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Small-scale irrigation in Africa - any lessons from Asia?

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INTRODUCTION

Irrigation has an important role in hot climates in enabling crops to be grown at times or in places which would otherwise be too dry. It may also be a necessary precondition both for national food security and for intensive agricultural development, involving high yielding varieties and cash crops. However the performance of many large formal irrigation schemes in Africa has been poor - they have proved expensive to construct and they have failed to achieve the planned transformation of agriculture.

Moris (Ref 1) provides an overview and various examples of poorly performing schemes (on two of which the writer of this paper worked in the 1970s). As a result of these problems, greater attention is now being paid to small scale irrigation in Africa, and FAO has recommended its further development (Ref 2). At a Forum on African irrigation in Nairobi in January 1988, it was suggested that more could be learnt from Asian experience in irrigation, and this paper attempts to contribute to this, based on the writer's experience of small scale irrigation in various Asian countries during the 1980s.

SMALL SCALE IRRIGATION

Definition

This paper follows the working definition of small scale irrigation which has been adopted by the UK based Informal Working Group on Small Scale Irrigation:

> irrigation, usually on small plots, in which farmers have the major controlling influence, and using a level of technology which the farmers can effectively operate and maintain.

Adams and Carter have provided a useful overview of small scale irrigation in sub-saharan Africa (Ref 3). This includes a simple classification into: valley swamp irrigation; floodplain irrigation; upland environments; coastal environments.

Extent of Small Scale Irrigation in Africa

The table shows FAO estimates of areas under modern irrigation and under small scale or traditional irrigation in sub-saharan Africa

FAO Estimates of Irrigated Areas, 1982

Country	Irrigated Areas ('000 ha)		
	Modern	Small-scale or Traditional	Total
Angola	0	10	10
Benin	7	12	19
Botswana	0	12	12
Burkina Faso	9	20	29
Burundi	2	4	6
Cameroon	11	9	20
Central African Republic	0	4	4
Chad	11	35	46
Congo	3	5	8
Equatorial Guinea	n.a	n.a	n.a
Ethiopia	68	45	113
Gabon	0	1	1
Gambia	6	20	26
Ghana	8	50	58
Guinea	50	135	185
Guinea Bissau	n.a	n.a.	n.a.
Ivory Coast	33	29	62
Kenya	21	28	49
Lesotho	0	1	1
Liberia	8	16	24
Madagascar	160	800	960
Malawi	19	2	21
Mali	93	57	150
Mauritania	3	20	23
Mauritius	9	5	14
Mozambique	66	4	70
Niger	7	17	24
Nigeria	35	805	840
Rwanda	0	15	15
Senagal	98	89	187
Sierrra Leone	5	100	105
Somalia	35	50	85
Sudan	1,700	-	1,700
Swaziland	55	5	60
Tanzania	34	106	140
Togo	2	8	10
Uganda	9	3	12
Zaire	4	38	42
Zambia	14	2	16
Zimbabwe	140	6	146
Total	2,725	2,568	5,293

Source: Ref 4

in 1982. This shows the importance of small scale irrigation in all countries except Sudan. However until recently, little attention has been paid to this type of irrigation in many countries, perhaps because it is carried out without government involvement. Nevertheless, studies and development projects have been carried out, which can also be used to guide future development (Ref 5, 6).

EXAMPLES OF SMALL SCALE IRRIGATION IN ASIA

The Typical Asian Environment

It is important to note that many parts of Asia provide a more favourable environment for crop production than typical conditions in Africa. This includes high rainfall, established high yielding crops (notably rice), and a developed infrastructure facilitating the supply of inputs and marketing of crops. In the irrigation context there are also the benefits of numerous small-medium sized rivers, local construction skills and industries, and usually local experience of irrigation and irrigated crops, coupled with resources of available labour for increased agricultural work.

Gravity Irrigation

The utilisation and control of local runoff is the basic form of water management for rice during the monsoon season in many floodplain areas, with individual farmers controlling the excess water from rainfall in cooperation with their immediate neighbours.

Catchment harvesting is carried out by groups of villagers constructing small embankments and dams to trap spate flows, as in parts of India (Ref 7).

Small canal irrigation is widespread in Asia, diverting water from small or medium sized perennial rivers. In some countries, government has promoted and assisted this form of irrigation, while leaving its control in the hands of the villagers. Examples are the "sederhana" (simple) irrigation schemes in Indonesia and the communal irrigation schemes in Philippines (Ref 8).

Hill irrigation is a special form of small canal irrigation, carried out in upland areas, where there are particular problems of instabilities along the canal line (Ref 9).

Lift Irrigation

Lift irrigation involves the lifting of water from either surface water sources (rivers, ponds etc) or groundwater. Various types of lift irrigation are described below.

Traditional pumps are found in various forms, such as human powered counterweighted shadufs and dhones, buckets on ropes, and animal powered bucket wheels, for raising water from surface sources or shallow wells.

Improved human powered pumps from surface sources, include the treadle pump and the rower pump in Bangladesh. These are manufactured locally, and many thousands are in use. They provide the small farmer with a cheap and effective pump which is efficient in use of water, but very hard work. WEDC has been carrying out research in Zimbabwe on the potential for the use of human powered pumps such as these and the rope-washer pump.

Low lift pumps are normally privately owned (sometimes with government credit or subsidy), diesel powered centrifugal pumps of 25 to 60 l/s capacity, which lift water from surface sources. This technology is also used in various places in Africa, including for irrigation of *fadama* land in Nigeria. However its high initial cost may make it accessible only to richer farmers, or farmer groups, and its high pumping capacity can lead to inefficient use of water.

