Spate irrigation: Good for people, livestock and crops

Spate irrigation is an ancient form of water harvesting. It is a method of managing unpredictable and potentially destructive flash floods for crop and livestock production. By making water available, it can contribute to increasing the diversity of farming systems where it is found. It is the major source of livelihood for many communities in west Asia, the Middle East and Africa. Despite being the oldest type of irrigation, it is still the least studied, understood and documented.

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Spate irrigation water management systems are among the most spectacular and complicated social organisations around. While spate irrigation has the potential to contribute to poverty alleviation and food security, it is often neglected and forgotten in agricultural investment programmes. The area under this type of irrigation is more than 2.5 million hectares worldwide, with about 2.1 million households depending on spate irrigation systems. It is found in west Asia (Pakistan, Iran, Afghanistan), the Middle East (Yemen, Saudi Arabia), North Africa (Morocco, Algeria, Tunesia) and the Horn of Africa (Ethiopia, Eritrea, Sudan, Somalia) and more sporadically in other parts of Africa, South America and Central Asia. The largest area is in Pakistan and Iran. In the Horn of Africa spate irrigation is on the increase.

This water management system requires the local construction of bunds and canals that are able to withstand flash floods. They must be designed to gently guide large volumes of water over large areas, slowing down their erosive power. Soil bunds, as they are in use in Pakistan and Eritrea, can stretch over several kilometres. This requires much ingenuity in their construction. Factors which need to be considered include: the location, the angle to the river bed, the distance from the new diversion bund, the soil from which they are made, the compaction and use of (brushwood) reinforcements. The amount of collective work needed is huge. This requires strong local co-operation and agreement on how to distribute a common good that is uncertain and uneven. In many cases the number of people working on the common structures is so large that it is in the benefit of upstream farmers to give a fair deal to downstream land users. This is the only way to mobilise enough people to carry out the repair works.

Higher production, fewer chemicals

Spate irrigation systems sustain highly productive low input agricultural systems. One example is the Eastern Lowlands in Eritrea, where sorghum yields of 3750 kg/ha are often achieved. On occasion, yields reach 6000 kg/ha, thanks to a sophisticated system of moisture management. The secret is a refined system of water management – in which the land is ploughed prior to the irrigation season to "open up the soil". After the fields are watered they are carefully ploughed and mulched – and the sooner this takes place after irrigation, the more moisture is stored. In the Eastern Lowlands the command area is also kept relatively compact. Because of this, it is possible to have two or even three spates on the land, and to store sufficient moisture in the soil to last throughout the season.

In most spate irrigation schemes, farmers prefer to use local cultivars as they are well adapted to the local agro-climatic conditions. There is minimal use of chemical and organic fertilizers as most farmers believe that their soils are naturally fertilized by the fine sediments that are deposited during each irrigation. The use of pesticides and insecticides is also rare. High costs, limited availability and risk aversion are other factors that have limited the use of agro-chemicals. Most spate-irrigating farmers cannot take the risk of losing their entire crop in a dry year by changing to higher yielding varieties that are less tolerant to drought and require fertilizers and other agro-chemicals.

Zero-grazing

Livestock is an integral and important component of the livelihoods of the resident households in most spate-irrigated areas. Access to sufficient fodder is therefore crucial. The main

How it works

Spate irrigation is a type of water management that makes use of water from "spates", short duration floods. Spates – lasting from a few hours to a few days – are diverted from normally dry riverbeds and spread gently over agricultural land. After the land is inundated crops are sometimes sown immediately. Often the moisture is stored in the soil profile and used later. The spate irrigation systems support low economic value farming systems, usually cereals (sorghum, wheat, barley), oilseeds (mustard, castor, rapeseed), pulses (chickpea, clusterbean), but also cotton, cucurbits and even vegetables. Besides providing irrigation, spates recharge shallow groundwater (especially in river bed), they fill (cattle) ponds and they are used to spread water for pasture or forest land in some places.

