IRRIGATION MANAGEMENT NETWORK

NEWSLETTER

June 1993

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Contents **Page**

Network papers in this set:

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1. NEWS FROM THE IMN

This Newsletter set takes a broader over view of irrigation issues, to look at production in irrigated agriculture as well as in managing the delivery of water.

Paper 23 *The Governance and Management of Irrigation Systems: an Institutional Perspective* by Shui Yan Tang and Elinor Ostrom, sets out a framework for understanding governance issues, and how institutional structures can be crafted which promote collaboration and partnership among irrigators and officials, as well as resulting in better water deliveries.

Paper 24 *Increasing Women's Benefits from Irrigation Development: smallholder irrigation in the Kano plains, Kenya* by Joitske Hulsebosch and Barbara van Koppen, provides a study of female irrigators in Kenya and how they participate and get benefits from irrigation. From this some conclusions are drawn as to how better support services for women can be developed, and how they can participate more fully in irrigation management decisions.

Paper 25 *Urban Agriculture and Cooperative Organisations in Addis Ababa, Ethiopia* by Axumite G Egziabher, provides information on urban agriculture - an area of small scale irrigation of great importance in rapidly growing cities. This study shows some of the support needs of urban irrigation, and the contradictions and confusion these can raise among government organisations who still see agriculture as a rural phenomena, and who conceive of urban landuse in limited ways.

Paper 26 *Farmer Organisations for Lift Irrigation: Irrigation Companies and Tubewell Cooperatives of Gujarat* by Tushaar Shah and Samindra Bhattacharya looks at the comparative success of two different types of organisations operating lift irrigation schemes in Gujarat. It raises the idea of looking at the <u>design concept</u> behind organisations, rather than details of structures and rules, as a means to understanding performance. It also introduces several new criteria for the operational efficiency of lift schemes.

Paper 27 is a compilation of comments to a paper by Anura Widanapathirana on the issue of irrigation and poverty alleviation in irrigated settlements. This paper was circulated as a mailshot to a number of network members, who have responded with a wide range of insights both from settlement schemes in particular and irrigation generally. Poverty alleviation has been seen as a benefit from irrigation development, but can it be a specific object of irrigation development? Anura Widanapathirana and the respondents set out to debate these views, and also how we can perceive benefits and objectives more clearly.

2. NEWS FROM NETWORK MEMBERS

The WATER Newsletter has been launched by ISPAN (Irrigation Support Programme for Asia and the Near East). This quarterly publication will look at water management and competition across these regions. For copies or further information contact Kathy Alison, ISPAN, 1611 N Kent Street, Room 1001, Arlington, Virginia 22209, USA.

Are you interested in *qanats, karez* or *foggaras*? A new collection of papers is available (mainly in French) covering material from Israel, Spain, Algeria, Iran and Afghanistan. *Les Eaux cachées* ed. D. Balland (1992) Publication 19, Département de Géographie is available from the Université de Paris-Sorbonne, 191 rue Saint-Jacques, F-75005 Paris, France. Price 140 French Francs + postage.

Inventorying Farmer Managed Irrigation Systems - IIMI held an Asian regional workshop looking at issues in registering and documenting FMIS. Papers were presented from Indonesia, Malaysia, Thailand, the Philippines, Nepal, Bangladesh and Portugal. For more information on the publications contact Doug Vermillion at IIMI.

Collector wells for small-scale irrigation continue to be researched by the British Geological Survey. For the latest reports on studies in Zimbabwe (Report WD/92/27) write to Peter Chilton, BGS, Keyworth, Nottingham NG12 5GG.

Handpumps are the subject of the latest issue of *Waterlines* (Vol.11:4) with insights from Tanzania, Zimbabwe, India and Bangladesh, plus some general studies on maintenance and regional experience. While focused on domestic water supply, the information here may be of interest to many of you. To obtain copies or subscribe to Waterlines write to Mary Bream, IT Publications, 103-105 Southampton Row, London WC1B 4HH.

Microcomputer software for irrigation has been the subject of a special study at ILRI. This study looks generally at issues and trends in computer use, but also has special reviews on material for design, operations and management. For a copy of the draft report *Inventory of Irrigation Software for Microcomputers* by K Lenselink and R Jurriens. Write to Rien Jurriens at ILRI, PO Box 45, 6700 AA Wageningen, Netherlands.

Issue 27 (1993) of the *ODU Bulletin* also focuses on **Information Needs in Irrigation Management.** For a copy write to Geoff Pearce at H R Wallingford Ltd, Overseas Development Unit, Wallingford, Oxfordshire OX10 8BA.

Readers interested in **irrigation, water resource and environmental policies** will be interested in two thoughtful recent Discussion Papers by Winrock International which try to examine how 'facts', 'values' and 'uncertainty' influence the evolution of irrigation policies, and also peoples expectation of 'policy'. For copies of *Irrigation Policy Management and Monitoring in Developing Countries,* and *Environment (DP4) and Natural Resource Policy Issues in Developing Countries (DP3)* write to David Seckler, Centre for Economic Policy Studies, Winrock International, 1611 N Kent Street, Suite 600, Arlington, VA 22209, USA.

Water Resource Issues, including questions of **water use efficiencies** are also addressed by two recent World Bank Technical Papers by Harald Frederiksen at the World Bank, *Drought Planning and Water Efficiency Implications in Water Resources Management* (Paper 185) and *Water Resources Institutions* (Paper 191). To obtain these, write to Harold Frederiksen, The World Bank, 1818 H Street NW, Washington DC 20433, USA.

A newsletter on **Self-Governance** may interest any members concerned with helping farmers to negotiate and organise for more effective livelihood strategies. To join the network write to Elise Paylan, International Centre for Self Governance, Institute for Contemporary Studies, 243 Kearny Street, San Francisco, California 94108, USA.

Macroeconomic data for eleven West African countries is now available in a software package AfroBASE. This includes a wide range of information on imports, exports, duties, state income currency factors, debt etc which might be useful to readers interested in irrigation sector policies. For more information contact Jean-Jacques Gabas, COBEA, IUT d'Orsay, BP 127, F91403 Orsay, France. Fax 33 (1) 60 19 33 18. Telephone 33 (1) 69 41 00 40 (ext. 387).

Watershed development increasingly interests our members, especially the development of lower cost technology in which local 'paratechnologists' could be trained. A set of case studies from India, with designs, has been compiled which looks at earthen dams, timber crib dams, tanks and ponds and low cost pipes/hoses. More information on 'Technology for Watershed Development Report and Compendium of Case Studies' can be obtained from K.R. Datye, Centre for Applied Systems Analysis, 'Ganesh Kutir', 1st Floor, 68 Pranthana Samaj Road, Ville Parle (E), Bombay-400 057.

Do you work with **Sprinklers?** A study from the Mount Kenya region of Kenya has surveyed both the use of low pressure sprinklers by farmers, and the responses of local manufacturers to changing markets. The report 'Evaluation of Jua Kali Sprinklers' by the University of Nairobi and the NGO, Terra Nuova, is available from Luca Rosso, Field Coordinator, Terra Nuova, PO Box 74916, Nairobi, Kenya.

3. COMMENTS ON PAST NETWORK PAPERS

Correspondence on Network Paper 18
Crop Based Irrigation in Pakistan: Initial Efforts in the North West Frontier Province
by D J Bandaragoda and Carlos Garces Restrepo

From B. Dan Bithu
Irrigation and Drainage Engineer, 306 Kailashpuri, Bikaner-334 001, Rajasthan
Optimisation of sustained irrigated agricultural production in the arid and semi-arid regions does need a shift from the traditional system of supply oriented irrigation operation to one that is based on realistic crop water requirement. The excellent study on 'Crop based irrigation in Pakistan' is, therefore, greatly appreciated for adaptation in similar arid regions of india.

However, the key issue of the design of Chasma Right Bank Canal (CRBC) to increase the water duty from the traditional value of 3.0 cusecs per 1000 acres to 8.56 cusecs per 1000 acres is something which we, in western Thar Desert, India have not found suitable. We, on the other hand, have decided to reduce the earlier approved duty of 5.23 cusecs per 1000 acres to 3.0 cusecs per 1000 acres to minimise deep percolation losses of irrigation water in the aeolian wind blown fine sands, and to control gradual moisture build up over the geological barrier in the moderate to shallow substratum. The subsoil moisture build up computation justifies reduction of water allowance from 5.23 to 3.0 cusecs per 1000 acres in the sandy tracts of western Thar Desert India (Bithu, 1993).

References

Bithu, B.D. *Conservation Irrigation Practices in Deep and Shallow Aeolian Sands.* CBIP Conference, India. January 1993.

Reply from Carlos Garces

We have read with interest Mr Bithu's comments to our paper, and we would like to respond as follows:

A water allocation of 3 cusecs per 1000 acres cannot meet the crop water requirements under the CRBC system environment; this has been proven in Pakistan under various settings and is in fact the main reason for the increased allocations. That allocation has invariably resulted in very low yields. We are aware that increases in allocations can bring about other problems.

Stage I of CRBC is already experiencing rising water tables. However, our research has documented that the area is being provided even higher water allocations than the intended 8.56 cusecs per 1000 acres. Tile drains are currently being installed at selected problematic areas but we recognise that this measure is not feasible (mainly for economic considerations) at all levels. Thus, a balance needs to be achieved between increased supplies and the increase in drainage needs. The fact that deliveries have been higher than those intended does not allow at this point to determine in a precise manner the effect of the design allocation. We should also keep in mind that soils at CRBC are quite different from those of Thar Desert, with the former having much higher water holding capacities.

Finally, we should be reminded that CRBC's actual cropping intensity is now 130% and increasing (not mentioned for Thar Desert) and that crop yields (wheat and rice) are currently above provincial levels (2,1 and 3.0 ton/ha respectively) although short of projections. Thus higher allocations are having an impact at a macro-level. The long-term environmental concerns must be assessed and addressed fully, of course.

Further replies from B. Dan Bithu
I have received valuable views of Mr Carlos Garces on my comments on the paper Crop Based Irrigation in Pakistan. I beg to further say as under:

It is true that water allowance is closely related to the cropping pattern and the crop water requirement. With increased water allowance for the high water consuming crops, the initial gains are higher, but the long term benefits, after internalising the resource degradation cost in the economics of irrigated crop production, are lower. In our head reach areas in stage I of the Indira Gandhi Naher project the higher water allowance (5.23 or even 7-8 Cusecs per thousand acres) in the initial two to three decades did result in higher production and higher crop yields. But it has now ultimately created an alarming waterlogging and soil salinity problem, which under the complex geopolitical situation is prohibitively costly and economically unaffordable in some cases. Here also mere reduction of water allowance or deficit irrigation does not allow flushing down of the salts and because of the seasonal increase in soil salinity the farmers are unable to grow crops, or the yields are low. This is why in our area the farmers also object to reduction in water allowance and prefer the status quo. However, the post-problem, long-term sustainable and profitable crop production requires drainage followed by low water application attuned to diversified crop water need and soil drainage. In the new areas in Stage II, low water application for diversified arid land crops consistent with crop ET and soil drainage would optimise and sustain production, minimising or distancing the future waterlogging and soil salinity problem.

Thus in the Stage I area the likely solution of the problem lies in drainage followed by frugal water application for low water consuming diversified crops. We may safeguard the new areas in Stage II area through low water application for low water-consuming diversified crops simultaneously using micro catchment water harvesting systems so as to optimally distance the difficult and costly drainage problem. It has been studied that initial higher production with higher water application followed sooner by the costly drainage situation (waterlogging and soil salinity) is less economical and has much lower cost-benefit ratio than protectively irrigated crops integrated with livestock, sheep and camel farming with almost zero future drainage cost using frugal irrigation aided by the micro-catchment water-harvesting

(MCWH) and soil trap techniques. The increase in water allowance does bring about other problems which may be very costly or infeasible to solve. The balance between increased water supplies and increased drainage cost may favour and tilt the balance towards frugal irrigation water use and low drainage cost.

Our soils are predominantly sandy with geological barriers at varying depths, but even the heavier soils need costlier future drainage (subsoil tile drains) and therefore more frugal use of water, sufficient to leach down salts and to keep secondary soil salination under control.

The water table build up over the geological barrier is more related to the higher water application than to the higher cropping intensity. In some of our stage I areas cropping intensity is as high as 150 to 170 percent but these areas are worse hit. The higher irrigation water allocation impact at micro and macro level, therefore needs to be balanced and judged against the higher future drainage cost and decreased production in the long run. The resource degradation and environmental pollution costs should be internalised in the economics of irrigated crop production.

Correspondence on Network Paper 20

The Command Area Development Programme in India: A policy perspective by Dr M V K Sivamohan and Mr C A Scott

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From Rakesh Hooja, Area Development Commissioner, CAD - Indira Gandhi Canal Project, Bikaner

Sivamohan and Scott (1992) have rightly pointed out that India's Command Area Development (CAD) concept is unique, aiming to integrate a very wide range of development, sectoral and functional components still thought by many to be unrelated to irrigated agriculture. Their analysis of the reasons why CAD was initiated in 1974 - concern for under-utilisation of irrigation potential, a change in the concept of irrigated agriculture, recognition of the need for infrastructure development below the outlet level, and concern for distributive justice - is unexceptionable and their summary of subsequent shifts in CAD policy is perceptive.

However, by only listing the components recommended by the National Commission on Agriculture in 1974, and not considering several subsequent reviews, I feel they have not managed to explain the rationale of all the changes, or the interplay of different forces, and ended up conveying an incomplete impression to the reader of the mosaic of differing CAD experiences in India.

It is not true that CAD merely became a part of either the agriculture or the irrigation department in every Indian state, thus neglecting one or the other aspect. Some states, such as Rajasthan, did set up integrated and separate organisations with seconded officers. It is correct that tensions between people from different departments exist, that attempts at integration face major difficulty and that no workable solutions have so far been found for unsatisfactory mains system operations or for the lack of success of farmers organisations. However, I feel prospects for improvement exist and have been considered by more recent workshops and policy meetings. The change from comprehensive On Farm Development (OFD) to concentration on construction on field channels and *waribandi* did occur, but the comprehensive area development approach was never abandoned by government. The conclusions of Sivamohan and Scott that the policy thrust developed in the earlier years have been more or less lost in all the states is perhaps partially true only for some states.

The Task Force 1990 was set up as a result of recommendations from a National Workshop on CAD held in February 1988. This workshop highlighted many inadequacies of the CAD programme, and suggested a number of actions, including rebalancing and revising some activities. The Workshop also recommended that removal of uncertainty in the supply of irrigation water be treated as the core element in the CAD programme.

The Task Force 1990 reminds us that "When the CAD programme was initiated in 1973-74 the main objective was to increase agricultural production in irrigated areas. Agricultural productivity was sought to be maximised by bridging the gap between creation of irrigation potential and its utilisation together with efficient management of irrigation water, soil and various inputs, provision of extension and credit facilities, scientific crop planning etc. However, this has not happened primarily due to organisational deficiencies". The report goes on to state "this task force feels that the concept of CAD Programme is a very well conceived one and it is as relevant today as it was at the time of its introduction. The primary objective of the Programme can, therefore, be said to be the optimisation of production in irrigated agriculture through a multi disciplinary, integrated and well coordinated approach to development of the Command Area".

The functions of CADA recommended by the Task Force 1990 also include construction and maintenance of main and link drains, modernisation of the main and distribution irrigation system, developing solutions for the ill effects of irrigation on environment, and the marketing and processing of agricultural produce and establishment of agro-based industries.

The September 1992 Irrigation Ministers conference also mooted the idea of Command Area Management to supplement CAD thus re-emphasising that CAD should not focus merely on engineering construction activities but also on management of resources.

Further debates about the objectives of CAD are given in Kathpalia (1989), Hooja (1991) and Jayaraman *et al* (1982). The activities which should be performed by a CADA have been discussed by Pande (1976), Sarupria (1977), Hooja (1991) and are being further refined by the author.

Various studies, including the 1990 Task Force have all commented favourably on the CADA set up in the Indira Gandhi Canal Project (formerly Rajasthan Canal) as incorporating all the objectives of CAD laid down by the Central Government with all relevant functions under the direct control of the CAD authority and linkages established with CADA through the budgetary process. Here (Hooja, 1992) the Area Development Commissioner (ADC) has been delegated powers equivalent to Chief Engineer in the Irrigation, Groundwater and Public Health Engineering Departments, and equivalent to Director or Commissioner from the various divisions of the Agricultural Department, Town Planning and Colonisation and even District Collectors. The Area Development Commission directly administers a wide range of tasks in remaining construction, operations, maintenance and regulation of canals; agricultural research, extension and training, project monitoring and data collection; regional planning and district development including settler support. Each state government department seconds its staff to the CAD set up where they work directly under the ADC as part of one organisation. Thus the CAD set up corresponds to what Jayaraman *et al* (1982) had called a new concept in rural development strategy where instead of separate departments, each having its own autonomy, the new strategy is an administrative unit based on natural resource activity that cuts across the usual administrative boundaries.

There have been problems of resistance and rivalries and the comments of Jayaraman *et al* (1982) for non-integrated CADAs that "much of the CADA commissioners time is wasted because of the ....time consuming procedures needed to attain coordination ... often the personal appeals of the commissioner to all units and his very senior status are the only means for achieving coordination" is partially applicable even for Rajasthan's integrated CADA set-up.

The IDS study (1990) has also indirectly referred to this problem when they mentioned the frequent recourse to meetings. However, the longer an integrated CAD set up remains in existence, the less the likelihood is of such intra-disciplinary tensions, and excessive display of loyalty towards the parent department continuing. More disturbing is the failure of even the best CAD organisations to evoke much farmers participation except in some rare instances. Partly this may be because as Chambers (1977) said "to a remarkable degree, many writers on irrigation ignore and even appear to be unaware of the relationship between people and irrigation water. Attention is usually fixed on hydrological, engineering, agricultural and economic aspects. Especially in official documents it is rare to find described, let alone analysed, the human side of the organisation and operation of irrigation systems. The management of those who manage water, the procedures of allocation of water to groups or individuals, and the distribution of water within groups. There may be almost as many instances of those omissions as there are reports on irrigation". (To Chambers' list we may add that analysis of farmers likely behaviour in varying circumstances also fails to find place in reports regarding CAD and irrigation). Hence efforts to involve farmers in water management are like groping in the dark, due to insufficient knowledge and understanding.

However, Sivamohan and Scott are correct in their assertion that water shortages (and also, in this writers view, uncertainty) due to main system operations lead to conflict, "erosion of communal ethics" and breakdown of farmers' associations. Here the argument repeatedly being set forth by Freeman (Freeman, 1992 and Freeman & Lowdermilk, 1991) is that main irrigation system requirements, knowledge and attitudes and environment differ drastically from those at the farm or outlet level, and that a middle level agency to function as an interface between the central irrigation system and the farmer/water user is an immediate objective - a middle level organisation whose short term goals, working, and administrative style would differ both from those of the central main line agency and from those of the farmers within the outlet command is likely to prove effective.

Perhaps initially this middle level wing could be a governmental organisation within CAD, which would also continue to perform the main line central agency tasks through a separate wing of CAD, and gradually the middle level organisation which would thin interact better with a grass roots farmers' association. Such organisational reform has not yet been contemplated in India's CAD approach. None the less, we should not forget that farmers' organisation is not a panacea and the costs involved may not be worth it (Parlin and Lusk, 1988) and that there is a need to achieve a fit between irrigation organisations and the technology in both type and scale.

However, despite the differences between states in the extent to which the CAD approach is applied, and to which the CAD organisation is integrated into a unified and comprehensive set up, the fact that a CAD approach exists - one that envisages interdisciplinary effort and a unified career structure for integrated and comprehensive area development based on water management using the skills, orientations and methodologies of all relevant disciplines - itself provides hope for the future of water management in India.

Editor's Note: this is a shortened article from the original paper sent to us. Let me know if you would like to recieve the original.

Do you think a special areal management authority works better than a project cell within a sectoral agency? Why do you think there are dfferences in performance? Do you agree that a 'middle level' organisation is necessary to link irrigators and operators, or do you think that such 'interface' problems can be resolved by farmers' groups or agency-appointed water guards, as happens in some large schemes? We would like to hear your views.

References

Chambers, R. (1977) *Men and Water: the organisation and operation of irrigation.* In B.H. Farmer (ed) Technology and change in rice growing areas of Tamil Nadu and Sri Lanka. Westview Press.

Freeman, D.M. (1991) *Designing the Organisational Interfaces between Users and Agencies.* In B.W. Parlin and M.W. Lusk (ed) Farmer Participation and Irrigation Organisations. Westview Press.

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Jayaraman, T.K.; Lowdermilk, M.K. and Clyma, W. (1982) *Command Area Development Authorities for Improved Water Management*. Water Management Synthesis Report No.8. Colorado State University & Utah State University.

Pande, V. (1976) *Planning and Implementation of Command Area Development*. In Command Area Development Training Seminar for Chambal Project Personnel. HCMSIPA.

Parlin, B.W. and Lusk,.M.W. (1988) *International Irrigation Development - factors affecting project success*. In Society and Natural Resources Vol.1, No.2.

From B. Dan Bithu
Irrigation and Drainage Engineer, 306 Kailashpuri, Bikaner-334 001, Rajasthan

The background and synthesis of Command Area Development (CAD) programme in India have been nicely described. The well thought out CAD programme has been very useful in effective utilisation of the irrigation potential created after the canal construction. But this programme also needs continuing upgrading and adaptation to the specific soil, climate, natural vegetation, and social situation of the region. Charting the role and direction of the CAD programme requires considerable agro-technical and managerial skill. A holistic and context dependent approach using the right mix of the goods and services is needed. Piecemeal treatment in isolation does not work.

For example, in Indira Gandhi Nahar Project, in Western Thar Desert, India a field water course lining programme without the supportive field grading or improved (overhead) irrigation practice marginalises the benefits of the CAD programme as shown below.

Considering field application efficiency of the ungraded fields to be about 30 percent and water loss in an unlined and tile lined field water course as 10.0 and 3.5 percent respectively, the total water lost in unlined and lined water courses of 2.0 cusecs discharge are:

a) Unlined water course

i)	conveyance loss water course	0.20 cusecs
ii)	field loss	1.26 cusecs
	TOTAL	1.46 cusecs

b) Lined water course

i)	water course loss	0.07 cusecs
ii)	field loss	1.35 cusecs
	TOTAL	1.42 cusecs

It shows that water course lining alone without field grading or improved irrigation practice had total water loss almost similar to that of an unlined water course. Our field experience of over 15 years of CAD programme in the Indira Gandhi Canal Project, in Western Thar Desert, India has shown that the context-independent paradigm and models covering the CAD (OFD) programme have degraded the field hardware system. Only programmes that are appropriately adapted to the specific soil, climate, natural vegetation and cultural specifities of the local people of the region work better than off the shelf programmes.

Also CAD programmes should not only cover irrigated agricultural production alone, but due attention should be given to sustainable biotechnological social land use options using protective supplemental irrigation integrated with livestock farming aided by micro-catchment water harvesting system. Site-specific appropriate CAD technology suiting the soil, climate, biotic wealth and social situation should be adopted instead of a conventional CAD programme.

4. PUBLICATIONS RECEIVED

Norman, W.R. and Walter, M.F. 1993 *Government Sponsored Irrigation in Smalls-scale Irrigation Systems in Niger.* Winrock International Institute for Agricultural Development, Route 3, Box 376, Morritton, Arkansas 72110-9537, USA.

This study of the Moullela system shows the changes made by farmers and government to create a well-managed, productive system at odds with the frequent stories of poor irrigation performance in the Sahel. The committment of the director to achieve production objectives seems critical to farmer satisfaction. In larger schemes, while personnel are often better paid, they concentrate effort on reducing general management headaches and workloads.

Norman, W.R. (1992) *A Field Manual for Water Lifting and Management in Small-Scale Irrigation Systems in Niger.* Winrock International Institute for Agricultural Development, Route 3, Box 376, Morritton, Arkansas 72110-9537, USA.

This manual has been developed primarily for small-scale irrigated "microsystems," which are usually characterized as single-source/single-user systems. It is targeted primarily at extension and agricultural service agents, and PVO/NGO personnel, who are involved in the development, design, study, or evaluation of small-scale irrigated production in Niger. The book attempts to provide practical information on technical aspects of small-scale irrigation that has otherwise been lacking or unavailable to field-level personnel. The manual gives information in French and English.

Adams, W.M. (1992) *Wasting the rain: Rivers, people and planning in Africa.* Earthscan Publications Ltd, London.

Africa's river valleys have been important targets for rural development planners. Most major African rivers have been dammed, some several times, and irrigation schemes have been built in many floodplains. There have been some successes among these schemes, but also many failures. Their planners, of course, have mostly gone home. The projects remain behind, and their benefits are enjoyed - or their impacts are endured - by the rural people who were caught up in their development. It is this intervention to develop Africa's water resources, and the persistence of the mentality that gives rise to grands schemes and sweeping environmental transformation, that form the subject of this book. Mistakes are common in development in Africa, and this book tries to analyse them. It seeks to do so constructively, and in a spirit of shared learning.

Tauer, W. and Humborg, G. (1993) *Runoff Irrigation in the Sahel Zone* Verlag Josef Margraf, PO Box 105, 6692 Weikersheim, FR Germany. 25$.

Scarcity of water, and how to identify potential areas for runoff irrigation systems is the theme of this book. It focuses particularly on remote sensing and GIS assessment techniques, and includes a special case study of the northern Kayes region of Mali.

Hailu, Z. and Runge-Metzger (1993) *Sustainability of Land Use Systems.* Vertag Josef Margraf, PO Box 105, 6692 Weikersheim, FR Germany. 25$.

Soil productivity in Sub-Saharan Africa, particularly indigenous measures to maintain productivity, is fundamental to sustainable agriculture on this continent. This book reviews approaches to the assessment of the sustainability of current land use practices, and sets up a research programme design to assess the sustainability of agriculture.

Seckler, D.; Gollin, D. and Antoine, P. *Agricultural Potential of Mid-Africa: A Technological Assessment.* Winrock International Institute for Agricultural Development, Centre for Economic Policy Studies. Discussion Paper No.5 July 1992. Winrock International, 1611 N Kent Street, Suite 600, Arlington, VA 22209, USA.

Conflicting statistics and conflicting views on irrigation and irrigation policies form the starting point of this review. The debates of the authors try to assess the options for policy reform from this debate.

Diemer, G. and Huibers, F.P (1991) *Gestion paysanne de l'irrigation dans la vallée du fleuve Sénégal: implications pour la conception des aménagements hydro-agricoles* Rapport de fin de project, ADRAO/Université Agronomique Wageningen, Project Gestion de l'eau. Saint-Louis et Wageningen.

Irrigation interventions in the Senegal valley have had a variable record, as a result of inappropriate designs and inappropriate expectations of farmers. This report discusses the events, experiences and impacts of dam developments, and subsequent programmes to support irrigation at village level. The report makes a strong case for social and technical aspects to be better integrated in the design and implementation of water programmes.

Raunet, M. (ed.) *Bas-fonds et riziculture* Actes de séminaire d'Antananarivo, Madagascar 9-14 December 1991. CIRAD: Montpellier, France

The proceedings of the 1991 Antananarivo seminar in Madagascar have now been collated. Some forty papers are presented together with seminar discussion, and look at environmental aspects of 'bas-fonds', the social and economic factors influencing their organisation and use and prospects for improving production. While the majority of papers are from Madagascar, there are also papers from Mali, Burkina Faso, Senegal, Guinée, the Comores, Rwanda, Burundi and China. The papers form a unique and important collection of work for rice production in flooded depressions and small valleys.

Crousse, B.; Mathieu, P.; Seck, S.M. (eds.) (1991) *La Vallée du fleuve Sénégal: Évaluations et perspectives d'une décennie d'aménagements.* Karthala: Paris.

This collection of papers provides a broad overview of the changing economic and social conditions in the Senegal valley, and the countries neighbouring it. In addition to examining the impact of water regulation on irrigation, papers look at the economic history of the valley upto 1990, at economic planning and development in Senegal and Mauritania and the effects of financial reform policies on national economies and state disengagement on farmers. They consider the prospects for the valley farmers and the regional economies to recover from the mistakes and conflicts of the last twenty years.

Chuzeville, B. (1990) *Hydrogologie Tropicale et appliquée en Afrique Subsaharienne* Collection Maîtruse de l'eau. Ministère de la coopération et du développment. Agridoc International: Paris.

This book presents a range of techniques useful for the assessment of rainfall and runoff which are clearly illustrated by examples using African data. It should be a very useful teaching tool for Francophone readers. To obtain copies write to Geneviève Leprince, Director du Centre Documentation, Information de BDPA-SCETAGRI, 27 Rue Louis-Vicat, 75738 Parix CEDEX 15, France.

Jaim. W.M.H. (1993) *Can potential capacity of deep tubewells be utilized? - a study in Bogra region of Northest Bangladesh with special reference to compacted earth channel.* Human Resource Development Program: Winrock International, Dhaka, Bangladesh.

Given the continued growth in Bangladesh's population there is a strong need for sustainable increases in food production. There is significant potential in some regions for further expansion of irrigation, particularly of minor irrigation utilizing shallow tubewells (STW) and deep tube wells (DTW). At the same time, the area actually cultivated with many existing tubewells is considerably smaller than the reputed command areas of those wells. This report addresses various aspects of deep tubewell capacity utilisation in the Bogra region of northwestern Bangladesh, with particular attention to compacted earth channels and socio-economic constraints to thier adoption.

Dhawan, B.D. (1993) *Trends and New Tendencies in Indian Irrigated Agriculture.* Institute of Economic Growth. Studies in Economic Development and Planning No.58. Commonwealth Publishers, New Delhi, India.

The Eighth Five Year Plan once again accords a key role to irrigation development in the overall agricultural strategy. The public sector outlays alone for the irrigation sector in this Plan are around Rs. 32,500 crores. As a result, new irrigation capacity of the order of 16 million hectares is anticipated by 1996-97. This book focuses on some salient trends and some note-worthy new tendencies in Indian irrigation/irrigated agriculture. Its coverage includes trends in irrigated yield and the impact of irrigation on foodgrains production and employment; sprinkler and drip irrigation; conjunctive water use; and several chapters on groundwater irrigation and groundwater markets.

Eaton, D.J. (ed.) *The Ganges-Brahmaputra Basin: Water resource cooperation between Nepal, India and Bangladesh.* Lyndon B. Johnson School of Public Affairs, The University of Texas, Austin. 1992.

Harnessing these three rivers is both a dream and an imperative for these three countries. Do the recent changes in South Asian politics offer any new options for either sustainable or cooperative development? This book has six papers looking at the problems of water resource policies within these countries as well as between them, with two papers looking at interstate cooperation in Australia.

Jarman, H. and Scrivener, B. (eds) (1992) *Sardar Sarovar: The Report of the Independent Review.* Resources Futures International Inc.: Ottowa, Canada.

This meticulous study of the history of the planning and construction of the Sardar Sarovar project on the Narmada river should be compulsory reading for all those involved in large-scale water projects. This independent study shows how both the World Bank and India failed to carry out adequate assessments of the human impact of dam and canal projects, causing misunderstanding of the scale of resettlement problems. It documents the disparities between the policies of different states involved, and the failings of the World Bank to meet its own operating principles. It ends with some thoughtful insights into lessons learned and points which have to be addressed by all parties to rebuild confidence.

Thukral, E.G. (ed.) (1992) *Big Dams Displaced People: rivers of sorrow, rivers of change.* Sage Publications: New Delhi, India.

This collection of papers looks at resettlement issues linked to a number of dams in India (Pong, Ukai, Hirakud, Baliraja), and their implications for both rehabilitation policies and the evaluation of irrigation projects.

Campbell, D.E. *Key factors and problems in the design and operation of internationally assisted small-holder irrigation in South Asia.* June 1992

This summary of irrigation experiences in South Asia is aimed at professional staff engaged in international development and national staff. It deals particularly with situations where the technology and the small-holder appear to be in conflict. It ranges over design, construction, operation and rehabilitation issues, for both surface, groundwater and conjunctive use. To obtain a copy write to Donald E. Campbell, Consultant, ANATECH Research Group, PO Box 9165, La Jolla, California 92038, USA.

Tyagi, N.K.; Kamra, S.K.; Minhas, P.S. and Singh, N.T. *Sustainable Irrigation in Saline Environments.* Papers from the National Workshop on Sustainable Irrigation, Central Soil Salinity Research Institute, Karnal, India, February 1993.

Developments in research are reported on crop responses and salinity models, together with reviews on feasibility studies for joint use of different quality waters, monitoring of salinity conditions and the management of irrigation in saline environments. To obtain a copy, write to the editors at The Central Soil Salinity Research Institute, Karnal-132 001, India.

Svendsen, M. *Assessing effects of policy change on Philippine irrigation performance.* Working papers on irrigation performance 2: December 1992. International Food Policy Research Institute.

Irrigation performance concerns many network members. This concise practical assessment of schemes in the Philippines might help many readers who find some of the theoretical literature somewhat abstract. From the results, the author is not only able to raise issues about the adequacy, equity and efficiency of schemes, but also to examine the impact of management changes in irrigation administration. To obtain a copy write to the authors at IFPRI, 1200 Seventeenth Street, N.W., Washington, D.C.20036-3006, USA.

Thanh, N.C. and Biswas, A.K. (eds.) *Environmentally-sound water management*. Oxford University Press, Delhi. 1990.

Teaching about experiences in water development and management, and discussion of how to improve them, is one of the most important means to sustainable water development and use. This publication aims to provide a useful book for training through 9 papers which examine both conceptual issues and decision-making examples, including a chapter of the impacts of the Asian High dam which should be useful for anyone interested in river basin planning. The book has been developed by CEFIGRE, UNEP and INWRA.

Blomquist, W. (1992) *Dividing the Waters: Governing groundwater in Southern California*. ICS Press, San Francisco, California, USA.

This book examines the evolution of successful public policy. It explains how California water users were able to protect and allocate underground water supplies despite rapidly growing demand for scarce water resources. It demonstrates how people who are self-governing can solve complex and important environmental problems without the need for centralised direction - in this case, a "water czar" or statewide bureaucracy. All that is required, along with will, effort, and creativity is an enabling institutional environment. This book thus points out the fallacies underlying the views of public policy advocates and environmental activists who believe that central direction and control are required to cope with today's environmental challenges.

Eaton D.J. and Hurlbut D. (1992) *Challenges in the binational management of water resources in the Rio Grande/Rio Bravo*. US Mexican Policy Studies Program Policy Report No.2. Lyndon B Johnson School of Public Affairs, The University of Texas at Austin, USA.

This monograph examines emerging water conflicts along the Texas-Mexico border, describes current efforts to resolve them, and identify possible solutions. It is optimistic in tone, perceiving realistic alternatives for existing surface water, groundwater, and water quality problems. But the solutions require money, significant institutional change, and modifications of behaviour of people in the region.

Gandarillas, H.; Salazar, L.; Sánchez, L.; Sánchez, L. C.; de Zutter, P. *Dios da el Agua. Que Hacen los Proyectos?* (God gives water, What do projects do?). Cochabamba, Bolivia: Hisbol/PRIV

With God giving water, and farmers looking after it, what is the role of external agents who intervene in rural life? This evaluation of the PRIV project in Cochabamba, Bolivia (El Projects de Riego Inter-Valles) documents how a project has redefined its role from being a benefactor providing water for needy farmers to a service providing assistance to farmers as required. This project, which rehabilitated and extended existing systems, made several early mistakes. Staff had to reassess their role, to learn how to interpret the history of rights, institutions and values presented to them, and how to reconcile these with requirements for current and future conditions. The dialogue has been built by mutual respect from both sides. The book gives no models or ideas to replicate, but presents many valuable insights and experiences.

SAWA Consultants (1993) *Gender and Irrigation: a manual for the planning and assessment of small-scale irrigation projects.*

This succinct and clearly-written report tackles the issue of integrating effective gender studies in irrigation development and management. It not only links insights from gender studies with the different technological requirements of various irrigated farming systems. It also looks at gender issues raised by different objectives in promoting or intensifying irrigation, especially in increasing equity for women rather than simply household survival or productivity. Their checklist of gender aspects to study in irrigation projects should be read by all field practitioners. It will raise an appreciation of dilemmas even if not all can be achieved easily.

Available through Sonia Vlaar, SAWA Consultants, Beukenlaan 2B, 6711 NH Ede, The Netherlands.

Verkruijsse, B.; Jordans, E.H.; Webbink, J.F.; Zwarteveen, M.Z. and van Koppen, B.C.M. (199) *Annotated Bibliography: Gender and Irrigation and Soil and Water Conservation.* Department of Gender Studies in Agriculture, Wageningen Agricultural University: Wageningen, The Netherlands.

This bibliography contains over 400 references to work undertaken since 1975. Entries on irrigation highlight the role of women in farmer-managed irrigated agriculture and the impacts of irrigation projects for women. Entries on soil and water conservation focus on the effects of land degradation for women, the impacts of technical interventions on them, and the experience of women's involvement in the implementation of projects.

To obtain this write to: Ms Dineke Wemmen, Department of Irrigation and Soil and Water Conservation in Wageningen Agricultural University, Nieuwe Kanaal II, 6709 PA Wageningen, The Netherlands.

5. SHORT REPORTS AND ARTICLES RECEIVED

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6. TRAINING COURSES

The *5th Annual Compendium of International Short Courses, Workshops and Conferences in Irrigation Management and Related Subjects* has been prepared by Louis Berger International Inc and Water and Power Consultancy Services (India) Ltd. This fifth annual compendium is produced as an aid in selecting and arranging international training in water resources management and related topics. For more information contact: Mr Tom Kajer, Winrock Training Specialist, LBII/WAPCOS, 213 Ansal Chambers II, 6 Bhikaji Cama Place, New Delhi 110066, India.

CEFIGRE organise courses in French and English, which will be of interest to engineers, water management and environmental protection executives. CEFIGRE is conducting these activities mainly in the fields of water resources, urban water supply and sanitation, rural development (water, sanitation, irrigation), environmental management, and institutional development. Countries hosting their courses include Thailand, Cote D'Ivoire, Burkina Faso, Niger, Cameroon and France. Write to CEFIGRE, Sophia Antipolis, BP 113, 06560 Valbonne Cedex, France.

The American Water Foundation will be holding short training seminars during 1993, including programmes on Environmental Management of Water Resources Projects (August) and Operation, Maintenance and Management of Irrigation and Drainage Projects. For more information contact them at 1616 17th Street, Denver, Colorado 80202, USA. Telephone: 303 628 5516. Fax: 303 628 5469

The University of Southampton, UK offers a range of MSc courses in irrigation, water supply and engineering. However, they are also offering the following short courses which may be of interest.

