associated with irrigation. Considerable care is taken in maintaining these systems and the failure to repair or maintain works in such instances is largely the fault of social institution, rather than the fault of physical forces.

HUMAN SETTLEMENTS AND DISTRIBUTION OF WATER

In Ladakh the natural environment constraints appear to dictate many aspects of traditional life, especially settlement sites and amenities. Topographical features, climate and seasonal variations effect the location of settlements. In Ladakh topography and shortage of water are the main factors which restrict the building of human settlements. In contrast to humid lands, where one often sees a gradual decrease in intensity of land use from the immediate site of a settlement to the fringes of village lands, most Ladakhi 'oases' display an abrupt transition from oasis to the desert. Oases vary in size, from a clusters of willows and poplars, settlements which sometimes occupy broad valley floors and elaborate irrigated terrace systems. There are three types of settlements in Ladakh: the *Gompas*, forts and palaces; grazing camps (*Droksa*) and associated agricultural villages.

Traditionally all land belonged to the *Gyalpo* (king), who gave its portions to his cronies, courtiers and administrative officers and *Gompas* and the like in return for their services. These estates were associated with supporting agricultural villages. The location of agricultural village was important so as to fulfil the re-

quirements of arable soil and water for irrigation and domestic purposes. The shortage of land for human settlements was aggravated by the geographical factors. Firstly much of the territory consists of slopes and was not easy to develop such lands for residential purposes. Most of the natural flat areas are fertile agricultural land. Secondly, paucity of water restricted land use.

The existing pattern of human settlements in Ladakh has evolved from the economic decisions of people. Though cultivated area was small, however, crops produced were excellent and provided subsistence base for Ladakhis. The total village area accounts 0.6 per cent of the total area: Cultivable land forms only 28 per cent of the village area. Most villages are located below 3,600 metres.

Practically, all the agricultural villages in Ladakh center around a stream, which brings water from the glaciers at the higher altitude. Where such a stream runs through a broadening valley, it is possible to lay out a series of terraced fields, which can be irrigated in turn by directing the supply into small irrigation channels. Above the area of cultivated terraces, and at the floor of the actual hills where it is too rocky and steep to plough and sow the houses are clustered, approached by story paths or tracks and are built into hill side.

Though drinking water from natural resources is available in all the villages, it is not treated or filtered in any way. It is directly led from the source either in galvanized pipes or small irrigation canals from the springs and canals from melting glaciers. Drinking water facility is much better in summer than winters when the water freeze because of low temperatures. All the houses do not have taps, so people have to fetch water from far off. Fetching of water still remains one of the main time consuming daily activity of the local population. In the traditional Ladakh, a free flowing stream in the village or town was kept as clean as possible. A free flowing stream was considered as pure as mother's milk and every endeavors was made to keep

dirt away from it. Older Ladakhis hardly remember any gastric epidemic or suffering from diarrhoeal diseases. But deteriorating state of hygiene in Ladakh, has given rise to diarrhoeal or other water borne diseases.

In the dry mountains of Ladakh the farmers are wholly dependent on artificial irrigation since in the summers it does not rain for weeks or even months. For Ladakhis water is a precious commodity and welfare of any settlement in Ladakh depends on its equal distribution. Strict laws have regulated the building, maintenance and use of the village irrigation system. Each settlement has a complicated network of irrigation channels (*Yur-ba*). These small channels are fed by a main channel which is supplied by high up stream which in turn gets water from melting glaciers. Generally, irrigation channels are dug out from earth or artificial water courses and constructed with stones or clumps of earth. On the main valley bottom the main channel then branches out in the multitude of small channels, so that all the fields could be irrigated. Most channels require considerable attention year after year because of environmental hazards.

