Basic document on Ahar-pyne

Traditional water management systems: An overview of Ahar-pyne system in South Bihar plains of India and need for its revival

I. Introduction

In recent years there has been growing attention to local management of common property resources, and recognition of the potential of farmer-managed irrigation systems. Many indigenous irrigation systems provide good examples of farmer management and are therefore, being studied for learning principles of management. Behind the existing indigenous systems of irrigation there are thousands of years of tradition. The development of irrigation systems received a great impetus after the discovery of iron and extensive use of it from around 3000 years before present. The three most common types of traditional works found in monsoon Asia are: diversion channels, surface-drainage tanks and wells (Sengupta, 1985). Diversion channels may be simple or may have extensive arrangements of channeling, aqueducts, etc. However, these traditional water management systems are increasingly being replaced by the other faster means of groundwater extraction systems, which are less labour intensive for the farmers in the shorter run. But, if long term sustainability of water as well as providing water at crunch times for irrigation has to be looked upon, the traditional systems do fare better than the so- called modern systems.

II. Ahar- pyne: Traditional water harvesting system

Ahar-pyne system is an indigenous irrigation technology, which continues to irrigate substantial areas even today in South Bihar plains of India. This system has evolved from an understanding of the particular agro-climatic conditions of the region. An ahar is rectangular embankment-type water harvesting structures i.e. a catchment basin embanked on three sides, the 'fourth' side being the natural gradient of the land itself. Ahar beds were also used to grow a Rabi (winter)[1] crop after draining out the excess water that remained after Kharif (summer) cultivation. Ahars differ from the regular tanks in that the bed of an ahar is not dug and usual tanks do not have the raised embankment of an ahar. While ahars irrigating more than 400 ha are not rare, the average area irrigated by an ahar during early 20th century was said to be 57 ha (Pant, 2004). Water supply for an ahar comes either from natural drainage after rainfall (rainfed ahars) or through pynes where necessary diversion works are carried out. Water for irrigation is drawn out by opening outlets made at different heights in the embankment. Pyne is the local name for the diversion channels. Pynes are artificial channels constructed to utilise river water in agricultural fields. These channels may be of various sizes. The small ones are those found originating in

[1] Indian sub-continent, which is one of the major irrigated regions of the world, has three major agriculture cropping seasons, namely Kharif (June-September), Rabi (October-February) and Summer (March-May). But it is very difficult to have a clear cut distinction between Kharif and Rabi seasons as the Rabi sowings of different crops start in the month of September in some areas while it extends upto November ending in some other areas.

ahars and carrying the water of the ahars to cultivable plots. The large ones have their origins in rivers from which water is diverted through these artificial channels by erecting embankment in the river beds (Fig. 1). They are led some way upstream above the level of the land they are intended to irrigate. It is often 3 to 5 kms before the water of the pynes reaches the level of cultivation. Some of the biggest pynes are 16 to 32 kms. in length, and some of them known as dasian pynes (pynes with 10 branches) irrigate many thousand acres of lands of hundreds of villages (O' Malley 1919). Most pynes flow within 10 km of a river and their length is not more than 20 km. (www.rainwaterharvesting.org). Pyne can be used for transporting the river water to an ahar, to irrigate the field through branches taking off from it and taking out ahar water for irrigation. It is this system that made paddy cultivation possible in South Bihar, which is otherwise unsuited for this crop. In particular, it helped farmers meet the crucial water requirement for paddy during Haathia[2] i.e. the grainfilling stage (MoRD, 2006).

