SPATE IRRIGATION IN PAKISTAN: Problems and Prospects

By

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Abstract

Pakistan being an environmentally diverse yet largely arid country, depends heavily on irrigated agriculture both at the market as well as subsistence economy. The practice of irrigation is ancient in this part of the world and the local communities have been developing and managing indigenous systems of irrigation for millennia. A variety of locally suitable physical systems such as Perennial, Kachcha, Gharkaaba, Glacial, Barani, Karez and Gandha/Rud Kohi have been prevailing under community based management institutions.

The traditional systems are considered extremely important by the communities as these are able to meet their food, fiber and other basic needs. Unfortunately, these systems are now on decline. In Balochistan for instance, traditional irrigation system are on alarming decline as is evident from the data of last thirty years. Area under cultivation of various traditional irrigation methods including Karezes, springs and spate/ flood was 232,900 hectares in 1970 which was decreased to only 47,000 hectares in 1990. (Government of Balochistan 1997).

This decline has given rise to a number of issues affecting the efficiency, equity and sustainability of farming systems in the country, leading in various cases, to the creation and perpetuation of the vicious circle of inequality, poverty, environmental degradation and destruction of social fabric, all accentuating each other.

This paper is an effort to identify the various factors responsible for this decline, selecting Spate Irrigation as an example of the traditional systems and treating it as a case study for analysis. The paper seeks to look into the structural and local factors which influence the acquisition, operation and maintenance of Spate Irrigation Systems and the resulting impacts. The paper also ventures into identifying a future prospect for renewed attention into these immensely important systems and the requisites thereof.

Introduction

Spate irrigation, despite its physical expanse and socio-economic significance in Pakistan, is a relatively less understood phenomenon even amongst the technical experts. The following narrative offers an introductory level explanation of this.

Physical Features

Spate Irrigation is a traditionally used system for diverting hill torrents into cultivable command areas for growing seasonal crops. It usually entails the construction of an earthen diversion weir across the torrent with large channels on one or the both sides of the river to convey flood water

across large distances. The site of the weir is usually selected at a point where the gradient of the flood torrent is not so steep that its momentum becomes uncontrollable. These diversion structures and the water conveyance system has traditionally been constructed by the beneficiary communities themselves, making use of the traditional technology i.e., human and draught animal labour. The communities used to divide the labour contribution towards system development pro-rata to the land holding or in the command area or the respective water shares. Farmers construct fields by making embankments to store the flood water. These embankments are 4 to 8 feet high depending upon the soil type, share in water and various other factors. Water is stored into these fields and upon drying crops are sown. The sown crops thrive on the moisture stored in the soil and there is no further irrigation except for the rains, if any occur.

Geographical Spread

The practice of spate irrigation is, and has been prevalent in various arid regions of the world. The diversion structures used for spate irrigation are known by different names in different parts of the world. Legends based on traditional knowledge describe that in order to irrigate more and more area Queen Saba made Sadds (literally, walls in Arabic) in Yemen many centuries ago. That place was the centre of Sadds in those days. Local traditional knowledge also highlights that one of the reason for desertification in Arabian Peninsula was increased number of Sadds constructed in those days which was in excess of the carrying capacity of the regional environment. However, written literature is mostly silent in this respect. In 1872 land settlements in the Indian sub-continent, the British colonial authorities had used the term Sadd for what is locally known as Gandha.

Spate irrigation has been practiced by native Americans in USA and various other parts of the world. African continent has excellent experiences from Ethiopia and Eritrea where system is in practice by local farmers even today. Large tracts of land in low land areas are irrigated by it. In the Middle East, Yemen represents spate irrigation on a larger scale. Spate flow from highlands enters into plains areas of desert and various crops are grown. This system is also in practice in Afghanistan. Mainly, the inland water basin system of Helmand River supports it. A strong social organization contributes in functionality of this system supported, in some cases, by state in organizational and implementation aspects. However, basic inputs needed for development, operation and maintenance come from community and beneficiaries. The system is called pago in Afghanistan. Spate system is also practiced in certain parts of Iran where it is called Sahraa. At first stage Iranian farmers divert hill torrents flow to newly developed fields. Silting process within few years makes it possible to grow crops. At the same time water infiltrates and recharges aquifer and thus water is available by other means also.

In Pakistan, spate irrigation is practiced on large tracts of land in Kachhi, Sibi, Loralai, Turbat, Panjgur, Gwadar, Awaran, Pishin, Kila Saifullah, Dera Bugti, Mastung, Lasbela and Khuzdar districts in Balochistan province, right bank of River Indus in Dera Ghazi Khan and Rajanpur districts of Punjab province, Dera Ismail Khan and Tank districts in NWFP and Malir, Larkana and Dadu districts in Sindh province.