Computer Applications in Irrigation: 10 January - 4 February 1994
Development and the Environment September 1993
Effective Irrigation Management 27 September - 15 October

For information write to the Course Administrator, Institute of Irrigation Studies, Southampton University, Southampton SO9 5NH. Fax 0703 677519

7. FUTURE CONFERENCES AND WORKSHOPS

13-15 July 1993. **Water: The Lifeblood of Africa.** Symposium on water and river management for developing countries. Contact: *Professor D. Stephenson, c/o Water Systems Research Group, Private Bag 3, WITS 2050, South Africa. Fax: +27 7172560*

1-6 August 1993. **International Conference on Rain Water Catchment Systems, Nairobi, Kenya.** *John Mbugua, PO Box 56, Nakuru, Kenya. Fax: +254 27 16255/37 44379.*

20-3 September 1993. **First Southern Africa Water and Wastewater Conference, Johannesburg, South Africa.** *Tracy Nolan, First Southern Africa Water and Wastewater Conference, 212 Molyneaux Road, Liverpool, L6 6AW, UK. Fax: +44 51 260 4097.*

8-11 November 1993. **International Conference on Environmentally Sound Water Resources Utilization, Bangkok, Thailand.** Contact: *Professor Tawatchai Tingsanchali, Division of Water Resources Engineering, Asian Institute of Tehcnology, Bangkok, 10501, Thailand. Fax: +66 2 5162126.*

29 January-1 February 1994. **The Nile 2000 Conference: Comprehensive Water Resources Development of the Nile Basin: The Vision Ahead, Khartoum, Sudan.** Contact: *The Secretariat, Nile 2002 Conference. The Hydraulic Research Station, PO Box 318, Medani, Sudan.*

1-3 February 1994. **International Conference on Groundwater - Drought, Pollution and Management, Brighton, UK.** *Jacqueline Watts, H R Wallingford Ltd., Howbery Park, Wallingford, Oxon OX10 8BA, UK. Fax: +44 491 32233.*

12-15 April 1994. **International Scientific and Tehcnical Colloquium, Marseilles, France.** Part of 'HYDROTOP '94'. Papers are invited on the main subject areas of: institutional aspects of water management, progress in technical management, and better resource management. Find out more from: *Mr Paul-Henri Roux, HYDROTOP, 314 Avenue du Prado, 13008 Marseille, France. Fax: +33 (91) 22 71 71.*

21-25 November 1994. **Systems-Oriented Research in Agriculture and Rural Development, Montpellier, France.** Contact: *Jacques Faye & Michel Dulcire, International Symposium, Systems-Oriented Research and Rural Development, BP 5035, 34032 Montpellier, France.*

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IRRIGATION MANAGEMENT NETWORK

THE GOVERNANCE AND MANAGEMENT OF IRRIGATION SYSTEMS
An institutional perspective

Shui Yan Tang and Elinor Ostrom

Network Paper 23

June 1993

Network papers in this set:

Newsletter June 1993

23 *The Governance and Management of Irrigation Systems: An Institutional Perspective* by Shui Yan Tang and Elinor Ostrom

24 *Increasing Women's Benefits for Irrigation Development: Smallholder Irrigation in the Kano Plains, Kenya* by Joitske Hulsebosch and Barbara van Koppen

25 *Urban Irrigation and Cooperative Organisations in Addis Ababa, Ethiopia* by Axumite G. Egziabher

26 *Farmer Organisations for Lift Irrigation: Irrigation Companies and Tubewell Cooperatives of Gujarat* by Tushaar Shah and Saumindra Bhattacharya

27 *Poverty in Irrigated Settlements: A discussion paper and replies from Network members*

Please send comments on this paper to the author or to:

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THE GOVERNANCE AND MANAGEMENT OF IRRIGATION SYSTEMS: AN INSTITUTIONAL PERSPECTIVE

by

Shui Yan Tang[1] and Elinor Ostrom[2]

Contents | **page**

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THE GOVERNANCE AND MANAGEMENT OF IRRIGATION SYSTEMS: AN INSTITUTIONAL PERSPECTIVE

by

Shui Yan Tang and Elinor Ostrom

Introduction

During the past three decades, massive resources have been invested by donor agencies and developing countries in technologically sophisticated, large-scale irrigation projects. Even though the planning processes for these projects rely on modern benefit-cost analysis, many projects that looked outstanding on paper have not fared well "on the ground." Costs have usually been higher than expected, and benefits have been lower. Cost recovery has often not proved feasible.

Widespread recognition of these failures has led to repeated calls for farmers' participation in the management of irrigation projects (Cernea, 1985; Asian Development Bank, 1973; Uphoff, 1986). Our own theoretical and empirical work leads us to agree with the recommendations to involve farmers in the day-to-day management of irrigation systems (E. Ostrom, Shroeder and Wynne, 1993). Our prior work also leads us to argue that "participation in management is not enough." In addition to participation in the management of irrigation systems, farmers have an important role to play in the governance of these systems.

By governance of an irrigation system we refer to the establishment of specific working rules used to allocate water, to assign responsibilities for labor and monetary resource mobilization, to resolve conflicts, to record certain information and to make that information public, to select and pay officials and workers, and to sanction non-conformance with these rules. Governance processes involve the crafting of rules as well as the choosing of officials to make day-to-day policy and operational decisions. Management involves individuals making decisions at the operational level, within constraints set by governance structures. Since operational decisions are made within constraints defined by governance structures, management will be ineffective unless well-designed governance structures are in place. A governance structure will be ineffective unless it helps participants formulate rules that meet the needs of farmers, detect and sanction rule violations, and hold officials accountable for their performance.

Efforts to involve farmer participation have frequently produced disappointing results because government officials have not understood the importance of farmers' roles in governance itself. Developing farmer organizations have too often consisted of central officials designing the "blueprint" for how farmers will organize themselves. In some projects, officials have ignored preexisting irrigation associations and have recognized only the farmer organizations they mandated. In other projects where efforts have been made to organize farmers, farmers meet and elect the officials they are requested to elect, but any further organization is thwarted. The failure of these projects to achieve predicted benefits is blamed on the farmers themselves rather than on engineering design or on the lack of effective institutional development.

Nirmal Sengupta (1991) provides a cogent example of the "misplaced emphasis" of imposing a pre-established organizational form on an already functioning, informal farmers' organization in Tanrwan village served by the Sone canal system in Bihar, India. Prior to the establishment of a Command Area Development Program with an objective of demonstrating the advantages of "on-farm development" (OFD), the farmers living in Tanrwan had already established ways to repair channels twice a year and to patrol the higher reaches of their distributary to prevent illegal diversions of water. Part of the official program was to establish formal irrigation associations. The The Tanrwan Chak Society was created by the Sone Command Area Development Agency in 1978. An outsider examining the formal records would find bylaws that closely follow the 42-clause long Model Bylaws. But the way that farmers in this village regularly relate to the governance and management of the irrigation works on which they depend does not conform in any meaningful way to these bylaws. What is particularly tragic about the Tanrwan Chak Society case described by Sengupta is that the farmers were willing to organize themselves to accomplish several major group projects and in many respects achieved remarkable results. But the farmers were required by the Agency to line 3.1 kilometers of irrigation channel with bricks provided by the agency and to adopt an official rotation system that was not well-suited to their local terrain or soil conditions. The rotation system never worked well given that the officials themselves were not motivated to release water on schedule. Further, illegal diversions made higher in the system generated highly unreliable water deliveries.

The farmers wanted to line the canals in a conservative manner by waiting until the earth had settled. The Agency interpreted the resultant delay as both a lack of cooperation and a potential misuse of the supplies provided. The leader of the Chak Society was later accused of embezzling materials even though no procedures were established for keeping records by the Agency or by the Society. Thus there was no way of establishing who, if anyone, obtained supplies improperly. After several decades of mismatched expectations, the "once enthusiastic organizer, has lost all enthusiasm and has become extremely guarded in his dealings" (Sengupta, 1991: 245). Unresolved conflicts among the farmers have reduced their overall level of cooperation below what it was prior to the creation of the Chak Society[1]. So long as farmer participation is interpreted as supplying needed labor and following the rules laid down by others, similar experiences will occur elsewhere as well. Farmers who are willing to work and cooperate with one another for their mutual benefit will be left worse off after efforts to "organize" them have occurred than before the "help" was offered.

Encouraging farmer participation in the management of irrigation projects will produce poor results unless effective institutional arrangements exist to structure the governance and management processes of irrigation projects. In this article, we discuss the concept of institutions and the distinction between the governance and management processes related to irrigation systems. This distinction enables us to understand ways to integrate effective farmer participation with institutional development. We also examine patterns of institutional arrangements found in an analysis of 47 case studies of irrigation systems from many countries to illustrate the relationships between institutional arrangements and performance of irrigation systems.

Institutions as Rules-In-Use

In the social science literature the term "institution" is used to refer to many concepts. It can refer to a specific organization, such as a particular Department of Irrigation; it can describe certain established human relationships, such as the family; or it can denote the rules that individuals use to order specific relationships with one another. We use the term

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[1] For further debate about Command Area Development Agencies in India and whether these new support initiatives should be state agencies and NGOs and whether they can lead to better performance, see Raja, 1992; Sivamohan and Scott, 1992; comments by Rakesh Hooja and C Dan Bithu in the current Newsletter (June 1993).

"institution" in this last sense: an institution is the rules actually used (rules-in-use or working rules) by a set of individuals to organize repetitive activities that produce outcomes affecting those individuals and potentially affecting others (E. Ostrom, 1990). Hence, an irrigation institution is the set of working rules for supplying and using irrigation water in a particular location.

Working rules are used to determine who is eligible to make decisions in some arena, what actions are allowed or constrained, what procedures must be followed, what information must or must not be provided, and what costs and payoffs will be assigned to individuals as a result of their actions (E. Ostrom, 1986). All rules contain prescriptions that forbid, permit, or require some action or outcome. Working rules are those actually used, monitored, and enforced when individuals make choices in operational or collective-choice settings (Commons, 1957).

Institutions shape the pattern of human interactions and their results. Institutions shape human behavior through their impact on incentives. For instance, rules determining access rights affect the perceived costs various individuals pay for the use of water from an irrigation system. Depending on how well access rights are enforced and penalties imposed for illegal diversions, those without access rights may consider the costs of breaking access rules sufficiently high that they refrain from efforts to take water.

Changes in formal regulations, however, do not automatically change rules-in-use and thus incentives. A new regulation increasing the penalty for stealing water may even produce different changes in incentives than presumed: officials may use the threat of heavy fines to extract bribes from errant farmers. Consequently, the rule-in-use may change so that diversions considered illegal under formal regulations may continue in practice so long as payments are made to corrupt officials. Thus, the incentives facing individuals cannot be determined by reading promulgated laws and regulations without examining how they fit into the physical, economic, and social context of a particular system. To actually use a set of rules, farmers must know these rules, consider them legitimate, and be willing to follow them so long as many others are following them.

Developing Irrigation Institutions

Developing irrigation institutions is a long-term process that requires the investment of resources and extensive trial and error. It often takes years and extensive efforts to develop and eventually to benefit from a set of functioning institutional arrangements. Developing an appropriate set of water allocation rules, for example, requires careful experimentation and fine adjustments. Large government agencies may be able to develop uniform rules that deal with those common problems that are shared by many farmers. Yet a great diversity of working rules is needed to tackle various context-specific problems that occur on specific branches of a large system.

Generating variety in institutional arrangements is important for resolving diverse problems farmers encounter in different locations. This requires considerable investment of time and resources in learning about the effects of various institutional rules on the behavior of participants and the results they can achieve. Thus, the choice of institutions is not a "one-shot" decision in a known environment, but rather an ongoing investment process in an uncertain environment.

When investments of any type are involved, two levels of analysis are required. First, an analyst needs to understand what is happening at an operational level, where individuals attempt to do as well as they can within existing constraints. Second, an analyst needs to consider what options are available to change the existing physical and institutional constraints. Considering these changes is like shifting to a "time-out" during the play of a game to reconsider the rules of the game itself. This type of shift happens when the suppliers of an irrigation project consider installing a new type of control gate or when farmers consider new rules for water allocation.

It is useful to distinguish three layers of rules that cumulatively affect the actions and outcomes achieved in irrigation systems (Kiser and E. Ostrom, 1982).

<u>Operational rules</u> directly affect the day-to-day decisions made by users and suppliers concerning when, where, and how to withdraw water; who should monitor the actions of others and how; what information must be exchanged or withheld; and what rewards or sanctions will be assigned to different combinations of actions and outcomes. The processes of allocating water, clearing canals, and monitoring and sanctioning the actions of irrigators and officials occur at the operational level.

<u>Collective-choice rules</u> indirectly affect operational choices. These are the rules used by irrigators, their officials, or external authorities in making policies - the operational rules - about how an irrigation system should be

managed. Policy-making, management, and adjudication of policy decisions occur at the collective-choice level. A change in "policy" implies a change in operational rules.

Constitutional-choice rules affect operational activities and results through their effect on: (1) who is eligible to participate in the system and (2) what specific rules will be used to craft the set of collective-choice rules, which in turn affect the set of operational rules (V. Ostrom, 1982). Formulation, governance, adjudication, and modification of constitutional decisions occur at the constitutional level. Constitutional choices may be made by many individuals in an ongoing process of learning and constitutional development. Any self-organizing activity is constituted and reconstituted over time as individuals learn more and more about how past rules have operated in practice.

Rules are changed less frequently than the strategies individuals adopt within rules. Changing rules at any layer increases the uncertainty that individuals face in making strategic choices at that level. Rules provide stability of expectations. Efforts to change rules rapidly reduce that stability. Operational rules are usually easier and less costly to change than collective-choice rules.

Different sets of collective-choice rules and different communities of participants may be involved in collective-choice decisions. Depending on attributes such as the size and the number of users of the irrigation system, different collective-choice entities may be constituted to exercise collective-choice prerogatives on behalf of the users and other concerned parties. Some irrigation systems, for example, are governed solely by a national government agency; operational rules may be created, changed, and enforced according to statutes adopted by the national legislature or executive. The collective-choice entity in this case involves not just one specific community of irrigators but also potential irrigators, interest groups, politicians, government officials, and the general public who share an interest in irrigation and other related activities. In other irrigation systems, the relevant entity is constituted primarily by irrigators who adopt and enforce their own collective-choice and operational rules.

Sometimes, a community of irrigators may be following multiple sets of operational rules adopted by different collective-choice entities. For example, irrigators in large irrigation systems are frequently subject to at least two sets of operational rules adopted by two different collective-choice entities - a collective-choice entity at the system level and another at a sub-system level. Collective-choice entities at the sub-system level, constituted by farmers themselves, are important for the effective operation and maintenance of large irrigation systems.

While collective-choice entities at a system level can help solve problems that occur on all units and facilitate adaptation to the specific needs of individual units, collective-choice entities at a sub-system level, however, can maintain their autonomy in relation to water allocation and maintenance within their respective areas. By constituting different levels of collective-choice entities to deal with problems of different scales, many coordination and control problems associated with larger irrigation projects can be avoided.

Crafting Operational Rules for Varying Physical and Social Conditions

If local farmers participate in crafting operational rules, system performance is more likely to be enhanced. One reason for this is the vast variety of physical and social conditions that affect the operation of any particular system. For example, what kinds of water allocation and input rules are the most effective and how these rules should be implemented depend on such specific attributes as the soil type, field topography, cropping pattern, and the amount of water available in the specific irrigated area. Frequent, quick, but non-routine decisions have to be made about water allocation and maintenance in response to such changes as the volume of water flow, climate, and the growth stage of plants. In many large irrigation projects, different watercourses vary in these attributes. If there is only one collective-choice entity to create and enforce a uniform set of operational rules for an entire project, it is unlikely that the resulting rules could serve the needs of all watercourses equally well. Local collective-choice entities at the watercourse level, if properly constituted, are likely to facilitate the utilization of specific time and place information (Hayek, 1948) in formulating and enforcing appropriate operational rules and choices.

Further, irrigators are more likely to have incentives to follow and enforce rules adopted by themselves than those handed down from an outside authority. Irrigators can also mobilize such informal mechanisms as social shunning to enforce their own rules, mechanisms unavailable to any external authority. The need to involve local users in crafting operational rules for varying physical and social conditions can be illustrated by examining the patterns of allocation and input rules found in a sample of 47 irrigation systems from around the world (see Appendix for the research method used).

Illustration I: Allocation Rules and Varying Circumstances
Allocation rules stipulate the procedures and bases for water withdrawal. They are important especially when the supply of water is inadequate to meet the crop requirements of all cultivators simultaneously. If proper allocation rules are adopted and effectively enforced, they can reduce uncertainty and conflict among irrigators. Three types of rules - percentage, fixed time slots, and fixed orders - are frequently used for water allocation:

1. *Fixed percentage*: the flow of water is divided into fixed proportions by some physical device.

2. *Fixed time slots*: each individual is assigned fixed time slots during which he or she may withdraw water.

3. *Fixed orders*: individuals take turns to get water.

Among the three types of procedures, *fixed time slots* are the most commonly used: 22 out of 37 cases use *fixed time slots* as the sole distribution procedure. The other 15 cases use *fixed percentage*, *fixed order*, or a combination of procedures. Assigning irrigators fixed time slots may be an economical way of distributing water. If all irrigators know their own time slots, each shows up and diverts water to his or her own plots from certain outlets when his or her time begins. This arrangement is self-enforcing and requires minimal supervision. Problems arise, however, if the water flow is erratic: an irrigator owning a share for a particular time slot is still uncertain about his or her supply.

Dhabi Minor Watercourse, for example, is located in a government-operated irrigation system where irrigators are assigned time slots in different water distribution cycles within a watercourse (Reidinger, 1980). At the system level, water supplies to various watercourses are determined by yet another water distribution cycle within a watercourse. Because of a lack of coordination between distribution cycles at the two levels, an irrigator assigned a particular time slot may fail to get any water if no water is scheduled to flow into the watercourse during the time. Irrigators in Dhabi Minor Watercourse, therefore, face a high degree of uncertainty about their water supplies, which in turn affects their willingness to cooperate in water allocation and maintenance.

A higher percentage of the cases using fixed time slots as the sole distribution procedure is characterized by problems in rule conformance or maintenance than those using other types or combinations of distribution procedures (see Table 1). Distributing water by fixed time slots may require less administrative costs than other distribution procedures. Serious collective-action problems, however, may arise if the procedure is used

Table 1: Rules-conformance/maintenance by allocation rules

	Fixed time slots as the sole distribution procedure	*Other types or combinations of distribution procedures*	*(Total)*
Positive in both Rule-conformance & maintenance	45% (10)	87% (13)	(23)
Negative in either Rule-conformance or maintenance or both	55% (12)	13% (2)	(14)
(Total)	100% (22)	100% (15)	(37)

Percentage difference = 42%
Chi-Square with continuity correction factor = 6.4
D.F. = 1 $P < 0.05$

Source: Tang (1992). This table is adapted from Table 5.4 in Tang (1992). Some numbers in the original table are inaccurate. The present table has corrected the inaccuracies in the original one.

without considering whether it is compatible with other institutional and physical factors. Within the sample, this kind of incompatibility appears to happen mostly in government owned and operated irrigation systems: seven of the thirteen cases that use fixed time slots as the sole distribution procedure and that have problems in rule conformance or maintenance, are governed and managed by an irrigation agency.

Even within one particular irrigation system, more than one set of allocation rules may be used for different occasions. A more restrictive set of allocation rules, for example, is used during certain periods in a year and a less restrictive set is used during other periods. In some irrigation systems, demands for water may temporarily exceed supplies during dry seasons or some growth stages of the crops. Water allocation rules in these irrigation systems may have to be adjusted in the light of changes in the balance between the supply and demand of water. Within the sample, 19 cases are reported to have two sets of allocation rules. All of them, except one, have more restrictive rules when water is scarce than when water is abundant. In some of them, appropriators are permitted to withdraw water freely during periods when water is abundant; some types of turns or time schedules are used when water gets scarce. In some other cases, officials or monitors begin to exercise discretion in setting up time schedules or turns for water allocation when the supply of water decreases.

Different rules may be adopted to coordinate water allocation under various circumstances. Even holding all other conditions constant and allowing only changes in water supplies, as within any one watercourse, allocation rules have to be adjusted from time to time to accommodate various degrees of water scarcity. Imposing a rigid set of allocation rules on a large irrigation system may create more problems than it is intended to solve.

Illustration II: Input Rules and Maintenance Intensity

Input rules prescribe the types and amounts of resources required of each cultivator. A major type of input required of farmers in most irrigation systems is labor for maintenance. Two major types of rules for labor inputs can be identified. One type of rule simply requires equal contribution from all the appropriators. The other requires labor inputs from appropriators roughly in proportion to the benefits each obtains from the resource, for example, proportional to one's share of the resource, to the amount of land cultivated, or to the amount of water needed.

Maintenance intensity appears to be a major factor affecting the choice of labor input rules. Maintenance intensity can be roughly measured by dividing the total number of person-days of labor per year mobilized in an appropriation area to maintain the irrigation system by the total number of irrigators in the appropriation area. Only eleven of the cases report information about both maintenance intensity and labor input rules for maintenance. For the seven cases that require equal labor contribution, the average maintenance intensity is 2.3 days per person per year. For the four that require proportional labor contribution, the average is 17.7 days per person per year. One possible inference from this limited amount of information is that systems with a higher maintenance intensity tend to adopt the proportional rule for labor inputs, while systems with lower maintenance intensity tend to adopt the equal-contribution rule.

Administrative costs appear to be a factor that makes equal-contribution rules a better choice than proportional rules in some circumstances. In order to enforce the proportional rule, resources have to be expended in counting, recording, and organizing various contributions from different appropriators. For systems that require only two or three days of work from each irrigator every year, the potential benefits of proportional rules could easily be offset by the costs for implementing the proportional rules. Whereas for systems with higher maintenance intensity, the gain from the proportional rules may be higher than the administrative costs.

This argument is supported by the emergency labor rules found in the sample of cases. In eight of the fifteen cases where information is available, equal contribution rules are used for emergency labor inputs. These resources are all located in steep terrain. The water distribution system can be destroyed easily by sudden increases in water flow in rainy or stormy weather. Speedy repair is needed to ensure the continual functioning of the entire system. By using equal contribution rules, labor can be mobilized rapidly. The prospect of losing the entire irrigation system can be a sufficient incentive for the cultivators to participate in the joint endeavor.

Crafting Operational Rules in Ongoing Processes

The patterns of allocation and input rules described above illustrate the need to craft operational rules to suit specific physical and social environments (see E. Ostrom, 1992). No single set of operational rules will fit all circumstances (Coward, 1980a; Uphoff, 1986). More important than searching for the "one-best" operational arrangement is involving irrigators in the ongoing process of crafting rules to deal with varying problems that they know about with some precision.

Crafting operational rules is a continuing process due to the complex task of devising rules to match the unique combinations of variables that are present on any one system, as well as to adapt to changes in many of these variables over time. The system is never really stable. Not only are climatic conditions variable, but physical systems tend to "wear out." In the case of an irrigation system, dams and canals silt-up, control structures break down, and underlying strata give way. If effective institutions are in place, considerable efforts can be devoted to counteract physical deterioration.

It is necessary to stress the ongoing nature of the process of crafting institutions since it is so frequently described, if at all, as a one-shot effort to organize the farmers. Rather, those who are directly involved with the flow characteristics of a particular system, the economic conditions of a locality, and the values and norms of the users must have continuing authority to craft at least some of the rules that impinge most directly on that system.

Crafting Governance Structures

Governance structures refer to the collective-choice rules that stipulate the terms and conditions for formulating, modifying, and enforcing operational rules. A set of collective-choice rules will be effective only if it can help those involved to formulate rules that meet the needs of farmers and officials, to detect and sanction against rule violations, and to hold officials accountable for their performance. Several collective-choice arrangements facilitate these processes. First, irrigators' direct involvement in making major collective decisions in water allocation and maintenance helps to ensure that the decisions meet the needs of farmers. Second, individuals will have little incentive to comply with a set of rules unless they believe that their non-compliance will be noticed and, if continued, will result in substantial loss. To enforce operational rules, it is necessary to develop mechanisms that are capable of detecting and sanctioning against rule non-compliance.

Officials vested with special authority are in a position to abuse their powers by interpreting rules to their own advantage or to demand favors from individual irrigators. Third, to hold irrigation officials accountable, rules are needed that stipulate how officials are selected and removed, to whom they have to report, and how they are compensated for their services.

Within the sample of cases discussed above, the collective-choice entities in most of the cases that describe "community irrigation systems" are characterized by governance structures with these three features: (1) the direct involvement of irrigators, (2) effective monitoring and sanctioning, and (3) holding officials accountable. Cases that describe systems governed and managed by government agencies are rarely characterized by these three features. We now focus somewhat more specifically on the difference in the governance structures of community irrigation systems and government irrigation systems.

Community Irrigation Systems

Collective-choice arrangements are present in 21 of the community cases in the sample. Ten of these cases are governed by irrigators' associations that are responsible only for activities related to the irrigation systems. In nine other cases, some village-wide or communal organizations that have other responsibilities besides irrigation are responsible for governing the irrigation systems.

In most of the community systems, major collective decisions are made in general meetings that involve most irrigators. In Thulo Kulo and Raj Kulo in Nepal, for example, general meetings for the entire membership of the irrigators' organizations are held in mid-May (Martin and Yoder, 1986). At the meetings, plans for major annual maintenance are drawn, new officials are elected if necessary, and operational rules for the coming season are reviewed and amended if needed. In Raj Kulo, the accounts of the organization are also presented and reviewed in the meetings. In both systems, other general meetings may be held throughout the year whenever major decisions concerning the operation of the system have to be made. General meetings are considered a major event in most of the community irrigation systems. In Oaig-Daya in the Philippines (de los Reyes, 1980), farmers are even required to pay a fine for being absent from a general meeting.

Specialized officials or monitors are appointed to enforce operational rules in most of the community systems. In Calaoaan in the Philippines (de los Reyes, 1980), for example, the chairman and the board members of the irrigators' association are responsible for organizing maintenance works. In Nabagram in Bangladesh (Coward and Badaruddin, 1979), water is distributed successively from one block to another during the post-planting period. A water distributor is employed to determine when an individual plot has received an adequate supply of water and to divert the water flow from one plot to another. By taking the water allocation process out of the hands of individual irrigators, the chance of rule violations is reduced. Provided that the water distributor is held accountable to irrigators, his service helps to reduce the chance of rule violations.

The chief executives in most of these collective-choice entities are selected through direct or indirect elections by irrigators. The periods that the chief executives serve, however, vary from case to case. In some of the cases, officials are subject to reelection periodically. In Silean Banua (de los Reyes, 1980), for example, the six officers on the board of directors are subject to re-election every two years. In other cases, officials can serve an indefinite period of time, subject to a vote of non-confidence by members.

The chief executives are compensated in most of the cases. Some of the commonly used compensations for irrigation officials in these cases include: reduced labor obligations; reduced membership dues; and fines or direct payments, in the form of cash or agricultural products, by irrigators. In return for their services, the irrigation headmen in Chiangmai in Thailand (Potter, 1976), for example, are excused from paying taxes on certain amounts of land, they do not have to contribute labor for maintenance, and they can keep some of the fines levied.

There are, however, a few exceptions where officials are not paid. In Diaz Ordaz Tramo in Mexico (Downing, 1974), officials have to perform various duties including the organization of water allocation, maintenance, and conflict resolution. For these duties, the officials receive no compensation and little praise. Every landholder within the appropriation area, however, is obliged to occupy the positions through rotation; each has to take an office for one year. In Cadchog and Calaoaan in the Philippines (de los Reyes, 1980), irrigation leaders are not compensated for their duties. Their own interests in the irrigation systems may have been a sufficient incentive for them to help govern the systems.

As a whole, the governance structures in most of the community irrigation systems appear to involve farmers in making major collective decisions, to spend substantial resources in enforcing operational rules, and to hold leaders accountable to farmers.

Bureaucratic Irrigation Systems

In a bureaucratic irrigation system, the headworks are governed by national or regional government agencies. In some irrigation projects, the same agencies may govern the entire system down to the watercourse level. In others, different collective-choice entities, such as irrigators' associations, are involved in governing activities at the distributary and watercourse levels. In six of the bureaucratic cases in the sample, the entire systems are governed solely by government agencies. In the other eight cases, the watercourses are governed by both government agencies and local collective-choice entities constituted by irrigators.

The governance structure of most government agencies in the sample appear to be unfavorable to rule formulation, rule enforcement, or holding officials accountable to irrigators. The major financial source of all these agencies, with the exception of one in Taiwan, comes from government allocation. Since these agencies and their officials are not financially dependent on irrigators, officials in these agencies are usually not as motivated to serve irrigators as their counterparts in irrigators' organizations. In all the cases, officials who are responsible for making major operating decisions concerning various watercourses are not irrigators themselves but full-time employees of government agencies. Instead of reporting to irrigators, these officials report to a higher authority within or outside their agencies. Local "water guards" or water operators responsible for local water provision often play a vital role or interface in translating information both ways, diffusing local tensions and helping irrigators arrange informal flexible scheduling where formal operational rules are inappropriate and difficult to change. Good examples of the role of such local officials come from the El Operado scheme in Western, Mexico (van der Zaag, 1992) and the Gezira scheme in Sudan (El Tom and Osman, 1989).

The Provincial Irrigation Department that governs Gondalpur Watercourse in Pakistan (Merrey and Wolf, 1986), for example, receives funding for recurrent and operational expenditures through allocations by the Provincial Finance Department. The allocations are based on the physical characteristics and inventory of the irrigation facilities. The Irrigation Department receives a fixed amount of funding per year for each kilometer of canal that exceeds a certain discharge capacity. The basis for budget allocations is rigidly fixed and often based on formulae that were established decades ago. The day-to-day field work of the Department is carried out under the direction of the Executive Engineer at the Divisional level who is responsible for thousands of hectares of farmland. The supply of water to various watercourses is decided by the Executive Engineer whose decisions are based primarily on instructions from headquarters and the available water supply in the main river, and not the conditions and demands in the command area. The Irrigation Department as a whole "can be fiscally accountable and fully responsible in [its] work and yet have minimal interaction with farmers, who often feel that the irrigation service they receive is not satisfactory" (Merrey and Wolf, 1986: 10).

In most of the bureaucratic cases, officials who make major decisions for watercourses reside in places far away from the watercourses they serve. These officials develop little identification with the interests of the local communities and have little incentive to be actively involved in solving farmers' problems. Their distance from the watercourse also prevents them from acquiring timely and accurate information about different needs of various watercourses. In all but two cases, government officials do not convene any general meetings with irrigators. Irrigators themselves usually have few formal channels to articulate their interests and grievances to officials.

Complex, bureaucratic irrigation systems that are governed solely by government agencies are unlikely to solve all water allocation and maintenance problems at the watercourse level. Within the sample, all six cases that are governed solely by government agencies are characterized both by a low degree of rule conformance and poor maintenance. In these cases, operational rules handed down from government agencies often turn out to be incompatible with the special circumstances of individual watercourses.

In some of these bureaucratic irrigation systems, even though local farmers are unable to develop their own collective-choice arrangements, they have developed "extra-legal" rules to suit their own circumstances. Examples of the difference between informal, farmer-established rotations and formal rotations established by the Irrigation Department are seen in the Gondalpur Watercourse.

> *. . . unlike the formal rotation, the informal rotation takes into consideration local conditions such as the sandiness of soils and the height of the field relative to the ditch. Thus, a sandy or high field is awarded extra time to ensure it can be irrigated. More time is also allowed for filling long sections of the watercourse (Merrey and Wolf, 1986: 46).*

The effectiveness of operational rules depends on local circumstances. Involving cultivators in the formulation and enforcement of operational rules at the watercourse level facilitates adaptation to the specific needs of different areas within a larger irrigation system. In some of the bureaucratic cases, local appropriators have adopted and enforced their own operational rules at the watercourse level. Complex, bureaucratic cases with local irrigators' organizations usually perform better than those without because operational rules developed and enforced by local collective-choice entities are usually more effective in meeting the needs of farmers. Among the bureaucratic cases in the sample, a higher percentage of those with local collective-choice entities is characterized by a high degree of rule conformance and adequate maintenance than those without (see Table 2).

Table 2: Rule-conformance/maintenance by Local Collective-Choice Entity in bureaucratic cases

	With Local Collective-choice Entity	*Without Local Collective-choice Entity*	*(Total)*
Positive in both Rule-conformance & maintenance	75% (6)	0% (0)	(6)
Negative in either Rule-conformance or maintenance or both	25% (2)	100% (6)	(8)
(Total)	100% (8)	100% (6)	(14)

Percentage difference = 75%
Chi-Square with continuity correction factor = 5.1
D.F. = 1 $P < 0.05$

Source: Tang (1992).

Local collective-choice rules in the bureaucratic cases are very similar to the ones found in community irrigation systems. Most of the local organizations in the bureaucratic cases involve their members in making major collective decisions. Specialized officials or monitors are appointed by irrigators to enforce operational rules within the watercourse. Executives are selected by irrigators.

Despite these similarities, however, one should avoid making any unqualified analogy between irrigators' organizations in community irrigation systems and those within bureaucratic irrigation systems (Hunt, 1989). Irrigators' organizations in community irrigation systems are self-contained entities, while those in bureaucratic systems are embedded in a larger organizational structure. Irrigators' organizations in bureaucratic irrigation systems will be unsuccessful if irrigators fail to perceive a need for them to organize or if they lack the freedom to govern and manage the day-to-day activities within their irrigated area.

Amphoe Choke Chai, for instance, is an irrigators' organization established under the auspices of the Royal Irrigation Department of Thailand to help govern two water zones within the Lam Pra Plerng Irrigation Project (Gillespie, 1975). Even with the encouragement of the government agency, the irrigators' organization has been unsuccessful in attracting members and organizing water allocation and maintenance activities. This is because farmers are able to receive sufficient water from the natural flooding of rivers and are not motivated to operate and maintain the canal networks that belong to the irrigation project.

This case is contrasted with Kaset Samakee, located near the head end of the same irrigation project. The water zone of Kaset Samakee has a reliable supply of water but no alternative source of water. The soil in the zone is porous in nature. To minimize water loss through seepage, water needs to be distributed quickly. Silt and weeds also need to be removed regularly to facilitate the flow of water in the ditches. Because of these physical features and the farmers' dependency on the water from the project, most farmers in the zone follow water allocation schedules and participate in maintaining ditches in the zone.

Kottapalle in India, as described by Wade (1988), is an example where farmers have been able to constitute their own collective-choice arrangements and to enforce their own rules governing their investments. The government agencies responsible for the irrigation system neither support nor interfere with the activities of the farmers' organization. Most of the officials are even unaware of the organization's existence. Members of the organization, therefore, have a free hand in developing and enforcing their own governance and management arrangements. This, together with the need for cooperation in water allocation, enables farmers to sustain their own governance structure.

Further, the irrigators' organization in Kottapalle also performs an important function by helping to secure water supplies to the community. When the water supply is scarce, leaders of the organization may organize to collect resources from members to lobby officials for more water supplies. Employees of the farmers' organization also help to ensure that the water flow to their community is not blocked by upstream communities.

Similar functions are also performed by the irrigators' association of Sananeri Tank in Sri Lanka (Meinzen-Dick, 1984). In that association, the president expends considerable efforts in obtaining more water issues to their water tank from the Public Works Department. These efforts benefit all irrigators in the watercourse and motivate irrigators to support their association.

In other cases, such as Nam Tan Watercourse (Coward, 1980b) and El Mujarilin (Fernea, 1970), government officials and local leaders cooperate in governing a watercourse. In El Mujarilin, for example, an official representing the Ministry of the Interior is responsible for hearing complaints between irrigators. However, unless the dispute involves a clear infraction of the civil code, the official routinely refers the case back to the leader of the local tribe or other tribesman whom the petitioners might choose. This practice allows the traditional tribal organization to remain a viable instrument for resolving conflicts among irrigators.

Farmers will have incentives to participate in governing an irrigation project only if they perceive that the benefits they obtain from their participation exceed the costs of the resources they devote to it. In the cases where irrigators' organizations perform relatively effectively, the organizations are able to secure extra benefits for the community of irrigators. Members of these organizations are also relatively free to develop their own governance and management processes that directly affect their own welfare.

Conclusion and Implications

During the past few decades, increased agricultural production in developing countries has resulted from massive investments in large-scale irrigation projects, in addition to investments in new agricultural inputs and technologies. The least expensive sites for irrigation development, however, have already been developed in most developing countries. The costs of new investments in large-scale projects tend to rise faster than farm produce prices. Thus, the rate of new irrigation water made available to farmers from new, large-scale projects will slow considerably. The key to increase agricultural production in the future is the improvement of existing irrigation systems.

While the operation of existing irrigation systems can be improved from better physical structures and technologies, the key problem concerns the incentives facing officials and farmers. If these individuals are not motivated to operate and maintain irrigation systems effectively, large-scale irrigation projects will continue to perform ineffectively. Over the next several decades, the most important consideration in irrigation development will be integrating farmers' participation with effective institutional development. While irrigators' organizations can potentially play an important role in the operation and maintenance of large-scale irrigation projects, these organizations may not always be successful. It is important to involve farmers themselves in crafting their own operational and collective-choice rules. Unless farmers have the freedom to participate in both the governance and management processes of their irrigation system, they will be uncertain about the returns of their efforts. Without considerable confidence about their ability to affect outcomes, farmers will have little incentive to participate in collective efforts in operation and maintenance.

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Appendix

Comparing irrigation systems requires a consistent way of identifying their boundaries. One way of conceptualizing such boundaries is to consider the four stages of the water delivery processes: production, distribution, appropriation, and use (see Plott and Meyer, 1975). Water is produced, for example, by damming a river. The dam is the *production resource* of the irrigation system. From the production resource, water may be distributed through a canal to the irrigated area; the canal is the *distribution resource*. In the irrigated area, water may be appropriated from the local ditches, tanks, or pumps; these physical structures are the *appropriation resource*. The water appropriated is then used to irrigate crops in the fields; the fields and crops together constitute the *use resource*.

With this distinction among production, distribution, and appropriation resources, two kinds of irrigation systems can be identified. In a simple system, the production and distribution resources supply water to only one appropriation area. In a complex system, the production and distribution resources deliver water to multiple appropriation areas. This study analyzes activities and attributes related to the entire appropriation resource of a simple system and selected appropriation areas (i.e., watercourses) within a complex system.

The data for this study were collected as part of a research project on common-pool resources including fisheries, forests, grazing land, groundwater basins, and irrigation systems conducted by the Workshop in Political Theory and Policy Analysis at Indiana University. Members of the research project have developed a series of coding forms, containing mostly closed-ended questions, to capture key physical, community, and institutional attributes of common-pool resources. These forms were used to code data provided by in-depth case studies.

Extensive efforts have been undertaken by members of the project to identify empirical studies of irrigation systems. Over 1,000 items, including books, dissertations, journal articles, monographs, and occasional papers have been identified in the area of water resources and irrigation (Martin, 1989). Over 500 documents have been collected by the research project on irrigation. Cases were selected from these documents for coding only if they contain detailed information about: (1) participants in the resource, (2) strategies used by participants, (3) the condition of the resource, and (4) rules-in-use for the resource. Cases were also selected in such a way as to include in the sample as much diversity in terms of physical, community, and institutional attributes, and collective outcomes as possible.

The sample of cases used in this study consists of 47 cases: 29 community systems that are governed entirely by irrigators; 14 bureaucratic systems whose production resources are governed by a national or regional government agency or enterprise; and 4 other systems whose production resources are governed by local governments. Twenty-nine of the cases are simple systems; 18 are complex ones. The major irrigated crop in most of the systems is rice. The systems are located in the following countries:

IRRIGATION SYSTEMS STUDIED:

Community	Bureaucratic	Other
Bangladesh (1)	India (4)	Peru (3)
Indonesia (4)	Indonesia (1)	Mexico (1)
Iran (2)	Iraq (1)	
Nepal (5)	Laos (1)	
Philippines (13)	Pakistan (4)	
Tanzania (1)	Thailand (2)	
Thailand (1)	Taiwan (1)	
Switzerland (1)		

For the detailed profile of these cases see Tang (1992). A special study has been made of over 127 irrigation systems in Nepal. Please contact Elinor Ostrom if you wish to obtain the reports written from this study.