III. Overview of the region

On the basis of its physical features, the Bihar state of India can be divided into three regions – the North Bihar plains, the South Bihar plains (the area north and south of Ganges respectively) and the Bihar plateau also known as Chotanagpur plateau (Fig. 2). The total area covered by South Bihar is about 40 thousand square Kms. which is slightly less than a fourth part of the total area of about 174 thousand square Kms. of the state of Bihar (Pant, 2004).The South Bihar plains are sandwiched between the Chhotanagpur plateau in the south and the Gangetic basin in the north. South Bihar is characterised by (a) scanty to medium rainfall; and (b) stiff clayey or highly sandy soils, both of which have very poor water retention capacity are highly retentive of runoff water. As this region has very low slopes, conventional ridge-to-valley planning may encounter certain difficulties here. The other unique feature of this region is the highly fragmented and scattered nature of holdings. Many farmers own small pieces of land spread across the village, at times even across villages (Pant, 2004). South Bihar has a marked slope from south to north towards the Gangetic valley and is comparatively rapid, the average fall northwards being about 1.13 to 0.76 meter per km. that causes rainwater to flow rapidly towards the north, causing floods. All these factors make floodwater harvesting the best option here, to which this system is admirably suited. The rainfall is conditioned by two constraints. First, there is a shortfall in the rains almost every third year. Second, there is an urgent requirement of water for paddy during the crucial period of hathia in case the rain fails. Bounded by the Bihar plateau in the South and the Gangetic valley in the north, a number of rivers debouch from the southern hills and intersect the region as they flow across it from south to north. Since these rivers are rainfed, following

2 Hathia refers to period of the post monsoon rains (approximately between last week of September and first week of October) when water is absolutely essential to fill out the ripening paddy grain.

the incidence of rainfall in their catchment basins, the rivers swell up into rushing torrents and discharge the rain water very quickly within hours through their sloping beds. As a result, the water is either rapidly carried through the area (in case the soil is stiff clay) or it percolates down through the land (in case the soil is sandy). On casual examination, the area would seem utterly unsuited for rice cultivation, both from the nature of the surface and the comparative scantiness of the rainfall. But both difficulties have been overcome by the ingenuity and industry of its inhabitants, who have devised a system by which the natural drainage is blocked and the water impounded for use and have also brought rivers into their services by diverting the water they bring down. Therefore, in order to prevent the water being wasted; long narrow artificial canals i.e. pynes are led off from the rivers by means of which the river water is transmitted to the fields. Further, the same rapid slope would facilitate the wastage of the water if it were not impounded – in extensive reservoirs i.e. Ahars, which are formed by constructing a series of retaining embankments across the line of drainage. Though there are variations across upper, middle and lower watersheds, the overall pattern repeats itself in micro-watershed after micro-watershed:

- dry uplands *(locally termed taand)* with shallow soils;
- dry upper midlands *(locally termed baid)* with deeper soils;
- seasonally wet lower midlands *(locally termed kanali)* with deep soils; and
- wet lowlands or valleys *(locally termed bohal)* with deep soils.

To be most profitable, dependable and sustainable, systems of NRM must be designed incorporating such variations.

IV. Present status of Ahar- pyne system

Ahar-pyne system of indigenous irrigation is historically the most important source of irrigation in South Bihar and even today provides a shining example of participatory irrigation management. Ahars, with sides that are more than a km. long, irrigating more than 400 ha are not rare, though smaller ones are more common. However, the average area irrigated per ahar during the early twentieth century was said to be 57.12 ha (Sengupta 1993). According to O'Malley (1919), this indigenous system is the outcome of the natural conditions and physical configuration of the country, and has been evolved to meet the obstacles which they place in the way of cultivation. However, with the passage of time, the collective institutions of management of the ahar-pyne system have declined. Area irrigated by ahar-pynes is on the decline, accounting for only about 12% of the total irrigated area in Bihar (Table 1).