Due to ecological constraints, cultivation of crops is limited to land which has a water supply, and a reasonable soil depth. About 74 per cent area of the Ladakh is above 4,500 metres. The land below this altitude has vast stretches of barren, rugged and rocky terrain interspersed by pockets of cultivable land and a few natural pastures. The total area of the Leh district is 35,476 hectares, out of which 39.9 per cent is cultivable. Out of the total cultivable land, 56 per cent has been brought under irrigation. Although bulk of the net area sown enjoys irrigational facilities rice is not grown in any part of the district. Grain is the principal crop and occupies 16,606 acres (1 acre = 0.405 hectare). Other non food and fodder crops together claim 14,691 acres. Pulses and millets are grown in an area of 6,427 acres, while barley is grown in 2,498 acres.

Farmers have small land holdings near streams, river banks and watershed areas be-

tween the ridges and mountains. More Buddhists own large tracks of land as the estates are passed on from one generation to another intact because of traditional laws of marriage and inheritance. Among Muslims the land holdings are small as a result of fragmentation of land on break-up of a joint family.

Distribution of Water

The fields are laid out with great skill into terraces to even out the steep gradients on the hillside and the uneven valley bottom. Watering of fields in Ladakh is by complicated network of irrigation channels spread over the entire valley and even along the cliffs. The water is a snow-melt, taken from mountain streams arrested by dams (*Chhu-lon*) and conducted to the crops by systems of channels (*Yur-ba*) and sub-channels, the flow being regulated simply by large clods of earth placed across them. These channels are laid out with simple tools like spades, pick-axes and crow-bars. Wherever possible the irrigation channels are dug out of the earth. Otherwise water courses are constructed with stones and clumps of earth, sealed by clay whenever necessary. Often this water course leads along a sheer, naked cliff for four or five kilometres and it frequently has to be supported by walls and props which are built into cliff with much difficulty when the steep rock-face offers no support. On the valley bottom the main channel then branches out in to a multitude of smaller ditches so that every adjacent field can be irrigated.

Water is led from the irrigation to different fields with a wooden shovel, till the fields are flooded. The water is allowed to stand in the fields for a while till the parched soil is soaked. The supply and control of water is the key factor in crop growing. Regulation of water in a terrace is a matter of some delicacy. Excessive flooding is often as great a threat as insufficient inundation, drainage is frequently a more intractable problem than irrigation. Timing is also important. This type of arrangement was present in other parts of India also. Sengupta (1994) has

dealt with the indigenous system of irrigation in South Bihar. In South Bihar, allocation of water within the villages is managed by the cultivators themselves. There was a system called *Parabandi* by which the distribution of water among the villages from a common source was regulated. Usually *Parabandi* arrangements began in the month of *Aswin* (mid-September), when the demand was acute and supply limited, and lasted for a month or two. At other times of the year it was usual to leave all branches open and let anyone use the residual water if one could. The *Parabandi* arrangements consisted of more than one cycle of watering.

The division of irrigation water which is derived from a common source is a communal task and is managed accordingly. In Ladakh, allocation of water within the villages is managed by *Churpan* and village committee consisting of *Yooths* from each *Mohalla*. *Churpan* post is not hereditary and he is elected or selected by villagers for a specified time. This system of distribution of water is called *Chorus*. There are written regulations for *Chorus* arrangements. There is an elaborate register maintained by *Churpan*, specifying the rights of villagers enjoying irrigation facilities from main ducts or *Nallaha*. Each villagers has its quota fixed either in number of days or in number of hours depending on the size and placement of his land, thus assuring fair distribution of water. This is basically determined by the location of the fields, that is fields on the higher mountain slopes receive water first and subsequently the fields down in descending orders. The farmer whose fields get water in the end-*Daspa* has to look after the maintenance. The farmers who have fields near the irrigation channel (*Yur-ba* or *Kuhl*) have to be vigilant about the maintenance, the level of the *Kuhl* changes each year due to erosion. Water supply for each *Mohalla* is on weekly basis, each house getting its share on certain days. For irrigating fields, *Chulak* help in *Chotter* (runner of water) according to the register. *Churpan* is helped by *Yooths* (elders) of each *Mohalla* or section of the village.

