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IRRIGATION MANAGEMENT NETWORK

file: Some findings

NEWS FROM THE FIELD

News from Balochistan, Pakistan; Nigeria and Western Thar Desert, India

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Some Findings from a Survey of Flood Irrigation Schemes in Balochistan, Pakistan

John Morton[1] and Hans van Hoeflaken[2]

Introduction

Balochistan is Pakistan's largest, least populated and most arid province. Flood or spate irrigation, using flash floods coming from mountainous areas, has traditionally been practised in most parts of the province. Both to maximize opportunities for cultivation and for protection against the destructive effects of floods, local people have long constructed small earth dams on seasonal watercourses, with guiding bunds and diversion canals. Such traditional systems have generally required thorough renovation, or complete rebuilding, each year.

Since the end of the nineteenth century, attempts have been made by successive governments to improve flood irrigation through the use of more durable materials such as masonry, concrete and gabions. Especially since 1960, the Provincial Irrigation Department has attempted to upgrade some systems, and build more permanent schemes at new sites. While much of this work has been funded from the Department's regular budget, it has also attracted donor interest; ODA, ADB, the EC, the Kuwait Fund and the Netherlands Government have all been involved in the field of flood irrigation.

In view of such interest, and in order to provide a solid base of documentation on flood water irrigation, a survey was organised of all existing and traceable sites where the Provincial Irrigation Department had constructed or upgraded flood irrigation schemes. More than 70 sites were visited by a team including an engineer, a socio-economist and a surveyor. From these visits, supplemented by study of Irrigation Department and other government files, a standardised technical description of each scheme and its defects, and a brief socio-economic appraisal, were put together. A final report on each scheme with introductions on each district, and an overall

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introductory volume, were then compiled by the senior consultants in Islamabad (Ground Water Consult 1991).

The survey was intended to provide a foundation for future studies and project planning, and has already proved useful to the development community in Balochistan. It was not intended to produce general conclusions, especially considering the huge area, and physical and socio-cultural diversity of Balochistan. Nevertheless, some general findings of the survey are worth highlighting for a wider audience.

Balochistan

Pakistani Balochistan has an area of around 350,000 km^2, and a population of around 7 million (van Gils and Baig, 1992). Average annual precipitation ranges from under 100mm in the south and west to over 250mm in the north-east. The terrain is mountainous, especially in the north-east, and with the exception of two plain areas, Las Bela in the south-east and Kacchi in the east adjoining the Indus Basin. Traditional farming systems are a complex mixture of grazing, including nomadic pastoralism, rainfed cultivation, flood irrigation and *karez (qanat)* irrigation. Self-contained perennial irrigation schemes were constructed in Pishin in the north under British rule, and parts of the Kachi area are now linked to the Indus irrigation system. Not surprisingly a huge range of crops are grown; wheat, followed by sorghum and millet, are the main staples, and *karez* and other irrigation systems have made a range of cash crops possible, notably apples.

Ethnically, Balochistan is equally varied. Baloch, Brahui and Pathans are the dominant groups, for all of whom tribal organisation persists to a substantial degree, while the lowland areas have a more complex, multi-ethnic, social structure, with substantial numbers of Sindhi-speakers.

Flood Irrigation

A flood irrigation scheme utilises the short duration run-off which flows down stream-beds after rain. Given mountainous terrain and sparse vegetation cover, floods are of short duration (from 24 hours to 10 days) but of great power, bringing large amounts of silt, stones and even boulders down onto alluvial fans below the mountains. The schemes consist of two components: a diversion weir built across the stream-bed to obstruct the flow, raise the water level by a few feet, and divert water through head-regulators to the second component; a canal system to distribute the flood over the command area.

Two main types of structures were encountered: those with gate-operated head-regulators, and those with open head-regulators that distribute water between primary distribution channels in fixed ratios.