Table 1. Area irrigated by ahar-pyne system

Year	Area irrigated (mha)	Region Covered
1930	0.94	South Bihar
1971	0.64	South Bihar
1976	0.55	South Bihar
1997	0.53	Whole of Bihar

Source: Pant (2004)

The ahar-pyne system of irrigation was overwhelmingly more important in South Bihar, where it was irrigating about 35% of 2.5 mha of cropped land during the first two decades of twentieth century. Compared to it, the irrigation in North Bihar was a mere 3% of 3 mha cropped area (Pant, 2004). During this period, of the 0.98 mha area irrigated by ahar-pyne, 0.88 mha area was irrigated in South Bihar, while only 0.1 mha was irrigated in North Bihar (Tanner 1919). The area irrigated by this indigenous source has witnessed a constant decline. The extent of decline can be gauged by the fact from 0.94 mha in 1930s in South Bihar, the area declined to 0.64 mha in 1971 and to 0.55 mha by 1975-76. As per the Government figures, the area irrigated by ahar-pyne system in whole of Bihar came down to about 0.53 mha constituting about 12% of all irrigated sources in the year 1997 compared to about 18% in South and North Bihar alone during the first two decades of twentieth Century.

V. Reasons for success of ahar-pyne system in the past

The farmers indigenous knowledge of utilisation of water for irrigating their paddy fields was based on great understanding of the local topography, flow of water and positioning of the fields. The major factors that led to the traditional ahar-pyne being so much prevalent in the region are furnished below:

1. Fragmented land holdings & equity in water distribution: An interesting pattern noticeable in each of the ahar-pyne areas and in general the whole of South Bihar and adjoining areas is that the land-holdings of the farmers in general are small, fragmented and scattered. As a result, every landholder in the command of a pyne had some land at the head, some in the middle and some at the tail of the irrigation channel. So all farmers have their plots both in advantageous as well as disadvantageous locations - head, middle and tail. Therefore, to optimize their irrigation, they would have to take active participation in all kinds of situations. To safeguard the interest of their tail-end farm, they would work with others so that the water reaches at the tail also. In this way, ahar-pynes seem to overcome the problem of headreach/ tailender conflicts that are a common feature of irrigated commands of major and medium projects. Ahar-pynes ensured equitable distribution of irrigation water in the command (Sengupta, 1985). Further, several irrigation commands get benefit from the same ahar or pyne and several ahars may get water from the same pyne. Since cultivators have unconsolidated holdings, they are not left with any choice other than to work collectively for a common good.

2. Cheap Source of Irrigation: In the past, ahar-pyne used to be the cheapest and easiest source of irrigation in the region which only needed a collective effort from the villagers. Although presently, ground water through diesel based borings and electric motors are available but the cost of irrigation is very high compared to the ahar-pyne system. In case of ahar-pyne, all major repairs are done by the government and farmers do not have to pay any water charges. Hence, cultivators do not mind working collectively for small maintenance or to meet emergencies like breach in pyne or embankment etc.

3. Uniformity in Cropping: All farmers grow the same crop (paddy) all over the irrigation command around the same dates. As a result, agricultural operations undertaken by all cultivators are similar throughout the irrigation command. Such uniformity of operations is essential when cultivators are utilizing the same irrigation channel. Since ahars and pynes have to be used collectively, all farmers have to synchronize their operations. In such a scheme of things, there is no scope for crop diversity in the same irrigation command. Uniform cropping also facilitates collective action when irrigation system is in the danger of non-functioning (Pant, 2004).

4. Collective action: Communal action for irrigation operation and maintenance referred to as *goam* consists of large groups. Ahar-pynes have been constructed by the extraordinary concerted effort of the human beings against the oddities of nature. Although in South Bihar also, like rest of India, a rigid caste hierarchy obtains, this does not deter different caste groups, including scheduled castes to come together for a common good and a common concern. All cultivators, who take water from the same pyne or the same ahar, irrespective of the location of their villages and irrespective of their castes, come together for collective action whenever their irrigation is affected or is likely to be affected. According to Pant (2004), cultivators had their vested interests to participate actively in collective actions. This was particularly true in respect of *goam* to meet the emergencies such as breaches in embankments, diversion in river and pyne routes etc. Hundreds and even thousands of people still come forward for *goam* even today in South Bihar.

VI. Institutional and Management Issues

Such a large system of irrigation which would sometime be spread over many villages could not have existed with a strong institutional mechanisms and proper management. Although no written rules existed in most of the cases but there were certain issues that were dealt upon by the people in their own indigenous manner.