Churpan works only for a period of six months in the year during the agricultural season. He receives two *Batti** of grain or sometimes in cash from each family. During his tenure whenever he visits any family to discuss or inform matter regarding irrigation, he is offered *Gur-Gur* tea and snacks. Strict rules regulate the building, maintenance and use of the communal irrigation channel.

For instance in Stok village of Leh district, there are six *Mohallas* (1) Choskor; (2) Toksham; (3) Chudnang; (4) Rutuspungral; (5) Kurpiklargangmarpo; and (6) Phikar. Apart from two general meetings in a year, meeting of the *Churpan* and *Yooths* is called for if some important matter comes up. *Chulak* (runner) informs about the meeting. The elders from each *Mohalla* and *Churpan* assemble in the school ground (a meeting place in this village). Decisions are taken by voting or by raising hands. In normal weather conditions water from big *Nallah* is let out 10 days at a stretch. During that period all the fields of one *Mohalla* are irrigated. After the next *Nallah* is opened and next *Mohalla* is benefitted.

If the fields of a household are scattered, the water is distributed accordingly and the account is kept by *Churpan*. The household with number of scattered fields, during irrigation time is helped by his mutual support group (*Langdepa*) or his *Pha-spun*. Just as farmer is allocated time to water the fields according to the size of the land holding so is he required to donate labour for the maintenance and construction of the irrigation channels. Most channels require considerable attention yearly because large sections can be damaged in a single day by avalanches of snow or wind. The fields in the vicinity of villages are well supplied with water. Communicating channels are connected to some natural source or reservoir on the higher ground. But even in solitary spots, far off from human habitation, some dykes are seen crossing the sides of mountains near their base: these

* *Batti* and *Khal* are measures of grain.
One *Batti* two seers, Six *Battis* = One *Khal*

are constructed by the farmers to assist the deposits of soil and gravel by the melting snows, and they are thus left for many years, perhaps for some generations, for the use in future.

As each Ladakhi watches jealously over the distribution of water so each one guards the irrigation channel against the ritual pollution. A ritually unclean person, either through contact with a during child birth or just by being present in the house during the confinement (*Ba-nag-spa*) or through contact with a corpse (*Ro-nag-pa*) is not supposed to cross over the irrigation channel or irrigate his field or touch the water. His requirements during this period are met by neighbours or his *Pha-spun*. The members of ritually unclean household, keep their utensils to be filled outside their house which are duly filled by neighbours or relatives. Ladakhis are afraid that if any unclean person crosses or touches the irrigation channel, he will make the *Lha* (gods) and the *Lu* (water gods, snake spirits) angry, who will in turn dry up the water and crops will wither in the fields. To avert the misfortune, an offering (*Lu-stor*) of pellets of bread yeast are thrown into stream and spring in order to purify offender and to placate the water spirits. In case of quarrell over irrigation water, the *Goba* (village headman) intervenes and the payments are made to the damaged parties. Defaulters if do not accept the *Goba's* judgement are punished by *Pheeng Sen-at* (ex-communication).

Antiquity of the System

The ingenious traditional water-control system of Ladakh could only have been created during a long period of persistent trial and error refinement of established system. Irrigation technology along with expertise and engineering works, construction of water furrows and terraced fields was transferred from neighbouring regions with local modifications. Traditionally the Ladakh was inhabited only by Tibetan nomads. Dards from the mountains of Gilgit and Astor moved into Ladakh from the north-west. In the mountain watersheds the immigrant Dards laid out fields and built houses, villages

and castles. Tibetans learned the art of agriculture from them and from Indian Mons.

Exact data are difficult to obtain but the extension of irrigated fields in Ladakh was restricted to a few, particular favourable areas. Because productivity was so dependent on irrigation, labour applied to improvement of such irrigation system was significant. At the initial stage, social organisations at higher levels were involved in matters of decisions, e.g. construction, repair of major areas of conflicts including external conflicts.

