

TENTATIVE LESSONS LEARNED

Lessons Learned from Engineering Approach as Development Concept for Spate Irrigation

For several decades, national governments with the financial support of international donors (i.e. World Bank, OECF, EC and IFAD) have developed and implemented projects aimed at the rehabilitation and improvement of existing spate irrigation systems. In general, these spate irrigation projects have been dominated by the heavy engineering approach as the development concept, whereby traditional, independent diversion structures have been replaced by one or a few concrete diversion weirs in order to increase the efficiency of (spate) water diversion to the command area. The results of most of these spate irrigation projects is not positive and the main lessons learned from dominant engineering approach aimed at the 'modernisation' of existing spate irrigation systems can be summarized as follows:

- The planning and design of the rehabilitation and/or improvement works have often been carried out without effective partnership of farmers and land users, so that their valuable knowledge of spate irrigation nor their preferences regarding the scope and type of works and/or changes in the layout of their spate irrigation system are used during the design process.
- The investment costs have been very high and it is doubtful if they can be justified in economic terms.
- The operation of the larger diversion structures and canal systems, including the distribution of diverted spate water, is more difficult and expensive. In particular sedimentation process have not always been well handled in the 'modernized systems'.
- Increased inequity in the distribution of irrigation water due to the collapse of traditional rather fluid water rights as the 'modernised' diversion structures give a larger control over (spate) water to the upstream farmers.
- Government agencies have taken over the responsibility for the O&M of at least the diversion structures from the farmers, who often had complex, well-functioning mechanisms for the O&M of their traditional spate irrigation systems based on the experience of many centuries. The role of the farmers has devolved from active irrigation managers to passive receivers of irrigation water, whose access to (spate) water for irrigation purposes is totally dependent upon the performances of the Government agencies as managers of the 'modernised' spate irrigation systems.
- The expected benefits of the 'modernisation' of spate irrigation systems, including expansion of command area and/or improved yields of spate-irrigated crops, are often not achieved, because the envisaged increase in diversion and conveyance efficiency could not be realized due to the (very) weak performances of the Government agencies with regard to the O&M of the 'modernised' spate irrigation systems. It is common that the (main) canal system cannot convey the designed capacity of spate water to the fields as it is heavily silted up due to lack of maintenance for many years. The following factors have often contributed to the ineffective O&M of spate irrigation systems by Government agencies:
 - insufficient funds for the O&M of the irrigation infrastructure because farmers do not pay (adequately) for the received irrigation services and/or inadequate amount of funds are allocated for the O&M of (spate) irrigation systems by the Government;
 - ineffective use and/or embezzlement of available O&M funds;
 - insufficient knowledge and skills to operate and maintain spate irrigation systems;
 - insufficient knowledge of existing rights regarding the allocation and distribution of (spate) water; and/or
 - corruption and favouritism, whereby influential and powerful farmers take more water than they are entitled to.

Although these lessons have been learned and well documented since the 1980s, it has not resulted in an adjustment of the development concept for spate irrigation as more recently formulated spate irrigation projects, which are implemented in countries such as Yemen and Eritrea, are still dominated by the heavy engineering approach. The main reasons for the dominance of the heavy engineering approach may be as follows:

- disbursement pressure, whereby it is easier to spend large amount of money on a few large, capital-intensive structures than on a larger number of small, labour-intensive infrastructure;
- preferences among engineers, government agencies and donors to design large and sophisticated infrastructure instead of low-cost structures using simple technology;
- donor's preference to implement projects in a relatively short period, whereby the construction of a few large structures without significant farmers' participation and contributions is preferred above the implementation of a larger number of small project activities with the full participation of the concerned farmers in all stages during a long-term programme;
- lack of interest and/or capacity among donors and government agencies to investigate and to design a spate irrigation project around the existing water rights, O&M practices and institutional arrangements, which are the result of an evolutionary process during many centuries;
- lack of experience among government agencies to facilitate the effective involvement of farmers in the various stages of the development of spate irrigation systems; and/or
- concept of participatory irrigation management is mainly donor-driven, while many government agencies only accept it formally as a condition for receiving the development loan although it is against their own interest aimed at having as much control over the rehabilitation and management of spate irrigation systems as possible, in particular the allocated rehabilitation and O&M budgets.

Integrated Approach for Spate Irrigation

Technical solutions, such as the construction of more permanent diversion structures, have the potential to improve spate irrigation by increasing the control over the diversion and distribution of spate water. However, any technical solution must take into account the existing irrigation practices based on traditional rights regarding the allocation and distribution of (spate) water as well as the existing agricultural practices, including the important role of livestock in the farming system based on spate-irrigated agriculture.