1. Equity in allocation and distribution of water: The Ahar-pyne system had well worked-out institutional mechanisms for sharing of water between farmers. Synchronization of the agricultural operations over the year was achieved by earmarking each 14-day period on the lunar cycle for each agricultural operation (Table 2). Buchanan (1939) noted that landlords appointed proper persons to divide the water among the tenantry. According to O'Malley (1919), the parabandi System was used to distribute water among the villages from a common source (usually a pyne). Parabandi derived from the term para (turn) and bandi (fixation) meant fixation of turn. Each village had its fixed turns of so many days and hours to avail the water. These turns were assigned by mutual agreements or ancient customs. A detailed register called lal bahi (red register) maintained in some systems specified the irrigation rights of each village. Usually parabandi arrangements began in the month of Aswin (mid-September), when the demand

was acute and supply limited. At other times, all branches of pynes were left open (CSE, 1997). The reliability and timeliness of ahar irrigation is ensured because water is stored in the reservoir and is utilized when pynes do not have any water left and rains are not forthcoming. This is the likely scenario during the hathia period, when water is critically needed by paddy (Pant, 2004).

Table 2. Timing of agricultural operations in ahar-pyne system

	Period	**Operation**
1	June 20 to July 5	Seed Bed Sowing
2	July 18 to August 15	Transplanting
3	September 12 to September 25	Field water drained out
4	September 26 to October 7	Fields filled again
5	October 8 to October 20	Standing water in fields
6	October 21 to November 3	Field water drained out
7	November 4 to November 15	Harvesting

Source: Aggarwal and Narain (1997)

Equity in water allocation was not a granted right but it was in-built in the system. The total landholding of each individual in a command was highly fragmented. In consequence, every major landholder who could influence the allocation had interests both at the head and the tail regions of the distributary (Sengupta 1993). If water available is not sufficient and does not reach the tail end, a part of the command area remains unirrigated, but everyone suffers. Pynes feed several ahars and several distributaries originate from each ahar. The primary level irrigation organizations correspond to the irrigators benefiting from a distributary (ayacut). The peculiar land holding pattern as that every cultivator owns a fragment of upper , middle and lower levels of ayacut have also been noted for irrigation systems in Sri Lanka (Leach, 1961) and Philippines (Siy, 1982). In addition they also were also close to neighbors though they did not belong to a single caste. The crop growing in the ayacut area is paddy, the same for every cultivator. Thus, all of them require irrigation at approximately the same time. Because of the characteristic distribution of the plots no one is deprived of water. Once the fair allocation of water is assured individual cultivators do not lack motivation to join in community works for irrigation (*goam*). However the system is not entirely free of disputes. One village often tries to get more water than it should, or else when rainfall is scarce, lower reach villages seek to get water before their proper turn.

2. Community participation & distribution of responsibilities**:** In the past community participation was extensive in traditional irrigation management. Community labour for repair, called *kudimarammath* in south India and *goam* in Bihar was an established custom. Ahar-pynes work, particularly the one relating to maintenance and overseeing of water distribution was looked after by three functionaries. These were headman, Barahill (supervisor) and Gudait (watchman). A unique feature of ahar-pyne management system in was that some posts were associated with particulars castes. For instance job of the

watchman, the drum- call for *goam* (Collective physical action) used to be made by beating of drums and the drum beatings used to be done by dafalis (Pant, 2004). Some of these indigenous irrigation systems (pynes) were so large that their water conveyance system ran over 30 kms, covering hundreds of villages and irrigating thousands of acres of land. Since the construction of such irrigation works required huge capital investment, only big landlords could do it. In fact, sometimes it required the cooperation of two or more landlords. In such occasions, each co-operating landlord used to appoint his team of officers to look after his interest on the negotiating table during the construction phase. Usually the cost involved in the construction of pynes was much higher than the one involved in constructing ahars. The construction of pynes, particularly the large ones, involved excavation of pynes running several kms. In addition, it also involved construction of dams across the river to divert the water to the pynes. Large pynes were mostly constructed several years ago when larger areas were under the control of the single zamindars (landlords) and their authority to enforce their orders and wishes was more absolute (O'Malley 1919).