Cropping Pattern

Most of these areas depend upon the monsoon runoff from the adjoining mountain ranges between the months of June to September, depending upon the rains. The cropping pattern is highly

dependent on the timing and magnitude of the floods. For instance, in case of a good rainfall in June or July, Sorghum, Millet, Gowar and melons are grown with intercropped pulses. In case of floods occurring after mid September, Wheat, Barley, Gram, Mustard with Sorghum as fodder crop are grown.

Small tracts of land in Pishin district of Balochistan depend upon winter rains runoff and Wheat, Maize and Melons are sown in December.

Economic Significance

Spate irrigation has coverage of more than two million hectares in all provinces out of a total cultivable area of 24.6 million hectares (Ahmad, 2002). This accounts for 10 % of total cultivable area under different irrigation systems in the country. Spate irrigated crops are a major source of food, fibre and fodder demands of the communities dependent on it, both at market as well as subsistence levels. Spate flows contribute a huge amount of water into main river bodies especially Indus. On Balochistan coast it contributes as fresh water intake required to sustaining the marine ecosystem, especially the mangrove forest. In monetary terms its values counts in billion of rupees. In DG Khan District alone, average annual area under spate irrigation is more than 0.2 million hectares. In Balochistan province floodwater and runoff contributes to 12,460 million cubic meters annually, of which only 1560 million cubic meters is utilized (IUCN, 2001). Thirteen major hill torrents have 5,394 million cubic meters average annual runoff from the Balochistan province (Ibid).

In order to illustrate the economic significance of spate irrigated agriculture, the following table is reproduced from the government records, which represent only one area of Pakistan, depending on hill torrents emanating from Suleman Range in Punjab and NWFP.

Table 1: Area under cultivation during 1981-92 in the Suleman Rud Kohi (acres)

S. No	*Crops*	*1981-82*	*82-83*	*84-84*	*84-85*	*85-86*	*86-87*	*87-88*	*88-89*	*89-90*	*90-91*	*91-92*
1	*Wheat*	*821500*	*832900*	*786000*	*778600*	*769700*	*222800*	*194800*	*224700*	*229700*	*223600*	*216400*
2	*Maize*	*23000*	*23700*	*23400*	*25800*	*26100*	*26400*	*26700*	*28300*	*9800*	*10500*	*9900*
3	*Millet*	*29100*	*24500*	*26400*	*28000*	*24200*	*28900*	*18600*	*27200*	*23300*	*18600*	*17500*
4	*Sorghum*	*52200*	*71500*	*77800*	*64000*	*61700*	*91300*	*40100*	*86400*	*74100*	*64100*	*48500*
5	*Guar*	*69781*	*61756*	*75089*	*74831*	*70714*	*85225*	*76689*	*164367*	*117726*	*99308*	*61908*
6	*Gram*	*92000*	*120600*	*120400*	*157900*	*158800*	*173600*	*118800*	*168800*	*118400*	*126300*	*105000*
7	*Rapeseed*	*45600*	*39800*	*35600*	*50500*	*33000*	*31600*	*19100*	*35600*	*32800*	*33500*	*25700*
8	*Pulses*	*20289*	*27730*	*28269*	*33795*	*44570*	*52319*	*49879*	*50068*	*72784*	*73723*	*64274*
9	*Dates*	*417*	*414*	*470*	*484*	*489*	*479*	*981*	*986*	*391*	*394*	*465*
Total		*4153887*	*1209000*	*1173428*	*1213910*	*1189273*	*712623*	*545649*	*786421*	*679001*	*650025*	*549647*

Source: Pakistan Agricultural Research Council, 1994

The economic contribution of other spate systems are also significant. For instance, some 50 years ago 80% of total revenue of former Kalat state was obtained through spate irrigation system of

Kachhi plains in Balochistan. (Personal communication with Tehsildar Gandha Jat and Naib, Khan of Kalat at Bhag)

It is evident from the table that the cropping pattern is centred around a farming system where the household economies are diversified around crop production, livestock rearing and small scale enterprises. Crops like sorghum, maize and millet are used mainly in livestock and poultry feed. These crops are not grown on a large scale in canal irrigated areas due to competition with other commercial crops and thus mainly cultivated under spate agricultural system.