The overall performance of the flood irrigation schemes seems to have been very poor. A large number of schemes were found that were gross technical failures, in that they had never successfully provided water to the intended command area, or had only done so for one season, before collapsing, or otherwise becoming inoperable. A further group were operating unsatisfactorily for a combination of technical and social factors; they were subject to poor maintenance, or were contributing to conflict within or between villages. Some schemes were technically satisfactory, but providing such restricted or unequal benefits that they could not be judged successful. Of 76 schemes studied, only 10 were in good working order and perceived by local inhabitants as unproblematically beneficial (a further 11 were successfully providing water, but not over the whole of their intended command areas).

Technical Findings

While it is impossible completely to separate 'technical' and 'social' factors in this failure, the siting and design of many schemes was plainly inadequate to provide long-term benefits to local people. Many schemes were wrongly sited in terms of their physiographic environment. If the headworks are constructed high on the alluvial fan they may be seriously damaged by the impact of flash floods' heavy bedload. Due to the deposition of this material in and around the structure, the next flash flood will often select a different path across the alluvial fan, bypassing the structure altogether.

The design of the structures was also frequently inadequate. Some were built on insufficiently deep foundations, and were consequently undercut and toppled over or broke up. Some were liable to excessive sedimentation due to a lack of proper silt excluders, undersluices and sedimentation basins. As a result entry to the head regulators was often blocked, leaving the schemes useless.

The reasons for the failings in siting and technical design were various. Firstly, almost no hydraulic data had been collected on the watercourses, which would have enabled engineers to plan the flood routing capacity of the weir structure, and to fix the optimum size of the offtaking canals. Surveys had not often been carried out to select the best location among alternatives. High-technology, but theoretically possible methods, such as aerial photography or satellite imagery, has rarely been used.

The habit of building permanent schemes on the site of traditional earthen systems was followed to excess. Such locations do not necessarily give good technical performance, or, as we shall see, great perceived benefits.

Schemes provided with gated head regulators or undersluices were very unlikely to have trained staff available to operate the system properly, to give optimum delivery of water while excluding the entry of silt into the system during high floods. Gauges were not maintained at the schemes, so missing a possibility of collecting hydrological information useful in planning modifications or further schemes on the same watercourse.

Socio-Economic Findings

Consultation and Scheme Organisation

The history of irrigation department involvement in flood irrigation schemes in Balochistan has not been one of participation by, or consultation with, the supposed beneficiaries. In most cases the irrigation department had made no meaningful efforts to consult local people on the need for a scheme, or the best perceived location. In a significant minority of cases, particularly in the lowland areas of Sibi and Kacchi, where much land is owned by extremely powerful traditional leaders, such leaders had been able to influence the locations of schemes in ways that ignored, or were directly detrimental to, the interests of similar farmers.

In virtually no case was there a formally constituted water users' association. At a few sites (mainly in the lowlands) there were landowners' associations, but these did not claim to represent all water users. Only in Pishin District, where the distinctions between flood irrigation and perennial schemes were hazy, did the government attempt to recover any costs from beneficiaries (by small water tax on each irrigated acre). In many areas beneficiaries collectively raised money or worked to maintain schemes, but it was not always clear whether this was on or near the headworks, or on farmers' fields or the channels nearest them.

Gross technical problems with schemes were so widespread that beneficiaries' participation, even where it was found, generally had little effect on overall scheme success. In Kacchi district there were codified and well-enforced systems of communal work, in one case in proportion to land cultivated, but the schemes were all failures. Interestingly there were two schemes in Quetta District where the reverse was true; no local participation in maintenance was reported whatsoever, but the schemes were continuing to work well, giving rise to great satisfaction among beneficiaries.

There was a similar lack of correlation between water distribution systems and overall success. The most common system was one of branching, unlined channels, each of which could be temporarily blocked. There were variations in physical layout; water could pass directly from field to field, over the top of each bund or by controlled breaching of bunds (these systems are described in more detail in WAPDA 1988). There was a general assumption that the highest lying fields would be fully irrigated before water was allowed downstream, but this was modified in various ways; by lot, by starting distribution at the point where water from a previous flood had finished, by aiming to irrigate a fixed proportion of each farmer's land. At Shebo in Pishin, each of three villages in the same scheme had a different system. In some perennial schemes, and flood schemes resembling them, some sort of time-share was practised, which beneficiaries approved of, but on true flood schemes the water distribution system did not seem to influence a scheme's chance of success.