As much of the available surface water is already effectively used for spate irrigation, the major benefits from any investment in spate irrigation must derive from increased productivity of water use. Therefore, the emphasis in the development of spate irrigation systems must be focused on the improvement of the existing systems of water allocation and distribution within the framework of existing water rights and O&M practices. Existing spate water rights are not static and they are often the results of frequent changes due to one or more of the following factors:

- population growth;
- new technologies;
- changing cropping patterns and new market opportunities;
- changing (socio-economic and/or political) power relations; and/or
- changing levels of enforcement (i.e. law and order).

It is common that water rights are amended following a serious dispute about the distribution of water between different groups of water users along the river and that third parties (i.e. traditional political and/or religious leaders, local government) often played a crucial role in resolving the conflict.

With low crop returns even in good years and the likelihood of crop failure always there, spate-irrigated agriculture makes a precarious living. To cope with the inherent uncertainties of spate-

irrigated agriculture, many farming households in spate irrigation systems have adopted a livelihood strategy of diversifying their household economy by depending on multiple sources of income, in particular livestock and wage labour. To alleviate poverty in spate-irrigated areas, it is not sufficient to focus only on the improvement of spate irrigation as water is not the only constraint to improve the productivity of spate-irrigated agriculture (using new market opportunities such as sorghum for commercial poultry or guar for ice cream industry) and many poor households do not only rely partially on spate-irrigated agriculture for their incomes. In addition to the improvement of spate irrigation, successful alleviation of poverty among poor households in spate-irrigated areas also depends upon:

- improvement of access to inputs, extension services and marketing for spate-irrigated crops;
- development of conjunctive use of ground and spate water, including access to credit for installation of (collective) wells with pumps;
- improvement of the productivity of livestock as well as the processing and marketing of livestock products; and
- creation of opportunities for wage labour and off-farm income, in particular for landless households.

If poverty alleviation is one of the objectives of a spate irrigation project, it shall also develop and implement activities in these additional fields, so that poor households in spate-irrigated areas have the chance to increase their incomes substantially.

The success of any intervention to improve a spate irrigation system largely depends if the following principles are incorporated in the development approach:

- Farmers shall effectively drive the planning, design and execution of the rehabilitation and/or improvement works as well as the review and amendment of existing rights to facilitate the improvement of allocation and distribution of spate water, so that they develop a sense of ownership and that the agreed changes are more likely to be adopted and respected by the farming community.
- There is a need to greatly rely on local authority and attach intervention to local government programs – for the sake of continuity, integration and to avoid heavy engineering approaches
- To increase the productivity of water use, the improvement of the existing systems of water allocation and distribution shall be the main objective of any intervention in a spate irrigation system based on a detailed investigation and analysis of the existing water rights and O&M practices, including their inherent inequalities and inefficiencies, in collaboration with all stakeholders. The development and adoption of an improved system of water allocation and distribution, including amended water rights, may be the single most beneficial component and certainly the most cost-effective.
- For the successful implementation of an improved system of water allocation and distribution, it is essential that effective institutions are established at different levels, which have sufficient authority and power to strictly enforce any agreed rules and procedures regarding the management of the spate irrigation systems, including the allocation and distribution of spate water.
- Adoption of an integrated water management approach within the boundaries of an entire river basin as:
 - spate water is essential for the recharge of ground water;
 - use of ground water for irrigation is increasing in spate-irrigated areas;
 - spate-irrigated agriculture becomes more reliable and profitable if ground water is used conjunctively with spate water;
 - use of surface and ground water by various users along the river for multiple purposes (i.e. domestic, agricultural, industrial, environmental, recreational) shall be properly coordinated; and

- physical characteristics of the river (i.e. riverbed levels) shall be closely monitored to avoid flood damage and/or uncontrollable degradation or changes in the course of the riverbed.
- The establishment of an effective institution with the power to enforce any agreed rules and procedures at river basin level, in which all stakeholders are duly represented, is considered to be crucial for the successful implementation of an integrated water management approach. Such an institution at river basin level could also play an important mediating role in settling disputes with regard to the allocation and distribution of spate water between different groups along the river.
- The replacement of a (large) number of independent (traditional) diversion structures by a (concrete) diversion weir should be avoided as much as possible as it may have the following disadvantages:
 - the risk of social conflict between upstream and downstream farmers could increase as the provision of a (concrete) diversion weir may increase the inequitable distribution of available spate water due to the collapse of traditional mechanisms for the allocation and distribution of water based on existing water rights; and
 - the O&M of the (concrete) diversion weir shall be carried out by a Government agency or third party as the farmers would not have the necessary technical and financial capabilities to undertake that responsibility.
- Low-cost, simple and maintenance-friendly technology shall be used as much as possible in order to:
 - keep the capital costs as low as possible so that the investment can be justified in economic terms;
 - ensure that farmers have the opportunity to carry out most of the construction works themselves;
 - ensure that as much local labour is used during the execution of construction works as possible;
 - ensure that farmers are able to operate the spate irrigation properly and that diverted spate water is distributed equally in accordance with the (amended) water rights;
 - ensure that farmers are able to finance and carry out the necessary maintenance and repair works themselves.
- The financing and execution of the O&M of the (entire) spate irrigation systems shall be the responsibility of the farmers, whereby existing institutional and resource mobilisation mechanisms shall be used as much as possible. Based on a detailed assessment, the existing institutional mechanisms shall be restructured and strengthened in cooperation with the concerned farmers, so that they have the necessary financial, technical and organisational capacities to manage, operate and maintain the (improved) irrigation infrastructure properly and efficiently.
- Simultaneously with the intervention in the spate irrigation system, agricultural improvement should be initiated aimed at:
 - improvement of the yields of traditional spate-irrigated crops, in particular fodder crops;
 - improvement of the productivity of livestock;
 - promotion of conjunctive use of spate and ground water; and
 - introduction of new crops.
- Instead of a project with a relatively short implementation period, a long-term phased programme is required as social change requires to be carefully worked out over a long period of time with all concerned stakeholders.