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IRRIGATION MANAGEMENT NETWORK

INCREASING WOMEN'S BENEFITS FROM IRRIGATION DEVELOPMENT:
Smallholder irrigation in the Kano Plains, Kenya

Joitske Hulsebosch and Barbara van Koppen

Network Paper 24

June 1993

Network papers in this set:

Newsletter June 1993

23 *The Governance and Management of Irrigation Systems: An Institutional Perspective* by Shui Yan Tang and Elinor Ostrom

24 *Increasing Women's Benefits for Irrigation Development: Smallholder Irrigation in the Kano Plains, Kenya* by Joitske Hulsebosch and Barbara van Koppen

25 *Urban Irrigation and Cooperative Organisations in Addis Ababa, Ethiopia* by Axumite G. Egziabher

26 *Farmer Organisations for Lift Irrigation: Irrigation Companies and Tubewell Cooperatives of Gujarat* by Tushaar Shah and Saumindra Bhattacharya

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INCREASING WOMEN'S BENEFITS FROM IRRIGATION DEVELOPMENT
Smallholder Irrigation in the Kano Plains, Kenya

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Contents **Page**

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INCREASING WOMEN'S BENEFITS FROM IRRIGATION DEVELOPMENT
Smallholder Irrigation in the Kano Plains, Kenya

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Introduction

In the approach of the Kenyan Provincial Irrigation Unit (PIU), Nyanza Province, that works within the framework of the Smallholder Irrigation Development Project (SIDP), the participation of the users of the schemes has a high priority. In the late eighties, however, the project realised that the farmers involved in the project's interventions were almost exclusively male, while women's contribution to irrigated agriculture in Nyanza is important. PIU and SIDP felt the need to adapt the project interventions towards a more gender-balanced inclusion of all users in irrigation development. By increasing women's benefits from rice cultivation, their interest in the project could be ensured.

J. Hulsebosch was asked to formulate and execute research that could lead to such actions. A study into gender-based division of labour in 1989 (Hulsebosch, 1990b) was followed by a study on decision making of women in joint, migration and widow's households (Hulsebosch 1990a). The issue of control over rice produce and the division of benefits at household level was started in 1991 (Hulsebosch, 1992). Based on research findings and recommendations, experimental actions were developed. In this way, a credit scheme was started in 1992 to stimulate rice farming at the household level. At the scheme level, women got more involved in collective decision making.

This article describes an analysis and recommendations that concern production at the individual farm level. Issues on women's inclusion in the design process and in Water Users' Organisations are beyond the scope of this article. This paper first examines the research framework. This is followed by discussion of the project approach and the nature of rice farming in Nyanza Province. The main research findings are given in Section 2. Data on labour (section 2.1), land (section 2.2) and control over rice produced (section 2.3) is used to assess the main constraints and benefits in rice farming for the different types of households (section 2.4). Finally, the recommendations for action at the farm level that were based on the research will be presented in section 3.

Set-up of the research
Insights into gender-based division of labour resulted from a study of a PIU-assisted scheme (Gem Rae) in Kisumu District in 1989 (Hulsebosch, 1990b). It monitored labour allocation in rice farming of five households on a daily basis, 30 households were interviewed twice during the rice season. The labour analysis revealed that women are important actors in rice farming.

This research was followed by a study on decision making of women in different types of households (Hulsebosch, 1990a). Distinction was made between:

1. Households that were *de-jure* headed by a woman. In this research they were all *widow's households* and are subsequently described as this.
2. Households that were *de-facto* headed by a woman. The husband has migrated, but remittance of goods and/or money takes place. In this research they are called *migration households.*
3. *Joint households*, were both husband and wife/wives are active in irrigated agriculture. The man is the head of the household.

Interviews were held with 21 women (seven in each category) and 14 husbands by means of a questionnaire concerning farm decisions. The closed character of the questionnaire limited the results; the area of women's control over rice remained especially unclear.

In order to highlight the issue of control over rice produced, research on the division of benefits at household level was started in 1991. Three rice schemes in Kisumu district were included in the research: an operational scheme, a scheme that was recently implemented and a scheme in a future project area. In each scheme a list of plot owners was available (male heads of households and widows with a plot). At random, 30 names per scheme were selected from this list. In the 90 selected households the wife was interviewed, especially on control over produce and benefits from rice farming. In the case of polygamous households one of the wives, who was at home, was interviewed; in five households the husband as well. To cross-check information, group discussions were held with women about benefits from rice farming. In 1992 several special meetings for women were organised within the context of a series of meetings with farmers to discuss results.

For the study set-up the researcher was inspired by participative observation, living with families in the area and taking part in community life and activities[1].

Project approach
The Smallholder Irrigation Development Project (SIDP) aims to assist small-scale irrigation development in Kenya by institution-building: The project is a cooperation between the governments of Kenya and the Netherlands since 1977. An Irrigation and Drainage Branch (IDB) has been set up within the framework of the Ministry of Agriculture (MoA). On the provincial level, Provincial Irrigation Units (PIU's) have been constituted to develop small-scale irrigation in their province.

In Nyanza province the PIU Kisumu is mainly involved in rice development. The area under smallholder rice irrigation in Nyanza Province has expanded from 100 ha in 1979 to 1500 ha in 1990 (Kimani and de Vries, 1991). These irrigation schemes range typically from 40-250 ha and in membership from 60-450 plot owners, who are organised in Water Users' Associations (WUA's) (Ombara, 1990). The participative approach adopted since 1988 implies an active participation of the users before, during and after implementation of a scheme.

The experience with this participatory approach has been that very few farm women have been participating in the discussions concerning design, implementation, operation and maintenance and few have taken a seat at WUA's. Farmers have been approached as an homogeneous group: in practice mainly male farmers have been participating.

Since 1990 the PIU Kisumu has been involved in an ambitious effort to implement the South West Kano Irrigation Project. The project involves 1130 ha of mainly newly available rice land, and over 2500 male plot owners.

[1] These research issues appeared to be similar to those suggested in the conceptual framework developed by Feldstein, Poats et al., 1990 for "selectively identifying and organising the information for gender analysis which will contribute directly to Farming Systems Research/Extension in a particular location and in light of a project's objectives". This framework defines four themes where gender analysis improves the understanding of the farming system and the changes induced by a project: labour, access to and control over resources, control over benefits and inclusion in project activities.

Project area and the place of rice farming in the farming system
The South West Kano irrigation project and most PIU-assisted schemes are situated in the Kano plains, where 80% of the farmers are smallholders. The Kano plains are densely inhabited: 177 people per square kilometre in 1979 (Noy and Niemeyer, 1988). The average landholding amounts to 2-3 ha and consists of 0.4 ha of rice land and 1.4 ha of upland crops. Upland crops are maize, millet and sorghum which are grown during the rainy season from February-July. Upland crops are grown for subsistence purposes, maize is the main staple food of the area. Occasionally green grams, cassava and vegetables like tomatoes and kales (swahili: *sukuma wiki*) are grown.

The irrigated rice crop is grown from August to January and is mainly used as a cash crop. On average 10% of the produce is kept for family consumption (Mbogoh, 1989). Rice cultivation is very profitable: one hectare can yield 50-75 bags (4-6 tons), equivalent to 25-38.000 ksh (= 760-1150 U$$). On the other hand rice cultivation is labour consuming: the average labour input is 4000 hours per ha (Hulsebosch, 1990). Therefore, rice farming depends on cash to hire additional labour. In a study in a smallholder rice scheme in Kisumu District the average cash input to hire casual labour in the season 1989/90 was 5500 ksh/ha (= 167 US$/ha) (Hulsebosch, 1990). Lack of cash at household level can force farmers to lease out their plots or can delay cultivation operations and reduce yields. Many households, especially migration households, do not have access to labour and cattle for ploughing; 75% of all households depend on cash to hire ploughing.

The area is inhabited by members of the Luo society. The Luo society is organised by lineages which are formed by descents from a common ancestor. The marriage system is exogamous and virilocal: women who get married move to live with their husband's lineage. In Luo, the customary practice in land inheritance is patrilineal. Men have access to land by belonging to a lineage. Women hold usufructuary rights by means of their marriage. Originally Luos are nomads and cattle still takes an important place within the farming system. Cattle are used for ploughing, payment of bridewealth and as a kind of savings account: when cash is needed cattle can be sold.

Research Findings

Women's labour in rice farming

The research on labour input in rice farming confirmed that women are important labourers on their own plots, their husband's plots and as casual labourers. As a result of male out-migration (40% of the households in Western Kenya) many women were responsible for their husband's plots.

In the research three types of plots were distinguished:

1. plots owned by men but managed by their wives because the men had migrated: 27% of the plots;
2. plots owned by widows or allocated to women by their husband: 37% of the plots;
3. plots owned by resident men; part of the labour was provided by wives: 37% of the plots.

The labour source and the contribution of women's labour differed according to plot type, as shown in Table 1.

Table 1: Labour source according to plot type (n=30)

	Labour source					
Plot type[1]	*hired*	*wife/wives*	*husband*	*children*	*other*[2]	*total (%)*
1	45	31	-	14	10	100
2	39	24	-	24	13	100
3	29	21	7	36	7	100

[1] See page 5 for classification
[2] For example sisters, daughter's-in-law, reciprocal labour arrangements

The labour of the wife was crucial to all plots. On the men's plots 7% of all labour was performed by the owner, on the women's plots a quarter of the labour. It should be noted that apart from cultivating their own plots these women, with the exception of the widows, were also required to work on their husband's fields. For instance, one of the wives of a polygamous man with a plot of 0.4 ha worked 18 days on her husband's plot apart from the labour on her own plot.

On all plots a considerable amount of labour was hired, but mostly on the plots of migration households; the husbands provided cash to enable rice cultivation. The men's plot of joint households relied considerably on children's labour. In absolute figures these plots were cultivated with more labour input that the other plots.

Although men performed all the labour for slashing and ploughing, women did most of the labour-intensive operations. They provided 61% of the labour for seedbed preparation, 51% of first harrowing, 62% of second harrowing, 81% of weeding, and 70% of threshing. When children's labour is excluded women performed 60% of all labour in the rice cultivation (Hulsebosch, 1990b).

Women's access to irrigated land
In the Luo land tenure system land belonged to the lineage and both men and women had well defined rights to land. Men, together with male clanmates, had rights to allocate land. Women hold use rights to a plot for cultivation by means of their marriage. Land could not be sold as it belonged to the clan. This situation changed after the Swynnerton plan in 1954 which introduced individual titles to land in Kenya. Land in the Luo area has been registered and adjudication on personal titles has taken place.

While all women used to have usufructuary rights under the former Luo land tenure system the research showed that in the project area only 54% of all married women had rice plots allocated by their husbands. These plots will further be called women's own plots, though this does not imply absolute ownership. This low figure might be due to a general decrease in landholding in the past. The total rice land size of the households where the wife had her own plot was higher than households where the wife did not have a plot: over 0.80 ha compared to 0.40 ha. Here again the allocation of plots to women depends on the total quantity of land of a household.

The access to, and size of, plots differed per household category. The widows had the best position regarding access to land: they had access to an average of 0.60 ha own rice land. In the joint households 51% of the wives had their own rice plot, the size was 0.32 ha on average. Their husbands held 0.56 ha on average. The other 49% were active in the cultivation of rice on the plots of their husbands (0.40 ha on average) but had not been allocated their own plot. The women of migration households were mainly cultivating the plots of their husbands who were absent (on average: 0.60 ha). Only 23% of these women had their own plot (on average 0.16 ha).

Table 2: (a) Women owning a plot for type of household (b) Average size of women's plots for type of household (n=90)

Household type	*Women owning plots (%)*	*Average plot size (ha)*
Widow's household	100	0.60
Migration household	23	0.16
Joint household	51	0.32

Women's control over irrigated rice produce

Women's control over rice produce was assessed according to the general reasoning and answers of respondents to questions about produce and expenditure. In this way three categories appeared:

- *Women with high control over the rice produce*
  The 'high control' women were talking in terms of "this year I may give my husband one bag after the harvesting of my plot" or "last year I decided to trade with my rice". The interpretation was that they could decide rather independently on the usage of the harvest of a plot.
- *Women with indirect control over rice produce*
  In the case of indirect control the expenditure was discussed between the spouses: "we decide together how we will spend the money from the rice harvest". The level of influence depended on the negotiation power of the women. Control over products of their own labour is in this case influenced by many factors like absence/presence of the male head of household, the total amount of female labour and female cash input, the personal relationship between husband and wife and access to off-farm income (Mackenzie, 1990). It was hard to determine whether indirect control resulted in high or low benefits.
- *Women with low control over rice produce*
  The women responding that their husband used the rice harvest and at best would give them 1-2 bags were categorised as 'low control' women. They were working in the rice cultivation but their husbands controlled the rice produce and decided independently on the rice harvest. Like the 'indirect control' women, they sometimes benefitted indirectly from rice cultivation because part of the revenues were used for household welfare, but this was not within their direct control.

The level of control over produce was related to the type of household and to the type of ownership.

Table 3 shows that ownership of land is positively related to the control over the produce from that land. However, this was not always the case. The pattern of control varied according to the type of household. In the next paragraph the control over rice produce will be specified for the different types of households. This will be combined with other characteristics of the different categories of households. In this way it will be possible to identify for each type of household the main constraints of the farming enterprise and the benefits for the women.

Table 3: Women's control over the rice produce for type of households and plot ownership (n=90)

household type	*plot ownership*	*control* *high*	*indirect*	*low*	*total (%)*
widow's households	owned	76	12	12	100
	non-owned	-	-	-	100
migration households	owned	65	35	0	100
	non-owned	10	49	40	100
joint households	owned	67	29	4	100
	non-owned	-	56	44	100
all households	owned	72	22	7	100
	non-owned	3	54	44	100
average of all plots		44	34	21	100

Women's constraints and benefits in different types of households
In this paragraph the research findings mentioned above will be complemented and analysed in order to develop a concluding picture of the main constraints and benefits for women of the types of households.

Widow's households The access to land and control over the produce of widows was high (Table 3). Their constraints were: lack of access to male ploughing labour, lack of cash to hire casual labour and consequently a heavy workload. They controlled the land of their deceased husbands on behalf of their sons. In cases where the widows were too old to farm, the sons had taken over rice farming and the widows depended on their sons.

In the sample 22% of the widows were not able to cultivate their plots in the season of 1990/91 due to lack of cash for ploughing. Instead they leased their plots to tenant farmers. The others who were able to start the cultivation had difficulties performing all cultivation practices in time; 25% of the widows were forced to cultivate their plots relying on family labour only. Delay in practices reduced the rice yields considerably.

<u>Migration households</u> Table 3 shows that although the women of migration households had to manage the rice cultivation of all household plots, 31% had no say about the rice expenditure, 46% had indirect control; 15% had a high control over a plot allocated to them and 8% had a high control over a husband's plot. Few of these women had been allocated their own plot (23%, Table 2). In many cases relatives of the husband, or the husband, returned at the period of harvesting, and exercised control.

The salary of the husband facilitated the cultivation of rice: all households were able to cultivate their plots in 90/91. In 54% of the cases the salary covered all costs of rice cultivation including the costs of casual labour which covered 45%-50% of all labour (Hulsebosch, 1990). A constraint to these women was that the money for rice cultivation was often sent too late (or in some cases, not at all).

<u>Joint households</u> Access to 'own plots' determined the constraints. Of the joint households women, 51% had her own plot (Table 2); 67% of them had a high control over the produce of this plot. None of the women without a plot had high control (Table 3). For the women without influence over rice proceeds, the situation was problematic. The men controlled the rice sales, with the result that irresponsible husbands could use the rice proceeds for their own entertainment leaving the wives without any say over the products of their labour. The women with their own plot had problems in cultivating it: the labour demand is high and they also have the obligation to work on their husbands' fields.

In this category the access to family labour was higher: 71% of the total labour (Hulsebosch, 1990a). Yet family labour is not sufficient: 14% of the joint households were not able to cultivate a crop in the season 1990/91 (either women's or husband's plots) due to lack of cash.

Research Conclusions and Recommendations for Project Action

The research on women's role in irrigated rice cultivation in the Kano Plains resulted in the understanding of both women's benefits and women's constraints in rice farming. Control over rice produce appeared to be closely related to the type of access to land. Women with a plot generally had a high control over the rice produce. They benefitted directly from the labour they put into rice cultivation.

As women in widow's households, migration households and joint households differ with regard to labour input, access to land and control over rice produce, the constraints they face and the benefits derived from rice cultivation differ too.

With these research conclusions in mind, recommendations for project action were formulated that would increase women's benefits from rice development in order to ensure their involvement in the project. Several ways to improve women's benefits from rice cultivation were identified. One way of improvement of the benefits of women who have low or indirect control over produce is by enabling them to get access to own plots. In this case this means enabling them to lease plots or stimulate husbands to allocate plots to their wives.

Another way is improving their negotiation power in rice expenditure. Control over produce depends on the negotiation power of the women which in turn depends on many factors like age, plot size, female labour input, and off-farm income. Negotiation power can thus be enlarged by reinforcing the economic position of women. By offering income-earning opportunities like cultivation of rice plots or other activities like trading, selling produce etc. this position can be strengthened.

Thirdly, the alleviation of the constraints in rice farming that the women of the different types of households faced, would also improve output and benefits.

A concrete action, that could stimulate women's interest and participation in rice development, was a flexible, multi-use credit system. Women who are able to control (part of) the rice harvest would probably invest in rice cultivation because it is profitable business with less risks than trade, for example. Women with high control might decide to use credit to improve the rice cultivation without leasing additional plots. Women with an indirect control could decide to lease a plot on their own, over which they would probably have more control. Women with low control might prefer to invest it in trading activities. This would give then an income and strengthen their position within the household. It might indirectly support the rice farming as the profits of trading might serve as inputs for rice farming at critical stages. Trading is partly complementary to rice farming as many women trade with rice in the off-rice season.

Table 4: Intended credit use of women for level of control over rice produce (n=90)

	Control		
Intended use of the credit	*high*	*indirect*	*low*
Rice	50	37	18
Rice & trading	28	33	18
Trading	6	7	35
Consumption	1	15	6
No interest	6	4	16
Other	2	4	6
Total	**100**	**100**	**100**

The expectations were checked by an inventory of women's interest in credit and their intended use of it. The results are shown in Table 5. It can be concluded that the needs of the women varied according to category, yet most women indicated an interest in credit, for various purposes.

Women with high control over produce were slightly more willing to invest in rice cultivation than women with low control. The low control women had a preference for credit for trading purposes. This would improve their general position by means of getting access to an income which they can control.

The intended use of the credit was also specified for the different types of households. The widows would use the credit in order to ease their workload to enable them to cultivate their plots in time and with increased yields. For the women in migration households it would give them an opportunity to perform cultivation practices in time and/or to lease own plots where their control over produce is high. For the women in joint households: women with their own plots indicated that they would like to use credit to improve the cultivation of their plots. The women without own plots indicated that they were interested in credit to lease own plots and to use some of the credit on their husbands' plots to improve their negotiation power and to keep peace within the household. When part of the credit is used to employ casual labour on the plot of the husband, he will benefit directly and will not accuse her of neglecting his plot was the argument of the women.

Thus it was recommended to the project to start a flexible credit system for varying purposes on behalf of farm women in order to enable them to get a controllable income from rice farming. The SIDP project staff recognised its importance and decided to implement the credit scheme.

A workshop was held with NGO's experienced in credit schemes to develop a sustainable credit system (MoA, 1992). A scheme has been developed and is run by the NGO 'Care International Kenya'. Some of the features of the scheme are:

- disbursement of credit will be done by means of women's groups in the area. A majority of the women (78%) are a member of at least one group. The activities of these groups are accepted and seen as beneficial for the whole community. The groups can enable women to keep control over the credit;
- the credit scheme will be flexible enough to allow activities outside rice farming. The choice on how to invest the credit will be left free;
- the groups may qualify for a revolving loan by raising an equity contribution of not less than one-third of the loan.

The credit programme in Ahero started in July 1992 with 11 groups, and loan repayments are going well, even before the ultimate repayment dates. An evaluation report is under completion by Joitske Hulsebosch.

Concluding Remarks

The research described in this article led to the recommendation to the Smallholder Irrigation Development Project to start a credit scheme, as well as to integrate women more in scheme management in order to increase women's benefits from the project and to ensure their participation. The project started implementation of both recommendations in 1992.

In the coming years the credit scheme will be closely monitored in order to assess in what ways the credit is used by women from different types of households, the profits they gain from these investments, the effect on rice production, husband's opinions on credit, changing intra-household relationships and credit management by the groups.

The inclusion of women in scheme management will be another important issue for further action-research. In order to increase the participation of women in the South West Kano Irrigation Project, it is experimenting with a quorum of a minimum of 50% female attendants at all meetings and with women-only meetings. In the latter women express their opinions more freely. They are invited to discuss their needs and constraints and to prepare a strategy on their inclusion in irrigation management (particularly in the WUA's) (Daamen, 1992).

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IRRIGATION MANAGEMENT NETWORK

URBAN IRRIGATION AND COOPERATIVE ORGANISATIONS IN ADDIS ABABA, ETHIOPIA

Axumite G. Egziabher

Network Paper 25

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Network papers in this set:

Newsletter June 1993

23 *The Governance and Management of Irrigation Systems: An Institutional Perspective* by Shui Yan Tang and Elinor Ostrom

24 *Increasing Women's Benefits for Irrigation Development: Smallholder Irrigation in the Kano Plains, Kenya* by Joitske Hulsebosch and Barbara van Koppen

25 *Urban Irrigation and Cooperative Organisations in Addis Ababa, Ethiopia* by Axumite G. Egziabher

26 *Farmer Organisations for Lift Irrigation: Irrigation Companies and Tubewell Cooperatives of Gujarat* by Tushaar Shah and Saumindra Bhattacharya

27 *Poverty in Irrigated Settlements: A discussion paper and replies from Network members*

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by

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Contents **page**

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URBAN IRRIGATION AND COOPERATIVE ORGANISATIONS IN ADDIS ABABA, ETHIOPIA

by

Axumite G. Egziabher

Introduction

Recent years have seen the continuing increase of population in urban areas, persisting problems of food supply, availability and distribution, and in some cases worsening hunger for many millions of people in Third World cities. Often, urban supplies are the first to suffer whenever food production declines for whatever reason, as farmers keep their products for their own needs. The urban poor depend on the market system for their food, while the rural population depends on both its own production and trade or markets: therefore, the urban poor are more vulnerable to market disorders and food interruptions.

This paper summarises current understanding of the character and role of urban agriculture in Addis Ababa, and the organisation of producers for whom urban agriculture is the sole means of survival. The study first summarises the socio-economic situation of Addis Ababa, the capital city of Ethiopia. It then looks at the contribution of urban agricultûre to the provision of food to the population, employment and income to the producers in the city. Finally, it reports the experiences of the cooperative in organisation, irrigated production, sales and income. The formation of the cooperative is seen as one of the urban farmers' survival strategies. Positive action, hard work and commitment by members, and technical assistance from government agencies have helped the cooperatives' development. However, the concerned authorities cannot give them the legal status that would give access to credit facilities and other services because of the urban location of the cooperative. This continues to hamper security and output.

Socio-economic Situation of the City

The Environment of the City

Addis Ababa is a relatively new city compared to older religious administrative and commercial centres like Axum, Yeha, Roha and Gondar. Addis Ababa was founded in 1881, after the seat of Emperor Menelik II had to move through several sites in pursuit of supplies of food, firewood, wood for construction material and water. The Addis Ababa Master Plan Project Office (AAMPPO) quoted R.J. Honat (1968), who stated that in Ethiopia, "the City moves to the food, rather than the food is transported to the City" (AAMPPO, 1985).

Addis Ababa is located in the centre of highland Ethiopia and covers some 22,200 hectares (CSO, 1986). It is a plateau region of volcanic origin where the altitude ranges from 2200 to 2900 metres (average 2438 metres) above sea level. Because of the altitude, the area has a temperate wet and dry climate with two important climatic regions: the "Degga" area, which is a cool zone and "Woina Degga", which is mild and relatively constant in temperature.

Addis Ababa is encircled by hills, volcanic cones and forest. Relief divides the area into two drainage systems, with water in the north flowing into the Blue Nile, and in the south into the Awash system. A number of rivers and creeks cross the urban area, although only two are perennial (and these have a strongly seasonal regime). There are two rainy seasons annually, with the main rains (mid-June to mid-September) giving some 750mm of the annual average of 1250mm. The lesser rainy season (February to April) accounts for the balance.

Soils are of two principle types: the heavy-textured black cotton soils (vertisols) and the light-textured, red volcanic soils (mitosols). Both types have a high clay content, but the higher content of the vertisols causes swelling, shrinkage and cracking, and such difficulties add to construction and agricultural development costs. Soil erosion is severe, especially on steep hilly slopes which have lost their vegetation cover.

Vegetation is not just an aesthetic consideration in Addis Ababa. Forests at the fringes of the city and other suitable surrounding areas are important sources of fuel and energy for the population, prevent soil erosion, supply construction material and are also important for recreational purposes. These forests, together with urban agricultural activities, make Addis Ababa the "green city" it is often called.

Population
The 1984 National Population and Housing Census indicated that Addis Ababa had a population of 1,412,575, accounting for 30 percent of the urban population in the country. Comparisons with 1961 estimates show an increase of almost 215 percent: the population of Addis Ababa had trebled in about 23 years. The sex-ratio of the population in the city had also changed, with an increase in the proportion of female population from 105 males per 100 females in 1961 to a proportion of 90 males per 100 females in 1984.

The average household size of the population in the city had also increased from 3.5 in 1961 to 5.2 in 1984. A survey of the dynamics of the Addis Ababa population with special reference to the migration indicated that 54 percent of migrants who were not heads of household reported that they had become established as family members of existing established households in the city (AAMPPO, 1985). This implies that the increase in the household size was the result of both natural increases and migration into the extended family system. Thus the population of Addis Ababa not only changed in size over the years; the household structure in the city had also changed from a nuclear to an extended form.

The CSO estimates indicated that the population growth rates in Addis Ababa decreased from 7 percent in 1961 to 5 percent in 1984. In 1985, the AAMPPO demographic studies suggested that the recent growth rate could be considered as 3.5 percent and might be an alternative for the maximum population growth level. The general decrease in the growth rate was due mainly to the temporary effects of the 1975 nationalisation of rural land.

AAMPPO's survey indicated that almost half the population (48.3%) of Addis Ababa in 1984 had been born outside the city. In fact, the trend showed an increase in the proportion of the Addis Ababa-born population (or non-migrants), from 44.4 percent in to 51.7 percent in 1984. The decrease was explained as the decline in net migration effects followed by a constantly higher rate of natural increase (AAMPPO,1985).

The Urban Economy
The AAMPPO (1985) study showed that the Central Planning Region contained 58% of employment establishments, 62% of employment, 61% of output and 79% of the fixed assets of the modern manufacturing activities (including medium-and large-scale industries) of the country. It further indicated that 85% of those establishments and 83% employment were located in Addis Ababa and its environs. Out of a population of 917,000

aged 10 years and above, 39.1% were employed, 3.1% unemployed and 57.6% economically inactive, giving an unemployment rate of about 7.5%, slightly higher than that of the CSO 1978 survey results (7%). Some 50% of the employed population in Addis Ababa were working in distribution and services, 27% were occupied in production (modern and traditional) and the remaining 23% were working for the government. The survey showed that the population employed in traditional production included people occupied in formal and informal activities, i.e. small-scale industrial and handicrafts activities, and those engaged in urban agricultural and related activities such as vegetable production, forestry, fishing, abattoirs and dairy farms.

In 1984, about 52.7% of the population in Addis Ababa had an income of less than Birr[1] 100 per month, 19.3% had an income of Birr 100-199 per month, 10.2% earned 200-299, 10.5% Birr 300-499 per month, 6.2% Birr 500-999 per month and only 1.1% had an income of Birr 1,000 or more per month (AAMPPO, 1985).

The AAMPPO working paper on population trends, urban households income and domestic expenditures quoted the Wages and Work Organisation Board which defined the minimum wage as "the remuneration that should be paid to an unskilled worker performing the least complex task at the time of his hire by his first employer." AAMPPO estimated the minimum wage required for urban subsistence (the food and non-food requirements of a reference family). Their estimate of the necessary minimum wage, using 1982/83, figures was Birr 123.85 per month; of which 56.6% was required for food and 43.4% for non-food items. Comparison with the earlier figures suggested that more than half of the population of Addis Ababa had an income below the poverty line.

Management Structure of the City

Every urban dweller is organised in his/her *Kebele* or Neighbourhood Unit, which is the smallest planning unit and constitutes about 500-1000 households. The population in Addis Ababa was organised into 284 *Kebeles. Kefetegnas*, or Higher Associations were also established depending on the size of the urban areas. Addis Ababa now has 25 *Kefetegnas*. Central Associations were formed comprising delegates from the *Kefetegnas* and

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[1] Ethiopian Birr 2.07 = US Dollar 1 up to September, 1992; Since October 1993, Ethiopian Birr 5 = US Dollar 1

Kebeles. Thus Addis Ababa was divided into 284 *Kebeles*, 25 *Kefetegnas* and one Central Association (the Municipality).

The Central Association is responsible for providing the necessary services for the vegetable producers' cooperatives in the city. Like other urban activities, the cooperatives pay land taxes (because they hold temporary title deeds - see below) to the Central Association. In fact some of the members of the cooperatives are also elected members of their *Kebeles*.

Urban Dwellers' Associations were subsequently formed to decentralise decision-making and increase local participation in development schemes. But their contribution was limited as they were faced with inadequate organisational, financial and technological resources.

Urban Agriculture in Addis Ababa

The traditional Ethiopian diet did not contain many vegetables, except for Ethiopian cabbages (kale), garlic, onions, pumpkins and peppers. It is said that Europeans imported seeds, grew exotic vegetables and sold them in Addis Ababa during the early years. Memories of such Greek, Italian, French, German and Russian products are still mentioned among the elderly vegetable producers in Addis Ababa. As food habits changed and the population of both Ethiopian and foreign residents in the city increased, the consumption of vegetables has increased. The vegetable production areas expanded and the variety of vegetables grown has also increased, sometimes mentioned as reaching up to 15 - 60 types. For example, even in the case of five vegetable producer cooperatives studied, the occupied production area expanded from 194.2 hectares in 1984 (AAMPPO, 1984) to 273.6 hectares in 1990 (Ministry of Agriculture Working Paper, 1990).

The city of Addis Ababa is chiefly supplied with fresh vegetables from:

- five producers' cooperatives within the city;
- private small producers outside the city; and
- state farms, i.e. Etfruit.

In addition, a survey of consumption of fresh vegetables in Addis Ababa in 1352 households revealed that about 17% reported they produced their own vegetables, and the average cultivated area of most of the households did not exceed 25 square metres (Hormann and Shawel, 1985).

The following five vegetable producers' cooperatives cultivate along the main rivers in the city, following irrigating cultivation along the rivers of Gefersa, Tinishu Akaki, Tiliku Akaki, Kebena and Bulbula and other small streams in the city:

1 the Mekanissa, Furi and Saris Cooperative;
2 the Kefetegna 24 and 25 Cooperative;
3 the Shankilla River Cooperative;
4 the Keranio Medhane Alem (or Kefetegna 24) Cooperative; and
5 the Kebena Bulbula Cooperative.

Thus the five cooperatives, with a total of 485 members, cultivate a total area of about 273.6 hectares, which covers about 1.23% of the area of Addis Ababa. Taking an average household size to be 5.2, this means that the livelihood of about 0.18% of the population of Addis Ababa depends solely or wholly on vegetable production.

Table 1: Estimated vegetables supplied for Addis Ababa market, 1983

Major crops (Vegetables)	*ETFRUIT*[1]	*Peasants*[2] *in Shoa*	*Coops*[3] *in AA*	*Total*	*MFS coop*[4]
	<—	—	*Tonnes*	—	—>
Potatoes	1	68,505	230	68,736	80
Carrots	-	991	658	1,649	280
Swiss Chard	-	175	684	859	540
Cabbages	2	2,447	1,140	3,589	220
Beetroots	-	1,064	370	1,434	200
Tomatoes	15	2,936	85	3,036	85
Onions	12	8,232	20	8,264	20

Source: [1] Compiled from ETFRUIT annual sales statistics for 1974/1975 E.C. (1983)
[2], [3] and [4] are compiled from the data of D.M. Hormann and Hailu Shawel 1985 report on pages 255-262
[3] The cooperatives indicated as major suppliers are:
a. The Mekanissa, Furi and Saris Cooperative (MFS Coop)
b. The Kefetegna 24 and 25 Cooperative
c. The Shankila River Cooperative
and production from communal and private plots
[4] Detailed figure for MSF (also included in 3)

D.M. Hormann and Hailu Shawel (1985) estimated that in 1983 only three of the five cooperatives supplied about 80% of the swiss chard, about 40% of the carrots, about 32% of the cabbages and about 26% of the beetroots provided to the Addis Ababa market (see Table 1). The Mekanissa, Furi and Saris Producers' Cooperative produced about 63% of the swiss chard, 17% of the carrots, about 14% of the beetroots and 6% of the cabbages supplied to the city vegetable market in 1983. Although it was not possible to obtain information on production in subsequent years from the various sources, these data can serve as indicative that the cooperatives contribute a significant proportion the vegetable needs of the city population.

The Mekanissa, Saris and Furi Producers' Cooperative

It has been suggested that when urban land was nationalised and the landlord-tenant relationship abolished, the urban farmer survival strategies were threatened, as there was no better opportunity for them in any other activities in the city. But the urban farmers did not just wait for poverty; rather they decided to become state-land occupiers and went on producing vegetables to satisfy their human needs, just as squatter settlements do. Furthermore, they decided to form a producers' cooperative to strengthen themselves against any threat and to improve their productivity.

The political situation was favourable for such organisation and the government gave the initiative and priority to agricultural cooperatives in the rural areas (Tesfaye Assefa, 1989). However, the formation of the Mekanissa, Furi and Saris (MFS) Vegetable Producers' Cooperative was on the members request and for their own interest - for their survival. The cooperative depended principally on the members' strength and effort to survive.

Here, it has been hypothesised that the cooperative offers organisational possibilities in urban agriculture where the urban farmer households and members are less exploited and less dependent on people (employers and traders). It is a social arrangement which will be more equal and more secure than a traditional landlord-tenant relationship. Such an organisational possibility in urban cultivation not only benefits its members, but also helps to improve the nutritional level of the urban poor.

Based on the experience of the Management Committee members, a selected sample of households, and an examination of records from the MFS Producers' Cooperative Office, the author will try to explain:

- who is in the cooperative?
- the organisational structure of the cooperative; and
- the process of production, distribution and the main constraints on the cooperative.

Formation of the Cooperative

The MFS Producers' Cooperative was formed in 1976 to protect the interests of the urban farmers. On their own initiative, the members approached the Ministry of Agriculture, which was responsible for organising agricultural cooperatives in the rural areas. On their request, the Ministry cooperated in providing technical assistance and allowed the formation of the vegetable producers' cooperative. The cooperative had 268 members at its formation. The information from the survey indicated that about 75% of all the members of the cooperative were tenants and 25% waged farm labourers in the surrounding area at the time the cooperative was set up. The criteria for joining the cooperative included:

- being not less than 18 years of age;
- willingness to occupy oneself in vegetable production only;
- residence within the vegetable production area;
- willingness to transfer one's land (i.e. the land occupied) to the cooperative;
- willingness to participate in the activities of the cooperative;
- being hard-working;
- willingness to be governed by the rules and regulations of the cooperative (as indicated in its by-laws).

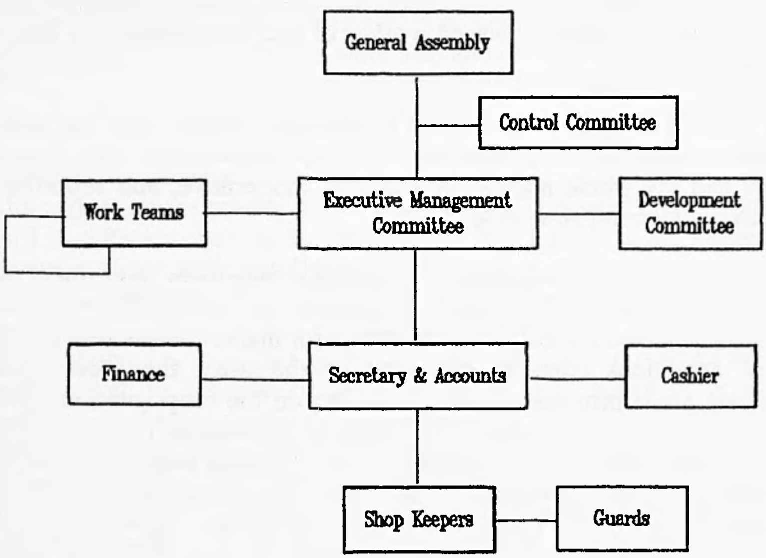
Failure to fulfil these criteria resulted in a number of people being dismissed from the cooperative during the early years.

At the time of this study (1991), there were 242 heads of households who were members of the cooperative. Of these, 17% were women heads of households who replaced their husbands over the years for various reasons including death, illness or separation; 83% were male heads of households. They had all lived in *Kefetegnas* 19, 20 and 23 since they had started cultivation and they all came from an extended-family background. The cooperative reported that of all its members, 78% were able to read and write, about 14% were illiterate and 8% were attending schools.

The household size varied from a one-person household to a 16 person-household, with a total population of 1727. The average household size can thus be taken to be 7.1. Of the total population 52% were males and 48% were females. The age structure showed that 24% were less than 10 years old and 35% were between 10-19 years of age, while 38% were in the age group 20-64 and only 3% were 65 years and above. Thus the population of the cooperative could be characterised as a youthful population, which is indicative of potential manpower supply, high consumption needs and other social requirements.

Organisational Structure
The cooperative members were organised in groups whose structure comprised the General Assembly, special committees and functional bodies (see Figure 1). Important decisions, policy matters and annual production,

Figure 1: Organisational structure of Mekanissa, Furi and Saris Cooperative



distribution plans and programmes were decided by the General Assembly (of all members). The last or final decision for any resolution was given by the General Assembly. Each member had the right to elect and be elected. Any resolution gaining two-thirds of the cooperative members' support was accepted for implementation. The General Assembly elected all the committee members who ran the cooperative.

The Executive Management Committee consisted of a Chairman, a Vice-Chairman, a Secretary, a Treasurer and one committee member. The Executive Management Committee prepared the work plan and budget of the cooperative and it ran the day-to-day business activities. Its main activities included preparation of production plans, follow-up for the implementation of the plans, estimation of production costs, estimation and collection of revenues, preparation of the necessary materials for production, preparation of quarterly reports for financial, material, production and marketing of the cooperative's products. The Executive Management Committee also coordinated the work of the other committees. The Chairman was responsible for any administrative and legal matters on the day-to-day work of the cooperative. The Vice-Chairman represented the Chairman whenever necessary. The Secretary was responsible for the day-to-day administrative matters of the cooperative office work and for recording minutes of meetings. The Treasurer was responsible for all the financial matters of the cooperative. The Executive Management Committee had a clerk who was a temporary waged worker of the cooperative and she was paid Birr 3 per day.

The Control Committee consisted of three elected members. This control committee examined the reports and records of investment, and financial matters and the whole management of the cooperative, and reported its views to the General Assembly.

There were seven Development Committee members and they took important decisions with regard to production and sales plans and programmes. Based on their own experience of market assessment and the physical conditions (climate, soil, etc.) of the area, the Development Committee made proposals for the decisions on the crop rotation system, selection of the type of vegetables produced each season, the inputs, sales and work programme of the cooperative. The proposals were then discussed with the Executive Committee and finally presented to the General Assembly for approval. The Development Committee together with the Executive Management Committee followed up the decisions and if necessary made alterations to the plans during implementation.