3. Repair and Maintenance: The repair and upkeep of the most ahar and its water conveyance system is of two types. The one involves major repairs and the other deals with the minor routine upkeep to make the system work. The responsibility of ahar-pyne construction as well as major repairs was of landlords (Buchanan, 1939; O'Malley, 1919). The amount spent by the estate was later realised from the farmers under the Gilandazi (improvement of irrigation works). Today, minor repairs are not done by the farmers and the repairs are done by the Minor Irrigation Department. In the past, farmers had to pay for the repairs as well as for the irrigation, while today they do not pay for any of these two things. The routine upkeep work involves cleaning and desilting of ahar and pyne and maintaining the water conveyance network, while the system is in operation. As a result, ordinary maintenance such as the periodic clearance of silt, the repair of small branches of the ahars and field channels is done by the cultivators themselves under *goam* system and it starts before the onset of monsoon. Apart from the routine activities, an important task is to keep constant vigil, particularly during monsoon against sudden damage of protective works which may occur due to natural cause or due to man-made reasons. The operational works include cutting and closing embankments for diversion, erection of bandhs or garandis across the pynes, opening and closing of outlets and at times even resorting to manual water lifts to irrigate uplands. *Goam* was and still is very effective in meeting the emergencies. The call for *goam* was made by beating of drums. *Goam* occurs even today every year in hundreds of villages of South Bihar.

4. Central control: Steward (1949) and Wittfogel (1957) opine that irrigation management requires a high degree of discipline and that in turn implied central control and an all-powerful bureaucracy. In the ahar-pynes of South Bihar, it is found that a centralised authority in the form of the landlord played an important role in respect of construction of ahar-pynes, their major repairs and allocation of water to different villages. However, landlords did not play any role in determining

the mechanism relating to how water was distributed among different individuals in each micro irrigation command and how they maintained the micro water conveyances structures. Further, Buchanan (1939) mentions that there existed some indigenous irrigation works in South Bihar which were constructed and maintained by tenants and that the landlords had no claims of rents against such works. Even where findings do indicate a centralised management in certain matters, it is difficult to assume that high level of participation of cultivators in the irrigation management was a natural consequence of the centralised authority (Pant, 2004).

VII. Reasons for decline

As discussed earlier, Ahar-pyne system were the lifeline of the farmers cultivating Paddy in this region. However, there has been a gradual decline in the area irrigated by the ahars because of the following reasons:

1. Abolition of the Zamindari[3] system: One of the reasons cited for the decline of ahar-pynes is the abolition of the Zamindari system. Zamindars (Land-lords) regularly organized maintenance and desilting of ahar-pynes before independence. Till the abolition of Zamindari system the Zamindars used to maintain these systems because they had the capital resources and had a vested interest in doing so. Tenants were required to pay Gilandazi (improvement of irrigation works) charges. Gilandazi is an excellent form of investment as the capital spent on it returns a dividend of 40 to 50 percent in the first year itself, in some cases 100 percent if the landlord even received only half of the produce of the land irrigated by these works, they would get a very good return on their capital outlay (O'Malley 1919). After the zamindari abolition there are no regular budgeted funds for the repair of these systems.

2. Development of new Irrigation sources: Development of new irrigation sources, notably canals and tubewells leading to easy availability of water made people lose interest in ahar-pynes, which needed community effort for upkeep and maintenance. Many indigenous works were directly suppressed by extension of modern methods. This has been aided by high doses of government subsidies in case of private tubewells. Even in 1970-71, the area irrigated by tubewells in Bihar was about 17%, this reached above 48% in 1994-95 (Government of Bihar 1972 and 1997). There are such examples from UP and Punjab where shrinkage in traditional well irrigation took place from the extension of canals and the modern groundwater exploitation techniques. Pandey (1979) also reported how traditional ahar-pyne irrigation was suppressed in many different villages by introduction of canal irrigation project in that area.