Economic Analysis of Spate Irrigation Systems

Any investment in spate irrigation can only be economically feasible if the net economic benefits are significantly higher than the present economic returns from spate-irrigated agriculture. However, the scope for deriving significant additional economic benefits from investments in spate irrigation is limited because of the following reasons:

- the cropped area and crop production vary considerably over the years due to the great variation in the size and frequency of floods from year to year and season to season, including the inherent risk of a total crop failure in years with no floods or very floods that wash away the diversion structures before any land could be irrigated;
- the cropping pattern is dominated by the cultivation of traditional crops with low market value, which are mainly grown for home consumption; and
- the diversion and conveyance efficiency of many spate irrigation systems is already relatively high as most surface water is used for irrigation.

As the scope of potential economic benefits from investments in spate irrigation is limited and to ensure that the improvement of any spate irrigation system would make sense in economic terms, the development costs must be curtailed accordingly. Less sophisticated technical improvements of the existing diversion structures and irrigation practices, the provision of bulldozers to reconstruct the deflectors more rapidly and more efficiently after floods as well as the use of less robust structures for bed stabilisation (i.e. gabions) and improved traditional structures are possibilities for a low-cost approach as an appropriate development concept for spate irrigation. Apart from the strict cost advantage, low-cost approach may also have the following significant advantage over the heavy engineering approach (i.e. concrete diversion weirs):

- simple technology that is easily adopted by local craftsmen, thereby ensuring that both construction and maintenance can be undertaken at the local level using locally available, inexpensive materials;
- independence from heavy machinery and imported supplies;
- most of the construction works can be carried out by the farmers themselves;
- repair would be less costly and can be executed faster as only locally available materials and/or craftsmanship are required; and
- impact of the failure will be partial as low-cost diversion structures have smaller command areas than larger, concrete diversion weirs.

In choosing low cost technology one should be careful to go for techniques that are low cost but still cumbersome to maintain in remote, poor areas. Gabion structures may not always necessarily be the best choice.

The feasibility of any capital investment in spate irrigation also depends upon the probability of spate irrigation, whereby areas with a more reliable supply of spate water give better opportunities for justifiable investments than areas with a less reliable supply of spate water for irrigation purposes.

In addition to the economic benefits, investments in spate irrigation may also have significant social and/or environmental benefits, including:

- poverty alleviation of a large number of households, who cultivate relatively small spate-irrigated areas as owner-operators and/or sharecroppers, due to improved agricultural production and/or livestock activities;
- improvement of food security in terms of number of months that farming households can satisfy their food consumption in normal years;
- multiplier effect because more money enters the local economy due to the involvement of local labour force, craftsmen and contractors in the execution of the construction works as well as an increase in the marketing and processing of agricultural and livestock produce;

- creation of temporary labour opportunities during the execution of construction works as well as more permanent labour opportunities in the agricultural sector due to increase of cropped area and/or cropping intensity, especially for landless households and farming households with small plots;
- reduction in (seasonal) migration as the need to migrate to areas in search of labour is reduced due to higher incomes from spate-irrigated agriculture and/or livestock keeping;
- reduction in the cutting of trees as the need to earn an additional income from the sale of (fuel)wood and/or charcoal decreases due to higher incomes from spate-irrigated agriculture and/or rearing livestock; and
- reduction in the cutting of trees as less or no trees are required for the annual (re)construction of the traditional diversion structures and any other irrigation infrastructure.

The assessment of the feasibility of investments in spate irrigation shall not only be based on the calculated economic benefits, but the above-mentioned potential social and/or environmental benefits should also be included. As it is not easy to quantify the potential social and environmental benefits of the various options, they could as a minimum be given scores in accordance with the probability that these benefits would be achieved due to the proposed investments in spate irrigation. In addition it maybe useful to explore different ways of valuing capital in investments that have an explicit poverty alleviation objective.