In addition to the direct economic benefits to the community, spate diversion structures also contribute significantly to the national income in an indirect manner. If not controlled properly the spate flows inflict tremendous damage to physical infrastructure, mainly Indus canals in its command areas. Flood damages to property, roads, bridges, settlements, fields and other ancillary structures are also significant. A single hill torrent Vehowa in DG Khan has caused losses of Rs. 45 million, Rs. 130.6 million and Rs. 150.30 million during floods season of 1973, 1975 and 1976. (Government of Pakistan, 1978) It can be argued that if the floods had been controlled to some extent in the upper foothills, the amount of damage could have been lesser.

On a macroeconomic scale, the equity dimension of the contribution of spate irrigation is important as well. All the districts where this system is practiced rank among the lowest in social ranking in Pakistan and are at the margin of political power structure. Also, large hordes of seasonal nomads visit the flood irrigated areas in winter season and have a unique symbiotic relationship with the hosting communities.

Social Organisation

Complex institutional practices govern the acquisition, operation and maintenance of spate irrigation systems both at individual system as well as the river basin level. Strong indigenous organisational structures have been evolved by the local communities regarding the sharing of costs and benefits of the system. Spate irrigation system is highly labour intensive and local resources and methods are applied. Local knowledge and expertise, technology, and material are used in it. It is supported by equitable and flexible social organization. Shares and rights of water have been allocated since centuries and practiced and respected by users. This irrigation system offers variety of local knowledge in many aspects of irrigation.

The water shares within a system are based on fixed flow division where the width and depth of each channel is fixed. The distribution of flood water between various systems on a single flood torrent is usually based on time flow where the duration for which a diversion weir can stand and has to be demolished afterwards, is fixed. In a few cases, the land size to be irrigated from a flood is also fixed and after the inundation of that land, the weir has to be demolished so that the downstream users can utilise it.

In most cases, these regulations are enforced through totally local and purely indigenous institutions. In some cases however, these regulations are recorded in black and white in the revenue records and the writ of state machinery can be invoked to enforce them, in case of a conflict.

In the erstwhile Kalat state and even under Pakistani authorities, there used to be special unit within administration, revenue and irrigation departments responsible for spate irrigation system. Tehsildar Ghandhajat and other staff were there as we inherited from English period. Later on when outsiders staff was transferred to these posts, system began to decline as it was not properly understood by new comers due to not having proper orientation of the spate system. Staff responsible for spate irrigation system used to stay in the field, during flood season- mostly monsoon, for supporting the local water user associations and farmers. They would make sure that water shares and rights are observed between upstream and tail end farmers according to agreed customary laws and procedures. They had the knowledge of spate irrigation system dynamics and knew the importance of social organization. Presently level of expertise and interest lacks among officials responsible for this system in spate irrigated regions as it does not offer favourable opportunities compared with perennial irrigation system.

Environmental Significance

Spate irrigation is not only an irrigation system but it applies to an ecosystem definition. This includes upstream and watershed regions, down stream and tail end, peculiar soil and field characteristics and biodiversity associated with it. The spate irrigation systems contribute both directly and indirectly in environmental improvement. The indirect or preventive benefits include recharge of groundwater in the downstream areas, no water logging or salination problems and prevention of flood damages to lands and infrastructure in the downstream areas.

The directly visible environmental benefits include creation of a micro eco-system in the flood diversion area as a result of transportation of fertile silt and seeds of wild plants from the catchment areas carried by flood water. These areas demonstrate environment friendly agriculture and other productive systems. Crops of native varieties are grown which are compatible to extreme climatic conditions. Use of pesticides and fertilizer is almost absent thus savingthe environment from adverse effects and the whole system represents pure organic farming. These areas also have scrub vegetation that meet fuel, fibre and nutritional requirements of million of people. Spate flows bring fine silt particles and according to farmers this increases the fertility of fields. Flows also bring seeds of plants, vegetables and herbs – all beneficial for the framers and community. Medicinal herbs and plants sprout in the area after the flood water dries. Plants of leguminous nature are here such as Kandi (prosopis cineraria) and multipurpose trees as Tamarix are common to these areas. Often there is no artificial plantation in spate command areas but flooded lands are full of vegetation after irrigation. Local farmers just protect these plants to grow and mature. There is no further watering requirements of these plants and they grow under natural conditions. These plants not only meet the needs of local population but are used by animals as feedstock also.

Hill torrents of Balochistan have several endemic species of fish confined to these areas only. Ecosystem of these hill torrents is close and confined and thus has resulted in the evolution of sthese species. Every year flow from these torrents contributes in fertilization process of fish in Indus. This aspect of biodiversity importance is often not known to many experts of irrigation who only look at spate irrigation as an input for agricultural production.