3. Lack of convergence between old systems and new schemes: Non-integration of the indigenous systems in the new diversion schemes undertaken by the

[3] During the British period all cultivated lands belonged to Zamindars (feudal landlords) who paid a fixed revenue to the British Government. After independence in 1952 this system was abolished and the land was distributed among the erstwhile tenants

Irrigation Department was also a major reason for the decline. Many authors have noted that the irrigation departments did not have adequate understanding of the value of this system. Hence, often the new irrigation schemes were at variance with the existing ahar-pyne system and no attempt was made to integrate the two. At present, some initiative is restrained because of expectation of assistance from external agencies like the Government and the reduced interest of those who have acquired pump sets.

4. Lack of centralized authority: Literature suggests that centralized authority in the form of the landlord did play an important role in respect of construction of ahar-pynes, their major repairs and allocation of water to different villages. Today, there is no coercive authority of the landlord or any one to force them to contribute community labour for irrigation management which has led to lack of interest of people.

VIII. Need for going back to indigenous systems

Even if the area irrigated by traditional methods is on a decline and it has been mostly replaced by various modern techniques of surface and groundwater harvesting systems, it is essential that we revive the old systems. The major reasons for the same are furnished below:

1. Delays in major and medium irrigation projects: Pant (1982) reported that the technical evaluation cell of Planning Commission approved 529 projects (106 major and 423 medium) between 1971 and 1981, with an original outlay of Rs.6820 crore. The cost of all these schemes, according to latest estimates, compiled by ministry of irrigation has gone up by a staggering Rs. 3828 crore to Rs. 10648 crore. This indicated an overall increase of 56.13 per cent during the last 10 years. Statistics also reveal that 60 schemes, including four major ones, were completed in nine states, bringing the success ratio to only 11.34 per cent. One of the major reasons for the inadequate growth of the irrigation sector is the long time that it takes to commission major and medium irrigation projects. Delays in completion and increases in project costs of major and medium irrigation projects is a cause for concern. Instead of pumping in huge amount of money in schemes that are marred by technical, political and social glitches, it is time that we need to look into the already practiced systems at the grassroot level and focus on providing technical and monetary support to the already existing indigenous water management measures and that are much more suited for that particular place. For an example, there is enough literature to support that ahar-pyne system of irrigation was instrumental in saving all of Gaya district from the ravages of famine and drought. It is worth highlighting that through the 1866 famine of Orissa, the Bihar famine of 1873-74 and during the famine of 1886-87, Gaya district required practically no relief. Apart from irrigation, another useful purpose served by ahar-pyne system is to minimize the floods. Writing in the context of the then Gaya district, the collector (1947-49) observed that as

long as these minor irrigation works were kept in a reasonable state of repair, floods in lower regions were well under control (Roy Choudhry, 1957). In 1949, a Flood Advisory Committee investigating continuous floods in Bihar's Gaya district came to the conclusion that "the fundamental reason for recurrence of floods was the destruction of the old irrigational system in the district."

2. Easy maintenance, cost and quality: The cost of ahar-pyne maintenance is quite low compared to canal maintenance which comes to about Rs. 5000 per ha. In case of ahar-pyne, it varies between Rs. 500 to Rs. 1000/ ha, depending on the extent to which *goam* is utilized. Further, the quality of construction is quite good because those who get engaged in the repairs are themselves the beneficiaries. Further, in some of the repairs the material used is the one which is locally and easily available. Pant (2004) noted that use of mozar which is obtained by mixing the wet mud with paddy straw quite effective in the repairs of embankment, including in raising its height. According to Pant (2004), as today's per ha cost of irrigation comes to about Rs. 80,000 and 46% of the total annual precipitation of 350 mhm in India is lost to the sea as river flow, the rejuvenation, development, and integration of ahar-pynes system with new diversion schemes present wide scope. The reason being, it mainly involves mobilisation of local material and man power resources with very little financial requirement (about Rs. 1000 per ha). This is especially important at present times when financial crunch surrounds most states from all sides and participatory irrigation management is the rhetoric quick-fix.