The production team leaders assigned work to their team members. They were in charge of supervision and evaluation and awarded points to the members of their own team. There were seven work teams. A team usually consisted of 30-40 members, depending on the location of the land and the spatial distribution of the households. Thirteen guards (six for night and seven for day shifts) provided security for the common property of the cooperative. Twenty two shopkeepers were in charge of the sale of produce in the cooperative shops in the nine *Kefetegnas* in Addis Ababa.

The members of the cooperative worked on the farms, in the shops, as guards, cleaners and on any other necessary activities within their cooperative. They were all evaluated and given points by their team leaders. For example, in the selected sample of 30 heads of households, one was an elected member of the development Committee, one was an elected team leader, two were working as cleaners in the cooperative office, two were guards and the remaining 24 were working in the farms at the time of the survey.

Thus it was reported that members were assigned wherever they were thought to be more productive and fit for the work required. As long as the members worked wherever they were assigned, their contribution was evaluated by their team leaders and given points which were then translated into how much they should receive when they collected their shares. Those who worked overtime were given higher scores or took compensation in time off. The cooperative members were also allowed to delegate their grown up children, above 16 years old, to replace them if they could not work in the farm due to unforseen circumstances.

Legalisation Problems

Although the cooperative had been functioning since 1976, strengthening itself in different ways and achieving important goals in the interest of its members, there were significant problems of legalisation. The cooperative had not been legalised up to the time of the survey. The main reason given for this was that the land was under the ownership of the municipality of Addis Ababa, i.e. the City Council, and the City Council claimed that it was not entitled to legalise or approve agricultural activities in the city. Legalisation for agricultural cooperatives was the responsibility of the Ministry of Agriculture. But the domain of the Ministry of Agriculture was in the rural areas. Thus although the Ministry of Agriculture had actually been giving technical assistance while the cooperative was being set up, providing inputs and other necessary matters, it had no legal right to interfere in activities within the city limit.

The cooperative, regardless of its contribution in terms of satisfying the basic needs of food for the urban population and income for the producers, and despite its potential to reduce the nutritional and economical vulnerability of the low-income producers and the urban poor, therefore remained an illegal entity running an illegal activity in the city. As mentioned earlier, the problem was a classic case of falling between two stools - that of the City Council on the one hand and the Ministry of Agriculture on the other hand, neither of which would accept that it had the power to legitimise the cooperative.

The other major constraint identified was lack of credit facilities, tied to the fact that the cooperative was not legalised. The Agricultural and Industrial Development Bank (AID Bank) had already informed members that only legalised cooperatives had the right to claim credit facilities. It was clear that such a lack of capital could impair the extension of production and increasing productivity. The cooperative needed favourable credit not only for investments but especially to procure production means, since it did not have enough financial reserves at its disposal and therefore often depended on trade for financing its production.

The lack of legal recognition also prevented the cooperative from implementing other planned development projects. For example, the cooperative had a plan to diversify a small part of its vegetable area into dairy production, so that it would be able to sell the milk and use the manure as fertiliser. But the project had to be postponed because of lack of credit facilities. The cooperative had managed to obtain a temporary title deed since 1984. This title deed does not give the right to invest in permanent structures. Thus the fact that the cooperative did not have the right to use the land according to its wishes also imposed restrictions on any development schemes that it could think of, such as getting loans from private individuals or an "Idir" (local fund-raising association).

The Executive Committee members also suggested that at times they had some minor problems with previous landowners. It was stated that the former landowners had tried to disrupt the production and the formation of the cooperative. Although they did not regard this as a major problem, the members explained that they still faced court cases one way or the other because of the lack of a permanent title deed to the land.

It was also stated that the cooperative was suffering from unaffordable heavy urban land taxes. The cooperative had been paying urban land tax to Addis Ababa City Council at a rate of Birr 0.02 per square metre, i.e. about

Birr 40,000 a year for the whole farm. But having a temporary title deed meant that they could not make a permanent investment, and the urban land tax that the cooperative paid was felt to be a very heavy burden. It was indicated that land tax was the major component of the production cost of the cooperative. It was also stated that not only was the tax high but the tax collectors never collected on time. The rural tax for similar production areas was Birr 2 per hectare, which is one percent of the urban agricultural land tax.

Other problems included occasional plant disease, frost and theft. But the committee members explained that those were not major problems as the cooperative members were tackling the diseases by using different crop rotation systems. Cooperative members were also obliged to guard the plantation whenever necessary. However, one could observe that better skills in sorting, packaging, handling and storing the vegetables might have enhanced income.

The committee members stated that whatever they had achieved to date was due to their dedicated struggle and they were determined to fight even harder for their rights and legalisation, harder because they had realised:

- that their survival might be threatened by any plans and programmes approved by the City Council; and
- that one of the main factors in improving their productivity lay in getting credit, and the only way to obtain credit was if they could have their cooperative legalised.

Land Holding

Up to 1984, the cultivation area that the cooperative occupied was 80 hectares, for which they had no title deed. In 1985 this was extended to 200 hectares, by occupying more state-owned land along the river side. It was observed that the occupation did not include the open land claimed by the nearest military camp; the reason given for this was "to avoid confrontation."

The cooperative managed to receive a temporary title deed for this area. According to the interview with the Executive Management Committee, this was the result of:

- the households' or the members' unity, determination and struggle for their survival and their rights;
- their achievement in the supplies that they provided for the city population; and

- their ability to convince some of the authorities who were highly involved in the 1984/85 famine relief programmes.

The cooperative uses irrigation water from the Tinishu Akaki and Tiliku Akaki rivers, which are the main rivers in the city. Water is taken from the rivers by the use of permanent and temporary structures - dams built by the cooperative members. The permanent water diversions are built of stone and concrete while the temporary ones are made of earth. The cooperative had built about 10 permanent structures, the large ones being about 288, 70 and 28 square metres and the others less than that. The cooperative had about six temporary structures which were usually washed away during the rainy season and had to be rebuilt in the dry season. Although the cooperative uses rain during this time, the effort (financial, material and energy) that it puts in to create such temporary structures is quite considerable. Irrigation from three of the dams is done using canal tubes because of the physical configuration of the farms, while gravity is used to move the water from the remaining dams.

The dams and canals were unanimously considered to be the most important investment the cooperative has made for all its members. These were estimated to be worth Birr 1.4 million. It was also reported that they had never faced a shortage of water since the permanent structures had been constructed, unless there was serious drought.

Of the total area, about 150 hectares of land has been used by the cooperative members as communal plots, while about 50 hectares of land had been allocated to all members of the cooperative as private plots. The reasons for dividing the land into communal and private plots was explained that:

- it was the heads of the households who were the official members of the cooperative and they were expected to work for the cooperative, i.e. on communal plots, and the production was intended mainly for sale; and
- the family members were expected to work on the area near their homes, i.e. on private plots, and be able to provide for household consumption.

The average number of private plots was three, with the assumption that one would be worked by the head of the household, who normally was taken to be the husband, one was for the wife and the other one was to be worked by the children of the household. But it was reported that some households were allocated four plots depending on the quality of soil of the area. The width of each plot was 6 metres, while the length varied between 12 and 50 metres depending on the configuration of the area.

For example, the selected sample of 30 households were allocated a total of about 1.7 hectares as private plots. Looking the number of the private plots of the selected households, 90% had three plots each while 10% had four plots each. The total area of the plots of each of the households varied from 288 square metres up to 1080 square meters. The members of the selected sample of households stated that they could do better if they were allocated more land as private plots, i.e. they felt that there was a shortage of land.

Farm Operations

The following operations were carried out in the urban vegetable farms:

Land preparation including slashing of old crop residues, ploughing, discing, land levelling; canal maintenance, nursery preparation, transplanting, irrigation, fertilising, weeding and harvesting. These were all done by hand on the communal as well as private plots. The cooperative started using a tractor for ploughing when it was donated by the Ministry of Agriculture. As the vegetable farms are located near the river and have relatively gentle to steep slopes, it was observed that ploughing was done along the contours to minimise soil erosion and to improve water penetration.

Nursery sites were selected by the Development Committee in the case of the cooperative, or by the head of households in the case of private plots. There was at least one nursery for each team. It was reported that transplanting was carried out when the seedlings reached a certain height and were believed to be strong enough according to the experience of the individuals concerned: the team leader in the cooperative and the heads in the case of the households. Weeding was done by hand as frequently as possible and cultivation was done using hoes and a forked cultivator.

The plots were mainly **irrigated** during the dry season. Water diverted from the river was directed to the vegetable plots using main, secondary and field canals. The field canals supply water to each of the individual plots (i.e. communal as well as private). These were all constructed by the cooperative members themselves. It was also reported that the frequency and intensity of irrigation depended upon the type of vegetable, soil and weather condition. For example, younger vegetables were irrigated more frequently than older ones. If a shortage of water occurred in the dry season, some had to irrigate in the day time while others did it in the evening.

With regards to **inputs**, the cooperative used improved seeds which were bought mainly from the government shops and it also supplied its members for the private plots. The cooperative also bought urea and applied it to some of the communal plots (especially for potato plots) in combination with manure. However, animal manure was used as a fertiliser in all private plots and in most of the communal plots. The cooperative bought the manure from the surrounding individuals who owned livestock for communal plots. In the case of private plots some households owned livestock; those who did not had to buy manure from others. The main reason for not using more commercial fertilisers was that they were too expensive. The animal manure was applied either when it was fresh in liquid form, mixing it with water, or dry manure was spread on the farm and mixed with the soil using hoes. Green manure and compost were non-existent, and the cooperative members stated that they were not familiar with these inputs.

Although it was reported that there were occasional plant diseases, no use was made of pesticides. **Crop rotation** was practised in the communal as well as private plots. Generally, vegetables were harvested all year round depending on the maturity and available market. All the farm work was done by the members themselves. There was no processing except for trimming the unnecessary parts and washing the root crops like carrot, potato and beetroot. The harvested vegetables were packed in baskets or boxes or tied in bundles and taken to the store and weighed and distributed to the cooperative shops in the city - using the truck in the case of the cooperative.

Cooperative Production

Leafy vegetables such as cabbage, swiss chard, cauliflower, lettuce, kale and spinach; root crops like potato, carrot and beetroot; and also pumpkin, onions, green beans, tomatoes, leeks, celery and others were grown in the communal as well as private plots in different proportions.

The **type of vegetables** to be cultivated and the timing for this were proposed by the Development Committee, discussed within the Executive Management Committee and approved by the General Assembly in the case of the communal plots. The most important factors taken into consideration during this **decision-making** included the soil type, weather (i.e. occurrence of heavy rain or frost), and information about the marketing period as more vegetables are consumed during fasting periods like Lent. Two crops were cultivated a year for almost all the vegetables, except for swiss chard which was grown all year.

Considering the most common **land use** and the major crops on the **communal plots**, it was indicated that each year the cooperative used about 33.3% of the area of the communal plots for potatoes, 33.3% for carrots, 11% for swiss chard, about 7% for cabbages, about 7% for beetroots, 3% for lettuces, 2% for onions, 1% for pumpkins and the remaining 2% for other vegetables, including green beans, celery, tomatoes, leeks, kale, spinach and eucalyptus trees. The cooperative had planted about 26,000 eucalyptus trees in the relatively steep slopes of their farm land to prevent soil erosion.

Although the Management Committee members mentioned that the cooperative has been improving in its organisational structure and the production process and distribution system over the years, production as well as yield per hectare from the communal plots was relatively low.

Table 2: Land use of communal plots, estimated average annual production and yield per ha of the major crops (vegetables) of the Mekanissa, Furi and Saris Cooperative, 1985-1990

Major crops Vegetables	*Average size of plots (ha)*	*No of crops per year*	*Estimated average annual production (MT)*	*Estimated yield per hectare (QT)*	*Estimated average price per QT (Birr)*
Potatoes	50	2	18.0	180	80
Carrots	50	2	15.0	150	75
Swiss Chard	17	1	3.4	200	50
Cabbages	10	2	4.0	400	65
Beetroots	10	2	4.0	200	50
Lettuces	5	2	1.0	100	30
Onions	3	1	0.8	250	40
Pumpkins	2	2	1.4	350	40
Others*	3	-	-	-	-

* other crops included green beans, celery, tomatoes, leeks, kale, spinach

The estimated **average annual production** (1985-1990) for the major crops was indicated as 18 tonnes of potatoes, 15 tonnes of carrots, 4 tonnes of cabbages, 4 tonnes of beetroots, 3.4 tonnes of swiss chard, 1.4 tonnes of pumpkins, 1 tonne of lettuces and 0.8 tonnes of onions. The **yield per hectare** of the communal plots also varied from 350 kg. for pumpkins, to 250 kg. for onions, 200 kg. for swiss chard, cabbages and beetroots, 180 kg. for potatoes, 150 kg. for carrots and 100 kg. for lettuces (see Table 2). Such low yields per hectare call for more technical assistance and credit facilities to enhance better production.

Cooperative Marketing
The production of the cooperative, i.e. production from the communal plots, was all intended for sale and the marketing system will be explained here. Before 1985 the MFS Producers' Cooperative, together with other vegetable producers' cooperatives, was running a producer wholesale market, which was a simply constructed hall, in Mercato (Emanuel) the largest market in Addis Ababa. They sold their products to distributing wholesale traders, who in their turn sold the products to groceries, small retailers, institutions, etc..

Prices were changing in the different marketing channels. Since 1985 the cooperatives were allowed to run their own producers' retail shops or cooperative shops in the 25 *Kefetegnas* in Addis Ababa. It was also observed that the cooperatives sold some of their products at the farm gate at the same price as that of the cooperative shops. But the quantity was not significant. Thus, the cooperatives were able to sell their products to consumers directly, be it in the cooperative shops or at the farm gate.

The MFS Cooperative ran nine cooperative shops in nine *Kefetegnas* in the city. This meant that the cooperative was expected to serve the population of these *Kefetegnas* and the population of the adjacent Kefetgna 21 as well. According to the 1984 Census data, these *Kefetegnas* contained about 39.9% of the total population in Addis Ababa. Thirteen cooperative members ran the cooperative shops (as shopkeepers), and the products were sold by weight.

Permission for the cooperative shops was given on condition that the cooperative sold the vegetables at fixed retail prices. The prices were agreed and approved by a special committee which consisted of representatives of the Executive Management Committee of MFS Cooperative, representatives of other vegetable producing cooperatives in the city and representatives of the authorities which were assigned to control prices in the city. Every change in prices had to be approved by the committee before it was implemented. It was stated that there had not been any changes of prices up to the beginning of 1990, when the cooperative increased prices of four of its vegetables: onions went up by about 150%, potatoes by about 82%, cabbages, by about 78% and carrots by about 100%.

The Executive Management Committee members as well as the shopkeepers stated that all the vegetables were sold on the same day they got to the shops and they did not have any problem of waste. The main reasons for such immediate sale were said to be:

- that the prices of the vegetable from the cooperative were cheaper than the same type of vegetables sold in the surrounding shops or small markets;
- that the cooperative shops always had fresher vegetables;
- that the cooperative shops had a greater variety of vegetables; and
- that most of the shops were located within walking distance of the community that they hoped to serve, so people did not have to spend extra time or transportation costs to get fresh vegetables.

Looking at the retail prices of the major types of vegetables in Addis Ababa, it is clear that the prices in the cooperative shops were lower by about 20% for potatoes, 32% for carrots, 50% for swiss chards, 23% for cabbages, 46% for beetroots, 72% for lettuces, 39% for onions and by about 20% for pumpkins than they were in kiosks and open markets in Addis Ababa (see Table 3).

In the more distant production locations, i.e. out of Addis Ababa, the products (vegetables) were mainly collected by wholesalers and delivered to the distributing wholesale trade in Addis Ababa. The products in the areas of cultivation were often bought by freelance or employed brokers on behalf of the collecting wholesalers. The peasants' power to negotiate prices was said to be severely handicapped by their frequent dependence on the wholesaler for credit and advance payments as well as for packing materials. The producer's price also suffered from the peasants' lack of market information. This situation can be clearly seen in Table 3. Most of all it was said that it was possible that the perishable products or vegetables lost their freshness while passing through the market channels.

Thus, apart from being fresh and more nutritious, it is obvious that the urban poor or the majority of the city population would prefer to pay less or reduce their expenses by buying in the cooperative shops at cheaper prices and reduced transportation costs. It might therefore be possible to say that the cooperative provided fresh vegetables to the majority of the population - the urban poor - in the nine *Kefetegnas* it served.

Table 3: Average prices of major crops (vegetable), 1985-1990

Major Crops (Vegetable) Kg	*Average[1] ETFRUIT price*	*Average[2] producers price in shoa*	*Average[3] MFS Coop retail price*	*Average[4] retail price in AA market*
Potatoes	0.50	0.59	0.78	0.96
Carrot	0.30	0.46	0.75	1.11
Swiss Chard	0.30	-	0.50	1.00*
Cabbage	0.32	0.31	0.63	0.82
Beetroot	0.30	0.36	0.50	0.92
Lettuce	0.20	-	0.30	1.07
Onion	0.84	1.14	0.88	1.44
Pumpkin	0.40	0.20	0.40	0.50*
Tomato	0.88	0.55	-	1.76
Green Beans	0.20	-	0.25	-

* Information from the sales of the household (private) plots.

Source:
1 Calculated from the price data of the Ethiopian Fruit and Vegetables Marketing Corporation (1987-1990). The prices exclude turnover tax. The products were mainly sold to government shops and supermarkets.
2 Compiled from CSO, Average Producers' Prices of Agricultural Commodities (1985-1990)
3 Average retail prices of the Mekanissa, Furi and Saris Cooperative (1985-1990), collected from the records of the cooperative.
4 Calculated from CSO, Retail Prices of goods and services in selected Urban Centres Statistical Bulletin (1985-1990). The study deals with open markets which decide their price on demand and supply. It includes kiosks and small shops, but it does not include the government shops and supermarkets.

Investment and Annual Shares

The main sources of income of the MFS Producers' Cooperative included the sale of the produce (the major part), rent from the vehicle the cooperative owned, registration fees from members, fines and donations (as in the case of the tractor). The records of the cooperative showed that the income was mostly invested in the vegetable production and partly shared among the members over the years. The capital position of the cooperative at the end of 1990 was indicated as follows:

- office building including, a multipurpose lightly walled shade (i.e. shade used as a meeting place and also as a store and weighing place) valued at an estimated Birr 50,000;

- office furniture, about Birr 4,842;
- farm implements, except the tractor, about Birr 13,045;
- truck valued at Birr 41,000;
- trailer valued at Birr 27,000;
- water diversion structures (dams, canals and canal tubes) valued at about Birr 1,400,000;
- other fixed assets included a tractor which was donated to the cooperative by the Ministry of Agriculture and was estimated to be worth Birr 100,000.

Thus the gross capital investment that the cooperative had made (i.e. excluding the donated tractor) during the period 1976-1990 was estimated to be Birr 1,535,887 or an average of Birr 6347 per member. Including the donated tractor, the cooperative had a gross capital of Birr 1,635,887 or an average of Birr 6760 per member. The investment on water diversion structures took up about 91% of the total investment expenditure.

Apart from this investment the cooperative members shared certain income every year depending on the points recorded for them while accomplishing the various tasks in the cooperative. The number of recorded points for each cooperative member were multiplied by the same value of money to come up with the share for each member. For example, in 1985-1990 the head of the selected sample of households received an average yearly income varying from a maximum of Birr 700 per member to a minimum of Birr 175 per member. The average yearly shared income of the heads of the selected sample of households from the cooperative over the years could be estimated to be about Birr 223 per head per year.

Gender Roles in the Division of Labour

There was a clear division of labour within the households. Similar to the situation in the agricultural cooperatives in the rural areas, the heads of the households were the only members of the cooperative. Therefore the heads of households were expected to work for the cooperative i.e. on communal plots, for six hours a day for six days a week on any task set for them. In the case of female heads of households, it was reported that they were given an option in which they could work three days a week as they were also expected to work on the private plots.

The working hours were normally between 8 a.m. and 2 p.m., from Monday to Saturday; there was no work on Sundays. But the times (and the points scored were arranged according to the type of work the members did; if they worked extra hours they were either compensated in time or the points were taken as overtime. Taking an average of six hours work per day per member, it meant that about 503.4 man-days were spent on 1 hectare of the communal land per year. All members of the cooperative participated in all the necessary tasks of the cooperative.

Much of the decision-making and control of access to resources was seen to be vested in the head of the household, who would normally be a man. Household membership and headship in the cooperative gave the privilege of access to a cash income when revenues were shared after the sale of products and the entitlement to the benefit of any investment that the cooperative made. Land usage rights could pass on to others, which was why the female heads of household in the sample joined the cooperative. The share allotted by the cooperative to the heads of the selected sample of households was usually used for maintaining or building the house, and buying livestock or clothes depending on his/her own decisions.

Although the work on the private farms was mainly performed by the women and other members of the households, the types of crops, selection of nursery sites and transplanting period of plants were all decided by the heads of the households. In the case of the female heads of households all the necessary decisions were their own but sometimes these were taken with the help of the older children. The marketing of the produce from the private plots was done by the women of the households and the revenue was expended on procuring other foodstuffs for household consumption by the women themselves. For the men the shares they received from the cooperative were used for procuring assets, like improvement of their houses or utilities. Their cultural perception persisted all the way in the discussions and it seemed to be taken for granted that the men ought to invest and the women would have to be able to feed the family.

The women were responsible for all the domestic work - the tasks of cooking, cleaning, childcare, care of the sick and aged. Women who were themselves household heads would do all the work unless daughters or other female relatives were available to help. The sexual division of labour was rigid for domestic tasks, boys still virtually never aiding their mothers. All children, however, helped the women in their work on the private plots.

The female heads of households had to complete their share of work in the cooperative and cultivate their private farms together with other household members as well. They prepared food for the family, got the children to school, tidied up the house, worked in the cooperative or on the private farms, went to the market to sell the produce or to procure the necessary ingredients for meals, and so on. The female heads of households had to prioritise their time and need. At times, they had to work less hours in the cooperative, although this resulted in less points scored and less annual values of share (income) from the cooperative. The eldest daughters seemed to share the responsibility for the housework and generally deputised for their mothers, while the boys helped mainly on the farm. In general, it was noticed that children and other residents in the women-headed households were more involved in the domestic as well as production and marketing process than in the male-headed households. Some of the adult children had even to rearrange their school programmes and joined evening classes to be able to help their mothers during the day.

Conclusion

Formation of the MFS Producers' Cooperative was one of the survival strategies of the members. The head of the households organised themselves into a producers' cooperative in order to strengthen themselves in the face of common problems. But membership for women was given only when they had to replace their husbands due to death, illness or departure from home. The cooperative's organisational structure indicated the rights and responsibilities of the members in participation and the tasks to be accomplished. The land allocation system of the cooperative reflected a clear division of labour within the member households.

The process of production and the distribution system of the cooperative demonstrated that although production and the yield per hectare were relatively low, the cooperative provided income and a share of investment for its members, created unity and solidarity among the members, and made a significant contribution to the city's supply of fresh vegetable. Production from the communal plots of the cooperative was marketed at a fixed price which was relatively cheaper than other sources (so there was a possibility of its products reaching to the urban poor).

But the cooperative faced legalisation problems. Regardless of its importance to low-income urban households, it has remained an illegal entity running an illegal activity in the city. The lack of legal recognition had strangled the cooperative in various ways including the acquisition of credit facilities, implementation of improved inputs and other development programmes. Lack of favourable credit facilities impaired the extension of production and increasing productivity on the farms.

Unlike the unsuccessful experience or failure of most of the cooperatives in Africa (Bakuramutsa, 1982/83, Mayoux, 1988), the responses for the relative success and survival of the MFS Vegetables Cooperative are summarised as follows:

- the formation of the cooperative was inspired by the members' interest or decision to survive (i.e. a survival strategy and not an imposition);
- the cooperative depended mainly on the determination, strength and effort of its members to satisfy its needs;
- there have not been many changes in the Management Committee members and it was observed that the same Chairman has served the cooperative over the years, since the formation of the cooperative. Apart from the commitment and effort of all the Management Committee members, one of the reasons for the success of the cooperative management was said to be the character and dedication of the Chairman. It was also observed that the Chairman was still the most influential and respected person in the community;
- majority of the members had experience in vegetable production;
- the fact that majority of the cooperative members came from the same ethnic group (*Guraghes*) and religious belief (Coptic Christians) meant that they had similar cultural values and this helped in developing mutual trust, especially during the formation of the cooperative;
- although the cooperative's legalisation problem has been exacerbated by lack of responsible management authorities and the cooperative has not been able to obtain credit facilities to improve its productivity, the general political situation in the country has encouraged the formation of cooperatives.

Thus, given the willingness and determination of the households to cultivate, urban agriculture can, in such circumstances, provide both income and a new form of social arrangement, i.e. a cooperative, which is more equitable and more secure than a traditional landlord-tenant relationship.

Urban agriculture has been undertaken by these households as a final stage in their sequence of survival strategies, responding to the threat of extreme poverty and food insecurity due to shortage of income and unemployment. The study demonstrates that low-income households' decision to cultivate was led by the need to feed their families and the expectation of improved returns in the absence of better paying jobs, i.e. as a matter of survival.

The determination, the ability and the willingness to work on urban land (or to cultivate), that is the motivation and application of the household and its members, have to be viewed as equally significant to the availability of land and water resources in relation to overall production capacity. This appears in contrast to treating availability of land and water resources as causal factors, as presented in most of the literature reviewed.

In this regard the study has further revealed the particular nature of cooperative forms of urban agriculture, their significant contribution to the unity and solidarity of their members as well as their role in improving production and providing food supplies for the urban poor. Urban agriculture has improved nutritional levels, income and employment opportunities, and the standard of living of the producers, and has also contributed a significant proportion of the supply of vegetables to the city. Thus urban agriculture should be encouraged, strengthened and given its rightful place, not merely tolerated. Support for low-income urban farmers or such cooperatives means building the communities, which would then be able to help themselves and the general development of the urban areas, and, above all, accepting the reality of the urban economy.

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IRRIGATION MANAGEMENT NETWORK

FARMER ORGANISATIONS FOR LIFT IRRIGATION: Irrigation Companies and Tubewell Cooperatives of Gujarat

Tushaar Shah and Saumindra Bhattacharya

Network Paper 26

June 1993

Network papers in this set:

Newsletter June 1993

23 *The Governance and Management of Irrigation Systems: An Institutional Perspective* by Shui Yan Tang and Elinor Ostrom

24 *Increasing Women's Benefits for Irrigation Development: Smallholder Irrigation in the Kano Plains, Kenya* by Joitske Hulsebosch and Barbara van Koppen

25 *Urban Irrigation and Cooperative Organisations in Addis Ababa, Ethiopia* by Axumite G. Egziabher

26 *Farmer Organisations for Lift Irrigation: Irrigation Companies and Tubewell Cooperatives of Gujarat* by Tushaar Shah and Saumindra Bhattacharya

27 *Poverty in Irrigated Settlements: A discussion paper and replies from Network members*

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Farmer Organisation for Lift Irrigation:
Irrigation Companies and Tubewell Co-operatives of Gujarat

by
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Contents **Page**

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Farmer Organisation for Lift Irrigation: Irrigation Companies and Tubewell Co-operatives of Gujarat

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Introduction

Group ownership and management of lift irrigation becomes important where small and fragmented land holdings make individual ownership of wells unviable, and where tubewell installation entails high capital costs and is fraught with high risks of failure. In central and north Gujarat where both these situations co-exist, a range of institutional innovations have facilitated the rise of a plurality of contracts and regimes for collective ownership and management of irrigation assets. Prominent amongst these are: water markets, tubewell co-operatives and irrigation companies. This study reports results of interviews with 27 co-operatives and 13 companies focusing essentially on their internal organisation, management and control. While member-owned irrigation companies appear uniformly more robust and productive compared to co-operatives, their equity impacts too are not necessarily inferior to co-operatives.

'Design Concepts' for Irrigation Organisations

In the area of natural resource management, much attention in recent times has been paid to the question of equitable access and sustainable use. In the case of groundwater resources, for example, many scholars have argued that because of the absence of clearly specified property rights and on account of the chunky investments needed to lift groundwater, the resource has been pre-empted by the rural elite; and this disorderly process of pre-emption is governed by the rule of the jungle than by the rule of law. Indeed, the law has often abetted this iniquitous political economy. Arguments for sustainability and ecological prudence have been used to erect and justify a plethora of barriers, licensing rules, conditionalities for provision of bank loans and electricity connections, etc, which keep the resource poor as late entrants in securing access to this precious resource (see Chambers, Saxena and Shah, 1989; Shah, 1992). In early decades of Indian planning, socialisation of groundwater through state ownership and management of tubewells was seen as a major way out of this dilemma. In many states including Gujarat, however, early public tubewell programmes met with uniform and resounding failure not only in enhancing equity in access to irrigation but even in terms of efficient and viable operation (see, for example, Abbie *et al.* 1982).

Distrustful of private ownership and disenchanted with public programmes, many social workers and researchers therefore increasingly turned to group ownership and management as a potential solution to the question of equitable access. If the resource poor can somehow act collectively, they can not only overcome the capital and risk constraints but also avoid bureaucratic hassles through self-management and self-governance. The Indian search for an appropriate 'design concept' of a group organisation for lift irrigation has however been dominated by an idealistic - almost romantic - pursuit of equality and democracy, and a strong suspicion of anything remotely approaching the market process. Thus experiments with irrigation groups which incorporate concepts of equity, democracy, participative decision making etc. in their 'core norms and rules' received a great deal of attention in the past decade.

There have been eloquent descriptions of the '*pani panchayats*' established in Maharashtra by the Gram Gaurav Pratishthan, the group irrigation schemes of Deoria and Vaishali in east UP and Bihar, the Sukhomajari experiment in Haryana, the lift irrigation co-operatives of Aga Khan Rural Support Programme (AKRSP) and of the Sadguru Water and Land Development Trust in Gujarat. Each of these has incorporated into its 'design concept' some unique and noble value or principle, evolved and advocated typically by the promoting individual or NGO. Thus, Sukhomajari gave water-entitlement to the landless members located in the command; and Pani Panchayats allocated water rights amongst members in proportion to family size rather than irrigable land of members in the command. The AKRSP and Sadguru 'design concept's too incorporated many noble values and principles of cooperation, such as one-member-one-vote, group decision making, compulsory saving and equal base-level water rights rather than allocations based on irrigation needs.

Many of these normative principles fired the imagination of researchers, donors and government planners who, in turn, actively advocated the replication and scaling up of these experiments as a major institutional approach to groundwater development. However, experience and studies have now begun to show that while all these experiments have important lessons to offer, never the less, they are little more than mere experiments. They certainly exemplify the art of the possible, but none of them has the qualities and features required in the design concept of a group organisation with a major possibility for up-scaling or replication on a sustainable basis.

By 'design concept', we refer to the vision of the concept of the organisation; of how it is to be created, structured, run and dissolved when redundant. It includes the goals that are stated and goals that are pursued, operative rules and norms that are written and unwritten (but operative, all the same), the authority structure on paper and in fact, the scale and the technology to be used, and the economic potential the organisation is created to exploit. In sum, the design concept of an organisation includes all *apriori* assumptions and judgements made about members, employees, technologies, opportunities, environment and all else that will determine the extent to which the organisation being envisaged will achieve the goals of its members. In the 'design concept' of an organisation thus, 'organisation design' of the mainstream management literature is but small and insignificant aspect. Instead it encompasses the entire gamut of questions that have to be addressed by a group of farmers between identifying a need worthy of organisation and the actual creation of an operating organisation.

For example, the 2500 *chikori* growers of Kheda, considering a marketing co-operative as an alternative to contract cultivation for Brooke Bond India Ltd. have first to produce satisfactory answers to an array of questions before having to decide whether the organisation structure will be 'tall or flat', whether the manager will follow the humanistic style or the machine model of management, or whether the structure will be hierarchical or 'matrix' type. Instead, they will have to decide on questions like: would the co-operative just pool members' *chikori* and market it to Brooke Bond, or will they pool and market it to other traders, or will they pool it, grind it and market it themselves in South India where coffee is blended with *chikori*, or will they manufacture coffee themselves? They will also have to decide whether village co-operatives should federate into a district union or whether farmers would directly become members of a district level co-operative. Whether each member should contribute Rs 10,000 as share capital (would he? under what conditions?) or should they raise debt with the co-operative bank? What will be each member's rights and obligations vis-a-vis the organisation? Under what law will we operate? Who will manage the day-to-day business and who will manage the people who manage the co-operative's business? How will losses be distributed if and when they occur? How will capital be raised in the future? and so on. Getting answers to these and similar questions right is germane to building successful farmer organisations. More sequential answering "we will cross the bridge when we come to it" does not help. A *chikori* co-operative of a certain scale starting with a marketing-cum-value adding programme may come up and grow more rapidly than small village co-operatives pooling members' *chikori* and bargaining with Brooke Bond. If an organisation starts with some of these crucial answers wrong, chances are high that it will soon flounder and perish because its members will desert it. Few co-operatives in India have failed because they chose 'tall' organisation structure when 'flat' was called for, or followed machine models where a more humane approach would work better. In our view, most co-operatives that failed to succeed started off with a wrong 'design concept'.

On the other hand, when farmers hit upon the right 'design concept' of an organisation that serves a worthwhile purpose, it propagates and replicates fast. In a 'design concept' with the qualities of replicability and up-scaleability, we would expect to find:

- the internal energy to self create and self propagate;
- the energy to avert external threat to its survival either through confrontation or mutation; and
- propensity to self correct.

'Design concepts' high on these qualities tend to propagate like wildfire and survive against odds until changing contexts makes them redundant. None of the experiments listed above were high on these, for:

- many of these experiments began to decay in less than a decade;
- the core values and normative principles seemed to begin to erode rapidly as soon as the prime-mover of the experiment turned his back;
- because of the heavy emphasis on 'core values and normative principles', many groups did not invest sufficiently in establishing widely accepted operating rules and procedures;
- as a result, the operating efficiency of the group projects tended to decline rapidly; and
- finally, it is seldom that 'replicas' of these successes came up on their own, even in their neighbouring areas; with sufficient 'coaxing', they did come up, but without the presence of a 'conscience-keeper', fell short of the original.

Thus the Deoria and Vaishali groups crumbled at the first sign of competition from private water sellers (Ballabh, 1989); the replicas of Sukhomajari turned out far short of the original model; the number of Pani Panchayats in Purandhar taluka stagnated at 45 now for over a decade; and even in many of the old Panchayats, loss of operating efficiency and erosion of 'core norms and values' has been increasingly recognised. All these experiments will continue to embellish, for a long time, the oral and written history of Indian irrigation organisation as abortive efforts of outstanding individuals who gave a good part of their lives to creating these programmes. However, it would be naive to draw major lessons from them in finding general solutions to the question of assuring India's small holders access to groundwater irrigation.

The Setting

For finding general solutions, we need to skip the sublime and look closely at the commonplace; underplay the values and norms that outsiders like NGOs enforce on local communities and instead study the rules and procedures people evolve on their own; avoid concluding from early successes of novel experiments and stick to analysing 'design concept's which have stood the test of time. This is what we attempt in this paper. We compare two alternative forms of lift irrigation organisations that have a significant presence in Gujarat. The first is lift irrigation co-operatives, which operate under direct and indirect patronage of the state and incorporate into their 'design concept's core values and normative principles that the state machinery supports for whatever reasons. The other are tubewell companies which operate in large numbers completely outside the state's influence and whose 'design concept' is evolved entirely by groups themselves without any external input. One purpose in doing so is to explore whether the two forms of organisations display significant differences in their organisational performance; and if they do, the other purpose is to probe into the reasons that might explain them.

Our sample includes 26 tubewell co-operatives and 13 irrigation companies. All co-operatives are from Kheda district; and all companies are from Mehsana. This was an unfortunate though unavoidable sampling problem since Mehsana has hardly any lift irrigation co-operatives. Kheda has irrigation companies too; however, most of these are small partnerships, partners usually drawn from the same extended family. The Mehsana companies can, on the other hand, have up to 50 partners often belonging to several caste and religious groupings. The Mehsana irrigation companies are thus more than mere kinship-based organisations.

Groundwater conditions differ vastly between the two districts. Mehsana has long suffered declining groundwater tables; current depths of tubewells range between 180-375 metres. Well yields are relatively low, and the risk of failure in new borings significant. Kheda, in contrast, is groundwater-abundant. In many parts of Kheda near the head-reaches of the Mahi Kadana canal, high groundwater tables, and the prospects of rapidly rising water table, represent a clear ecological threat. Even so, for the dynamics above the ground, Mehsana has more in common with Kheda than, for example, with Panchmahals, another water-scarce district of Gujarat. Tubewell investments in Kheda as well as Mehsana are high compared to the borewells and filter points widely in use in Panchmahals. Electric tubewells dominate both Mehsana and Kheda; diesel engines are widely used in Panchmahals where shallow aquifers yield low water output in shallow borewells mounted with oil engines. The socio-economic settings of Kheda and Mehsana too are similar with their rural economies dominated by the sturdy, hard working Patidars with a strong business sense. The two districts, likewise, have vigorous agricultural economies base on lightly irrigated cash crops such as tobacco, cotton, cumin, *raida*, etc and well developed dairying. Finally, compared to many other regions of Gujarat, Mehsana and Kheda have also led in institutional innovations of various types which have fuelled rural economic upsurge during recent decades.

The Sample

A majority of Kheda's tubewell co-operatives are the legacy of the 30-year long abortive effort by the Gujarat Groundwater Resources Development Corporation to manage tubewells under the public sector. While in relative terms, Gujarat's experience in public tubewell programmes has been somewhat less abject than in states like Bihar and Gujarat, in absolute terms, the internal contradictions of the programme have increasingly come to the fore. The Corporation has been looking for ways to salvage the resources sunk to establish some 3500 such tubewells throughout the state, most of which operate at less than 10-15% of their capacity, irrigate less than a fourth of their design commands and incur heavy cash losses year after year.

The key problem with the public tubewell programme has been with its 'design concept'. In operational terms, the problems are similar to those that have afflicted public tubewell programmes in other states. Maintenance and repair suffer heavy delays; operators remain absent for long periods; pipelines are not maintained; farmers can not get adequate service without offering 'illegal rents'; the operators cannot be insulated from local power games. Operator salaries at government rates are already far above the surpluses the tubewells can produce, but operators' unions have demanded overtime for night irrigation thereby further reducing the viability of tubewells. None of these is an outcome that could not have been predicted. All of them could be traced to flaws in the basic assumptions made in the 'design concept' of the programme.

In its strategy to salvage its investments, the Corporation hit precisely at these flaws. It offered to turn over numerous defunct tubewells to farmers in their commands provided they meet certain conditions:

- at least 11 farmers in the command had to approach the Corporation for a lease of the tubewell;
- they had to form and register a lift irrigation co-operative under the Gujarat Co-operative Societies Act and accept the model by laws designed by the Corporation;
- the promoters of the co-operative have to mobilise and supply a security deposit of Rs 5000 to the Corporation;
- the co-operative would manage the tubewell in the interest of its members with the help of hired operator who will be accountable to the Co-operatives management committee; and
- undertake such repairs and maintenance as may be needed to commission the tubewell and operate it.

If these conditions were met, the Corporation would hand over the tubewell to the co-operative on lease at a rent of 1 Rupee per annum.