Shallow tubewells have spread rapidly among farmers in the Indian sub-continent in the 1970s and 1980s. They are constructed by a government agency or local artisans, and privately owned by individual farmers or community groups, who arrange maintenance and repairs privately. Some governments have supported the spread of shallow tubewells through subsidies or credit.

Shallow tubewells typically have depths of 10 to 60 m, discharges in the range 14 to 21 l/s, and command areas of 3 to 5 ha. They have centrifugal pumps powered by electric motors or diesel engines - rural electrification has encouraged the spread of groundwater development in India. The major benefits of a shallow tubewell to a farmer are that it can be used to grow profitable dry season crops (eg wheat in north India, rice in Bangladesh), and that the water supply is controlled by the farmer.

Deep tubewells are larger and technically more sophisticated than shallow tubewells, and lie at the margin of the definition of small scale irrigation. They have depths of 50 to 150 m and discharges of 30 to 90 l/s, from turbine pumps, powered by electric motors or diesel engines. Command areas are in the range 20 to 100 ha. Deep tubewells are installed by government, and operated and maintained variously by government or a farmers' cooperative.

Hand tubewells on the other hand are simple, farm level installations, with depths

up to about 10 m and discharges up to 3 l/s. An example is the Bangladesh MOSTI which has proved very popular with small farmers. It consists of two 6 m sections of 40 mm galvanised pipe, a brass-wrapped strainer 1.8 m long, and a Bangladesh No 6 hand pump. The pipe is installed by tubewell mechanics, and spare parts are available in every town (Ref 10).

LESSONS FROM ASIAN EXPERIENCE

Set out below are some tentative lessons from the writer's Asian experience which may be useful for development of small scale irrigation in Africa.

The Importance of Agricultural Demand

The farmer's incentive and the driving force for small scale irrigation is the desire to produce crops which require irrigation. If the farmer has no interest in these crops, perhaps because they do not meet local tastes or could not be marketed, then the potential of small scale irrigation to increase production will not be realised.

Farmer Participation

Operation and maintenance (O & M) of small schemes have to be carried out at local level by the people themselves, which will only happen if they regard the scheme as their own. This requires their involvement from the beginning in the planning of any new works.

Applications for assistance should be received from the farmers before any government or NGO considers development work; the agency should hold a village meeting to explain the obligations clearly (eg for construction and O & M), and formally agree these with the farmers.

Local leaders are crucial to this process, both by their attitude to the irrigation, and for their assistance in organising meetings and other forms of participation. An interested local leader can make a success of a difficult scheme, whereas a selfish leader may try to manipulate the development to capture benefits for himself.

Walking the canal line with the farmers is a very effective way of discussing problems and proposals, and planning new works.

The farmers' existing skills and procedures for farming and water management should form the basis of proposed improvements. From their experience the farmers can also explain local physical and social conditions, including complexities which would be difficult for outsiders to understand.

Land and water rights need careful consideration and can be a source of conflict which may even prevent irrigation development. It is important to consider other users of the land and water source, and to agree with the farmers the setting of command area boundaries, alignment of canals and positioning of outlets.

Farmers' limited perceptions however can be a constraint, restricting the works that can be implemented - for example in hill irrigation in Bhutan and deep tubewell irrigation in Bangladesh, the farmers are keen to improve the supply of water from the source, but reluctant to work on improving its distribution.

Demonstration irrigation areas have been used successfully to widen these perceptions by taking farmers to see examples of improved schemes - see photo 1.

Design Approach

Simple, rugged structures are needed, which are easy for farmers to operate and maintain - local materials are often appropriate for ease of repair. Methods of operation and control should fit any traditional practices, such as dividing the discharge in fixed proportions (as in Bali and Nepal - see photo 2), or rotating the water on a time basis.

Canal design discharges may need to be higher than theoretical calculations would suggest, because of high water losses and low irrigation efficiencies, and limited watering hours (often daytime only) and the need to take advantage of peak flows at the source.

Construction

The farmers themselves ideally carry out any construction work, as paid or unpaid labour, so that they identify with the scheme and improve their operation and maintenance skills.

Labour management may be a problem since farmers have many other demands on their time, and construction work therefore needs to be planned carefully around times when farmers can be available. It is important to agree a schedule, and keep to it. This may involve work in the dry season only, with each family contributing labour on agreed days.

A construction committee can be formed to organise the work, and this can develop later into a water user association for operation and maintenance.

Complex structures such as intakes may be beyond the farmers skills, and require

experienced labour and technicians, either directly employed or by giving the work to a contractor.

Construction quality control is difficult, both with beneficiary labour and contractors. Initially the labourers need to be trained in the various skills, and the works explained carefully. Demonstration schemes can provide useful models here, photographs and drawings are less easily understood. Close supervision of construction is essential to back up the training and prevent the labourers making "shortcuts" in the works.

Operation and Maintenance

A water user association of some form is needed to organise O & M. This will often be an informal meeting of all the farmers, based on traditional forms of organisation (Ref 11) Agricultural extension (including organising skills) will probably be needed to maximise benefits from the irrigation development.

CONCLUSIONS

Small scale irrigation schemes differ according to local circumstances, and a flexible approach is needed to their development. Hopefully the ideas set out in this paper may provide some guidance on this.

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Photo 1: Showing farmers around a demonstration irrigation scheme in Bhutan

Photo 2: Traditional wooden structure with notches to divide water in fixed proportions.