Photo: Spate Irrigation Network

Simple infrastructure development can help people to manage flash floods and spread water over land – the working procedure of "spate irrigation".

source of fodder is crop residues and rainfed grazing lands. A second source is the cultivation of spate-irrigated fodder crops, such as (green) sorghum. In Eritrea and Sudan, ratooned sorghum is an important feed for livestock as well. Weeds cut from the fields and along the canals are another source of forage, as are leaves from trees in and around the spate-irrigated fields. For instance, households in the Sheeb area in Eritrea practice "zero-grazing" from October to May. In this system, the animals are fed with cut grass from the fields. This prevents livestock from causing damage to standing crops, and economises on the scarce animal feed. Farmers in the northern part of Amhara State (Ethiopia) also indicated that spate irrigation boosted the availability of animal feed due to a significant increase in biomass production. The improved availability of animal feed has improved household income generated from livestock products.

Spate irrigation systems generate important benefits. In the first place, obviously, spate irrigation makes it possible to grow crops in hot arid and semi-arid regions where evapotranspiration (the loss of water from soils and plants) greatly exceeds annual rainfall. In addition, spate irrigation systems may also have one or more of the following benefits for the households living in and around the command areas of these schemes: (improved) access to animal feed; recharge of groundwater aquifers; (improved) access to water for humans and livestock; and (improved) access to forest products.

Efforts to support spate irrigation farmers

In general, the provision of agricultural extension services to farmers in the usually remote spate-irrigated areas is poor, whereas any available services often do not meet the specific needs and demands of spate-irrigating farmers. The entire range of Green Revolution techniques, for instance, is not applicable.

For a long time, attention to spate irrigation has focused very much on civil works improvements. These have in many cases disturbed the balance and the sustainability of the system. Typically, an ingenious system of independent structures able to manage the high floods and high sediment loads, was replaced by a single concrete diversion structure. This was the pattern followed in the so-called modernisation era in Yemen and Pakistan. The net result has either been the rising of the command area, water rights conflicts (as a many independent systems were replaced with a single off-take) or interference with the subsurface flow feeding the local aquifers. Moreover, attention to improving the diversion of river water from such modernised systems was in retrospect uncalled for in some areas, as most water was diverted from the dry river beds anyhow and no water was left unused.

Many small things make magic

There are several ways of improving spate irrigation beyond focusing on diversion works only. This is best described as the magic of many small things. Promising activities include:

- Improving water productivity and soil moisture management. Field-to-field structures (inlets and overflow structures) can be improved, allowing more regulated inflows and outflows during the hectic times of spate irrigation. Another strategy is to ensure that animal traction power is adequate for ploughing and mulching, so as to conserve soil moisture after irrigation. A final strategy is to consider concentrating flows towards a relatively compact command area, so as to increase the probability of land being irrigated. This makes it less risky for farmers to prepare their land prior to irrigation. More compact command areas also increase the chances of a second and third irrigation, taking crops out of the "stress zone", as practised in Eritrea.
- Introducing new crops – vegetables, cucurbits, pulses, oilseeds. What is common and popular in one area often has not spread to the next area.
- Making more of wild crops. In most spate areas there is a large variety of wild vegetables, fodder plants and mushrooms (including truffles). Seeds of these are collected from a large catchment and dumped during the floods into the favourable moisture conditions of the spate systems.
- Investing in post-harvest technology, such as seed cleaning and improved storage, which in Pakistan for instance, reduced grain losses from 7% to zero.
- Enhancing the productivity of livestock. This would include improved access to animal feed, watering points and veterinary services, as well as the processing and marketing of livestock products.
- Promoting local agroforestry, particularly of indigenous trees that serve to stabilise surrounding areas and provide fuel and timber, medicinal products or bee forage. Sometimes this has to be accompanied by improvement in the governance of local forestry.
- Controlling invasive species. In spate irrigated areas in Sudan and Yemen, an invasive weed has blocked river beds and grown over canals. Innovative ways of reusing this weed (for charcoal for instance) could turn it into a resource.
- Improving drinking water facilities in the spate areas. These are often inadequate and unreliable, such as unprotected open ponds. A range of technical and institutional measures are available to improve drinking water supply.
- Developing complementary uses of groundwater and spate water, including promoting recharge with small structures and special water allocation rules. The combination of spate and groundwater can sustain production systems that are among the most productive anywhere.

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