3. Sustainability in the longer run: The sustainability of ahar-pyne system can be judged by the fact that these modes of irrigation are in existence for centuries. All the ahar-pyne systems that exist today are at least nearly hundred years old. The main reason of the sustainability of these indigenous systems is that the advantages emanating from them are two fold. First, these systems utilize water which otherwise would be wasted. Second, these systems, particularly in the past, saved the plains of South Bihar from the recurrent floods which otherwise would have devastated the countryside regularly. Lastly, if these indigenous systems are properly integrated with the recent canal irrigation schemes, the sustainability of both types of irrigation systems will enhance manifold (Pant, 2004). Proper utilisation of natural resources requires proficient consideration in many different aspects related with it. The real difference between the so-called modern and traditional methods is that the former, with an independent start, need gradual attainment of the proficiency, while the latter must have perfected those over centuries, otherwise those would not have survived. Detailed knowledge of traditional water resource management method therefore, may not only help in better formulation of new development projects but an hasten the gradual rectification process which most of the existing problem projects are facing at present (Sengupta, 1985).

IX. Attempts for revival

Some villages in Bihar have taken up the initiative to re-build and re-use the system. One such village is Dihra. It is a small village 28 km southwest of Patna city. In 1995, some village youths realised that they could impound the waters of the Pachuhuan (a seasonal stream passing through the village that falls into the nearby river Punpun) and use its bed as a reservoir to meet the village's irrigation needs. Essentially, this meant creating an ahar-pyne system. After many doubts, the village powers-that-be gave the go-ahead. Money was collected and work began in May 1995. After a month of shramdaan (voluntary labour) the villagers completed their work mid-June. Their efforts have borne fruit. By 2000 AD, the ahar was irrigating 80 ha of land. The people grow two cereal crops and one crop of vegetables every year. The returns from the sale of what they produce are good and the village is no longer a poor one. Even now community work of irrigation (*goam*) occurs every year in several villages of Bihar (www.rainwaterharvesting.org).

X. Future strategy

Revival of this traditional irrigation system could be one of the major activities for livelihood security. Ahar-pyne system is based on a minute understanding of the topography so that even at such mild slopes, pynes carrying water over several hundreds of metres could be constructed. Pynes also diverted water from the streams over long distances, irrigating large areas. According to a report by Ministry of Rural development (MoRD, 2006) revival of this system and ensuring their proper maintenance through community action should be a major plank of watershed projects in South Bihar.

For revival of traditional water harvesting systems, the most critical thing which needs to be done is the integration between new and old schemes. In the decade of 1950's, particularly during the first and the second five year plans, a number of diversion schemes were undertaken in South Bihar. In most of the cases, the area brought under the command of these schemes had very elaborate system of indigenous irrigation network through ahars and pynes, particularly in the upper reaches. The planners realizing the valuable contribution of this indigenous system in subsidiary storage and water distribution; dovetailed it in their plan and thereby increased the capability of the run-of-the-river scheme on a rainfed river proposed to serve an area subject to fitful monsoon. They relied on the contribution of the existing ahars so much that they planned about two-third of the command was to be irrigated during the critical hathia period through the ahars which were to be filled up from canal networks by drawing maximum possible water during favourable period of river flow. However, the envisaged integration of ahar-pynes with the new schemes could not be done in a large number of cases and this indigenous system was made to languish over time. A recent study shows that the number of ahars in the command of Upper Mohar Irrigation Project covering the districts of Gaya and Aurangabad had

dwindled to 44 in post project period from 109 in preproject period (Metaplanner 1994), consequently affecting the irrigation in an adverse manner. Had due attention been given to proper maintenance of these indigenous systems and integrated management of new canal networks and old ahar-pynes was devised, all these new diversion schemes would have been grand success stories (Pant, 2004).