Prior to the advent of Dogras, Ladakh was ruled by native chiefs termed as *Gyalpos*. The administration was in the hands of *Kahlon*. The *Kahlon* was assisted by *Lon-po* (governor). At village level, *Goba* or *Mip-on* was responsible for village affairs. During the days of *Gyalpo*, the responsibilities of construction and maintenance of main irrigation channel lay mainly with *Kahlon* and *Lon-po*, although they were not responsible for similar works on smaller distribution channels emanating from main channels and for distribution of irrigation water in the villages. This was the responsibility of *Goba* (village head man). Most of the main channels are very old and how these were constructed cannot be asserted.

There is a collective system called *Chorus* in which every cultivator had to supply one man per plough to turn out on certain occasions and carry out the physical works. But the *Kahlon* or *Lon-po* had the responsibility of organising such collective works by fixing and announcing the date and even by forcing the unwilling to participate in such matters. The maintenance works need to be carried out regularly, being crude earthen high silting of the hilly rivers and the method of diversion of water by various ways of cutting the embankments. If repaired regularly, these works do not involve great effort either in manpower or finance. But negligence results into quick deterioration of these crude works, so much so that within a few years, even the trace of an old work may be difficult to locate. The smaller parts of these repair

works, the negligence of which would affect only a few plots are probably done by the interested cultivators themselves. As Geertz (1968) puts it "Once created, an irrigation system has a momentum of its own, which continues, and even increases, to the point where the limits of traditional skills and resources are reached". In Ladakh, the quantity of preparate labour in creating new irrigation channels and bringing them up to the level of existing ones tend to discourage a rapid extension of terraced areas. In already developed systems, people who have spent hundreds of years in building an irrigation system are not likely to leave it readily for new resources even if the established system become overcrowded. They are already so deeply involved that at the most they will gradually make a few terraces on the periphery of the already well-irrigated area, where water resources and terrain permit. "But this reluctance to initiate new terrace construction because of the heavy "overhead" labour investment is characteristic even of areas where irrigation is still undeveloped, because of the inability or the unwillingness of peasants to divert resources from present production" (Geertz, 1968).

In Ladakh, the water management and distribution is being looked after by the community. The history of human societies all over the world has witnessed the community management of forests, water and land before the onset of state control towards the end of the nineteenth century. Socio-economic aspects of common property resources have been studied by Guha (1985), Gadgil and Vatrak (1976), Wade (1987) and Nadkarni et al. (1989).

Community organisation by and large depend on and are reinforced by, existing structure of authority. If tradition and authority uphold conservation, it is accepted. Jodha (1985) explains that, in Rajasthan, the management and ownership of CPRs was in the hands of feudal lords, the focal point of traditional authority. Management carried out through some traditional sources of authority, religious or social was always a success.

People co-operate and follow the rules set down by the community only if the use of the resources to be managed satisfies some of their very significantly felt needs. Water in arid and semi-arid environments, where people's livelihoods depend on them fall in this category. Resources accessible to the whole community to which no individual has exclusive property rights are Common Property Resources (Jodha, 1986). Broadly defined, common property resources are used by entire community. In the absence of any regulatory institutions, it is difficult to control its degeneration depletion. In Ladakh, a social system characterised by the bond of community and work ethics helps in maintaining the system. Division in terms of caste is absent, and people traditionally lived and worked for survival against harsh climatic and economic conditions. Community bonds were also manifested in the polyandrous system of marriage, which along with the religious system of Lamaism, served to ensure a low population growth.

The finite resource base resulted in limited production of food grains and livestock products on which large population base could not be sustained. Among traditional Ladakhis the relative population homeostasis was achieved through social customs such as polyandry and monasticism. Traditional family structure, the marital system and mode of inheritance all helped in maintaining population at a surprisingly low level. The focus of the family was maintenance and management of the estate and network of relationship with other related families in a co-operative chain. Monogamous system with fraternal polyandry limits population while maintaining an effective labour force on the estate.