The Corporation turned over a total of some 40 public tubewells in Kheda district and 150 in the state as a whole during the 1988-92 period. If there were expectations that farmers would come forward wholesale to cash in on this new opportunity, they were largely belied. In much of north-Gujarat (including the districts of Mehsana, Sabarkantha and Basnaskanths), farmer response to the offer was lukewarm. This was understandable because farmers there realised that, even with good management, they could not supply water to members at the low rates that public tubewells are doing now. North Gujarat public tubewells use 60-75 hp motors which attract the highest electricity tariff rates under Gujarat's progressive flat tariff structure[2]. However, since the Corporation charges uniform water prices throughout the state, there is heavy cross-subsidisation from water abundant areas to water scarce areas such as north Gujarat. In Kheda, the response to the Corporation's open offer was better. A total of 30 public tubewells were handed over to tubewell co-operatives; our sample includes 26 of these. Some of the tubewells so turned over ran into various problems and either became defunct or were taken back by the corporation.

The irrigation companies of Mehsana, on the other hand, represent a completely indigenous form of irrigation organisation. They are known to have been in existence for over four decades; new companies come up in sizeable numbers every year. Indeed, in recent times, the bulk of the new private investments in tubewells take place through these informal companies. In our assessment, there are probably 5-7,000 such irrigation companies in Mehsana district alone. In the course of our fieldwork, we noted that as we move further north, companies become less popular and numerous. This is because in many areas of Banaskantha district, for example, land holdings are large and farmers can afford, and prefer, individual tubewells.

Irrigation companies of Mehsana are informal organisations with membership ranging from 5 to 120, but with modal size of 25-40 members. They are not registered under any act; as a result, in law, they are non-entities. The formation of a company is signified by the agreement on a Rs 10 non-judicial stamp paper entered into by all promoter partners of the company. Companies generally maintain bank accounts in the name of the manager (who is elected and the equivalent of the chairman of a co-operative) or in the name of the company itself. Other than the status of the agreement under the Contract Act, irrigation companies have no links with the 'state'. All the resources for the start, as well as for its continued operation, are internally generated. All the authority needed to ensure the smooth running of the company is provided by its member-partners to the managing committee or the manager. This complete independence and

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2 In Gujarat, the power rates are linked to hp of motors as follows:
Rs 192/hp/year for all tubewells of less than 10hp
Rs 330/hp/year for tubewells between 10 and 20 hp
Rs 660/hp/year for tubewells over 20 hp.
This is progressive flat tariff because that rate per hp itself rises as the motor gets bigger. Before 1987, Gujarat had progressive pro-rata tariff, under that regime use of power up to a limit was charged at lower rate/kWH.

the'internal locus of control' that companies enjoy - in principle and in practice - is amongst the most important features of their 'design concept' and something member-companies place a great value on, as we discuss later.

Preliminary Comparison

Table 1 presents some basic features of the two classes if organisation in our sample. In order to do this, we use average values as well as the range of values for the respective sample. We note the impact of the differences in groundwater conditions in the two districts: the depth of the bore in Mehsana's companies is significantly greater than in Kheda co-operatives. Correspondingly, the average size of the motor too is larger in Mehsana. In reviewing the rest of the information, we need to keep in mind the fact that all Kheda co-operatives inherited tubewells which had already been established by the Corporation several years ago, and therefore had to make

Table 1: Preliminary comparison of co-operatives and companies

		Co-operatives (Kheda)	*Companies (Mehsana)*
Sample size		26	13
Age* (years)	*Average*	2.53	6.15
	Range	1-6	3-17
Membership	*Average*	24.3	15.0
	Range	11-115	6-20
Gross Command (acres)	*Average*	163	114.4
	Range	42-320	48-200
Hp of the motor	*Average*	25.13	27.23
	Range	15-38	22-40
Depth of the bore (feet)	*Average*	438.8	583.4
	Range	240-515	480-710
Length of underground pipeline (m)	*Average*	1465.1	2427.3
	Range	400-4200	1750-3500
Capital cost (Rs)	*Average*	n.a.	4.7 lakh
	Range	n.a.	4.2-5.9 lakh

* We refer here to the age of the organisations and not of the asset

no capital investment decision. In contrast, all of Mehsana companies began with a sizeable capital investment from resources contributed by members. It is significant therefore that the investments made by companies in underground pipelines are substantially higher than those made by the Corporation not only per tubewell but, more importantly, per acre brought in the tubewell's command. It implies that companies have a denser network of pipelines, and that a greater proportion of holdings are served directly by the pipeline. In contrast, in the co-operative tubewells, it is likely that water has to be conveyed through open field channels for a long distance before it reaches most holdings. Indirectly, it follows, somewhat counter-intuitively, that companies made larger capital investments to secure efficiencies in the use of power as well as water, compared to the state-owned corporation.[3]

The significantly smaller membership and command area of companies relative to co-operatives can be explained by a combination of the following reasons:

1. in designing commands and enroling partners, companies are driven primarily by the aim to provide a good irrigation service to members. In contrast, the Corporation was guided by the aim to reach the largest possible membership and command area even if it required making some sacrifice in the 'quality' of irrigation service;
2. securing membership of the co-operative entails insignificant one-time cost (of Rs 51); partnership in the company requires contributing to initial and subsequent investment costs in proportion to one's stake in the company. For most partners, this would involve a major personal capital investment decision necessitating careful cost-benefit calculations;
3. partly as a consequence of the cost-less entry into a co-operative, most co-operatives we interviewed had a sizeable number of 'nominal' members who have enrolled either as a dummy member or in the

[3] Companies show a strikingly fine sense of pure economic rationality. The heavy investments made by companies in underground pipelines reflected not so much a desire to save water as the urge to cut electricity costs under the high pro-rata electricity tariff that the Gujarat Electricity Board charged until 1987. More importantly, heavy conveyance losses in open field channels raised dramatically the effective cost of irrigation to holdings away from the well-head. Further, with open field channels, water could not be delivered to higher lands thus unduly restricting effective command. Underground pipelines made the location of tubewell irrelevant, equalised effective irrigation cost regardless of location and made topographical variations immaterial.

hope of future benefits. Thus, it is certain that in no tubewell co-operative is it the case that all members are users of the co-operative's service; in contrast, it is certain that there is no company which has partners who are not active users of the services of the company. In the case of both the classes, however, it would be largely true that there are several non-members who are active users.

Operating Efficiency

Instead of technical efficiency in tubewell operation, in energy use and in water use, we focused our investigation on overall operating efficiency as an important element of organisational effectiveness. Several criteria can be used to assess and compare the operating efficiency of a tubewell co-operative or a company. The critical dimension these criteria need to capture is the actual activity level of the organisation relative to the highest possible. We have used three criteria which seem important and on which data was easily available. The first is the number of acre[4] waterings in different season. These will naturally depend upon a number of factors; demand for irrigation itself would be an important factor, but the quality and reliability of irrigation service too would be important. If alternative irrigation sources are available within the command, that may also affect the extent of irrigation service provided by the tubewell. Acre waterings would thus indicate a sum total of all the impacts of all these factors.

However, the irrigation organisation has no control over many of these - what it can control is its own tubewell, the quality of service it provides and the competitiveness of its terms of business vis-a-vis competitors. If one class of irrigation organisations manage their facilities more efficiently than another, we would expect that their facility would be used more intensively. Thus we would expect that the capacity utilisation of the former class of organisations would be better relative to the latter class. We tried to capture this by computing the average hours of operation of co-operative and company tubewells in different seasons. We also computed the average of the total hours of operation per year.

However, the over-riding constraint that limits the hours of operation of an electric tubewell is hours of power supply available which, in effect, fixes its upper limit. To incorporate this, we computed a third index, namely, hours

[4] 1 acre = 0.4 hectares

Table 2: Comparison of irrigation performance

Irrigation performance	*Co-operatives (Kheda) average per tubewell* acre waterings*	hours per day	% of power** hours used	*Companies (Mehsana) average per tubewell* acre waterings	hours per day	% of power** hours used
rabi 1991-92	289.7 (13)	7,09 (26)	43% (18)	314.2	9.59	48.56%
summer 1991-92	349.8 (13)	6.31 (26)	34.8% (18)	273.1	7.31	48.56% (9)
kharif 1991-92	98.2 (13)	1.56 (26)	8.7% (18)	65.4	2.56	16.22% (9)
Annual pumpage (hours)	1843.9 (17) 1260-2450			2784.7 2000-3400		

* We have used acre waterings as a rough measure of the area irrigated. The number of hours of pumping taken for giving one acre water may differ from crop to crop and area to area. However, within a given command, there is likely to be much uniformity in crops grown as well as time taken per watering.

** average number of hours of operation per day has been divided into average number of hours for which electricity was available during a given season.

The figures in parenthesis indicate the number of tubewells for which data was available on each item for analysis.

of operation as a proportion of the average hours for which electricity was available in the respective area during different seasons. Since demand for irrigation is high during *rabi* and summer[5] and since power supply tends to be scarcest and least reliable during summer, we suggest that the proportion of power hours that a tubewell used for irrigation would be a good indicator of its overall operating efficiency especially in summer. Table 2 compares co-operatives and member-companies on these three criteria.

Table 2 shows that, at least in our sample, member companies perform significantly better compared to co-operatives in terms of 'operating

[5] *rabi* is the post monsoon season; 'summer' is the hot dry period, February to May.

efficiency' as we have defined it. True, in terms of acre-waterings, they fare poorly compared to the Kheda's tubewell co-operatives in rabi and summer, but this does not seem to have much to do with the tubewell and its management. For there is clear evidence that, compared to co-operatives, companies are able to operate their tubewells for longer hours per day in all the three seasons. More, member-companies optimise better - uniformly and significantly - against the binding constraint of limited power hours per day in all the three seasons. As a result, a company managed tubewell operates for 50% more hours per year than a co-operative managed tubewell. This has dramatic impact on the economics of the tubewells managed by co-operatives and member-companies.

Economic Performance

In absolute terms, companies charged higher average water prices to their members than co-operatives charged to theirs. A part of the difference is explained by the higher lifting costs, as well as higher scarcity value of water in Mehsana. However, even relative to their respective competitors' price, companies charged higher than cooperatives. The average price charged by tubewell co-operatives was 15% less compared to the average price charged by private tubewell owners in their commands. In comparison, companies charged only an average of 4% less to their members than private tubewell owners would have charged them. Even so, an average member of a company depended far more heavily on the company's tubewell for his irrigation needs than an average co-operative member depended on the co-operative's. We take up this somewhat paradoxical situation for discussion in a latter section. We note here, however, that hours of operation have a bigger impact on the economics of tubewells than prices whose differences within a region, in any case, are not very significant. We also note that contrary to popular understanding, companies do not depend very much on water sales to non-members, although they certainly sell more to non-members than co-operatives seem to do.

Companies incur significantly higher operating costs than co-operatives. The prime reason is differential electricity charges. In the progressive flat power tariff structure, companies come in the penal rate-slab of Rs 360/hp/year: For example, a 30 hp tubewell would have to find Rs 10,800 for its electricity bill per year. A co-operative falling in the lowest bracket of Rs

192/hp/year would have to pay only Rs 5700[6]. Even with higher electricity bills and higher repair and maintenance costs, companies in general posted superior financial results. All 13 have run in profit, and all systematically set aside earnings for depreciation and future investments. In contrast, 6 out of 18 co-operatives which gave us all financial figures were in loss in 1991-92. In the past, some tubewells leased to co-operatives have had to be returned to the Corporation because they could not be run viably. Thus an average company earns twice what an average co-operative earns in gross income but its impact on profit and reserves is manifold. Significantly, an average company undertakes a considerable amount of capital accumulation which seems enough to keep it going in perpetuity. In contrast, co-operatives always seem to run short of capital.

Organisational Performance

In comparing the performance of co-operatives with member companies, we believe that primacy should be accorded to the purpose for which these organisations were created. It is reasonable to think that when a group of farmers come together to collectively create and manage an irrigation asset, their prime objective is to secure high quality irrigation service at a reasonable cost on a perpetual basis. We further propose that if the 'design concept' of a member organisation assures its members services they value in a manner that is consistent with member values and expectations, then

- it would come up on it own or with limited external effort;
- it will perpetuate itself by generating its own resources; and
- it will sacrifice, confront or mutate for self-preservation.

An organisation which has these characteristics provides the proof of its usefulness to its members by the very fact that it exists and perpetuates. In comparing the organisational performance of different classes of organisations thus the presence or absence of some or all of these can be indicative of their vigour and vitality.

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[6] In 1987, when Gujarat Electricity Board changed to flat tariff system from metered tariff system, the tariff slabs were more progressive than they are now. For 30+ hp tubewells, the original tariff was Rs 660/hp/year; a company at that time had to pay Rs 19,800 per year for power alone. At the behest of some NGO leaders, special concessions were given to lift irrigation cooperatives which were made subject to the lowest tariff slab applicable to tubewells with 7.5 hp motors.

Table 3: Comparison of economic performance 1991-92

	Co-operatives (Kheda)	Companies (Mehsana)
Average hours of pumpage/year	1844	2785
% of pumpage supplied to members	82%	76.9%
Simple average of price/hours (Rs)	18.37	25.23
Price charged by private tubewell owners (Rs/hour)	21.67	26.23
Gross income Average/year (Rs)	~33,844	~70,266
Operating expenses (Rs/year)	~22,928	~33,719
Salary costs (Rs/year)	~7,034	~7,590
Replacement or new investment**	~2,779	~21,614
Profits (Rs/year)	~1,133	~7,343
Accumulated reserves (Rs)	4,890 (12)*	26,000 (13)*

* Figures in brackets represent the number of organisations which reported accumulated reserves. While only 50% of co-operatives had accumulated reserves, all companies reported reserves.

** This is derived as a residual figure. Respondents told us figures on profits, on salary costs, on electricity and maintenance costs; but these did not reconcile. Upon questioning, items of expenditure were cited - such as rewinding of motors, deepening of bore, replacement of pumps or foot valves, repair or extension of pipelines and/or 'kundis' many of which were in the nature of capital costs. Since this figure is derived as a residual, it may also contain aggregated measurement errors in other figures.

Tubewell companies of Mehsana manifest all these three characteristics; and the tubewell co-operatives of Kheda, none. Tubewell companies came up on their own, as '*swayambhoo*' (self-created) organisations. No agency went to create them by offering incentives, managerial and capital subsidies, technical guidance and political support. They multiply and propagate themselves. New companies come up by the day, and all these are organised along the same lines as the earlier ones with few, minor variations. Tubewell companies are seldom known to fail or become defunct. There are well established mechanisms to cover all manner of contingencies and problems. Tubewells owned by companies may fail, but Companies themselves seldom fail except when they have outlived their purpose. Finally, tubewell companies have actively sought to protect their 'design sanctity'. Being in no way connected with the government system which, for all practical purposes, treats them as individual tubewell owners, these member-companies have not had to face any major onslaught of adverse change in their macro-environment. However, companies could easily change their design and register as co-operatives to obtain the concession in electricity tariff; this has not been an insubstantial amount especially at the post-1987 tariff rate of Rs 660/hp/year. However, we heard of no company which has shown inclination to change their character; when probed, one farmer blurted: "what is that saving worth if we lose all our independence and '*sarakari sahib*' will breath down on our neck night and day! ...we are fine the way we are... we make our own rules .. and when we do not like them, we change them..no hassle...".

Several tubewell co-operatives in Gujarat have come up without an official agency playing 'parent' to them. Each of these, however, is a special case because of the presence of some resourceful individual playing 'parent'. Often this individual is one of the co-operatives potential member-users but stretching himself considerably beyond the call of duty as a potential member. Sometimes it is a local politician, an NGO or even people experimenting with broader collective ideals that plays 'parent'. Member-companies of Mehsana had no 'parents'; they were *swayambhoo* (self-created), and therefore more robust in their 'design concept'.

All co-operatives in our study were 'nurtured' by the Corporation. They were nurtured on 'special food' of zero capital costs, nominal lease rent and subsidised electricity. Indeed, one can legitimately raise doubts about whether these organisations came up for the same purpose as member-companies of Mehsana did. It is plausible, indeed very likely, that the primary motivation in co-operative formation is to secure the subsidies. Worse, in each case, it is possible that a large farmer mobilised 10 others to join him to acquire the lease on a valuable asset at extraordinarily low cost and effectively to privatise it to establish a lucrative private business in water sale.

Likewise, there appears no sign that the 'design concept' of tubewell co-operatives that the corporation has evolved by the corporation has begun to self-propagate. After four years of open offer, no more that 50 of the 3500 public tubewells under the corporation management have been turned-over. There is no evidence of any substantial interest amongst farmer groups to bring these assets under collective self-management. If anything, several efforts at takeover have failed and the lease been terminated. Finally, tubewell co-operatives in general have shown high propensity to either fail outright - in which case the lease is terminated - or become defunct or near defunct because the original group has not been able to evolve effective mechanisms for problem solving and conflict resolution. As organisations, thus the tubewell co-operatives of Kheda are fragile and weak in comparison to the member companies of Mehsana.

The' Design concept'of irrigation companies and tubewell co-operatives

Why should the tubewell co-operatives of Kheda perform poorly as member organisations compared to the member companies of Mehsana? After all, the technology available to both the classes of organisations is the same. The people too are the same. If member companies of Mehsana are dominated by the Patidars with exceptional entrepreneurial abilities, so too are the tubewell co-operatives of Kheda. Indeed, more companies in our sample were mixed caste, mixed religion groupings than in Kheda's co-operatives! If anything, the member-companies face far more adverse groundwater conditions that the co-operatives of Kheda; the companies also do not have the advantage of zero capital cost, of nominal rent and of subsidised electricity that the Kheda co-operatives enjoy. It is clear that what failed the co-operative is not the technology nor the economic possibility but the organisation and its 'design concept'. The problem must be traced back to the birth conditions, the bye laws, the *de jure* and *de facto* rules, norms and authority structure, and all the rest that constitute their 'design concept'. Perhaps the organisations to whom the tubewells are turned over are not designed to "provide their members with the services they valued in a manner consistent with their (members') values and preferences"; but member companies of Mehsana are.

Consider how and why a new tubewell co-operative comes into being. It is clear that if conditions were ripe for a group of farmers to come together to jointly own and manage an irrigation asset, it would have come up already without external stimulus. That it did not suggests two things:

1. existing institutions - individual overship, public tubewell, water markets - were widely considered satisfactory; or
2. although the need is felt, farmers were not aware of a 'method' of organising that was readily acceptable to all potential members.

Now, the Corporation's offer provided a stimulus which was likely to be perceived differently by different groups. As we mentioned earlier, a large farmer can perceive it as an opportunity to privatise a public tubewell at low cost by creating a facade of a co-operative. At the other extreme a group genuinely interested in co-operative self-governance and self-management of a member organisation for tubewell irrigation is likely to find the 'conditionalities' attached by the Corporation oppressive and unworkable. According to the byelaws developed by the Corporation for a tubewell co-operative for example:

- registration of the co-operative under the Gujarat Co-operative Act is compulsory;
- share capital can not be raised except within the framework stipulated by the bye-laws which offer no incentive to a member to supply more than the minimum required share capital;
- borrowings cannot exceed eight times the share capital;
- funds have to be invested according to the provisions of the co-operative act;
- the chairman and the management committee cannot appoint, remove, punish or dismiss the manager without prior approval of the district registrar of co-operatives;
- members will have to put at least 50% of their land under food and vegetable crops (the violation of this will entail a penalty of Rs 25 per acre);
- net profit of the co-operative shall be applied in the manner prescribed by the bye laws, these require that 25% goes to a reserve fund, that dividend cannot exceed 12% and that compulsory contribution to the education fund is an increasing function of the dividend declared; that a member cannot get more than 5% of the value of water purchased by him during the year as a patronage bonus; that 20% of the surplus from profit must be assigned to an irrigation development fund which cannot be used except with the prior permission of the district registrar of co-operatives; that the bonus to the operator can not exceed on month's salary; and so on;
- the reserve fund can not be invested or used except with the prior approval of the district registrar; and
- a member can withdraw his membership by settling all his dues with the co-operative (and then refuse right of passage to convey water to distant fields).

To a group of farmers contemplating the formation of a co-operative, this sample of design features of the new scheme poses a difficult set of conceptual as well as operational questions. The latter are the immediate, 'here-and-now' kind, and therefore more relevant. The registration of the co-operative would, for instance, require anywhere between 5-12 visits to the District Registrar's office in Nadiad. At least one co-operative we interviewed confessed that a bribe of Rs 1200 alone could do the trick. Who will make these visits? Who will bear the cost of these visits and the '*chai-pani*' involved? The same hassle gets repeated with the Corporation and the insurance company and so on. In 'nurtured' co-operatives, either an NGO or a resourceful, well connected promoter provides this invaluable service by taking over this process to complete which no ordinary farmer would have either the resources, time, energy or incentive to do.

But the hassle does not end there. In fact, this is the beginning. For there is hardly anything that the chairman and the management committee can do without getting the prior approval of the district registrar and/or the Corporation. True, if the Chairman or secretary has struck a good relationship with the registrar's office, a lot of the hassle can be avoided. However, even in these cases, the 'locus of control' still rests outside the co-operative. All in all, the 'design concept' of a farmer organisation that is being offered by the Corporation to farmers makes it difficult for them to first create the organisation and them manage it in consonance with their goals, values and priorities.

At the conceptual level, this 'design concept' ensures that except for an exceedingly high level of altruism, trust and solidarity within the group, the effort and resources needed to smoothly manage the operations do not come about. The 'design concept' does not even encourage, leave alone stipulate, that capital contributions by different members match their land in command. In one irrigation co-operative, the chairman and the secretary together control a fourth of the command; but like all other members, they too contributed only Rs 300 by way of share capital. This is clearly inequitable because the small holders in the command end up providing capital subsidy to the large farmers.

A number of stipulations (some described above) circumscribe the application of surpluses which depresses capital formulation and generates powerful incentives to pass on all surpluses to farmers in the form of low water prices. Declaring dividends is costlier than building reserves since dividends divert surpluses to education and other funds. However, building reserves too is unattractive because using them for repair and replacement is full of hassles. Raising new capital in times of need is difficult because methods provided by bye laws are inequitable to members with small holdings in the command. Finally, at the level of the group, incentives are low for undertaking major long-term investment plans - such as extension of pipelines, replacing *kundis*, replacing motors, etc. - since there is no guarantee that the Corporation will give another lease after the first five year lease expires. In reality, it is not uncommon for the Corporation to take back a tubewell even before the lease expires on one pretext or the other.

Naturally, therefore, one of the principal operating problems that co-operatives face is of capital shortage. Many of them look up to the Corporation to provide them capital grants and to undertake repairs and maintenance. Those few which do not face any of these problems fall into either of two categories:

1. they are backed by a resourceful leader/NGO; or
2. the capital, time, effort and other resources needed to create and operate the co-operatives are provided mostly by a few members with large holdings in the command who will have a strong temptation to acquire complete control over decision making.

Both these categories are co-operatives in name, oligarchies in fact.

The member-companies of Mehsana, in contrast, are oligarchies in name and co-operatives in fact and spirit. They come up with the sole purpose of serving its members' needs in perpetuity. They are completely self-financed with members contributing capital in proportion to the use they make of the company's services. All who are members are invariably users as well. Some who are users but are not members have a strong incentive to enrol as members at the first opportunity. They are democratic in the sense that they are completely self-governed, and the distribution of voting rights is proportional to use when not equal. Membership to companies is as voluntary as it can be, given the peculiar characteristics of its business. Obviously, companies do not accept as partners farmers way outside the potential command: nor is it likely that such farmers would want membership of companies which cannot benefit them. However, there is evidence that companies make substantial efforts to persuade every farmer within the command to join, not out of any sense of altruism, but for the simple reason that it makes sound business sense. Finally, as a good co-operative, all benefits produced by member-companies are distributed in proportion to the sue of the company' services by different members as stipulated by the equity principle of cooperation.

The organisational structure and processes of a member company too are strikingly similar to an idealised co-operative. The general body meets once a year or in times of an emergency. A Managing Committee of 7-9 members meets once a month or once in two months. It is the (honorary) Manager, the equivalent of the Co-operative's chairman, who runs the show and wields all the power of the general body and the managing committee while they are not in session. He keeps the accounts, supervises the operator, makes instant decisions about repairs, replacements, selling water to non-members, scheduling water deliveries, resolving conflicts amongst members, sacking a recalcitrant or corrupt or careless operator. For slightly weightier issues requiring quick decisions, he quickly consults two or three large stake holders, arrives at and executes a decision. Keeping the tubewell pumping is the mandate of the manager; and the members back him to the hilt in doing so.

All companies we met claimed that in general body and managing committee elections and meetings, the principle of one-man-one-vote is followed. Instances were cited of noisy general body meetings and occasional instances of the replacement of the manager on one ground or another. Invariably, however, the manager in every company was a large stake holder. Examples of companies having managers with very small stakes were as rare as those of companies having elected non-members as chairmen, just because of the prestige and respect these individuals commanded. Where the manager was very busy with his own business, it was common for the company to maintain a paid assistant who would help the manager with the accounts and supervision work. There was much evidence, however, that at all times when decisions were needed, the buck stopped at the manager; and the survival of this apparently non-participative system seems to suggest its acceptability.

Perhaps, an important reason behind their smooth, trouble free management is the proportionality principle which is the hall mark of the 'design concept' of member companies (Phansalkar and Srinivasan, 1992). Since only large stake holders end up as managers and key decision makers, other members know that costs of decision errors will be borne by the manager in proportion to his stake. If the tubewell remains out of order for a long time, the manager will suffer larger losses than most other members. As a result, it is not uncommon that even when companies have no savings, the manager and two or three other large stake holders cough up money to get a burnt motor replaced or other major repairs carried out in as short a time as possible. This is smooth, trouble free management. Absence of conflicts of interests are widely associated with the 'design concept' of member-companies. When new tubewell investments are planned, people instinctively think in terms of this 'design concept'. Differences in the basic design across companies are thus minimal and inconsequential. Thus some companies are strong on distributing profits, saving less, and raising capital every time there is a need. Others never distribute profits and save all profits. Some keep bank accounts; others do not; some pay the operator a fixed wage and also enrol him as a member; others pay him on a per-hour-of-operation basis. Other than these minor variations in operating procedures, the 'design concept' of member companies is the same throughout north Gujarat and is distinctly different from the 'design concept' of lift irrigation co-operatives elsewhere.

How does a member company come into existence? Usually it is a large farmer who takes the initiative. If he needs to develop and irrigation source, his first preference would be a captive tubewell. Where this is feasible, as in parts of Banaskantha, private tubewells come up. Even with somewhat smaller holdings, private tubewells would still come up in areas like Kheda and Baroda where risk of well failure is not very high and where presence of active water markets increases the chances of the tubewell being utilised to viable levels. However, conditions would become ripe for the birth of a member company where even large farmers are too small to:

- mobilise the capital needed to establish a tubewell;
- command enough of their own land to utilise the tubewell to viable levels; and
- absorb the risk of a failed well.

The member-company is thus primarily a social device for spreading the risk of immediate or future well failure which may be too much for even a wealthy farmer to easily absorb. And members agree easily to participate in this device because they can determine in precise terms the extent to which they would be willing to share the risk.

The basic 'design concept' of a member company is simple. Anyone with land in the command area of a proposed tubewell can become a partner. The stake of a partner is determined by how many 'paisa' (or percent) share he owns in the company. No one would be normally allowed more than 45 paisa share; but in general, in most companies, there will be 2-4 partners with 10-12 paisa share each and a large number owning 1-5 paisa share. The share holding would generally have close correspondence with members' land holding in the command. The initial capital is raised in proportional terms; profits and losses are borne in proportional terms. However, water shares have no strict correspondence with member stakes except in times of extreme shortages. Leaving a company is not as easy as leaving a co-operative. Many companies stipulate, in the initial agreement that if a member withdraws from his membership, he cannot withdraw his capital before 10 years. However, transfer of shares is informally permitted if the transferee belongs to the company's original command.

One reason why member companies set their water prices close to market rates is to ensure that members do not grow water intensive crops which are not consistent with the water output of the tubewell. Only rarely is group pressure used to discourage a member from growing a certain crop. The other reason is that larger farmers who generally manage companies do not have the undue incentive to keep water prices low which large framers managing co-operatives would have. In companies, we note, subsidising water cannot benefit large holders; in co-operatives it can. Finally, the primary reason why a farmer becomes a member of a tubewell company is to obtain secure access to an irrigation source, profit share is an insignificant consideration. Most companies never distribute profits: instead, surpluses are retained for future contingencies.

Over years, as member-companies have become popular, even ordinary farmers are able to easily describe how to form and operate new companies. But when the first few such groupings had come up decades ago, there must have been experimentation with a variety of rules, norms, operating procedures. These must have, over time, stabilised in to a 'design concept' that is known to work well and in consonance with the community's accepted notion of what is a just and proper way of arranging things. New companies continue to come up almost by the day, but these use the same standard 'design concept' that has kept several thousand tubewell companies going for decades.

Management and Leadership

Do member-companies need and use exceptional talent and leadership resources to perform so well? No: will and active interest in managing the company well appears far more important than unusually strong 'extension motive'[7] or exceptional managerial and leadership capabilities. Companies seem to need and utilise ordinary capabilities of farmers who are interested. People who end up doing the managing are interested because managing the

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[7] 'Extension motive' is loosely defined as the empathy for and motivation to help others

company's affairs is nearly like managing their own business. The coalescence of incentives and motives that this brings about seems widely recognised as the prime reason for good management. It was therefore not surprising that there appeared no sign of tension about who should be the manager of the company's affairs; it seemed natural that only a sizeable stakeholder should be the manager.

Table 4: Profile of land holdings in the command

Land holdings in the command		*Co-operatives (Kheda)*	*Companies (Mehsana)*
smallest	*average*	2.13	2.65
	range	0.5-3.5	1.5-6.0
largest	*average*	9.13	9.85
	range	4.0-16.0	6.0-18.5
Chairman/manager	*average*	7.49	8.23
	range	2.5-16.0	4.0-14.0
secretary	*average*	6.37	
	range	3.5-15.3	
operator	*average*		3.25
	range		1.5-4.5**

* In 18 out of the 26 co-operatives sampled, the chairman was the largest land holder in the command; in the rest, the chairman usually had a large landholding. In no more that 3 of the 26 co-operatives, for example, the chairman's landholding was less than twice the smallest holding in the command and each of these 3 represented an exceptional situation.

** Co-operatives typically have an elected chairman, an honorayr secretary and a paid operator. The secretary is effectively the executive officer and looks after the day-to-day operations. In companies, the elected 'manager' combines the role of both the chairman and secretary of a co-operative whereas the operator in both cases operates the tubewell and distributes water.

Interestingly, in the case of Kheda's co-operatives, this scale bias in the choice of chairmen and secretaries was even stronger; as Table 4 shows, the average land holding of the chairmen of the 26 co-operatives was very nearly the highest amongst their respective groups. In fact, barring a few co-operatives, in the remainder the chairmen were the largest farmers in the command. The secretaries were also large farmers, and between the two the chairmen and secretaries of most co-operatives accounted for over a third of the tubewell's command areas. These features combined with the widespread evidence of hourly payments to tubewell operators and encouraging them to use the tubewell's services as members (on leased land if they did not have their own), suggest a deep understanding amongst farmer groups of complex 'agency-type' problems that the Corporation's 'design concept' singularly lacked.

This dominance of large farmers among the decision making bodies of co-operatives further elucidate why co-operatives set their water prices low. We examined earlier that the snapping of the proportionality principle, accompanied by the hassles in getting district registrar's approvals for even minor investment decisions and the myopia caused by a short lease period, account for low propensity to save amongst co-operatives. Setting prices low (rather than first making surpluses and then paying dividends and patronage bonus) is an easier, superior and hassle-free method of ensuring that the co-operative's demonstrate a strong tendency to charge low prices. This is analogous to dairy co-operatives' propensity to pay high procurement prices for milk (except for a small tax dimension). Indeed, low water prices are widely regarded as the best indicator of the tubewell co-operative's performance just as high milk procurement price is the most popular indicator of the performance of dairy co-operatives. The Narsanda co-operative, for instance, sells water at an unheard of rate of Rs 4/hour; but because it has been managed well over decades, it does not face the kind of capital crunch many lesser co-operatives routinely face.

Conclusion

In this paper we have been concerned with understanding the conditions under which farmers create their own organisations for lift irrigation and manage their irrigation assets on a self-sustaining basis. We have been so interested in such spontaneous experiments in Mehsana and Kheda that we are not looking yet to see what is actually working in riskier conditions, and how these have developed independently or evolved from well-known projects.

Member-companies of Mehsana which serve the same purpose as the tubewell co-operatives of Kheda are superior farmer organisations from the viewpoint of their farmer members. They are more efficient in operational and economic terms. They are more robust and vigorous as organisations because:

- they self-create and self-propagate;
- they actively guard their design sanctity; and
- they adapt and self-correct.

Water companies are driven by their members' individual goals of appropriating and using groundwater for irrigation. They make groundwater development possible where it would not be if left to individuals. Hence, they may exacerbate the problem of over-development and make its monitoring relatively more difficult.

The primary features of their 'design concept' that account for their superior performance include:

- complete autonomy and self-governance;
- acceptance of the proportionality principle in capital contribution, land holding within the command, patronage, share in profits and in risk;
- implicit recognition of the agency problem vis-a-vis honorary manager as well as paid operator;
- vesting of all powers of the general body in the manager and the managing committee;
- costly exit.

Aspects of the 'design concept' that make tubewell co-operatives fragile and inferior farmer organisations include:

- limited autonomy;
- compulsion to get approval from district registrar and/or corporation officials for most financial and administrative decisions;
- violation of the proportionality principle so that small land holders are required to subsidise large holdings in capital supply;
- externally imposed rules of surplus application which strongly discourage capital accumulation and encourage unduly low water prices;
- myopia induced by the conditions of lease;
- low exit cost.

Will the turn-over scheme operate better if the Corporation agreed to consider companies with a 'design concept' similar to the Mehsana member-companies? In our judgement it will, especially if it saves the members the hassles of getting the registrar's permission to do anything. The companies will perform even better if the Corporation raises the lease rent to Rs 10,000/month for example, but in return provides the members complete autonomy and self governance. Better still, the companies will tend to invest more if the lease period were increased from 5 to 10 years.

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IRRIGATION MANAGEMENT NETWORK

POVERTY IN IRRIGATED SETTLEMENTS
A discussion paper and replies from Network members

Network Paper 27

June 1993

Network papers in this set:

Newsletter June 1993

23 *The Governance and Management of Irrigation Systems: An Institutional Perspective* by Shui Yan Tang and Elinor Ostrom

24 *Increasing Women's Benefits for Irrigation Development: Smallholder Irrigation in the Kano Plains, Kenya* by Joitske Hulsebosch and Barbara van Koppen

25 *Urban Irrigation and Cooperative Organisations in Addis Ababa, Ethiopia* by Axumite G. Egziabher

26 *Farmer Organisations for Lift Irrigation: Irrigation Companies and Tubewell Cooperatives of Gujarat* by Tushaar Shah and Saumindra Bhattacharya

27 *Poverty in Irrigated Settlements: A discussion paper and replies from Network members*

Please send comments on this paper to the author or to:

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Comments received by the Network may be used in future Newsletters or Network papers

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POVERTY IN IRRIGATED SETTLEMENTS

A discussion paper and replies from Network members

Contents — **page**

POVERTY IN IRRIGATED SETTLEMENTS

A discussion paper and replies from Network members

Introduction

In 1991, the IMN received a request from Anura Widapathirana for better discussion of 'poverty alleviation' issues. He sent us a paper which both raised general questions for debate and also provided examples from Sri Lanka of problems commonly found in settlements there. An important issue was raised about whether irrigation projects can also cause impoverishment or sustain conditions of poverty, rather than be seen only as contributing to poverty reduction (as also raised by Michael Cernea in this set). How can the gains from food production and cash crops that have accrued from irrigation, and the needs for future production, be weighed against these risks? How can we learn from the interventions of the past to lessen these risks in the future?

I too felt there was a need for some 'stocktaking', of the changing attention towards poverty issues in irrigation development and support programmes, of the changing world in which we are assessing poverty, and how both sets of changes might be affecting irrigators and field staff. I decided to circulate this paper to selected IMN members to get their reactions to this paper and to see their interests in a debate.

As we hoped, people wrote back with comments which show how assumptions need to be challenged, or dealt with differently in different locations. We had papers reminding us that settlement could involve contexts of land reform and resettlement of oustees, not only land development. This left different future options for change as well as a different legacy of 'problems' in poverty alleviation. In his paper, Anura used the term settlements to indicate both planned development and colonies that have developed over time but which may not have a sense of 'community'. Others have also discussed such 'hydrological communities', where inhabitants have little in common except being neighbours and have little social cohesion (as in the El Salvador paper by sent by Eduardo Quiroga).

Others wrote in to debate who were 'the poor', and what constituted 'poverty' and 'poverty alleviation' in today's world. Some noted that the poorest were often those without land, or people who have been displaced from their lands, so that thought was needed to see how they could benefit from changing production. Others wanted to unpack the association between irrigated agriculture and stagnant or declining rural incomes for irrigators. One view was that new irrigation investments and support services had created significant benefits that were valued for current and future livelihood options. Another view was to see national or 'clique' interests over-ruling individual interests, without adequate attention to social or agricultural support programmes that could have made discrepancies less problematic. Others suggested rephrasing the question to a format more amenable to research, and more related to the current options and interests of policy makers and scheme managers.

In circulating a paper like this, there is a danger that readers will remember the 'problems' cited rather than the issues requested for debate. Hopefully this paper, and the comments that follow, emphasise the issues that need to be disentangled. No one is helped by generalisations that irrigation does, or does not, alleviate poverty - least of all the poor who are still positively interested in irrigated agriculture as part of their livelihood strategies, or dependent upon it. Greater attention to poverty alleviation issues may help us to understand not only what constitutes 'good performance' of a scheme, but also why a scheme performs well. As Professor Levine points out, it might be helpful to consider not only how irrigation can help alleviate poverty, but how the non-economic benefits of poverty alleviation can influence the design and operation of irrigation systems.

We hope that ODI will produce more on this debate shortly. Please write in and let us have your views.

Linden Vincent June 1993

POVERTY IN IRRIGATED SETTLEMENTS: Should it Deserve Emphatic Attention in Future Irrigation Development Work?
by Anura S Widanapathirana[1]

The Background

The objective of this paper is to raise the issue of the importance of poverty problems and to highlight the need for *specific* action for its alleviation in irrigated settlements, and to incorporate this consideration into future irrigation planning. The paper is confined to Sri Lanka but the issues raised may be relevant elsewhere with a similar environmental and political context. The paper discusses the origin and nature of the problem, main causes and some suggestions in order to alleviate poverty. The aim of the paper is to generate further discussion on the poverty issue since this has not received positive and serious attention in irrigation circles. Recent discussions on irrigation development often do not even refer to this problem, but continue to emphasise land and water use issues, as in the past. To site an example quoting the ICID President, it was reported in the Irrigation Management Network Newsletter 90/2a that increasing agricultural production in the developing world in a sustainable manner is the key to alleviating poverty and famine. The above is not fully correct in the context of the irrigation sector. This sector has undergone several changes in the past decades and, increasing irrigated agricultural production alone will not help alleviate poverty, although it may help prevent famine. Production increase alone is not the key to poverty alleviation. Is this alone satisfactory? Has not the irrigation sector changed over the last several years, such that there are new dimensions and new problems that need discussion?

Poverty in irrigation systems is no different from poverty in other sectors of the economy. However, because of the extent of investment in irrigated settlements in several developing countries, including Sri Lanka, and in considering the virtual absence of programmes to alleviate poverty in this sector, the time has come that this issue can no longer be neglected.