Other Factors in Scheme Successes

The overall conclusions of the socio-economic survey were that people's level of satisfaction, even with technically successful schemes, was generally low, and that the success of schemes was hard to correlate with socio-economic variables (participation and water distribution as discussed above, land tenure). There were however distinct geographical patterns in the success or failure of schemes; schemes in Quetta District, for example, showed a high level of success, schemes in Kacchi were subject both to severe technical failures and to severe social tensions.

This may related partially to the ethnic diversity of the province. Several schemes in Pathan areas had experienced severe social conflicts that had obstructed scheme functioning. This could be ascribed to the extreme atomism and egalitarianism of Pathan societies, documented for example by Ahmed (1980). Schemes in Brahui and Khetrani areas were generally successful, which could be ascribed to the cohesion of these societies around relatively benign traditional leadership. Upgrading of schemes in the socially complex areas of Las Bela and Kacchi showed very little improvement over the existing traditional system.

Two other factors are probably more useful in explaining scheme success or failure. The first is the previous use of the land irrigated by the scheme. Some of the most striking successes were of schemes irrigating land formerly cultivated by direct run-off, or used for grazing, or unused. These schemes were successful in terms of expressed satisfaction and lack of complaints; there is some evidence that they would be more successful than other schemes in terms of economic costs and benefits. A few of these schemes,

but not all of them, were associated with land reallocation at the time of construction, ensuring greater equity and a better match between land rights and water rights.

Looked at another way, schemes that merely upgraded traditional flood irrigation systems have rarely given enough additional benefits to satisfy the population. Sometimes they have proved technologically less effective than the original systems, sometimes the new technology has raised popular expectations it could not fulfil.

The second factor is that of scheme size and complexity. The most successful schemes are those in which flood water exits from an uninhabited area, is used by only one village downstream that has any claim on it. Quantifying this variable is difficult, as it involves defining the limits of communities, but the overall impression is clear.

The converse is equally true; schemes serving many distinct communities, or schemes linked to others along a major watercourse, are unlikely to be free from complaints. The new technology raises aspirations of total control over water in each community, and traditional systems of water allocation are ineffective in resolving inter-community disputes. This was particularly evident in Las Bela District, where several schemes were grouped along the Porali watercourse, and almost every community had complaints about water distribution against those upstream or on other branches, while ignoring similar complaints from those downstream. In many cases such complaints have been translated into poor maintenance or unauthorized alterations and the scheme's technical performance has declined drastically.

Of course this variable, the size/complexity of the scheme, is itself affected by the ecology of the area, mediated through the patter of human settlement. This explains the concentration of schemes perceived as failures in Las Bela and Kacchi, where schemes of any size are bound to affect villages downstream. It remains true that targeting schemes in this way on single communities is an important and simple way of minimising the chances of scheme failure.

Aspects of Scheme Success and Failure

Just as generalising about the preconditions of scheme success is difficult, so is generalising about its effects. For a variety of practical reasons no cost-benefit analysis was carried out. In many cases schemes were so old that no reliable information on the pre-scheme period could possibly have been collected, and in only a few of these was there nearby rainfed cultivation that could have served as a proxy.

Successful flood irrigation has allowed the cultivation of new cash-crops: the recent adoption of sunflower in Quetta District is the clearest example.[3] Castor and cluster bean (in southern districts) and in cumin (in northern districts) are increasing in importance, but the extent to which this can be ascribed to flood irrigation is unclear. In some areas farmers have been able to diversify the cereals grown, particularly into maize,[3] and to grow cereals, particularly maize[3] and millet, specifically as fodder. It is clear however that flood irrigation in the strict sense has nothing to do with the great range of fruit and vegetable crops made possible in Balochistan by perennial schemes, tubwells and *karez*.