In Balochistan spate flow contributes into wetlands development such as bund Khushdil Khan at Pishin in Northern Balochistan and famous Lake of Zangi Nawar in Chaghi district. Hub dam is another example where spate flow is stored for domestic water supply to be fed to Metropolitan

Karachi. Several ponds and depression in hill torrents are excellent refuge and seasonal camps for migratory birds of global significance.

Watershed of these hill torrents represents global significant biodiversity such as Juniper forest, Chilghoza forest in Suleman range and upland Balochistan. These areas are extremely important to cater while designing any project of hill torrent in down stream area. Since fields are not in use round the year therefore, biodiversity especially wildlife including reptile and birds prefer to stay here due to undisturbed characteristics of the area. Even during crops native and migratory birds, reptiles, mammals, and bees prefer to stay there as pesticides are not used in these fields.

Spate irrigation system never went into problems associated with canal irrigation system such as water logging, salinity, drainage, soil deterioration etc. Spate irrigation structures require local material for construction and are thus cost effective. Since structures are temporary thus problem of silting, mainly associated with modern dams, does not appear.

Constraints

In the above narrative, an effort has been made to demonstrate that traditional irrigation systems in general and spate irrigation in particular have been providing a major contribution to the society in terms of economic productivity, equity, social cohesion, environmental restoration and poverty reduction. Despite this, the traditional systems have seen a steady decline during the last few decades. The following account seeks to identify the major critical constraints that prevent the continuation and further development of these systems. The constraints have been classified into extrinsic and intrinsic factors for success and failure of spate irrigation.

Extrinsic Factors

The critical factors that determine the success or failure of spate irrigation systems and are of regional nature, or have to do with policy level, have been classified as intrinsic. Some of these are listed below:

Political Economy of Irrigation Development

As has been stated earlier, the spate irrigated areas of the country lie in the most marginalised and socially low-ranking districts. This is reflected in the decision making and resource allocation for irrigation sector at the national level. A review of budgetary records clearly indicates that the bulk of investment in agricultural research and physical development has gone into the canal irrigated agriculture. Spate irrigation is not the part of agriculture or engineering curriculum in any formal educational institution of the country. The severe lack of knowledge in the academia about spate irrigation and the lack of empathy in decision makers for the marginalised communities has negatively affected both the understanding about -and the state support to- this sector.

The local indigenous institutions managing all traditional irrigation systems are not recognised in the development policies of the country. They, therefore, remain on the very margin of decision making structure, without any entitlement to seek institutional support of the state.

Since main structures remain unattended on the basis of economics alone, therefore, activities in command areas are also remain untouched. Crops in these areas are of native varieties and

scientists have not worked on the improvement of these cultivars. Yields remain low as improvement work has not been done at research centres and laboratories to harness the further potential. When analyzing these structures on cost-benefits ratio, these native crops do not show favourable cost calculations. Environmental cost conservation because of positive side effects such as absence of water logging, salinity, seepage, drainage, displacement and other aspects are not credited to this system.

On technical side, we have not yet reached to a solution of silting associated with this system. All efforts are made in the light of modern irrigation structure and problem is seen in the light of mega projects. Result is obvious in no progress and leaves uncomfortable feelings among local communities dependent upon this system. Local knowledge and expertise is hardly appreciated for research, study and consideration. Technical experts believe only in cemented structures and reinforced material, policy makers believe in cost–benefits ratio, politician believe in mega projects and poor farmers only wait and are frustrated.

Climatic Change

The whole of the region which serves as a watershed for the spate irrigated areas has been chronically arid and the rainfall pattern has been historically arid. The last decade has been particularly catastrophic because of little or no rainfall, leading to an extremely severe drought. This has wreaked havoc on the local economy and the farmers have been ruined. As a result, massive out migration from these areas has occurred and now there is little man or animal power available for construction of diversion structures.

Environmental Degradation

The upstream watershed of most of the spate irrigated areas has been massively degraded. Due to deforestation and over-grazing, the rains in the mountains turn into flash floods and lead to soil degradation. This results in degradation of riverbeds in the flood irrigated areas, making the river bed too deep for the farmers to construct diversion structures.

Biased Mechanisation Policy

The degradation of river beds has made the farming communities more and more dependent on mechanised construction of diversion structures and channels. The political economy discussed above is reflected in a bias for allocation of subsidised bulldozer hours to the perennial agriculture making it impossible, or at least very difficult, for the poor farmers to obtain this support. Even the locally appointed officials from the line departments, because of the lack of political support and lack of understanding about these systems, fail to play an active part in allocation of these services to the farmers.