For the purpose of this paper, poverty is defined as the inability of the people to generate sufficient income required for the sustenance of their

[1] Dr Widanapathirana is an Agricultural Economist with Irrigation Management Policy Support Activity, Sri Lanka

lives. The primary cause of poverty is unemployment and the initial effect is under-nourishment.

Irrigated Settlements

Irrigated settlements involve about 300,000 hectares and roughly about 400,000 farm families in Sri Lanka. The latter represents about 13% of the country's population. About 7-10% of the public expenditure in the country is devoted for irrigation development work. The irrigable area is developed under two main types of irrigation, namely major[2] and minor[3]. All these irrigation works are gravity-fed systems comprising of a storage tank and a channel network. The majority of the irrigable area is located in the Dry Zone[4] where the rainfall distribution makes it unfit for agricultural production unless the water is stored in tanks to be used during the lean period. The Dry Zone land mass has a high potential for agricultural production through the provision of irrigation water.

As mentioned before, the irrigated land base is the life-support activity for about 13% of the country's population. The people settled under major schemes have been brought from other parts of the country at the time of their development, while the minor schemes have been the home for people for several generations. The former type of settlements began only during the current century.

The irrigated land base represents 22% of the agricultural land area of the country. A total of 90% of the paddy crop from which the staple diet of the Sri Lankan is produced, comes from the irrigated sector. A large variety of

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[2] A major scheme is one with a command area of over 80 hectares. There are about 150 such schemes in the country.

[3] A minor scheme is defined as one catering to a command area of less than 80 hectares. There are about 21,500 minor schemes scattered throughout the country.

[4] Dry Zone is the largest part of the country occupying two-thirds of the land mass which receives an annual rainfall ranging from 500-1,000 mm. In absolute terminology, this zone may not be called 'dry'; however, in terms of the distribution of rainfall, it is dry during most part of the year since 90% of the rainfall is confined to the months of October through December.

other field crops[5] (OFCs) both for domestic consumption as well as for export is also produced under irrigation.

The main objective of developing the irrigated settlements of the country as embodied in the relevant legislative enactments, are the provision of land for the small farmers to develop agriculture; it means to increase production beyond the level of subsistence and eradication of poverty. Some questions worthy of attention at this juncture are as follows: Have the settlers been able to expand production significantly beyond the level of subsistence? Does poverty prevail in irrigated settlements, and if so, what is the scale? What is the gravity of this problem? What are the main causes of poverty? What can be done to alleviate this?

Poverty: the origin and its nature

Let us examine the origin and status of poverty in irrigated settlements. Poverty in irrigation settlements is a result of several problems facing the people living in them. Some of these problems date back to the origin of the settlement itself, while others emanate from the inability of these settlements to address the growing needs of the settler community. The lack of attention to the root causes of poverty and the absence of appropriate measures to alleviate them have been responsible for the growth of the poverty-ridden population over the years.

Relative Wealth of Settlers and Poverty

An important factor which contributes to poverty is the relative wealth of the people at the time of their joining the settlement. The settlers are drawn mainly from the villages in the Wet Zone[6]. When the people are removed from their traditional land base and placed on irrigation schemes, they find it difficult to adjust to the new environment which is a slow and difficult process. In the traditional villages, life is not dependent on irrigation; income is derived from several non-irrigation sources such as

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[5] Crops other than the staple paddy crop are know as 'other field crops' (OFCs). Some of the specific crops include pulses, chilies, vegetables, yams, cereals other than paddy, fruits such as strawberries, pineapple, etc.

[6] The Wet Zone occupies about one-third of the total land area of the country. It receives an annual rainfall of over 1,000 mm which is distributed fairly well throughout the year. Because of the better social and economic facilities found in this zone, it is heavily populated compared to the Dry Zone.

highland and rainfed crops, tree crops, and other non-farm activities. Studies indicate that adaptation by the wealthy groups of people in the new irrigation environment is faster and more stable compared to those who are relatively poorer in the villages. The relative poverty status was found to have been widened in the new settlements, even though all the settlers have been provided with the dwelling units and other basic facilities for farming. In the subsequent years, when the facilities given to settlers were withdrawn, the 'relative poverty' status was expected to grow larger. This means, from the origin of the settlement itself, some people are poor while others are able to escape from the poverty trap.

Differential Access to Resources and Poverty

Differential access to land and water by different settlers enables some people to gain advantage of the settlement facilities and to increase production significantly, while others fail to produce even enough for their own consumption. Some farms are well levelled while others are not; some have good access to irrigation water, while the irrigation channel network delivering water to others is obscure. The people occupying poor and degraded lands with severe water shortages end up with low production levels; poverty is a common phenomenon among these people. Because of the shortage of water, the cultivation in minor schemes in particular is often disrupted. In these schemes, a good harvest is obtained once in several years only. On the other hand, evidence is mounting concerning the severe water distribution problem within major schemes; the headenders cultivate in two seasons, while the tailenders in some schemes do not receive irrigation water at all for cultivation. There are more crop failures reported in the tail areas than in the head reaches. All these structural differences and defects could lead to differences in agricultural production and thereby contributes to growing income disparities, the end result of which is poverty.

Paddy Cultivation and Poverty

The main crop cultivated on irrigated settlements is paddy, the cultivation of which often forces the resource-poor farmer into a poverty cycle. This may be explained through the analysis of profitability fluctuations and labour absorption capacity in paddy farming as shown below.

The cost of production of paddy has increased substantially over the last several years. During this period paddy yield has been stagnating and the marketing margins have not recorded an increase corresponding with the cost increases. The net result has been the consistent low level of returns. The examination of returns to paddy farming indicates that it is not only low, but has remained stagnant. When the gross returns are converted to real terms, it gives the dismal picture of stable and near constant level of returns! This picture is common in all the irrigated paddy areas of the country. As an example, the movement of returns in Polonnaruwa district which is one of the predominant paddy growing areas of the country is given in Figure 1.

Together with the stagnant returns, the prices of other consumables have increased by several folds. For instance, an analysis of the movement of the consumer price index over the last several years shows that the cost of consumables such as food, shelter, clothing, etc, has increased by over three times. It is basically through the income that the settlers derive from paddy sales that the dues on these consumables will have to be settled. Looking at the movement of real income attributable to irrigated paddy farming on the one hand, and the increase in cost of consumables on the other, a farmer who invests on paddy may end up with further depletion of his previously accumulated resources, thereby adding to his poverty status. Under the above scenario, investment in paddy farming is facilitated by credit and borrowed resources which is repaid through the meagre returns realised when the crop is sold in the market. Once the dues are settled from the earnings, there is very little remaining! This cyclical process leads to a rotation of indebtedness as observed in several pilot irrigated settlement schemes of the country. The limited holding size allocated to each settler in irrigation schemes is another physical obstacle to increasing returns beyond the level of subsistence. In fact, whether the allotment size of one hectare is able to generate an income excess of what a family requires is a question raised by several researchers.

The labour absorption capacity of paddy has been stagnant following the years after the advent of new high yielding paddy varieties. For instance, labour absorption per hectare of paddy remains around 120-130 labour days for the last decade. In the meantime, the labour force increases almost daily. Therefore, paddy cultivation does not help create a 'dent' in unemployment unless the areas under the crop is increased[7]. The introduction of technologies such as mechanisation, application of herbicides instead of hand weeding, etc, has also displaced some labour which otherwise would have been absorbed into the paddy sector.

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[7] After the completion of the Mahaweli programme, the area under paddy is expected to remain static. With the conclusion of this programme, the country cannot afford to invest in any more development of irrigable land.

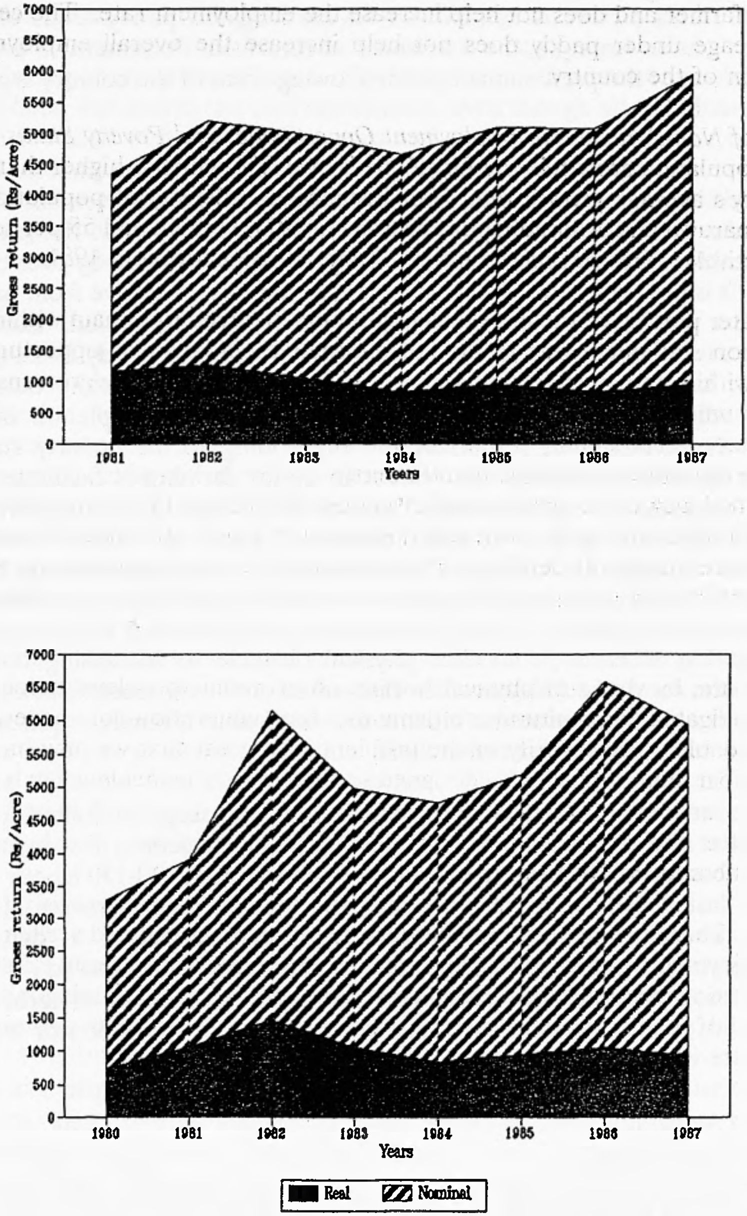

Figure 1: Gross return (real and nominal) from paddy production, Polonnaruwa

Therefore, continuous paddy farming does not appear to increase the wealth of the farmer and does not help increase the employment rate. The ceiling of acreage under paddy does not help increase the overall employment position of the country.

Lack of Non-Agricultural Employment Opportunities and Poverty Status
The population growth in the Dry Zone is over 2%, which is higher than the country's average growth rate. For instance, the density of population in Polonnaruwa and Anuradhapura districts in 1971 were 48 and 55 per sq km respectively. This has increased to 77 and 82 respectively in 1981.

A greater portion of the increased population is forced to remain within the irrigation settlement due to lack of alternative employment opportunities both within and outside this sector. This leads to low level returns per labour unit, growing unemployment, and ultimately poverty.

Weak Operation of the System and Poverty
The efficiency of the gravity-fed irrigation systems in the country is poor. It is said that most of the schemes operate at or below 50% efficiency level. There are structural defects, poor operation and maintenance, and weak planning for water delivery, etc. These factors adversely affect the yield and thereby negatively affect farmer income.

Therefore, by virtue of physical, social and economic problems associated with irrigated agricultural settlements, the generation of poverty is unavoidable. The severity of the problem is so great that we may have to plan programmes specifically designed so as to lower the incidence in future.

Absolute and Relative Poverty

Let us now see the severity of the poverty problem in irrigated settlements. Poverty could be measured in absolute, as well as in relative terms. As seen in Figure 1, the real gains in income attributable to paddy farming is about Rs 1,000 per acre per season[8]. This works out to Rs 200 per month. Compared to the poverty line of Rs 750 per month established for the implementation of the national poverty alleviation programme, it is quite clear that the people in irrigated settlements are saddled with absolute poverty.

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[8] A season comprises of about 5 months.

The relative poverty position, on the other hand, is difficult to assess due to insufficient, relevant data. However, there are three indicators which may be used as proxies to assess the relative poverty position, namely, the incidence of land leasing, size of the agricultural worker population, and paddy yield distribution. With regard to land leasing, several micro-level studies indicate that a growing number of settlers lease their property for farming purposes to non-settlers such as businessmen, traders, etc. It is shown that the extent of leasing is as high as 40% of the total operators in some major irrigation schemes of the country. Studies also indicate an increasing trend in land leasing which is undertaken in an informal manner, since any type of land transaction is prohibited by law which govern the major irrigation settlements of the country[9]. The settlers having leased out their land, work as hired labourers on the very land owned by them. This corroborates the earlier observation that continuous paddy farming contributes to poverty, which is avoided by leasing their paddy lands.

As shown in two consecutive agricultural censuses, the agricultural workers have increased from 45% of the employed population in 1980/81 to 47% in 1985/86. This means, large numbers of people are forced to become paid agricultural workers in an attempt to avoid poverty by being directly engaged in farming.

Evidence is mounting in several major schemes with regard to the large variation in paddy yields realised by individual farmers. Some farmers are obtaining a yield almost as high as the potential yield of cultivated varieties, while others realise less than a quarter of the potential yield, even when the farmers are located in a given hydrological area. If we consider the paddy yield realised by a farmer as proxy for his income, then the above evidence indicates the relative poverty position in irrigation settlements. For the country as a whole, the income distribution has worsened over the period 1980/81 to 1985/86 as reflected in the gini-ratio which has increased from 0.42 to 0.58 respectively during this period.

[9] See Land Development Ordinance and its amendments.

Poverty Alleviation: Past attempts

Having recognised the seriousness of the poverty issue in settlement agriculture, let us examine past investment patterns and how they have looked at the question of poverty alleviation. Irrigation investments until recently took the form of construction of new facilities either by damming rivers or by resorting to trans-basin water diversion. The new construction generates employment opportunities both in the short and long-term and thereby helps to alleviate poverty. New construction also leads to provision of land for the people thus providing employment. Expansion of the irrigation base also leads to development of service facilities which open employment opportunities. As an example, the Mahaweli programme alone has contributed to generation of employment for about 675,000 people which is equivalent to about three-fourths of the unemployed at present. Therefore, new construction of irrigation has contributed in a significant manner to provide employment for the people thus leading to alleviation of poverty.

With the increase in construction cost and the decreased availability of better sites where irrigation could be developed, the potential for new construction is diminishing. Moreover, with the increasing number of irrigation schemes becoming unoperational and the performance less than satisfactory, a programme is needed to refurbish the existing schemes. Thus from the mid-1970s rehabilitation began to gather momentum. The focus of past rehabilitation has been entirely to upgrade the conveyance system (thereby to improve land and water use efficiencies), and to provide water for the already developed command area. Hence, the focus has been entirely on improving the irrigated agricultural production frontier. Although figures are not available, the rehabilitation works have not created new and sustained employment opportunities outside the irrigation base. As revealed in several studies, the past rehabilitation exercises have not substantially increased the cropping intensity and the yield either. Therefore, it can be argued that they have not dealt with the poverty problem and which remains unattended. It is suggested that future rehabilitation should include specific components to alleviate poverty since the construction of new irrigation work which would generate new employment opportunities are not expected to be undertaken in future.

Having established that poverty is widespread in irrigated settlements, and that past efforts have not dealt with this issue in a significant manner, the question is what should be the form of future investments if they are to create a dent in unemployment and to reduce poverty in a meaningful manner? What are the specific components in the irrigation sector that should be considered in future in order to generate employment and higher overall returns to enable effective poverty alleviation? These issues will receive attention in the next section.

Poverty Alleviation: Some basic issues

The basic principle of alleviating poverty is to increase the net income per head of work force involved in irrigated agriculture. The fundamentals in achieving this are to increase *employment rate* and *increase returns*. The limited capacity of irrigated agriculture to generate employment opportunities should also be mentioned at this point. Let us briefly discuss some components in the irrigation settlement which should be considered in a strategy of alleviating poverty. There are four basic components, all of which should be taken within the context of irrigation development. They are irrigated crops, non-irrigated crops, the livestock and non-farm employment generation. Therefore, in a strategy of poverty alleviation, one may essentially have to look beyond the irrigation sector per se.

Irrigated Crops
The irrigated crops are those whose production is essentially determined by irrigation. All past investments focused on increasing production of irrigated crops through the refurbishment of the conveyance system and encouraging farmers to participate in management of the system. However, as discussed earlier, this approach has not generated new employment opportunities outside the irrigation base nor a substantial increase in farm returns sufficient to alleviate poverty. Past experiences also stress the need for an effective programme to diagnose the problems involved from the total systems perspective. The specific constraints must be isolated, assessed and quantified in respect of each scheme in a strategy of increasing average yield of paddy. The picture with regard to other field crops is still uncertain since the level of crop yield under farm conditions is also not known. Hence, a study of practical research needs is necessary to diagnose the problem, and then adaptive research for solving them is necessary, although this may change with space and time.

Non-Irrigated Crops
The non-irrigable crops which are most important in settlement agriculture are the tree crops, other perennial and the annual crops, all of which are grown mainly in the highlands. Each settler is provided with a smaller

extent of highland, in addition to the lowland within the settlement. However, due to absence of irrigation facility, the highland is not utilised adequately. Soil and water conservation practices are rarely adopted, leading to overall poor management of the highland areas. Among the main constraints affecting highland utilisation are lack of water, lack of appropriate technologies, and lack of institutional support including programmes to bring the existing technologies to the people. Among the possibilities to improve highland utilisation are to encourage water saving measures including the adoption of conservation farming techniques, reforestation with economically important varieties, integration of crops and livestock, and the adoption of other types of livestock rearing. The irrigation investment efforts undertaken in the past have done nothing with respect to the above.

Livestock Husbandry
Livestock husbandry has been part and parcel of irrigation in the country since ancient times. It provides draught power for agricultural operations, provides products such as milk, *ghee* (butter oil) and eggs for sale of which generate additional income to the farm family, and the sale of animals for meat and hire purposes (such as for draught power) also add to farm income. Therefore, the development of the livestock industry within the overall irrigation sector is an important component in generating income.

Non-Farm Employment and Industries
With the increase in settler population and lack of available land, it is necessary to encourage people to seek alternative employment in the non-agricultural sector. This is an important proposition in order to maintain high returns per worker involved in irrigated agriculture. As agriculture progresses, the withdrawal of part of the labour force should take place so that the income per agricultural worker could be maintained at a higher level. Among the non-agricultural enterprises which could absorb labour are the agro-based industries, both small and medium-scale, which could utilise agricultural raw materials and by-products generated under irrigation. Industrial development is seen as a major vehicle in alleviating poverty in irrigated settlements of the country.

However, the development of appropriate agro-based industries has not been given any attention in the past. Hence, the outcome, as may be expected is that the surplus labour is forced to remain within the irrigated settlement leading to low returns per worker.

Conclusions

It must be pointed out that if the focus of poverty alleviation concentrates entirely on the irrigated agriculture, it is doomed to be a failure. We must recognise that there is a practical limitation to increasing income from irrigated crops on the one hand, and that surplus labour must be withdrawn from the irrigation base on the other, if farm income is to be increased substantially. With increasing fragmentation of irrigated land and various types of tenure arrangements emerging, any impact on yield and profitability resulting from on-going irrigation investments is likely to be marginal; it will be the non-settlers such as traders, businessmen, etc, who might largely benefit from these investments.

Therefore, in helping the 'ordinary' settler to alleviate poverty, it is important to concentrate on aspects other than irrigated crop production, and the settlement must be considered from the systems perspective. In this regard, highland production, livestock enterprises, crop-livestock integration and non-farm enterprises will have to play a decisive role in future scenarios.

The ultimate aim of irrigation development is to provide a better standard of living for the people in the country. In this connection, it is a necessary condition that poverty is eliminated. However, poverty is often not spoken of in irrigation circles, and programmes specifically designed for its alleviation not planned for. The low emphasis on poverty is reflected in research, training, papers produced, dialogues conducted and action carried out with respect to irrigated agriculture. What proportion of the papers on irrigation are devoted to the question of poverty? It is almost taken for granted that if the irrigation sector is developed the way it was done in the past (by improving efficiency of use of the land and water base), all other problems facing the settlement will be solved. In contrast, the discussion pursued in this paper shows that poverty is a central question facing irrigated settlements and appropriate programmes should be developed to attack it. In fact, our understanding of the poverty situation itself is weak since we have failed to consider this issue in the past. For instance, as discussed in the paper, issues such as relative poverty status is yet to be uncovered. It is finally to be concluded that poverty and its alleviation should be brought into the focus in dialogues and discussions concerning irrigated agriculture and investment programmes should include specific components addressing to this problem in the future.

Professor Gilbert Levine, Professor Emeritus, Cornell University

Dr Widanapathirana's paper raises a number of issues which, in reality, transcend the question of irrigation's role in the alleviation of poverty, and involve a much more general view of poverty alleviation. He poses the question "Should (poverty in irrigated settlements) receive more emphatic attention in future development work?". I would like to suggest that the more appropriate question would be: "How can irrigation investment be made a more effective component of a poverty alleviation strategy?"

Dr Widanapathirana discusses the background to poverty in settlement projects, the absolute and relative levels of poverty and then suggests some ways of addressing the issues. My comments will follow the same sequence.

Background to poverty in the settlements
Dr Widanapathirana identifies the several problems that plague settlement projects in general, and irrigation projects, specifically. It is well-known that settlement projects, require many years (sometimes decades) to achieve optimal levels of logical knowledge and experience, and development of physical and logistic infrastructure.

Information insufficiency characterises new settlement projects. Almost invariably, there is a lack of adequate information about local hydrology, farm level soils and topography, crop suitability, etc. To obtain this information, at a level of precision necessary to the livelihood of farmers on small holdings, at the time of design, usually would be prohibitively expensive.

A similar situation exists with respect to physical and logistic infrastructure. Even when roads and other basic physical infrastructure are provided in the project, they rarely reflect on optimal pattern for the project as it develops. Similarly, the development of appropriate production input, marketing and credit facilities usually extends for a considerable period beyond project initiation. The need for some evolutionary development is recognised generally, and "grace" periods usually are provided for repayment of development loans to permit the project to reach its anticipated performance level. In many instances these grace periods do not reflect accurately the time need for full utilisation of the project.

Dr Widanapathirana also identifies the prior economic condition of the settlers as a critical factor determining individual success in settlement projects. This, again, is a well-known situation with most development projects, and it takes a high (and unusual) degree of political commitment to overcome, even when a project has been designed with this in mind. The foregoing are characteristics of settlement projects, generally, and are not unique to irrigation projects.

A problem that is unique to irrigation projects is the classic "head/tail" discrepancy. In many, if not most, gravity irrigation projects the "tail" areas are disadvantaged in terms of irrigation service, in comparison to the head sections. The reasons may have a physical base, but often reflect problems in system management. The problem is widely recognised, but has been difficult to overcome in many projects.

The result is, as Dr Widanapathirana suggests, differential ability to utilise the potential of the project, and delayed achievement of the production goals. However, the issues are not unknown, and they usually receive significant attention during the process of design and development. What often is lacking is political commitment to make the necessary changes in social structure to minimise differential access, and to resist the influence on irrigation operations of more powerful individuals and groups.

Absolute and relative levels of poverty

Dr Widanapathirana clearly expresses many of the economic problems associated with paddy culture in Sri Lanka. There are similar problems in many paddy growing areas in other countries. For a number of years, the world prices of grain crops have been low, exacerbated by export policies of the United States and the European Community. Very low per hectare net returns are characteristic of almost all paddy producers, irrigated or rainfed. Areas with irrigation facilities frequently have the potential to produce crops with higher economic value and the question "why don't farmers shift to these other crops?" has to be raised.

Two questions are inherent in determining the answer:

- What are the economic and social incentives and disincentives associated with a shift from paddy to other crops?
- Is the technology and supporting economic infrastructure available for higher value alternative crops?

Illustrative of the importance of incentives is the Mahaweli experience with paddy and chilies. When government policy was to support the price of paddy and to import chilies if the domestic price rose too high, farmers in the Mahaweli project persisted in growing paddy in areas physically inappropriate for paddy, with resulting relatively low yields and very high water usage. As soon as the policy was changed to permit more profitable production of chilies, the farmers shifted their cropping pattern. Dr Widanapathirana argues that irrigation development will not solve the poverty problem and recommends a systems approach in analysing the problem and in developing solutions. I am in full agreement with this view. Poverty, in most countries, has causes that are complex; alleviation attempts cannot depend upon any single type of development, but inevitably must involve a complex mix of activities. Where poverty is markedly influenced by the prevailing social/cultural conditions, irrigation development is a very crude instrument to use in attempting to alleviate poverty. In view of the fact that irrigation should be considered only one, if a very important, element of a poverty alleviation strategy, some questions arise for those involved in irrigation planning, design, implementation and operation? To what extent, and how, can the non-economic benefits from poverty alleviation be factored into the decision-making calculus about system design and operation? The answers are not obvious, and merit wider attention.

S.N. Alukonya, MWEA Irrigation Agricultural Development Project, Kenya

Background

The Mwea Irrigation Settlement was initiated by the colonial government as a settlement scheme for ex-*mau-mau* detainees with the objectives of employment creation, poverty alleviation and boosting food production for the country. This was back in 1955 and since then remarkable success in the pursuit of the initial objectives has been recorded. However, due to social economic changes, poverty has continued to show its ugly face, as revealed by the generally lower standard of living of farmers in the scheme.

The irrigated land is owned by the Government and farmers have a lease licence which is renewed annually automatically, except for a few cases of eviction due to absolute negligence and disregard of irrigation regulations.

Most farmers are not able to generate sufficient income to sustain comfortable life-styles due to the general increase in the cost of farm inputs. The more or less stagnant net income payable to farmers is largely to blame for the frequent upward prices of farm inputs, particularly fertilisers and other agro-chemicals; as well as farm machinery which is imported from countries with strong currencies.

MWEA Scheme as an irrigation settlement

At present 3,248 families are settled in the MWEA scheme with an average family size of six (6) members or a total of 20,000 persons deriving their livelihood from paddy cultivation. The scheme operates according to provisions of the Irrigation Act, Cap 347 of the laws of Kenya published in 1966. As stated in background information, increasing farmers incomes beyond the level of basic subsistence and eradication of poverty is a central policy which the Government considers in their annual revision of prices payable to the farmer for his produce. However, poverty has not been fully eradicated due to reasons discussed under subsequent headings.

Origin of Poverty - Mwea Case

Compared to general living standards prevailing elsewhere the Mwea Irrigation Settlement Scheme cannot be considered poverty stricken as such, although much more is expected by the farmers. It is mainly the limited farm size (1.6 ha) and large families which force the farmers living standards downwards. Large families are still preferred due to social conditions. A recent socio-economic study in 1991 revealed an average family size of 9.1 persons with 50% of men having more than one wife. Many people are competing for limited income from limited plot size.

Relative wealth of settlers and poverty Analysis of farmers incomes, into income classes, reveals a wide disparity in net income between those who end up in debt and those enjoying an annual net income of over ksh.30,000 annually. Farmers who have been able to subsidise their paddy incomes by cultivating tomatoes and french beans end up better off than the rest. Farmers who are in debt may decide to sell their crop to the National Irrigation Board through wealthy farmers who buy the crop at reduced prices and also purchase fertiliser at lower prices. The poor farmer ends up with a poor crop which is marketed at a lower price while wealthy farmers will be able to have a bumper crop to sell at high prices. This transaction makes wealthy farmers wealthier each year and poor farmers sink deeper into poverty unless assisted otherwise.

Differential access to resources and poverty Presently the Scheme is divided into five sections; namely Tebere commanded by water of Nyamindi river and the Mwea, Thiba, Wamumu and Karaba sections which are commanded by water from Thiba river. Until now Tebere farmers have surplus irrigation water while the other sections suffer from periodic water shortages. Tebere farmers are able to grow horticultural crops, notably french beans and tomatoes to subsidise their paddy income, while this activity is carried out to a much smaller extent in other sections. Under a grant aid programme from the Government of Japan, a link canal is under construction to effect inter basin transfer of water from Nyamindi to Thiba river to alleviate water shortage in the four sections commanded by Thiba Head works. This work is nearing completion and it is expected that the 1992/93 crop will benefit from this engineering work.

Table 1: Net income levels for MWEA farmers during the period reviewed for Sri Lanka farmers

Year	*Production*			*Mean return per farmer Kshs*	
	Ha	*M-tonnes*	*Kg/Ha*		
1979/80*	6,302	29,202	4,642	8,963	
1980/81*	6,315	32,248	5,106	8,861	(633$)
1981/82	5,782	29,848	5,162	11,087	
1982/83	5,784	28,751	4,971	11,348	
1983/84	5,820	29,336	5,041	13,853	
1984/85	5,825	27,553	4,730	12,776	
1985/86*	8,271	26,407	4,530	9,017	
1986/87	5,799	25,736	4,438	15,448	
1987/88	5,795	27,153	4,686	16,695	
1988/89	5,818	27,555	4,736	19,947	(1,066$)

* Limited double cropping years

<u>Paddy cultivation and poverty</u> Table 1 shows net income levels for Mwea farmers during the period reviewed for Sri Lankan farmers in the eighties. Limited double cropping was tried and incomes to farmers fell due to low yields. Leaving aside double cropping years, Table 1 shows a general increase in farmers income, the value of the Kenyan shilling has dropped from about Shs.14 to a US dollar in 1980 to Shs.32 to a US dollar in 1992. So real incomes have at best stagnated for wealthy farmers but have dropped drastically for bëlow average farmers.

Mwea Rice Mills and Mwea Cotton Ginnery are the only agro-based industries within the settlement area. Given the seasonal functioning of the ginnery from September to December only, the two industries have not made a big dent in unemployment which is prevalent in the area. Thus the huge population of unemployed or under employed adds to the poverty of the farmers. Although the price of rice is de-controlled, the low earning population can only pay model prices for the rice and hence payment to farmers cannot be revised without hitting a snag.

Lack of non-agricultural employment opportunities and poverty status Mwea is 100km from Nairobi - the main industrial town. Therefore, release of labour to industry is limited to the two factories mentioned above. Ultimately, this leads to poverty.

Weak operation of the system and poverty Most of the water shortage problems arise from an inefficient conveyance system with a lot of seepage because it is costly to line canals, drains and field bands with concrete slabs. Irrigation efficiency is low and hence we are faced with the naked truth "POVERTY BEGETS POVERTY". Mwea is a gravity fed irrigation system and as such water losses do not result in conspicuous yield losses. However, in other rice schemes, where pumped irrigation systems are in place the impact of such water losses on the overall increase of pumping costs is enormous.

Absolute and relative poverty

As stated earlier, farmers in Mwea Irrigation Settlement are on average only relatively poor rather than absolutely poor. As the Table 1 shows, the previous target of Kshs 5,000 annual income per family has been met and exceeded. The Mwea farmer without subsidiary income is only poor in the sense that he cannot keep up his income to match the ever escalating cost of living, but basic food, shelter and clothing needs can still be sustained. Unlike Sri Lanka where an increasing proportion of farmers are leasing their land to business men, Mwea farmers stick to their land and only engage in casual labour at transplanting and harvesting time when their holdings are free from these operations. The money so earned is ploughed back into their holdings to fund transplanting and harvesting expenses when their turn comes.

Attempts to alleviate poverty

The following measures are in place to assist the farmer to float above poverty line:

- Annual price increases for paddy.
- Differential price structure whereby basmati, a favourable aromatic variety is more highly priced than non-aromatic

varieties. This compensates for the lower yield potential of basmati compared with other commercial non-aromatic varieties.

- Transfer of water from Nyamindi to Thiba river will alleviate water shortage problems in Mwea, Thiba, Wamumu and Karaba sections, contribute to yield increase and ultimate poverty alleviation to the farming community. The main Tebere canal has been lined most of it's entire length. This will result in minimization of seepage losses with subsequent benefits to crop yield levels and hence to income and consequently to alleviate poverty.

Poverty alleviation - some basic issues
Like the Sri Lanka situation, the basic principle of alleviating poverty of Mwea farmers is to increase net payout to the farmer by minimising direct costs of crop production which are usually passed on to the farmer on the one hand, and increasing price payable to the farmer to reflect the general inflationary trends on the other. In addition the following aspects can also be considered.

<u>Irrigated crop area</u> Plans are in the pipeline to increase the cropped area of the scheme by some 3,900 ha. This will improve general food supply in the area and minimise the degree of poverty.

<u>Utilisation of red soils</u> As far as possible, the red soil area should be utilised, as indeed is happening to produce more subsistence crops like maize and beans. This will reduce pressure on rice as a source of subsistence and hence transfer the paddy saved to cash to alleviate poverty.

<u>Livestock husbandry</u> Farmers are allowed to keep cattle for draught power particularly field levelling and transport at harvesting time. They also sell the cattle for meat as well as getting milk. Poultry are kept for eggs and meat and other farmers are engaged in pig production.

<u>Non-farm employment and industries</u> Only Mwea Rice Mills and Mwea Ginnery provide paid employment outside direct farm production sector, and installation of other industries in the near future as a vehicle for alleviating poverty is not in focus.

Conclusions

It is becoming increasingly clear that despite provision of adequate water and land resources to the irrigation settlement communities, although it is a big stride towards poverty alleviation, other measures must be in place to enable the farmer to survive above the poverty line. Usually irrigation is expected to contribute to tremendous national economic development but although this sweet dream quite often materialises, it is often at the expense of the farmer who is squeezed between de-controlled high input costs and controlled price for his products. Tax exemptions on agricultural machinery and farm inputs, and marketing assistance are yet further approaches to poverty alleviation in irrigated settlement schemes. When future schemes are planned, realistic internal rate of returns should be used to justify construction, operation and maintenance of new irrigation schemes so that poverty amidst the settled farmers does not take anyone by surprise.

Tissa Bandaragoda, Senior Management Specialist, IIMI-Pakistan

The ground situation demonstrates that despite notable advances made in overall agricultural production in Pakistan and its apparent contribution to the development pockets mostly in urban areas, its impact on the poor in rural areas has not been very satisfactory. The official recognition of this fact can be seen in the following statement by the National Commission on Agriculture (1988:9)

> *During a period of declining public investment in agriculture and irrigation, expenditure on research and extension has exceeded the target, though it would seem that there has not been a comparable impact of this on small and low-income farmers. ....In fact, performance regarding the lot of small farmers has been least satisfactory. No specific policy instruments or packages have as yet been devised for this category of producers despite the stated objectives. The Sixth Plan policies of input subsidies and price supports for cash crops worked more to the advantage of large farmers who also managed to pre-empt a major portion of the subsidy on credit and fertilizer. In fact, most of the increases in production resulted from the minority of the large and the medium farmers, and the yield gaps between the progressive and traditional farmers remain wide. The overall institutional support has not adequately benefited all crops nor all categories of farmers.*

The overall national statistics also confirm the observable poor conditions in rural areas where the drama of irrigation is actually played. The average per capita income in Pakistan's rural areas (where about 70 percent of its 106 million population lives) is currently less than half that in urban areas, and value added per worker in agriculture (which employs about 50 percent of the work force) is less that one-third of the rest of the economy. The apparent prosperous scene in the major cities belies the poor status of, and contribution by, the majority in rural areas; the effect of this poverty burden can be seen in Pakistan's low per capita gross national product of only US $350, lower than in some of the other less resource-endowed countries in the region (World Development Report, 1990). Pakistan's relative position in its overall socio-economic status compared to some similar developing countries can be seen in Table 2.

The reasons for this conspicuous anomaly have to be found in the national policies which obviously, as indicated earlier in the conceptual background to this paper, are closely related to the current institutional framework. Its static nature acts as an impediment to the formulation of progressive policies, illustrating the vicious circle in which policies and institutions are interlinked. In an overview of the policy scene of the past few decades, Hamid and Tims (1990:12) make the following comment which confirms the observation on the ground:

> *No noticeable progress has been made over the past 25 years in rural education: literacy has remained at a low level, even compared to that of other countries at the same or lesser stage of development. This is a major handicap for the lower income strata, even if the labour market develops in a manner that promises full absorption of supplies. Also health extension services are scarce and in most cases inefficiently used. Access to rural health facilities appears in fact to have declined. There is a remarkable contrast in Pakistan between the attention paid to the improvements of its agricultural base and on-farm capitalisation, and the relative neglect of the supporting environment. Little care has been given to the people or the social infrastructure.*

The policies that were aimed at improving the agricultural base and economic development through investment, price adjustments and income transfers ignored two, apparently inter-related, major features of the country's irrigation sector. The policies were not only insensitive to the earlier mentioned skewed social capacity within the sector, but also to its uneven land distribution. Consequently, the opportunities and incentives provided by such well intended policies favoured the few large land owners. The average size farm in Pakistan is about 4.7 hectares, depicting basically

Table 2: Some selected socio-economic indicators of Pakistan and other selected developing countries

	GNP pc $(1988)	*Growth rate %*	*Agr % of GNP*	*Life exp (yrs)*	*Illiteracy %*	
					Female	*Male*
Bangladesh	170	0.4	46	51	78	67
Bhutan	180		44	48		
Nepal	180		56	51	88	74
Burkina Faso	210	1.2	39	47	94	87
Nigeria	290	0.9	34	51	69	58
India	340	1.8	32	58	71	57
Pakistan	350	2.5	26	55	81	70
Sri Lanka	420	3.0	26	71	17	13
Indonesia	440	4.3	24	61	35	26
Sudan	480	0.0	33	50		
Philippines	630	1.6	23	64	15	14

	Infant Mortality Rate/1000 live births	*Maternal Mortality /100,000*	*Population (million)*	*Population Growth Rate Ann %*
Bangladesh	118	600	109	2.8
Bhutan	127		1	2.1
Nepal	126		18	2.6
Burkina Faso	137	600	9	2.6
Nigeria	103	1500	110	3.3
India	97	500	816	2.2
Pakistan	107	600	106	3.2
Sri Lanka	21	90	17	1.5
Indonesia	68	800	175	1.7
Sudan	106	607	24	2.7
Philippines	44	80	60	1.9

Note: The developing countries mentioned in this Table are some of those in which irrigation is used as a major development strategy, and where IIMI programs are also located

Source: World Development Report, 1990 a small-farm structure. However, the overall distributions of farms in number and size are skewed. Three percent of the farms are over 30 hectares in size and account for 23 percent of the cropped area, whereas 17 percent of the farms are less than one hectare and cover only two percent of the area (World Bank Staff Appraisal Report on the Second Irrigation Systems Rehabilitation Project of Pakistan, March 18988).

In such a situation, access to major inputs is fairly inequitable, so is the access to benefits from irrigation water. Although land distribution and hydrological lay-out cannot be clearly correlated, it has been observed that "canal supplies tend to be pre-empted by large farmers near the distribution channels, while small farmers occupying the far reaches of the system may receive inadequate and unreliable supplies" (Hamid and Tims, 1990). More clearly seen is the skewed access to tubewell water the cost of which only the larger farmers can easily afford.

This brings to focus an area at which allocative policies can probably be directed. While scale-neutrality is assumed for the benefits of canal water supply as its distribution is based on the extent of land to be irrigated, in terms of access to benefits, the location and the size of land seem to place the large land owner and the head-end farmer in a more favourable position. The ownership of land is concerned with a broader national level allocative policy involving agrarian and land reforms, but the location-based equity problem is a typical irrigation management policy issue. Incentive structures for groundwater development can provide opportunities to help the water-starved tail-end farmers, and if the institutional barriers are appropriately handled they can even be directed towards methods of conjunctive use of canal and groundwater aimed at reducing the present disconcerting features of inequity.