An interesting finding was the extent to which successful schemes were having positive effects on livestock. This was true wherever schemes were successful. On schemes that had once been successful but them failed, a decline in benefits to livestock was reported. Benefits were not usually described in detail, but it was clear that both herd numbers and herd condition were improving. Many successful schemes reported increased numbers of seasonal visitors. Presumably the increase was mainly due to the increase in standing crop residues, but some schemes had made possible the growing of crops specifically as fodder. Scheme success or failure had few consistent effects on livestock marketing; increasing , decreasing and stable marketing were all reported from both failed and successful schemes.

The clearest social effects were on failed schemes; it was here that resentment against traditional leaders had grown, as people began to perceive their power as more arbitrary and less benign. However, traditional authority is in decline in most parts of rural Balochistan. There is a genuine (and probably two-way) causal link between technical failure and inter-village conflict; the latter can contribute to declining standards of maintenance and repair. In only a few cases did informants admit to an increase in intra-village conflict, and virtually nowhere were differences between rich and poor perceived to be increasing.

There was no coherent pattern of scheme effects on land tenure, which is in any case extremely complex and variable in Balochistan, with shifting combinations of tenancy, owner-cultivation and communal ownership. Some (but not all) successful schemes were associated with land reallocation, and some schemes appeared to have failed mainly due to failure to agree on division of land. Scheme success could bring about either increased or

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[3] Editor's note: Ther would appear to be a lack of distinction between flood (spate) diversion and perennial irrigation: sunflower and maize are both irrigated crops which do not and cannot survive on spate irrigation with only one or two waterings in Balochistan.

decreased marketing of land. A few successful schemes were attracting new tenants. Only on perennial schemes was there a clear difference in the terms of sharecropping between irrigated and rainfed land. Many failed schemes were associated with a drifting away of potential tenants and labourers (particularly from the Kacchi schemes to the nearby Pat Feeder perennial scheme, and from Las Bela to urban Karachi) that was probably a partial cause, as well as effect, of failure.

Conclusions

While the nature of the survey requires that general conclusions be treated with caution, we would like to suggest that the piecemeal upgrading of traditional flood irrigation systems with modern construction methods practised in Balochistan over the last three decades has not overall been a successful strategy. Schemes were gross technical failures, or had failed to provide perceived benefits for local people. Comments have been made in Section 4 on the technical shortcomings in the design of schemes, and on the failure to collect and use relevant information for planning purposes. Comments have been made in Section 5.2 on the greater chance of success of schemes that are not upgradings of traditional systems, and schemes that are socially and technically self-contained. A series of more specific technical comments can be added:

- Scheme construction should not be attempted on high-flow watercourses (this largely coincides with the recommendation against large and complex schemes);
- Schemes on small-flow watercourses should consist of rigid structures, schemes on medium-flow watercourses could be constructed of gabions with masonry abutments and head regulators;
- Silt excluders should be used wherever possible;
- Canal heads should be designed with care, of permanent materials, and gated wherever possible.

It would furthermore be useful if flood irrigation schemes were not planned in isolation, but in the context of integrated plans for river valleys or similar areas. This would enable area-specific social research, recognising the diversity of Balochistan in aspects such as land tenure and traditional authority, and the development of improved water distribution methods to suit local conditions. It would also facilitate the integration of flood irrigation with other interventions such as reforestation, and agricultural extension.

While such recommendations for improving or complementing the implementation of flood irrigation schemes can be made, there are more fundamental questions of the value of this technology. Economic analysis was beyond the scope of the current survey, and the existence of secondary benefits, such as increased fodder, make a realistic analysis of real schemes very difficult, but it is unlikely that such schemes can be justified on purely economic grounds. Halcrow-ULG (1989) have argued that such schemes provide marginal economic returns, but may be justified as an investment targeted on the poorer sectors of society, into which (relative to the rest of Pakistan) the average Balochi farmer falls. Given the record of such schemes in reality, it is worth asking whether there may be less costly solutions, in the development of livestock and more extensive cultivation, to the enormous problems posed by the environment of Balochistan.

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