Intrinsic Factors

The critical factors that determine the success or failure of spate irrigation systems and are of local nature, have been classified as intrinsic. Some of these are listed below:

Physical Factors

The environmental degradation in the watershed areas and the resulting flash floods have made the river beds so deep in certain areas that it is no more physically possible for the farming communities to construct the earthen bunds to divert water. The political economy of resource allocation at the policy making levels makes the availability of state support for reversing the degradation very difficult. This affects the local population depending upon this source of livelihood.

In various areas, the construction of physical infrastructure such as roads and perennial irrigation canals has obstructed or diverted the natural water ways that the communities used to utilise for spate irrigation. A recent study done by a national NGO shows that construction of Chashma Right Bank Canal has deprived various communities of the flood water for irrigation. Similar doubts are being expressed about the newly proposed Kachhi canal in Balochistan.

Economic Factors

Spate irrigation is largely a source of subsistence agriculture and the incomes are neither too high nor very reliable. This has led to people switching to other sources of livelihood such as paid government employment elsewhere or as farm labourers in perennially irrigated areas. Additionally, the connection of various areas to the national electricity grid has prompted the relatively richer farmers to invest in tubewell development for growing cash crops. This factor has also contributed towards people withdrawing from spate irrigation in favour of more lucrative modes of farming.

The Way Forward

A number of issues need to be addressed at various levels to save and further promote the spate irrigation systems which play an immensely important social, environmental and economic role in the country. The broad categories of the salient issues are described briefly in the following narrative.

Rethinking National Development Policies

The political economy of development planning in the country has been directing the investment towards large infrastructure development projects, driven by the "modernisation" paradigm of development. This thought is popular among the implementation level officials as well because of larger possibilities of rent seeking and corruption in such projects. There is a need to redirect the investment towards community oriented and need based interventions with intermediate technology components.

The spate irrigation systems, operated by the community based local institutions, using intermediate technology, are in a dire need of state sponsorship in the form of support in subsidised earth moving machinery. This has to be provided at least during medium to short term until the environmental degradation is halted and reversed to a manageable extent. Also, the local indigenous institutions have to be recognised as legal entities to work as intermediaries for this investment to ensure local level accountability and transparency.

Similarly, while planning large productive and social infrastructure, the social and environmental cost of the damage to spate irrigation systems is often disregarded in "the supreme national interest". The case of Chashma Right Bank Canal and the proposed Kachhi Canal are examples of this empathy. This is largely a product of the skewed power structure, absence of a democratic culture and obsession of the policy makers with "modernisation: paradigm of development. This trend needs to be halted through lobbying and advocacy by civil society groups, media and human and cultural rights organisations.

Innovative Technical Solutions

It is not useful, even possible, to divert all the flood through the construction of a concrete wall across the flood torrent. An optimal mix of modern concrete, semi-modern gabion and traditional earthen construction material has to be used. For this, a re-orientation of the governmental staff working on irrigated agriculture is needed. Unfortunately, local institutions and traditional irrigation systems do not form the part of formal educational curriculum in any national institution. There is ample experience available with some entities from the civil society who have worked on this sector through community participation. There is a need to bring this knowledge together in an organised manner and made part of educational and training curriculum.

The true potential of spate irrigation as a source of organic food and fibre as well as of other ancillary products needs to be recognised at academic, policy and implementation levels. Agricultural experts can come forward to investigate field level problems pertaining to crops and associated cropping pattern. Crops resistance to drought and shortage of water can be studied and improved through research. Extension work can improve the land husbandry practices such as skills enhancement in the fields like seed improvement including grading, storage, and handling, that will have great impact on yield. Cultivation of medicinal plants is another aspect which needs attention. The herbal experts believe spate irrigation to be an ideal cultivation systems for these plants without the use of fertilizer and pesticides. In the international market, especially in developed countries, the popularity of organic products is an emerging trend. The state and market institutions need to explore the opportunity for tapping this potential source of earning for the country and the communities.

Integrated Water Resource Management

Rivers and other eco-systems do not follow the man-made sectoral or administrative boundaries. It is not possible to effectively address the issue of degradation by providing symptomatic spot relief at one point and ignore the rest of the system. In order to make the floods more manageable, both for loss-prevention and for productive use, consideration will have to be given to the whole of the river basins starting from watershed management to off-take level construction. At present, soil conservation, watershed management, rangeland conservation, irrigation development and on-farm water management form the mandate of different entities within the government and they do not always work under an integrate plan on an eco-system. Their diffused interventions prevent any significant, visible and discernable impact from coming to the forth. This inter-institutional disharmony needs to be resolved so that a systematic plan for resource conservation and poverty alleviation can be implemented.

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