Presently, the possible avenues of repair and revival are: hard manual labour during drought period, NREGA (National Rural Employment Guarantee Act), some relief schemes, food for work programme and also Minor Irrigation department which can spend some planned funds in the name of renovation of these systems. Knowledge of water management handed over from generation to generation is extensive. One way to use it is to undertake extensive studies by the experts and then reflect it in their works. The other is to channelise it through peoples' participation in the projects themselves (Sengupta, 1985). Collective action is essential for the repair and maintenance of the system. For that, Olson (1982) argues that collective action is likely to be more feasible (I) The smaller the groups, (II) the more homogenous the origin of the group (III), the longer the members of the group have been associated with one another or the group has been in existence, (IV)the closer the social and physical proximity among group members, (V) the more differentiated (in a complementary way) the goals of different members of subgroups, (VI) the greater the sensitivity of the group to a threatened loss due to inaction and (VII) the more unequal the distribution of wealth and power among members. Keeping in mind the points discussed above, it is essential that concrete measures are taken at the earliest as the rate at which the traditional systems are declining; it would not be long that they would be left only for academic and historical importance.

References

Aggarwal, Anil and Sunita Narain (1997): *Dying Wisdom: Rise, Fall and the Potential of India's Traditional Water Harvesting Systems,* State of India's Environment A Citizen's Report No. 4*,* CSE, New Delhi.

Buchanan, Francis (1939). An Account of District of Bhagalpur in 1810-11, Bihar and Orissa Research Society, Patna.

CSE (1997). Dying Wisdom: Rise, Fall and Potential of India's Traditional Harvesting Systems - State of India's Environment: A citizens' Report (4th), Centre For Science and Environment, New Delhi, pp. 87

Government of Bihar (1972). Season and Crop Report (table-III A), 1970-71, Patna.

Government of Bihar (1997). Directorate of Statistics and Evaluation, *In*: Pant (2004)

Leach, E.R. (1961). Pul Eliya: A village in Ceylon, Cambridge.

Metaplanner (1990). Metaplanner and Management Consultant. Report of Post Facto Study of Upper Morhar Irrigation Project, Bihar: XII.

MoRD (2006). Report of the Technical Committee From Hariyali to Neeranchal Report of the Technical Committee on Watershed Programmes in India Department of Land Resources Ministry of Rural Development Government of India, January 2006

Olson, Mancur (1982). The Rise and Decline of Nations. Yale University Press, New Haven.

O'Malley, L.S.S (1919). Bengal District Gazetters - Gaya. Superintendent, Government Printing, Bihar and Orissa, Calcutta, pp.146-147

Pandey, M.P. (1979). Impact of irrigation on rural development, Concept, New Delhi.

Pant, Niranjan (1982). Major and medium irrigation projects:Analysis of cost escalation and delay in completion. *Economic and Political Weekly*. June issue, pp. 34-43

Pant, Niranjan (2004). Indigenous Irrigation in South Bihar: A Case of Congruence of Boundaries, http://www.indiana.edu/~iascp/Final/pant.pdf

Roy Choudhry, P.C. (1957). Bihar District Gazetters: Gaya, Government of Bihar, Patna, pp. 205

Sengupta, Nirmal (1985). Irrigation: Traditional vs Modern. *Economic and Political Weekly*, Vol. XX, No. 45- 47, pp. 1919-1938

Sengupta, Nirmal (1993). Land records and irrigation rights. In *Land reforms in India, Volume 1, Bihar-institutional constraints*, eds. B. N. Yugandhar and K. Gopal Iyer. New Delhi: Sage Publications

Siy, R.Y. (1982). Community resources management: Lessons from Zanjera, University of Phillipines Press, Quizon city.

Steward, Julian H (1949). Cultural Casuality and Law, *American Anthropologist,* Vol.51, pp.1-27.

Wittfogel, Karl (1957). Oriental Despotism: A comparative Study of Total Power, New Haven, Yale University Press.