A religio-cultural system with strong emphasis on the propitiation of nature and evil spirits, and on community as manifested in community rituals. Community culture fosters a character system in which the individual is less egoistic, more of social being. The dominance of religion in daily life of Ladakhis helped in preserving the traditional values. There was a lit-

the change in the operative technology, almost no surplus production. The inter-regional trade was limited to barter with grain, butter, wool, salt being the main exchange commodities. Regional isolation helped to retain the traditional socio-economic system till the winds of change swept in.

The fabric of traditional socio-economic system was shattered by extrinsic forces like development programmes and political events. The economy of Ladakh is changing from a traditional subsistence economy to a commercial consumer economy. The monetisation of economy is linking Ladakh to overall economy of India whereas traditional economy was independent of outside world. The changes in the traditional set-up are effecting the existing population structure. Today, polyandrous marriages are become rare, and since it is not a legal form of marriage, the co-habitation of a brothers with a wife of one of them is purely informal arrangement of economic benefit. Moreover, the percentage of monks and nuns have also decreased. Both these factors, breakdown of monomartial principal and decrease in number of monks and nuns means that Buddhist population is on the increase.

Unfortunately, growth of population has not been matched by an increase in irrigation facilities and food production. Soil conservation and stabilisation of the traditional irrigation system, together with the creation of new irrigation potential through small scale, irrigation works, more and more areas are being brought under cultivation. For all this, people are depending on governmental agency. An important constituent of community resource management is perceived power of local authority relative to the central one. Both in Rajasthan and Uttarakhand, the extent of community management declined when the local authority became dependent on the central state. As the recognition of the existence of collectivity at the local level decreases, individuals are left to themselves and community management is no longer possible. Alienation between the individual and nature, leads to environmental degradation. Jodha (1985) argues that when village pan-

chayats depend more on governmental revenue, they become ineffective. They do not levy taxes on users as they are empowered. They are neither as authoritarian as are *Jagirdars* nor bold enough to take hard decisions (such as imposing taxes) that would displease their voters (Jodha, 1985). According to Jodha, authoritarian *Jagirdars* were good managers of common property resources.

It is the contention here that authority, stemming from tradition, together with the crucial role of water in economic subsistence and the absence of any distant central authority undermining the local one were the factors that led to the continued sustenance of this system of community management. In other parts of India, community management, witnessed a decline after the end of the nineteenth century. This decline has been attributed to the pressure of population, state intervention and the operation of the market forces.

REFERENCES

- Gadgil, M. and Vartak, V.D. : Sacred groves of Western Ghats of India. *Economic Botany*, 30 : 152-160 (1976).
- Geertz, Clifford : *Agricultural Involvement : The Process of Ecological Change of Indonesians*. pp 12-15 and 27-28. The Association of Asian Studies. University of California Press, Berkeley (1963).
- Guha, R. : Scientific forestry and social change in Uttarakhand. *Economic and Political Weekly*, Vol. 20 Special Number, pp. 1939-52, November 1985 (1985).
- Jodha, N.S. : Population growth and decline of common property resources in Rajasthan, India. *Pop. Develop. Rev.*, 11 : 247-264 (1985).
- Jodha, N.S. : Common property resources and rural poor in dry regions of India. *Economic and Political Weekly*, XXX, 27 : 1169-81 (1986).
- Nadkarni, M.V., Pasha, S.A. and Prabhakar, L.S. : *Political Economy of Forest Use and Management*. Sage, New Delhi (1989).
- Sengupta, Nirmal : Technology, management and control pp. 122-131. In : *Social Ecology*. Ramachandra Guha (Ed.). Oxford University Press, New Delhi (1994).
- Wade R., : The management of common property resources : Collective action as an alternative to privatisation or stall regulation. *Cambridge J. Economics*, 11 : 95-106 (1987).
- Wittfogel, Karl A. : *Oriental Despotism*. Yale University Press, New Haven (1957).