In large scale, publicly administered irrigation systems, such as those in Pakistan, the possibilities of helping the sizeable section of the land-poor (the landless and agricultural labour) in the rural population cannot be clearly seen, but must be sought through conscious efforts (Silliman and Lenton, 1987). However, for irrigation to contribute effectively towards poverty alleviation, this significant section of the rural poor should also be within the ambit of irrigation-related policies.

For more details see OECD's *Agriculture Growth and Economic Development: the cast of Pakistan* (Hamid and Tims, 1990).

Dr R K Sivanappan, Director, Water Technology Centre, Tamil Nadu Agricultural University

The author Anura S Widanapathirana is of the view that irrigation planners have not given due emphasis to poverty problems. Poverty is a multi-dimensional, socio-economic malady. Irrigation has to be perceived as one among the major components to help in the process of poverty alleviation in agrarian societies. The fact cannot be forgotten that irrigation has engineered major socio-economic transformations in the developing economies and has paved the way for minimising the evils of poverty and alleviation of poverty under certain situations in the Indian context.

In irrigated areas where mono-crop specialisation has happened due to various socio-cultural and economic reasons, the developmental path was seriously hampered and at times stagnation marks the scenario as pointed by the author. However, this is not universal and it is location-specific. The question is why the incidence of such a phenomena where decentralised farming systems are in vogue, and individual farmers are in a position to decide what is best to improve farm productivity, (eg. crops, livestock, horticulture, poultry, etc.) and get increased incomes. It is in situations where the pattern of irrigation system, by itself, does not permit free choice of enterprises that attendant problems emerge. Limiting the options has perforce constrained the farmers to intensive cropping and more often exclusively paddy.

The match between paddy and poverty is proverbial but this nexus weakened with the advent of high yielding paddy varieties. Crop diversification and increased cropping intensities have ushered in larger employment opportunities and enhanced income levels and helped in alleviation of poverty.

In the "*Green Revolution Reconsidered: The Impact of High Yielding Varieties in South India*" (Baltimore, Md, USAL: The John Hopkins University Press for IFPRI-1991) Peter Hazell and C Ramasay, along with several associates, finds that landless labourers and small scale farmers gained proportionately with large scale farmers. Virtually all farmers eventually adopted the high yielding varieties and significantly increased their productivity. Although the use of hired labour employed in crop production declined somewhat, real wage rates increased modestly for some tasks and agricultural employment earnings virtually doubled for small paddy farm, non-agricultural and landless households. In addition to increases in wage rates, the distribution of income improved and absolute poverty declined.

In the context of what have been stated above, I am inclined to view that such a hypothesis has only locational applicability. However, I agree with his views expressed in the last paragraph of the note.

Further the situation in large irrigation projects is different in India. Here in India, there are no irrigated settlements as in the case of Sri Lanka. The proposed irrigated area was under rainfed crop production but when water is given for the land, the production is increased. In Indian conditions, the average yield with rain is about 0.7 T/ha whereas it is about 1.7 T/ha under irrigation. Therefore, the statement of Dr Widanapathirana need not be true in all places.

Edward Mallorie, Independent Consultant, UK

Irrigation and Poverty Alleviation
There is evidence to suggest that the benefits of irrigation (and other development of the agricultural infrastructure such as flood control) are skewed towards those with land and against the landless and marginal farmers who make up a high proportion of the rural population. Irrigation can dramatically increase the profitability of crop production to the benefit of land owners. Although agricultural labourers do benefit from increased employment in harvesting, rice transplanting etc., this may be offset to some extent by investment of increased profits in labour saving mechanisation to meet the tighter time demands of more intensive irrigated agriculture. Interviews with landless and marginal farmers indicates that they see themselves benefitting indirectly - for instance in building houses for richer farmers.

The limited benefits for poor people from many agricultural development activities explains why many NGOs stress non-agricultural income generation. NGO sponsored groundwater development is aimed more at generating income through sales of water to larger farmers than through irrigated farming by group members.

Involvement of NGOs in irrigation
There is considerable interest from donor agencies in Bangladesh in using NGOs as a more appropriate avenue for developing farmer organisations than government agencies. NGOs have some success in developing tubewell groups. However, the potential to extend their role into surface irrigation appears limited by NGOs unwillingness to become involved in this area as:

- Many of the major NGOs limit their activities to a target group of landless people and very small farmers (up to half an acre owned). This tends to preclude an area-based water users association including all the farmers in an irrigation area.
- NGOs who might support water users groups at a tertiary level have reservations about relying on a government agency to ensure that water is reliably supplied to the tertiary. Unlike other South Asian countries, Bangladesh has no tradition of operation of large-scale surface irrigation systems.
- The success of NGOs has been built around the gradual development of small voluntary groups of like-minded people. Surface water irrigation will demand rapid development of many groups with diverse membership.

Dr B C Barik, Gujarat Irrigation Management Society, India

Irrigation projects are conceived as development projects. It is strongly believed that any development projects, in the natural course, eliminate poverty and inequality in the society. Irrigation projects are no exception to this. During the last century, several thousands of irrigation projects have been constructed in the developing, as well as developed, countries with an aim to see the overall development of society. But the lesson we have learnt that these projects are unable to bridge the gap of inequality and poverty. Several research studies support this finding. The present paper on poverty in irrigated settlements by A S Widanapathirana is a new addition to the process of ongoing dialogue and hence is welcome.

The paper deals at length with irrigation projects (major and minor) in Sri Lanka. I strongly disagree with the way the author has tried to define poverty:

> "*... ability of the people to generate sufficient income required for the sustenance of their lives.*"

I personally feel that it is not the inability of the people which leaves them poverty ridden but, it is the performance and thus the responsibility of the state and its improper planning, coordination, implementation from which the people of the project area remain under absolute poverty.

In his paper, Prof Widanapathirana deals at length with resettlement of beneficiary farmers in the major irrigation projects and its consequential absolute poverty but has not tried to present a comparative view with minor irrigation in Sri Lanka. That projection would give us to understand more clearly the structure of parameters of poverty and inequality.

In any irrigation project, there are advantageous as well as disadvantageous groups visible. The farmer falling under the head reach and middle reach zones of the irrigation projects tend to take maximum benefit of irrigation water, while the farmers falling under the tail reach zone of the project command tend to suffer. This phenomenon is ever pervasive and one issue is how to reconcile this?

In the new irrigated project area, the farmers will tend to grow more market oriented crops. This requires intensive use of capital, labour, fertiliser and pesticides. Several research studies in the Asian countries have demonstrated that only the affluent class of society have taken maximum advantage of irrigation. The poor farmers owning an acre of land or half tend to always lease out his land to the affluent farmer for cultivation and in turn works on his land as a labourer. Secondly, the common property resources such as pasture lands which were available in each village for grazing of cattle and other domesticated animals are now gradually brought under irrigation and by and large these lands are cornered by the affluent class.

I welcome the paper of Prof W and hope that many researchers will join in the debate and contribute papers on the area of poverty, inequality and irrigation.

J.M. Beeny, Independent Consultant, UK

Most of the problems identified in the paper concerning low profitability of paddy growing are essentially national concerns, such as pricing policies for staples, overt population pressure, dearth of off-farm employment opportunities, lack of regulations concerning land inheritance and fragmentation, or matters of village politics (i.e. daily distribution of water between head and tail enders). Unless engineering design is found wanting (as it often is) - but no technical detail on this is given in the paper.

It goes without saying that new irrigation settlements should offer adequate income opportunities for all participants, and, if the irrigated parcel sizes per family are insufficient, then adjacent dryland/hill/livestock enterprise areas will be needed to make up potential farm family incomes to acceptable levels, and that these should be considered in the overall farming system including labour balances and farm family cash flows. To do otherwise is questionable planning.

It would have been helpful to read of opportunities for producing higher value crops on irrigated land (always subject to soil suitability). Maybe the costs of tank irrigation barely justify engineering investment for low value staples, and that paddy is better grown in naturally wetter areas. Then consideration of grading/packing/processing/marketing chains would be relevant, as would the acceptability by farmers of relative profitability and risk of crop diversification.

To me the paper implies criticism of irrigation systems for being unable to deliver the impossible, thus following a popular trend. If national policy favours paddy growing in dry areas, rather than importing it from other areas/countries more suited to growing it, and if paddy prices are restrained for political reasons, then 'irrigation' is hardly to blame. Provided good yields are being obtained, 'irrigation' is doing its best.

Eduardo Quiroga
Sylvagro, 36 Rue Viger, Kirkland, Quebec, Canada H9J 2ES

The above paper raises the issue of poverty and irrigation development fairly clearly.

Indeed, the mechanisms that generate and maintain poverty in irrigation settlements are complex and varied. I am enclosing two irrigation case studies I published on this issue. In both cases I found that the social classes that control the State have a vested interest in maintaining poverty.

Irrigation Planning to Transform Subsistence Agriculture: Lessons from El Salvador Human Ecology, 1984, Vol 12(2):183-201

Experience with irrigation schemes designed to improve the productivity of subsistence farmers in Latin America seems to parallel the results of the green revolution in Southeast Asia. Although in some cases the impact on the productivity has ben significant, in far too many cases the pervasive pattern of inequity has been reinforced. This case study of the Irrigation District of Zapotitan analyses some of the reasons for the unexpected results, with particular reference to the planning process. It essentially illustrates that the transformation of subsistence agriculture through irrigation demands new institutions designed not only to service agricultural production but also to ensure the accrual of benefits on the targeted group.

Irrigation Development in the Sahelian Countries: The Kirene District in Senegal Human Ecology, 1990, Vol. 18(3): 247-265

Sahelian decision-makers must discern whether the wider adoption of irrigation techniques would relieve the existing food production crisis. This case study illustrates how, despite the capital intensive investment, the prevailing design fails to adequately adjust or reform existing institutions so as to provide incentives to farmers. Consequently the full economic potential remains untapped. Vested interests in the status quo to perpetuate the monopoly of the State further compromise the potential benefits that irrigation could provide.

From: the editor
Thank you for your papers. Both raised fundamental concerns about land tenure, which I agree is an issue that has rarely been dealt with effectively. It needs some new debates, especially with the increasing tendency to have a conditionality of 'productivity' on land access as defined by those supplying irrigation. Do you have any recent data on the 'minifundistas'? Likewise questions of giving credit and subsidy are still unresolved, and more significant than ever as new communications and urban growth open up opportunities for high-value but high-risk crops. Your Senegal paper illustrates the risks for production of high value crops even close to cities. This seems important in view of the current interest in urban agriculture and market gardening in Africa.

The Senegal paper raised a set of issues for me. Firstly, it reminded me that district organisations had been given irrigation development responsibilities, not only sectoral organisations or special project authorities. Do you know how these have fared under state disengagement? It also raised another 'old' issue - the debates about public cooperatives who were never given the financial or managerial powers or flexibility that private companies have had.

Again, old experiences are very relevant given current action in privatisation and 'turn over' of systems.

Your El Salvador paper put several broader development debates into a readable context most people could understand. As you noted (pg 198), the discrimination in benefits received was not unexpected by many people. Many have said that it is not growth as such that is problematic, nor lack of profitable crops that is the cause of such problems, but the institutional structure and processes of change. However I was unaware of the belief of several others that under processes of economic development, it takes at least one generation for the poorest 60% to recover from a spurt of economic growth. It would be useful to know if there has been that recovery, and consider whether we can expect the same 'generation gap' again as schemes modernise and adapt to new market opportunities.

Reply (March 1992)
Thank you very much for your letter. Regarding the Senegal paper, I am following up SENPRIM's activities resulting from state disengagement and the implications this has for district planning. I would like to hear from any Network members also interested in this issue.

Regarding the tenure system, I believe the alternatives are not state or private. We know the problems that arise from state ownership. It is not clear, however, if private ownership within the orthodox capitalist context will be free from problems in rural Africa, or rural El Salvador for that matter. On the other hand, it is evident that there is a need to enhance the farmers' role in decision-making in the use and management of natural resources. This issue may call for a substantial examination of traditional forms of land management and the means of allocating it. Based on this analysis, it may be possible to ascertain what form privatisation can take in order to elicit farmers' incentives to increase productivity.

In the case of El Salvador, so far nothing indicates that the latifundia-minifundia complex is under substantial reform. Institutional constraints for the production of high-value crops by smallholders appear pervasive. Although cooperatives appear to have gained some grounds, the information is still not sufficiently clear.

Michael M. Cernea, The World Bank, USA
Risks of Impoverishment

Michael M Cernea, Senior Adviser, Social Policy and Sociology, The World Bank, Environment Department, 1818 H Street NW, Washington DC 20433 USA sent us *Poverty Risks from Population Displacement in Water Resources Development*. Development Discussion Paper 355, August 1990, Harvard Institute for International Development. We publish here a summary of the contents of the paper, and its last section (Section 5). Please contact the author for more information, or a copy of the full paper.

Development Discussion paper 355 discusses how people risk being impoverished and marginalised when displaced by large-scale water developments, particularly by reservoirs or canal networks. Thus, it is directly related to irrigation development but in a way complementary to Anura's analysis. The paper looks at the magnitude of the problem of population displacement, and gives examples of adverse consequences in Brazil, Indonesia and Kenya. It sets up a *synthesis model of impoverishment risks* from population displacement with seven categories - landlessness, joblessness, marginalization, morbidity, food insecurity and social disarticulation. It then discusses four frameworks under which preventive and mitigating measures can be built into projects to combat the risks of impoverishment. These include the policy framework, the legal framework, the planning framework and the organisation framework. Section 5, reproduced below, is the last section of the paper which concludes with a discussion of possible production-based approaches to re-establish the self-sufficiency, prevent the impoverishment processes, and improve the living standards of reservoir populations after their relocation.

Section 5. Production-Based Strategies for Resettlement
Since displaced groups lose their prior production systems, the key to reestablishing economic self-sufficiency is production-based resettlement. This is precisely what compensation handed over in cash does not ensure for most people, except perhaps for the better-off among the displaced population. Therefore, water resource development programs are faced with the obligation to incorporate full scale redevelopment programs for those displaced from their lands and/or houses.

There are positive experiences in some involuntary resettlement programs that show how this can be done effectively. In principle, two broad strategies are possible, each open to many adjustments and adaptations -

land based strategies and non-land based strategies. I will focus on three promising approaches.

In Indonesia, several relocation options were used, with mixed results. As shown earlier for the Saguling reservoir, the simple cash compensation approach backfired badly for the lake shoreline families: they saw their land holdings and incomes reduced to about half. This case confirms by repetition many negative experiences elsewhere with cash compensation alone. The resettlement through transmigration to new lands in the outer islands appears, from first reports, to have been considerably more effective, but systematic evaluation is not yet available.

The most innovative and successful reestablishment was achieved at Saguling through a non-land based option: floating-net aquaculture. Under conditions of high population density and land scarcity, this option was to make economic use of a new, project created resource: the lake. At appraisal, it was estimated that about 1500 families could benefit from this option within five years after reservoir impounding. Accomplishments to date (1990) suggested that this estimate will be achieved. Significantly, evidence showed that the market value of the fish production exceeded by far the value of the rice produced in the reservoir area, prior to filling.[10]

In Brazil, the Itaparica Resettlement and Irrigation project embodies another innovation through its approach to organisational design. Itaparica is the first World Bank-financed project to assist involuntary population resettlement as a full, free-standing project on its own rather than being a component within a dam project. The project will establish some 8,000 ha of irrigated farmland for part of the 8,100 displaced families and will install electric power systems for household use, health, education, social services, and rural infrastructure. It will also support urban resettlement for the population of several townships. Because it is a free-standing project, the incentives for staff and criteria for evaluating performance refer solely to the project's success in re-establishing settlers. Although serious difficulties in local costs financing, as well as other technical difficulties in execution, have appeared during the implementation of Itaparica project, its organisational framework as a free-standing project helps focusing the attention of both the domestic agencies and the donor on the relocation and socio-economic reestablishment issues to be resolved.

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[10] to keep discussion simple references are not cited here, but are given in the original text.

The possibility of resettling displaced reservoir farmers in the command areas downstream, although an excellent option for production based resettlement, is rarely used, and then on a small, unsystematic scale. Asking downstream farmers to absorb some of the displaced farmers within the command area (whose carrying capacity increases due to irrigation), tends to be regarded by planners as a theoretical possibility only, unfeasible in practice. Nevertheless, taking advantage of agricultural intensification within irrigation command areas is one of the most promising resettlement strategy available.

Successful relocation in the command area requires the agreement of downstream farmers who receive access to water. Productivity gains from irrigation make it worthwhile to them to sell some land for resettlement purposes. Some states in India (for example, Madhya, Pradsh, Gujarat, and others) attempt to achieve relocation into command areas by enacting land-ceiling laws for newly irrigated land and through administrative measures only, rather than also having to gain the voluntary cooperation of command area farmers.

Though difficult, obtaining cooperation from downstream farmers is not impossible. Field anthropological research has described certain traditional practices among farmers which embody the same principle of land sharing between those with easy access to water and the tailenders, during the water scarce dry season. The best case known is the traditional *bethma* system in Sri Lanka. Significantly, recent attempts have been initiated in Sri Lanka during the '80s to revive *bethma* practices in some sections of the Mahaweli irrigation scheme, with reported success. Learning from such traditions that demonstrate practical and not just theoretical feasibility, and adapting them to resettlement circumstances would require considerable work at the grass roots by the relocation organisation, to gain the cooperation and participation of farmers and their organisations. But the stakes are high: the needs for productive and equitable reestablishment of the victims of reservoir submergence justify such additional work.

With all such efforts, and even assuming that new or improved policy, legal, planning and organisational frameworks will be put in place, reestablishment of displaced population will still be a formidably difficult task. But water resource development programs are likely to expand even more in the '90s and beyond, into the 21st century. Since the complex issues of involuntary displacement will stay long on the development agenda, they will continue to demand innovative policy and operational responses.

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IRRIGATION MANAGEMENT NETWORK

NEWSLETTER

April 1994

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IRRIGATION MANAGEMENT NETWORK NEWSLETTER

April 1994

Contents **Page**

1. NEWS ON THE NETWORK

During the last 18 months, the Irrigation Management Network has reviewed the scope of its activities in research and information exchange, and considered it was time for a change in our focus and mandate. A number of issues underpin this decision, reflecting both the changing use and management of water in rural areas reported by network members, and also the range of other organisations now involved in debating and researching irrigation. Changing pressures on water supplies have been accompanied by changing pressures on land which require new water management initiatives at the 'watershed' level and higher, as well as specifically focused on irrigation.

We have decided to move into a new programme provisionally entitled the *Water Resources Network* (WRN), which deals more broadly with water management in rural areas, while keeping a strong focus on agricultural water use by the weaker sections of society. The programme has four main themes:

- water use in the income strategies of resource-poor users;
- policies, programmes and institutions to support these strategies;
- access to water through technology options and resource allocation;
- related training needs.

While these concerns are visible in all environment, the programme proposes a special initiative for more marginal and difficult areas, often referred to as complex, diverse and risk-prone. There are many people who now share these broader concerns of water management in addition to interests in irrigation, but there is no forum for the exchange of ideas. At the moment the programme has *research* funding, but is looking for further assistance to support related network activities. If your organisation would be interesting in assisting the new initiative, in funding or research collaboration, please let us know.

This is the last set in the series of the Irrigation Management Network, and the last network edition I produce. I have taken up the post of Professor of Irrigation at the Department of Irrigation and Soil and Water Conservation at Wageningen Agricultural University. I am naturally very excited by the new job, and hope you will all keep in touch.

Hugh Turral[1] joined ODI in late March 1994, as my replacement. The

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[1] Hugh Turral is an agronomist and irrigation management engineer with long term field experience in Botswana, Nepal, Pakistan and Indonesia. He has recently completed a

WRN will expand its field of interest to cover a greater range of water use and water resources issues in addition to the topics outlined by Linden in this piece.

There is no further funding available for a large information dissemination-based network, and future activities will be focused on research with emphasis on synthesis of important issues. We have every hope of maintaining a small research based network and will be looking at other forms of information dissemination. We look forward to continuing association with as many network members as possible. Please continue to send your thoughts and information to ODI

Linden Vincent

2. OBITUARIES

It is sad that this last network set has to report the deaths of two network members who have made important contributions to the network, and to the irrigation world at large. We have lost people who worked harder than most to bridge the engineering-management divide that is criticised so much, and who were committed to getting better conditions for from the irrigation systems, managers and farmers they enjoyed working with.

Peter Bolton
Hydraulic Research, Wallingford, United Kingdom
Peter Bolton died suddenly and tragically in 1993. Peter was an indefatigable worker and traveller, with strong interests and commitments to many projects and people. Employment agencies always warn us that everyone is replaceable, and that we should limit our expectations and commitments to our workplace and colleagues. However, Peter actually is irreplaceable, and he never accepted that philosophy. The UK irrigation world has lost a man with a unique range of skills in the water field, and commitments to both technical and social aspects of irrigation. For many of us, we have also lost a good friend, who always had time to talk and be supportive, no matter how busy.

PhD at Melbourne University in Australia on irrigation management in the wider context of water resources management and environmental protection.

Hans van Hoeflaken
Water Resources Consultants, Islamabad
Hans, who helped contribute to the paper in the current 'News from the Field' paper, was killed in Afghanistan in February, 1993. While less well-known to Network members, I think we all recognise the tragedy and loss when talented people are lost in this way.

3. NEWS FROM NETWORK MEMBERS

Mary Tiffen will be retiring from ODI at the end of February. Mary left the Network in 1990 to concentrate on research full-time. She has since produced the highly-acclaimed study on environmental management in Machakos district, Kenya (*More People, Less Erosion: Environmental Recovery in Kenya* by Mary Tiffen, Michael Mortimore and Francis Gichuki published by ODI in association with John Wiley & Sons). However, she will continue to be associated with ODI through various research activities. I would like to take this opportunity to thank her for her work on the Network in previous years.

Maintenance of Irrigation Infrastructure in the Third World. Wye College has begun a study on maintenance issues, with support from GTZ. The team has produced a bibliography, and some informal discussion notes. If you want to know more about the work, write to Professor Ian Carruthers, Wye College, University of London, Ashford, Kent, TN25 5AH, UK.

The IIMI, Sri Lanka Office is starting a new project on **'Shared Control of Natural Resources'** (SCOR). Its aim is to strike a balance between production and protection, and will start in two pilot watersheds. One in the Dry Zone and one in the Wet Zone. The project also aims to increase the share of users' control over natural resources in close collaboration with the agencies involved. A newsletter may evolve in this area. For more information contact C.M. Wijayaratna, IIMI, PO Box 2075, Colombo, Sri Lanka.

Interested in **Water Resources in the Middle East**? Two recent publications may be of interest. The Bureau for the Near East, USAID has published a 'Water Resources Action Plan for the Near East' (August 1993) which gives a good overview of the background issues and options in water management in the region. To obtain a copy write to Peter Reiss, ISPAN - Irrigation

Support Project for Asia and the Near East, 1611 N. Kent Street, Room 1001, Arlington, Virginia 22209, USA.

The Luftia Rabbani Foundation has published a report 'Water and Environment: Perspectives on Co-operation between Europe and the Arab World' (1993). This set of papers gives a broader political perspective to water issues in the region, and prospects to implement the water management approaches promoted by a number of Western donors. To obtain a copy, write to the Lutfia Rabbani Foundation, Amaliastraat 9, 2514 JC, The Hague, The Netherlands.

The Tamil Nadu Agricultural University (TNAU) has recently begun a *Scarce Water Management Network*. The third newsletter is dated May 1993. Contact Miss M Santhamani, Editorial Assistant, Water Technology Centre, TNAU, Coimbatore 641 003, Tamil Nadu, India.

The WASH initiative on Water Sanitation and Health is ending to be replaced by a new **Environmental Health Project** (EHP). This signifies recognition of the broader environmental contexts of health problems, and interests in water remain very strong. Apart from water and sanitation, EHP will encompass eight other sub-sectors: tropical diseases; solid waste; waste water; air pollution; food hygiene; hazardous materials; occupational health and injury. For more information contact Dennis Carrol, Office of Health, 1234 Bureau of Research and Development, AID, Washington DC 20523-1817, USA.

The **Centre Sahel** continue to publish reports on African agriculture and agrarian conditions in Africa. They include a number of papers on women in agriculture. Recent reports include:

NT28 Sissoko, Keffing - *Rôle socio-économique des femmes dans les unités de production rurales en zone semi-arid de Banamba au Mali.*- Août 1993. -47p. ISBN: 2-921590-04-2

NT29 Cloutier, Luce; Pelchat, Yolande. - *Femmes, rapports sociaux de sexe et stratégie de développment en Afrique de l'Quest. Document préparatoire au séminaire D'autres voix, d'autres perspectives (Québec, 11 et 12 mars 1993).* - Octobre 1993. - 59 p. ISBN: 2-921590-08-5 (English version - ISBN: 2-921590-08-5).

MT7. Simard, Paule. - *Expaces d'autonomie des femmes Bambara du Manghadié (Mali).* - Août 1993. - 198 p. - ISBN: 2-921590-00-X.

For further information contact Publications du Centre Sahel, Pavillon Jean-Charles-Bonenfant, Cité Universitaire, Université Laval, Québec, Canada G1K 7P4. Telephone: (418) 656-5448, Fax: (418) 656-7461.

4. COMMENTS ON PAST NETWORK PAPERS

Israel E Naor

Reference: Comments on Rakesh Hooja's comments on Network Paper 20: *The Command Area Development Program in India: A policy perspective* by Dr M.V.K. Sivamohan and C.A. Scott (Newsletter of June 1993).

Based on personal experience[2], I believe that CADA's concept as an interdisciplinary agency aiming at amalgamating all activities to fully utilize the irrigation potential of command areas is well conceived. However, even if CADA had all the authority and power it needs to discharge its duties, it exists within an environment of entrenched line departments which, as everywhere else in the world, are notoriously weak in coordinating activities with each other. However, the fact that CADA was able to draw on seconded staff from primarily-concerned line agencies (irrigation, agriculture) is a good indicator that the chosen path may lead to yet better results in the future as agencies acquire experience and trust in cooperating with each other. CADA was, and is, playing an uncontested major role in coordinating land-development and preparation activities and inputs which in the past had not bee coordinated and often not done. This, however, should not relieve line agencies from their mandated duties and responsibilities and therefore I was dismayed to read that a 1990 workshop on CAD recommended to make timely, adequate (or equitable) supply of water a core element in the CAD program. This activity is unquestionably the most important responsibility of every irrigation department, and transferring it to CAD signals a lack of readiness to tackle an admittedly tough, but not unmanageable issue. It also raises a question in the mind of readers whether the systems, as built, could be effectively operated in their present state as explicitly or implicitly envisaged by their designers.

In answering the editor's first question, a special areal management authority has, in my opinion, a better chance of succeeding than a project cell within a sectoral agency due to the multi-disciplinary nature of tasks.

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[2] The writer, an irrigation Engineer, has been engaged in irrigation developments in South-East and South Asia since the early 1970s; during the 1980s as World Bank staff member he worked on irrigation projects in India.

I can't think of any successful attempts by a line agency to provide services and inputs which are within the domain of another without raising the latter's resentment. I don't suggest that cooperation amongst line agencies is easily achievable, it never is, but an areal management authority as a non-line agency, stands a better chance. Particularly when given adequate authority, as is the case with CADA. There is also another option such as the one implemented recently in the Philippines, namely to place the Irrigation Department into the Department of Agriculture. However, I am not sure whether India's State Irrigation Departments would welcome such an arrangement.

A linkage between public irrigation operating agencies or departments and water users could conceivably be established by a multi-layered association of irrigators, each based on a common source of water. The areal coverage of each tier of the association would depend on the physical configuration of the system, on traditions and social conditions (cooperation possibilities) of farmers, on the organisational capacity of the parent administration (in this case an irrigation department, CADA or both) and finally, on the willingness and readiness of farmers to join. The latter was proven not to be a major issue in other countries in the region where similar developments took place. As long as irrigators perceived tangible benefits or incentives, such as, for example, constitute irrigators on a single turnout or outlet, nominally covering an area of up to 100 ha[3]. Usually, within this area the outlet or turnout group, through elected officers, would operate, maintain and manage irrigation systems and supplies without external interference (Except for resolving occasional disputes). Formation of such groups should not present major problems given appropriate training and incentives. The second tier could constitute an association of a number of turnout groups served by a single (secondary) canal, and could cover areas up to, say 1,000 ha. Such an association would follow that of the turnout group and after the former had an opportunity to consolidate. The process would successively be replicated to cover larger areas, again as dictated by physical and sociological considerations. The objective of such an undertaking is to transfer gradually system operation and maintenance responsibilities to irrigators as experience in both South-East Asia and in other parts of the world has shown that in the long run irrigators operate and maintain irrigation systems within their technical and administrative capabilities more effectively than public departments can. Exceptions to this rule are periods of severe water shortage during which even well-functioning

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[3] The areal coverage would have to be smaller where land holdings are less than one ha.

Irrigators' associations have difficulties in maintaining equitable water supplies. But the same problems are also faced by most irrigation departments. For all other 'normal' times, irrigators' associations have proved to have a better track record in O&M than irrigation departments.

In this context I would argue against the notion quoted by Mr Hooja from Parlin and Lusk (1988) that 'farmers' organisation is not a panacea and the costs involved may not be worth it...'. Farmers organisation per se is not an objective by itself, but farmers organisation to assume operational and maintenance responsibilities and share in the management of irrigation systems is considered in most countries unavoidable if indeed irrigation systems are to become more effective and better performing.

Rakesh Hooja
Response to the above comments by Mr I E Naor

It is gratifying to see someone reacting event if only to the summarized extracts from my paper included in the Newsletter of June 1993 and to find agreement on the need for a multidisciplinary approach to irrigation command area development because there are so many especially in irrigation departments (and even in other government departments, or amongst the experts in the field) who insist on looking at and dealing with issues in a sectorally segmented uni-disciplinary manner and saying that they are not concerned with issues not covered directly by other disciplines. As if the cultivator can segment his activities so conveniently in practice, or the project administrator at least in CAD could say that let some other agency or person bother about what is not directly related to his subordinate functionaries discipline or parent department's concerns. Even within CAD there are strains and conflicts based on the different cadre sources of the employees and Mr Naor's suggestion that functionally segmented line agencies and the CADA both co-exist in an area, or that the irrigation department be placed within the agriculture department (or even vice versa) appears impractical. In fact, where in a CADA the head is not a generalist administrator but comes from a line department, the internal tensions within the CADA organisation are normally greater.

However, I am responding chiefly because my earlier drafting was somewhat unfair to Parlin and Lusk. Neither they, nor I, feel that farmers organisation would not prove very useful. In fact I have recently reviewed three books on farmers' participation for the journal *Administrative Change*, where I have specified that while many problems could be tackled successfully by farmers' organisations. However, the participation of farmers is not a panacea for all irrigation problems. Parlin and Lusk had also meant this. As I am so used to listening to many irrigation engineers saying that all problems should be left either to the farmers' organisations or to the agriculture department (which presumably has better contacts with the farmers than the irrigation engineers) and that the engineers should not be bothered about whether water reaches the farms and whether crops can be grown optimally as these are socio-administrative, organisational or agricultural issues and that the engineers should be left to construction or to repair works, that I have started pointing out in various forums that farmers participation is useful, as well as difficult, but cannot be a solution to all problems, any of which may have to be tackled elsewhere. I perhaps over-did things in my earlier comment. Of course, to achieve successful farmer participation would involve many monetary and non-monetary costs and efforts.

Also the farmers organisation may be resented by many in government but more so by the local political entities like the village panchayats which have other political orientations and objectives, and in fact local political elites and vested interests may even try to capture local farmers' organisations to serve their own interests. But that can be debated another time.

Israel E Naor

Reference: comments by B. Dan Bithu on Network Paper 18: *Crop Based Irrigation in Pakistan: Initial Efforts in North West Frontier Province* by B J Bandaragoda and Carlos Garces Restrepo (Newsletter of June 1993)

I read with great interest Mr Bithu's powerful arguments against raising the water duty (WD) on the Chasma Right Bank Canal (CRBC) in Pakistan to reduce a rise in the (saline) water table and Mr Garces' argument favouring an increase in the WD to meet crop water requirements even though he implicitly acknowledges a rising water table. I understood from Mr Garces' reply that dominant crops are paddy and wheat.

I believe that both gentlemen will agree that as long as paddy dominates cropping (presumably seasonably), a rise in the water table is unavoidable. Even reducing the WD will not prevent such a rise, as unless the water table rises, water will continue to percolate as the soil is pervious, sandy, and a suitable environment for paddy cultivation will not be created. The associated cost of sustaining paddy under these conditions is high because of a need to drain the saline ground water. I am afraid that an unbiased feasibility analysis will show that the development is economically unfeasible.

Theoretically, there is a way of sustaining paddy cultivation in pervious soils without raising water tables, but that requires creating an impervious paddy pan, such as that created traditionally by ploughing animals, e.g. by adding colloidal material to irrigation water. However, it would be interesting the hear the authors' reaction on the feasibility of such a procedure. Short of this, I believe that we should accept the physical fact that water tables will rise under paddies particularly in pervious soils as a consequence of ponding water. Reducing the WD does not eliminate the phenomenon but does result in sub-optimal production either by low yields, if water is 'stretched', or by low cropping intensities.

Another possibility for sustainable irrigated cropping under these conditions would be to diversify from paddy to dry-footed crops, if that can be feasibly done. If the answer is affirmative, there are, of course, known irrigation methods that will minimize deep percolation (and rising water tables), match water supply to crop water demand and require little investment in drainage.

Such methods, including various sprinkling or drip systems are well known the world over and have been used in arid and semi-arid countries for years. Clearly, they are more costly than traditional gravity irrigation on-field systems and often difficult if not impossible to justify economically for the cultivation of low-priced crops. However, I am afraid the same would apply to the feasibility of a comparable, sustainable, traditional system for the same crops. Irrigated agriculture in arid conditions anywhere is often difficult to justify economically and that fact will, unfortunately, not be altered by reducing water duties. I would partly like to stress, though that not including drainage as part of a traditional on-farm development is not the solution as the traditional irrigation system will not be sustainable without drainage.

B Dan Bithu

Farmer Organisations for Lift Irrigation: Irrigation Companies and Tube Well Cooperatives of Gujarat by Tushaar Shah and S Bhattacharya (Network paper 26, June 1993)

This is an excellent success story, Gujarat is a pioneering state in India in Cooperative movement. However, many big and small irrigation projects in India lack effective operation and management organisation directed by the farmers themselves. The untold failure stories are numerous. The projects need appropriate diagnostic analysis to make innovative changes in the design concept and thinking, of not only the farmers but also the governmental managers. A probe into the impediments and ill-conceived interventions is also required to improve project performance with minimal hardware changes.

For example, the water course Chak Samitis in Indira Gandhi Canal Project in Western Rajasthan have not been effective mainly because of inadequate democratic decentralisation of powers and responsibilities and non-accountability of the decision-makers. The delegation of powers is, to some extent, considered as loss of authority and administration. The project beneficiaries have, over the last four decades, developed a sense of inferiority complex to manage their own things. Politicisation without value based decentralisation of powers and responsibilities has led to dominance of élite and power-eager bureaucrats. This has resulted in farmers looking toward government department for everything with consequent inefficiency and cost ineffectiveness. The top down approach with fiat from above tends to kill grassroot initiative and endeavour.

Nevertheless the water distribution set up of the irrigators under the traditional rotational irrigation scheduling (Warabandi) has served well in spite of the inherent weakness of Warabandi to supply water as per crop water requirement. This shows that the potential for cooperative and participative management with active farmer's involvement does exist. The only thing required is to encourage and motivate the farmers through genuine down to earth decentralisation of powers and responsibilities and increasing the accountability of the governmental decision makers. The decades old socialist thinking and approach may have to be dampened and diluted.

5. BOOKS AND REPORTS

The State of Food and Agriculture 1993
Part III of the annual volume has a special section on 'Water Resource Issues and Agriculture'. It is packed with useful figures and examples on irrigated agriculture and water resources development, and also has overviews of policy issues. For more information write to F Segarra, SOFA Editor, Policy Analysis Division, FAO, Viale delle Terme di Caracalla, 00100 Rome, Italy.

Biswas, M.R. and Maudel, M.A.S (1993) *Irrigation Management for Crop Diversification in Bangladesh.* This book contains the findings of the first phase of a research project integrating issues in water markets, crop production and the performance of minor irrigation. The 13 chapters by different authors deal with weaknesses, inefficiencies and inadequacies in water markets and irrigation technology and prospects for improvement. The hypothesis is that performance of water markets can be improved by promoting production of non-rice crops under irrigation as well as rice. One finding was the preferences for shallow tube-wells in this cropping strategy because of their greater flexibility. Recommendations cover policy, technical and research interventions.

The 15th Congress of the International Commission for Irrigation and Drainage was held in the Hague in August 1993, and the Transactions have now been published with a wealth of papers on 'Water Management in the Next Century'. The Congress questions covered a wide range of topics related to infrastructure, water management and water use. If you are interested in obtaining the papers or the summaries from each theme, write to S P Kaushish, Secretary ICID, 48 Nyaya Marg, Chanakyapur, New Delhi 110021, India.

IIMI Conference Reports
'Quel Environment pour le développement de l'irrigation au Burkino Faso?' Ougadongou 2–3 February 1993, editors J-C Le Goupil, Hilmi Sally, AM Panya
'Irrigation Research Priorities for Nigeria', editors E.U. Nwa and P. Pradhan. University of Ilorin, 20–23 April, 1993.
For copies contact the Information Office, IIMI, PO Box 2075, Colombo, Sri Lanka.

6. SHORT REPORTS AND ARTICLES RECEIVED

Observatoire du Sahara et du Sahel programme de concertation 'Aquiferes des Grandes Bassins' [Sahara and Sahel observatory - dialogue programme 'Aquifiers and large basins'] *Bulletin de Liaison du Cieh*, 1993. 92:39-44 {location: ODI Journals}

ABBOT, P. G.: Research and development of simple silvicultural systems for community management of miombo in Malawi. Typescript. Department of Forestry, University of Aberdeen. For ODA funded collaborative project with Forestry Research Institute of Malawi on the 'Management of Miombo as community woodlots', 1992. 15p {location: F 1439}

ABEYSEKERA, W.A.T.: Rehabilitation of irrigation systems in Sri Lanka: A literature review. (IIMI Country Paper - Sri Lanka - no. 11) Colombo, Sri Lanka: IIMI, 1993. 100p {location: ACG}

ADOGRE-BANG, D.: Irrigation around N'Djamena. *BAOBAB*, 1993. 10:14-16 {location: ODI Journals}

BAGDA, V.K.: On-farm development and water management. *WAMANA*, 1983. 3(2):1-7 {location: ODI Journals}

BALAGOPAL, K.: Andhra Pradesh: A year of drought. *Economic and Political Weekly*, 1993. 28(38):1970-72 {location: ODI Journals}

BARDHAN, P.: Analytics of the institutions of informal cooperation in rural development. *World Development*, 1993. 21(4):633-639 {location: ODI Journals}

BISWAS, A.K.: Water for agricultural development: Opportunities and constraints. *Water Resources Development*, 1993. 9(1):3-12 {location: ODI Journals}

BRAMMER, H.: Protecting Bangladesh. *TIEMPO*, 1993. 8:7-10 {location: ODI Journals}

BURNS, R. E.: Irrigated rice culture in monsoon Asia: The search for an effective water control technology. *World Development*, 1993. 21(5):771-789 {location: ODI Journals}

CARROLL, F. P.; PARKER, R.: Southern Africa drought assessment: Impact on water and sanitation. (WASH field report 375) Washington, DC. USA: WASH, 1992. 63p {location: R-WASH FR 375}

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COHEN, A.: Baseline survey of 3 villages Rajudia, Kheda, Sabli, Panchmahals, Gujarat. 1990. ca 30p {location: F 1480}

CULLIS, A.; JIGJIDSUREN, S.; BUJANTOGTOH, T.: Preliminary assessment of the potential of rainwater harvesting for fodder production. (Policy Alternatives for Livestock Development (PALD), Research Report no. 6) Brighton, UK: IDS; Research Institute of Animal Husbandary (Mongolia); Institute of Agricultural Economics (Mongolia), 1993. 49p {location: R-PALD RR 6}

DATTA, K. K.; JOSHI, P. K.: Problems and prospects of cooperatives in managing degraded lands: Case of saline and water-logged soils. *Economic and Political Weekly*, 1993. 28(12&13):A16-A24 {location: ODI Journals}

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HAAGSMA, B.; REIJ, C.: Frentes de trabalho: Potentials and limitations of large scale labour employment for soil and water conservation in Cape Verde. *Land Degradation and Rehabilitation*, 1993. 4(2):73-85 {location: ODI Journals}

HARRISS, J.: What is happening in rural West Bengal. *Economic and Political Weekly*, 1993. 28(24):1237-1247 {location: ODI Journals}

HOFER, T.: Himalayan deforestation, changing river discharge, and increasing floods: Myth or reality. *Mountain Research and Development*, 1993. 13(3):213-233 {location: ODI Journals}

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MATHIEU, P.: Culture, rapports sociaux et efficacite de l'irrigation: Lecons d'experience en Afrique Sahelienne. [Culture, social integration and effectiveness of irrigation: Lessons from the Sahelian experience] *Land Reform, Land Settlement and Cooperatives*, 1991:57-74 {location: ODI Journals}

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MORVARIDI, B.: Large dams and the environment: A case study of the South East Anatolia dam project, Turkey. (Development and Project Planning Centre, University of Bradford discussion paper no.24) Bradford, UK: Development and Project Planning Centre, University of Bradford, 1992. 13p {location: R-Bradford DP 24}

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OTERO, G.: The new agrarian movement: Self-managed, democratic production. *Latin American Perspectives*, 1989. 16(4):28-59 {location: ODI Journals}

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SINGH, R. P.; HAZELL, P. B. R.: Rural poverty in the semi-arid tropics of India: Identification, determinants and policy interventions. *Economic and Political Weekly*, 1993. 28(12&13):A9-A15

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SOMEL, K.: Agricultural diversification in the Middle East and North Africa. *Journal of Economic Cooperation among Islamic Countries*, 1992. 13(1&2):71-107 {location: ODI Journals}

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SVENDSEN, M.: The impact of financial autonomy on irrigation systems performance in the Philippines. *World Development*, 1993. 21(6):989-1005 {location: ODI Journals}

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WILKINS, R. P.; BISHOP, P.: Examination of investment appraisal techniques. Wiltshire, UK: WRC, 1990. 42p {location: AAV}

WORLD BANK. WATER DEMAND RESEARCH TEAM: The demand for water in rural areas: Determinants and policy implications. *World Bank Research Observer*, 1993. 8(1):47-70 {location: ODI Journals}

7. TRAINING COURSES

The Institute of Irrigation Studies, University of Southampton offers the following courses:

12 Month MSc Courses

Irrigation Engineering; Soil Conservation and Land Reclamation Engineering; Engineering for Development (Infrastructure, Water Supply and Sanitation); Planning and Management for Development; Transportation Planning and Engineering (full or part-time).

Short Courses

Rehabilitation and Management of Irrigation Projects
13 June - 30 July 1994

An intensive seven-week course organised in association with Mott MacDonald consulting engineers drawing on many years' practical experience of the rehabilitation, upgrading and management of irrigation schemes. This course includes a one-week study tour to irrigation schemes in Southern Europe or North Africa.

Effective Irrigation Management 26 September - 14 October 1994

An intensive course organised in association with Hydraulics Research, Wallingford, which draws on extensive experience of irrigation management methods and performance assessment techniques.

International Course on Computer Applications in Irrigation
13 March - 7 April 1995

Course for irrigation professionals who require up to date training in the use of personal computer software for irrigation design and management. Module One held at the Institute of Irrigation Studies, Southampton, UK, Module Two at the International Institute for Land Reclamation and Improvement, Wageningen, The Netherlands.

For further information on all the above courses please contact: Administrative Assistant, Institute of Irrigation Studies, University of Southampton, Southampton, SO17 1BJ, UK. Tel: +44 703 593728 Fax: +44 703 677519.

Wye College, University of London, Department of Agricultural Economics offers the following training courses:

Microcomputer Applications in Agricultural Development 10 week course from July to September 1994 and October to December 1994. Designed to meet the growing need for professionals to develop computing skills by offering intensive training on a 1:1 participant to commuter ratio assuming no previous computing experience. Teaching is done in a modern Microcomputer laboratory with IBM PS Value Point 486 machines working in DOS and Windows environments. Emphasis is placed on the practical application of software packages in helping to perform professional tasks of data collection, analysis and report writing, and the course teaches word processing, spreadsheets, databases, statistical analysis and project management software. Fees: Tuition fees are £3,750. For accommodation, travel and other expenses £180 a week is recommended.

Managing Rural Development 8 week course with a 2 week computer study option. January to March 1995. The course meets the needs of those involved in project management, monitoring and evaluation and the running of management information systems. The course covers project planning and survey design, whilst providing instruction in techniques of defining minimum data needs, data collection, analysis and reporting in the setting of practical development programmes. Emphasis is given in the case study material to the use of computers. Fees: Tuition fees are £4,250. For accommodation, travel and other expenses £180 a week is recommended.

Environmental Assessment and Management in Agricultural Development This 2 week course runs in July 1994 and is for senior professionals working in environmental assessment and management within the project cycle and national policy context. It examines issues of environmental economics, natural resource policy, environmental impact assessment, and resource management. An optional third week teaches GIS computer software IDRISI and its application to environmental management and natural resource accounting. Fees: Tuition fees for 2 weeks are £1,350 and full board and accommodation is £700. For three weeks tuition fees are £1,950 and accommodation is £1000.

For more details about any of these courses contact:

Mrs Mary Arnold, Short Course Office, Department of Agricultural Economics, Wye College, Ashford, Kent, TN25 5AH, UK. Telephone: 44 233 812401 (ext 359); fax: 813006; telex: 94017832 WYEC G.

The Institute for Land and Water Management is offering the following course:

International Course on Microcomputer Applications in Water Resources Engineering and Management Course Option A: Microcomputer applications in irrigation and drainage. Course option B: Microcomputer applications in surface and groundwater hydrology. Course option C: Microcomputer applications in remote sensing and GIS for land and water resources management. Introductory module — module 1: 4 weeks, July 4–29 1994. Course options A, B and C — module 2 and 3: 7 weeks, August 1 to September 16, 1994.

For details on this and other courses in the Inter university programme in Water Resources Engineering contact: Mrs Greta Camps, Course Secretary, Institute for Land and Water Management (ILWM), Katholieke Universiteit Leuven (K.U.Leuven), Vital Decosterstraat 102, 3000 Leuven, Belgium. Telephone: 32 16 231381; fax: 32 16 230607; telex: 27210 Kuland.

8. FORTHCOMING CONFERENCES

May 2–5 1994, Accra, Ghana Water Africa '94 (including 1sr Western Africa Water and Environment Conference). Attendance is expected from Directors of Water from Benin, Burkina Faso, Cameroon, Cote d'Ivoire, Gambia, Ghana, Mali, Nigeria, Senegal, Sierra Leone, and Togo; there will be contributions from engineers and technicians representing external agencies and NGOs. Papers are invited, and Synopses of not less than 250 words should be sent to: Water Africa, 94 Mornington Business Centre, 37 Upper Duke Street, Liverpool L1 9DY, UK. Fax: 44 51 709 7801.

June 13–16 1994, Helsinki, Finland International Conference on 'Future Groundwater Resources at Risk'. *Contact*: IAHS, Ms Tuulikki Suokko, FRG 94 National Board of Waters and the Environment, PO Box 250, Helsinki, Sf-00101, Finland. Telephone: 358 04028 258; fax: 358 0 4028 345; telex: 126086 vyh sf.

June 28–30 1994, Karlsruhe, Germany International Symposium on 'Water Resources Planning in a Changing World'. *Contact:* IHP/OHP Secretariat, IAHS, c/o Bundesanstalt für Gewässerkunde, PO Box 309, D-5400 Koblenz, Germany. Fax: 49 261 1306 313.

August 1–6 1994, Tokyo, Japan Tokyo International Rainwater Utilisation Conference. *Contact:* Congress Secretariat, c/o Tokyo International Rainwater Utilisation Conference, 1-23-20, Azumbabashi, Sumida City, Tokyo 130, Japan. Fax: 81 3 5608 1297.

August 21–6 1994, Colombo, Sri Lanka 20th WEDC Conference. Early offers to prepare papers on affordable water supply and sanitation, and other topics related to water and infrastructure are welcomed. *Contact*: John Pickford or Rowena Steele, WEDC, Loughborough University of Technology, Leics LE11 3TU, UK. Fax: 44 509 211079.

September 5–9 1994, Adelaide, South Australia Twenty-fifth Congress of IAH: Management to Sustain Shall Groundwater Systems. *Contact*: Peter Dillon, Centre for Groundwater Studies, Private Bag #2, Glen Osmund, SA 5064, Australia.Telephone: 8 274 9311; fax: 8 338 2144; telex: AA 82406.

November 11–14 1994, Shatin, Hong, Kong Third Commonwealth Conference on Diarrhoea and Malnutrition. *Contact: Dr Peter B. Sullivan, Organising Secretary*, Department of Paediatrics, Prince of Wales Hospital, Shatin, N.T., Hong Kong.

November 21–6 1994, Cairo, Egypt Eighth International Water Resources Association World Congress. Topics include: Economic and environmental aspects of demand management, satisfying demands under drought conditions, and the World Water Council. *Contact*: Dr Mahmoud Abu-Zeid, Water Research Centre, 21 El Galaa Street, Bulak, Cairo, Egypt. Fax: 20 2 773678 or Dr Glenn E. Stout, IWRA, University of Illinois, 205 North Mathews Avenue, Urbana, IL 61801-2397, USA. Telephone: (217) 333-0536; fax: (217) 244-6633.

December 1–2 1994, Perth, Australia International Water Supply Association Conference on 'Desalination and Water Reuse'. The major focus will be on the latest, most effective technologies, and participants will include engineers and scientists. Papers are invited on solar distillation, reverse osmosis, electro dialysis, ion exchange, ultra*filtration, rainwater* harvesting, waste water reclamation and reuse. The deadline for abstracts is **15 March 1994**. *Contact:* Dr K Mathew, Remote Area Developments Group, Institute for Environmental Science, Murdoch University, Murdoch WA 6150, Western Australia. Fax: 61 9 310 4997.

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IRRIGATION MANAGEMENT NETWORK

MULTIFUNCTION IRRIGATION ORGANISATIONS
Advantage or Handicap

Parmesh Shah and Meera Kaul Shah

Network Paper 28

April 1994

Network papers in this set:

Newsletter April 1994

Please send comments on this paper to the author or to:

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UK

Comments received by the Network may be used in future Newsletters or Network papers

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Multifunction Irrigation Organisations: Advantage or Handicap

Parmesh Shah[1]
Meera Kaul Shah[2]

Contents **Page**

1 Aga Khan Rural Support Programme (India) and Institute of Development Studies, University of Sussex, Brighton.

2 International Institute for Environment and Development, London

Multifunction Irrigation Organisations: Advantage or Handicap

Parmesh Shah
Meera Kaul Shah

This paper describes the experiences of an NGO, the Aga Khan Rural Support Programme (AKRSP), in supporting the formation of lift irrigation cooperatives and their performance as multifunction organisations (MFOs), in South Gujarat, India. It also examines the conditions under which Irrigation Organisations (IOs) are likely to become multifunction. It then discusses the mechanisms which facilitate the functioning of irrigation organisations and multifunction organisations.

Background

AKRSP works in Bharuch District of Gujarat State in Western India. The area has a number of seasonal and perennial streams, rivulets and rivers. Most land is undulating sloped and rainfed. The existing extent of irrigation in the area is about 10 per cent. The area is inhabited by the tribal community, which has been predominantly dependent on natural forests for their livelihoods. However, with increased deforestation, tribal farmers are practising dryland agriculture with low productivity.

AKRSP works for enabling village communities to manage their local natural resources through establishment of their own institutions. It has supported development of village institutions (VI) like lift irrigation cooperatives and village development associations.

The Government in the last fifteen years has established and constructed a number of lift irrigation schemes in the area. However, this involved very limited consultation with the community in design, implementation and management of the irrigation systems and no effort was made to create institutional framework for operation and management of these systems. The organisational structure of the Government departments (Irrigation Department) does not enable them to spend enough time on institution building aspects and relies on traditional leaders for the institutional inputs. The people did not develop as stakeholders and did not supervise the construction process resulting in poor quality construction and layout. As a result some schemes never worked as no water flowed from the system. Others did not work as there was no demand for water and they were no longer viable.

When AKRSP started dialogue with the village communities, most indicated small scale irrigation to be one of their major priorities. They also indicated that they had no faith in the existing systems and would like to develop a new scheme for lift irrigation with their involvement. AKRSP worked with them to develop and renovate these schemes with participation in design and lay-out of irrigation systems, developing a VI framework, operational rules and procedures for management of these systems. After the first set of irrigation organisations were established and performed well in contrast to the ones promoted earlier by the Government, the District *Panchayat* (the local government body with the responsibility for creating irrigation infrastructure) passed a resolution asking AKRSP to help in renovating about 35 defunct lift irrigation schemes in the area. Since 1986 AKRSP has helped in setting up about 10 lift irrigation schemes and in renovating a canal irrigation system in the area. This has resulted in creation of irrigation potential of 1917 hectares. The current level of utilisation is about 79%.

AKRSP initially works with the village community in preparing a village natural resource management plan. If irrigation is identified as one of the priorities, the village is asked to form an institution with at least 80% of the households as members. It actively promotes equity and encourages all the landless to become members even if the only piece of land they own is their home stead. Subsequently the VI is asked to nominate extension volunteers from the community who are trained in design, maintenance, management and financial book keeping. These volunteers take substantial responsibility for management of the irrigation system. The VI is supported to be registered as an irrigation cooperative. This enables them to get access to development assistance from the Government and institutional finance from the financial institutions. We will refer to them as irrigation organisations (IOs) subsequently in the paper.

Over a period of time (three to five years) most of these IOs have taken up a multiplicity of functions and activities. These include supply of agricultural inputs including hybrid seeds, fertiliser, plant protection chemicals and implements, provision of short and long term credit, marketing of agricultural produce, provision of agricultural extension services and post harvest processing. These MFOs have handled input supply worth Rs.1.36 million, helped in marketing of produce worth about Rs.5 million and conduced 40 training and extension programmes with 2840 participants in the year 1991-92.

In the next section we will study the reasons why the irrigation organisations become multifunction and the implications of their being multifunction on their performance as IOs.

Why Irrigation Organisations become 'Multifunction'

There are many reasons which steer irrigation organisations towards being 'multifunction'. Based on AKRSP experience in Gujarat, the following seem to be more important than others:

Poor access to services

In most rainfed areas, the introduction of irrigation leads to diversification into new and multiple crops requiring increased supply of good quality seeds on a yearly basis. Since state agencies at the District level do not have adequate stock of these seeds and are slow in responding to the demand, the IO has to respond to these needs and fulfil the functions of input supply.

Most input supply in the rainfed agriculture is dominated in Gujarat by local traders and markets. However, most farmers practising irrigated agriculture want to use certified seeds. These were not available in the local market and had to be procured from large institutional suppliers like GROFED[3], who deal only with VIs and NGOs. Since no other institution existed at the village level irrigation cooperatives logically took over the input supply function. Also when seeds are in short supply the large suppliers of seeds prefer to give seeds to the VIs on a commitment fee as opposed to individual (unorganised) farmers. IOs were able to secure commitment of seeds and ensure supply of seeds in shortage situations.

Irrigated agriculture requires higher investment in inputs, implements and needs recurrent investment at regular intervals. The existing terms of credit were exploitative and resulted in lower investment. The irrigation society helped in arranging credit for its members. This helped in breaking exploitative credit systems and relationships with traders. It also enabled the members to get access to crop insurance services which are not easily accessible to the farmers in rainfed areas.

IOs enabled access to inputs and credit and later access to markets for their members. It became necessary for the IOs to diversify into providing these services for its members, as it was realised that viability of irrigation as an enterprise was closely linked with provision of these services.

[3] Gujarat Groundnut Growers Federation (GROFED) is an apex federation of village level cooperatives engaged in procurement of groundnut, processing and marketing of edible oil and other products.

Cost effectiveness of delivery and lower costs to the farmers
Good quality certified seed was not supplied in small quantities as institutions only provide supplies in bulk. IO interventions lead to lower transport costs and improved profitability of irrigated agriculture for farmers.

Institutional vacuum
In a situation where there are no existing institutions or where they are ineffective, IOs can become an effective vehicle for revitalising institutions in the area. In the case of rainfed areas in particular institutions are not well developed and IOs tend to fill the institutional vacuum. IOs are able to take up multiple functions effectively as irrigation activity itself requires intensive management and constant inputs.

Viability and Profitability
Most irrigation systems in the rainfed areas require a change in cropping pattern and seed supply mechanisms (both local and hybrid varieties). Farmers taking up irrigated agriculture for the first time perceive irrigation as a risk since it requires higher investments. If the water rates are very high in the first year of the operations, the demand for water is rather conservative. As a result the system fails to break even in the beginning and take off. Understanding the sensitive situation, IOs charge lower water rates initially. To supplement their income, IOs take up activities like input supplies for which members pay a small commission to the IO. This helps in meeting the operational expenditure of running and managing the irrigation system. At the same time it also helps members to get access to good quality inputs at reasonable prices and ensures high productivity. The data illustrated in Table 1 shows that most IOs tend to subsidise the operational costs of irrigation systems by taking up activities like input supply, credit and marketing in the first three years of operation. The contribution of commercial activities, other than the sale of water, to the total earnings of IOs varies between 10-40%. In most cases profitability of IO would be severely affected if input supply and other commercial activities are not taken up. This ensures that during the gestation period, before irrigated agriculture becomes a viable enterprise for the farmer and the farmer is in a position to pay higher water rates, the operation and management of the irrigation system is unaffected. Once the demand for water increases, the IO is able to charge higher rates and become viable and sustainable.

This also enables the IO to experiment with different water pricing mechanisms. In our experience, IOs with no prior experience of irrigated agriculture vary between volumetric, hourly and crop wise differential rates before arriving at an optimum differential pricing strategy. The process of iteration is critical for IO in the first year of operation. Taking up other

Table 1: Financial performances of Lift Irrigation systems in Bharuch District during 1991-92 (all figures are in Indian Rupees)

	Lift Irrigation Society			
	Ghodi	N. Devrupan	Ubharia	Dhavliver
Total number of acre waterings	193	252	143	143
1	40814	58766	32429	28752
2	8544	25752	32447	10983
3 = 1+2	49358	84519	64876	39735
4	42002	22944	58900	33153
5 = 4-3	7355	61575	5975	6581
6 = 2÷3 (%)	20.9	30.4	50.0	27.6

Notes: 1: Income from sale of water
2: Income from other activities like input supply
3: Total income
4: Total operational expenditure
5: Profit
6: Income from other sources as percentage of total income

Source: Annual Progress Report, AKRSP, 1991-92

activities which are profitable helps IO to stabilise and experiment. Many IOs which do not have this flexibility tend to collapse in the first year of operation.

The taking up of input supply, credit and marketing activities also helps to increase the turnover of the irrigation enterprise as the demand for water increases and so does crop productivity. Experience has also shown that the lift irrigation organisations also seek new members by making water accessible to the landless and women homestead owners in order to increase the turnover of both the irrigation and the input supply enterprises. Thus there is a synergism between the growth and viability of irrigation as an enterprise.

Activities like input supply are taken in the first phase by IOs to enable the irrigation system to stabilise and become viable. In the second phase, these activities are undertaken to increase the profitability of the members and the irrigation enterprise.

Leverage

The sustainability of most IOs is affected by the regular payment of water charges by the members. Most IOs that collapse in the first year of operations do so due to non-payment of water charges by the members. IOs take on other functions such as input supply and credit and use provision of these services as an effective leverage to ensure member discipline. There are a number of conflicts on water rates and distribution of water. The multifunction nature of the IO acts as an incentive for dispute resolution within the IO itself and helps strengthen the management of irrigation. Also if the members are expected to make contributions for maintenance and when they are not forthcoming the IO could use other financial transactions to ensure compliance and contribution by the community.

Credibility and Legitimacy

IOs have to often interact with the Government departments to ensure adequate power supply and lobby for equitable power rates. Also, most large seed supply agencies like to deal with institutions which handle multiple functions. Having multiple functions enables the organisation to be legitimate and credible vis a vis members as well as the external institutions and markets. A good example is the pressure put on banks, which were advancing credit to the members of the IO, to put pressure on the State Electricity Board for ensuring adequate power supply as this would affect recovery and the performance of the financial institutions.

Limited managerial pool

If the IO is the first village institution being set up for management of resources in the village, most of the local managerial talent gets attracted towards it. Since most members have their own fields and enterprise to run, there are limited number of people who are committed and capable of managing different activities. When new needs and activities are identified by the IO, these managers prefer to diversify rather than create new institutions. This helps them to concentrate and consolidate their expertise. This also contributes to the multifunction nature of the IOs. However, this leads to considerable strain on the effectiveness of these organisations and limits the scope of diversification over a period of time. In our experience, most irrigation organisations find it difficult to diversify into activities like watershed management and forestry, involving other common property resources, but find it easier to diversify into commercial activities like input supply, credit and marketing.

Equity
IOs initially start with a common interest group and develop the organisation around the initial group. IO then realises that due to the topography of the land there are a number of other households in the village who have been excluded, including small farmers and women farmers having small homesteads. This also obstructs the functioning of the irrigation system as it leads to conflicts. As the viability of the institution is directly related to irrigation and the business turnover, the IO tries to increase its membership and clientele. Normally it happens in the second or third year of operation of the organisation. Also over a period of time different members expect the IO to provide different services e.g. in an area having a poor public distribution system, large numbers of women and small farmers, on becoming members, expressed the need for IO to open a fair-price shop at the village level. This has become a major enterprise of IO and helps it in ensuring availability of other consumption goods at the village level. The need to develop an equitable IO also induces formation of multifunction organisations. A good example of this process is the initiation of irrigation of homestead lands owned by the landless and women and subsequent seed supply resulting in involvement of almost all households in the village in the irrigation programme. This also leads to multiplier effects in terms of diversification of farms into vegetable cultivation and horticulture.

Favourable conditions for IOs to become MFOs

In an area with an institutional vacuum, IOs would always be expected to diversify. Interestingly this need is expressed as a concern by both the members as well as the external agencies and the markets. The members would like IOs to be multifunction as the state departments and agencies are not expected to perform the service delivery functions efficiently and in a cost effective manner. Also, access to the institution and ability to participate in decision making enables people to develop a stake in the running of the institution. The members also visualise an IO as a means of creating pressure on the state systems to get access to resources and services. The state agencies also have targets for distribution of inputs and extension services. Similarly banks and financial institutions have operational targets in terms of development programmes. The existing organisational structure of these institutions disables them to deal with a large number of households. These institutions view IOs as a vehicle for achieving targets and improving their performance in terms of irrigation potential, productivity, disbursement of resources, credit disbursement and recovery. IOs have evolved as multifunction organisations in view of these opportunities and pressures.

Limitations of IOs as Multifunction Organisations

AKRSP works with VIs in developing natural resources and irrigation is only one of the activities it supports as part of village natural resource management. A number of other activities such as watershed management, afforestation and animal husbandry development are also undertaken by the VIs.

From our experience of IOs, most IOs find it difficult to manage these programmes along with the irrigation management function. There are a number of reasons and explanations which help in understanding why this happens. Firstly, the management of forests and other common property resources requires a different management pattern to water management. The resource is well defined in the case of water, distribution or use is visible and could be controlled by the IO. In the case of forests and other resources, resources are spread over a bigger area and require controls on grazing and voluntary protection by the communities. The interests of users of these resources are often in direct conflict with each other and conflict resolution becomes an important function for the organisation. Most IOs find it very difficult to cope with two resources, water and community land at the same time and in the instances when they try to manage them together it leads to problems in running the irrigation function of the organisation. Handling both functions requires a mature organisation and most institutions are able to take these multiple functions only after five years or more of operation as an irrigation enterprise.

The activities which IOs are able to take up easily relate to private resources such as land levelling and shaping of individual farmers' fields resulting in efficient water utilisation. IOs are also able to take up commercial functions as the extent of contribution by members is of a higher order, and management of these activities requires simpler inputs and it is possible to develop an incentive system of IO managers. Developing similar incentives and getting contributions from the community for other activities such as afforestation is difficult due to low returns and a higher gestation period before returns materialise.

Another function which IO finds it difficult to undertake is animal husbandry and milk procurement. The cooperative network in Gujarat is well established with provision for milk procurement from the villages and processing providing quick and simple returns to the farmers. Milk procurement has to be carried out in the morning and evening requiring continuous inputs and management. When IOs try to do it in conjunction with irrigation management they find it difficult to cope with management intensity of the activity. In our experience, in most areas where IOs are functioning, milk cooperatives with a different leadership pool have emerged in the same village and are functioning effectively as separate institutions.

Similarly, IO leadership generally tries to keep away from the political process as this might affect the working of the IO. Although IO leadership does not take formal positions in political institutions but wields considerable influence on the decision making process of formal institutions like *panchayats*.

The impact of taking up multi-functions like agricultural input supply, credit and marketing mostly improves the performance of the IO enterprise. Looking at the track record of the IOs which have taken institutional finance for construction of lift irrigation programmes in Gujarat, it is evident that those IOs which have taken up multiple functions of input supply, credit and marketing are more regular in repayment and are also able to create a depreciation fund for replacement of the machinery when it becomes obsolete. Multifunction IOs are also more profitable and are able to subsidise the water rates initially[4] in order to enable the system to break even in the first one or two years.

Support required by IOs to become MFOs

Irrigation organisations go through a transition process when they become multifunction organisations and their institutional effectiveness can go down if adequate support is not given to them during this phase. Also a number of IOs hesitate to take on other functions an absence of support mechanisms.

Based on our experience, the following support mechanisms are helpful to enable IOs to increase and maintain their performance and effectiveness while diversifying into new functions.

IOs require institutional support for management for the first three years of operation. If the IO is assured that management costs would be covered to some extent for the initial period, IO managers take more risk and are able to take up new activities resulting in increased turnover. This support should be reduced over time. AKRSP gives management assistance to the extent of 50%, 30% and 10% of the total management cost for 3 years of

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[4] Although the water rates are subsidised, they are still much higher than the rate charged by the Government e.g. the rate charged by the Government for pigeon pea crop is Rupees 100 per acre for two to three waterings whereas lift irrigation organisations in the area charge Rupees 120 per watering per acre. Whenever IOs are free to fix water rates they fix it at a much higher rate than the Government.

operation. Experience has shown that most IOs become viable after two years but the financial security enables them to take risks and be enterprising.

IOs also require significant training support in terms of operation of irrigation systems, maintenance and repairs, financial management, accounting and business management. They also need additional skills in dealing with external agencies like large seed suppliers, banks, financial institutions and other government and private agencies. A strong training component for IO managers helps in enabling effectiveness of MFO. Skills of liaison are very critical for IO managers who have to deal with external agencies as well as the farmers.

Developing an effective financial management system and the process of regular auditing is critical for better management of the organisation.

IOs also need to be given autonomy and flexibility to fix water rates and work out differential pricing mechanisms for water rates. They should also be allowed to fix norms and procedures for using credit and marketing as a leverage for enforcing member discipline. In our experience, if NGOs or the Government supporting the IO does not allow it the space to take decisions on its own, the growth and management capacity of the IO is stifled in the long run.

Implications for policy and practice

Most IOs do not realise their full potential as 'multifunction' organisations. They operate at a lower level of activity and are not able to help the members to increase their income to a significant extent in the short, as well as the long, run. Most irrigation establishments (NGOs as well as government) do not perceive IOs as potential MFOs when they conceive of the institutions for the systems. At the pre-design stage, during the dialogue with the village community, discussions centre around the irrigation system and its installation. Issues, like water distribution, are discussed and irrigation organisations are established around the objective of water distribution and operation of the irrigation system. It becomes clear after the first irrigation season that the irrigation utilisation is low because of poor availability of seeds and other inputs.

Since people are not prepared in the initial dialogue to take additional responsibilities they take more time to develop an institutional structure for other activities. This might lead to a lower irrigation utilisation and may lead to higher operational losses of the irrigation enterprise in the first year and in many cases leads to eventual closure of the irrigation scheme. This shows that there is a strong case for the initial appraisal process for irrigation systems to include other aspects related with agriculture and credit. Also the institutions created should be equipped and trained in skills related to handling these activities in the initial phase itself so that the gestation period before IOs are able to become effective in other functions is increased.

The viability of the irrigation enterprise can increase significantly if the IOs function as effective MFOs. At present many initiatives are undertaken by NGOs to incorporate this aspect in the design of irrigation programmes. However, in order for this aspect to be handled by the irrigation departments of the government, their mandate needs to be widened for minor irrigation programmes on the same pattern as Command Area Development programmes.

The ability of the IOs to function efficiently during water distribution would also be considerably enhanced if they function as multifunction organisations at the outset. This also helps to develop member discipline which is the most important contributor to the sustainability of the IO. Another aspect which gets facilitated by the multifunction nature is the equity aspect of the working of the IO. An IO is able to take care of a large section of the community needs and helps in reducing conflicts around the irrigation enterprise.

There is a recurring debate in India on the effectiveness of both minor and major irrigation programmes and the low utilisation of the irrigation potential created. A major reason for the low utilisation is attributed to the lack of work done on creating IOs which manage the irrigation systems. We argue that farmers do not get attracted towards IOs because it is concerned with only a small aspect of the agriculture enterprise. If the IO was promoted to an MFO, more farmers would show interest in joining these organisations and contributing towards its effectiveness. It would also need significant interventions and effort in training some of the existing staff members of government departments and the NGOs in the aspects of institution building and management of MFOs. At present these aspects are a small component of the training institutions.

This also requires significant training of the IO members and managers in a number of aspects such as financial and business management. We feel that this aspect is given very poor attention in most irrigation schemes. Lack of good trainers and limited importance given to these aspects in the performance evaluation of irrigation systems inhibits IOs to becoming MFOs.

Being multifunction helps irrigation organisations to become effective, sustainable and deliver better services to members. However, if IOs are not equipped with management skills of financial institutions and business enterprises, multi-functions affect their performance. There is a strong need to spend at least a small proportion of resources on training of IO members and creating a cadre of professionals from government, private sector and NGOs which can facilitate the diversification of IOs.

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GRAMEEN KRISHI FOUNDATION
A Multifunction Organisation

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GRAMEEN KRISHI FOUNDATION
A MULTI-FUNCTION ORGANISATION

Edward Mallorie

Contents **Page**

GRAMEEN KRISHI FOUNDATION
A MULTI-FUNCTION ORGANISATION

Edward Mallorie

Introduction

The Grameen Krishi Foundation (GKF) is a subsidiary of the Grameen Bank, a large Bangladeshi NGO. GKF was primarily established as an irrigation organisation to operate deep tubewells (DTW) and supply farmers with water. However economic pressures, together with a wish to provide farmers with a wider range of services, are leading it to widen its activities into more general contract farming and agricultural support.

This paper briefly describes the background of groundwater irrigation in Bangladesh and the activities of the Grameen Bank. It then examines the operational experience of GKF and explains how it has evolved into a multi-function organisation (MFO). Finally its future prospects are reviewed and consideration given as to what extent its experience is typical or replicatable.

The information in this paper is largely drawn from the first review mission of the Grameen DTW Project funded by UNCDF and the Dutch Government. The author is a member of the Mott Macdonald International team responsible for these review missions and acknowledges the contribution of his colleagues, Martin Gillam and Catherina van Heel, have made to the information in this paper.

Groundwater Irrigation

The green revolution, coupled with rapid expansion of irrigation, has enabled Bangladesh to achieve a high degree of self-sufficiency in rice, it's staple food. This is despite an extremely high population density, rapid population growth, and extreme vulnerability to flooding with consequent loss of crops. Irrigation has enabled farmers to increase the area of HYV paddy grown in the dry season (known as boro). Not only does this yield more than HYV paddy grown in monsoon (the aus and aman crops), but it is less at risk from flood damage. The area of HYV boro paddy tripled in the 1980's and by 1989/90 accounted for 21% of the total paddy area and half the HYV paddy area (World Bank).

The expansion of irrigation has almost entirely involved minor irrigation, mostly groundwater although surface water is also utilised via low lift pumps (see Table 1). Widespread groundwater development started in the early 1970's with the installation of DTWs. Approximately 28,000 have now been installed, almost all by government organisations, mostly the Bangladesh Agricultural Development Corporation (BADC), but also by the Bangladesh Water Development Board (BWDB). The output of these wells (2 cusec) is well above the requirement of an individual farmer. BADC wells are mainly operated by farmers groups who initially rented, and later purchased (via a bank loan), the well. BWDB operates its own wells and charges farmers a water fee.

Table 1: Irrigated Area in Bangladesh ('000 acres)

	1970	1978	1988	1990
Large-scale gravity schemes	300	544	527	658
Minor Irrigation				
low-lift pumps (surface)	24	63	115	200
tubewells	33	127	1,466	1,676
shallow (STW)			868	1,046
deep (DTW)			554	593
hand operated			44	37
Traditional methods	725	770	353	400
Total irrigated	1,082	1,514	2,461	2,934

Source: World Bank

Although a large area of irrigated crops have been produced by these DTW, there are substantial problems in organising farmer groups, and in collecting sufficient user charges to cover operating costs and to service loans. As a result some groups have collapsed leaving wells unused, while others have, de-facto, been taken over by an individual who finances well operation and sells water to farmers.

Government policy towards minor irrigation has changed in the last five years with the private sector taking over the prime role in development, operation and ownership. As well as developing most DTW, BADC had supplied virtually all pumps and engines for the smaller shallow tubewells (STW) and low-lift pumps (LLP). This has now been opened up to the private sector and since 1988 controls and duties on the import of small diesel engines have been removed. As a result the market price of equipment for STW fell below the previously subsidised BADC price: in fact in the 1993 cost of a STW was about Tk20,000 – about the same as the BADC price in 1980 – a fall of over 50% in real terms (Gisselquist). The availability and support for such equipment has also improved as thousands of machinery dealers have established themselves in every town and many villages. STW are a more affordable alternative to DTW over most of Bangladesh where the water table is close to the surface.

Subsidies on government supplied irrigation equipment have now been phased out. Subsidies used to account for well over half the cost of DTWs installed by BADC and sold to farmer groups. With development being left to the private sector, BADC is no longer installing significant numbers of DTW, or supplying STW/LLP equipment. BADC is divesting itself of its remaining DTWs still on hire to farmer groups, and BWDB has been encouraged to make similar moves.

The result of these policy changes is an explosion in the number of STW and the total irrigated area increased by over half a million hectares in the two years 1988–1990. According to the Water Resources Planning Organisation of the Ministry of Irrigation, Water Development and Flood Control, STW now supply 40% of the irrigated area, compared with 23% covered by DTW. In future DTWs are likely to by restricted to areas with a water table inaccessible to STW, and be scaled down to be within the resources of private individuals.

Grameen Bank

The prime activity of the Grameen Bank (GB) is lending to the rural poor and supporting income generating activities aimed at this group. It was registered as a bank in 1988, although it had existed as a project since 1976. GB is jointly owned by customer shareholders and the government, and is usually classified as an NGO although its part government ownership and scale of operations sets it apart from other NGOs.

GB is a remarkable success story. It is presently disbursing over $100 million per annum, and has over $45 million in accumulated savings from its clientele of 1.6 million borrowers, 90% of whom are women. The Bank's loan recovery rate is more than 95%, which is remarkable given the rate of no more than 30% in the government owned commercial rural banking system.

In recent years the government has been eager to dispose of poorly performing development projects, and Grameen has been asked to take over a number of these, and has set up commercial enterprises based on fish and shrimp farming, cold storage facilities, and irrigated agriculture.

Grameen's principal agricultural ventures are in DTW operation, where it took over the Tangail Agricultural Project in 1987, and the Rangpur–Dinajpur Agricultural Project in 1988. They were grouped together as the Grameen Agricultural Project (GAP). In terms of resources this is the most significant Grameen non-banking activity, with GB having invested $7m to date.

Grameen Krishi Foundation

In December 1991 GB formally established, as a separate entity, the Grameen Krishi (agricultural) Foundation, to take over the GAP tubewells in the Rangpur–Dinajpur area. It is licensed under section 26 of the companies act and is a non-profit making NGO, wholly owned by GB, which also provides its senior staff on secondment.

A total of 2,460 DTWs had been made available to GAP in the Rangpur–Dinajpur area. These included 1,500 ex-BADC DTWs and 960 ex-BWDB DTWs that had been installed with external funding from ADB and the Saudi Development Fund. Almost all of these wells had never been operated, having been installed and the tail-end of the 'DTW era' in Bangladesh.

The number of DTW actually acquired by GKF and available for operation, is about 790: 565 ex-BADC and 225 ex-BWDB. GKF purchase the BADC wells is on credit provided by BADC at a cost of Tk175,000 each – which was the current sale price for new wells (net of subsidy) at the time of the take-over by GKF.

GKF Operational Experience

Each DTW is organised as a 'primary farm' (PF) with a resident manager employed by GKF. GKF enters into contracts with farmers to provide irrigation water. As well as supplying irrigation water, GKF also provides some farmers with crop inputs, hires out machinery, and may market crops on behalf of farmers. Farmers pay GKF for water and inputs by agreeing to hand over a share of the resulting crop to GKF.

Initially GKF took a share of 25% of the boro crop for the supply of water alone, and 33% for water plus seed and fertiliser. Experience in the first season of operation indicated that this was insufficient to cover GKF's costs and the share was increased to 30%/40%. The proportional share arrangement encouraged farmers to under-report yields to minimise the amount handed over to GKF. GKF have therefore now switched to a flat rate share arrangements for most paddy: farmers pay 12 maunds (448kg) per acre for water and 20 maunds (746kg) for water and inputs. This switch to flat rate has dramatically increased the average reported yield of boro from 1.1 t/acre to 1.7 tons (which is typical for the region). Those farmers still on the proportional share arrangements are mostly those with whom GKF have a good relationship and who can be relied upon to report genuine yields.

Table 2 shows the number of DTW's operated, and areas of crops grown, by GKF each year since it commenced operations in 1989/90. Operations in 1989/90 were limited by delays in handing over BWDB wells and other initial teething problems. Well numbers and crop areas increased sharply in 1990/1 as farmers gained confidence in GKF. This was despite the fact that GKF increased its charges and suspended operations at some DTW where sandy soil makes irrigation uneconomic. The switch from proportional shares to flat rate water charges met with considerable resistance from farmers and resulted in a sharp fall in well numbers and crop area in 1991/2. There was a further drop in well numbers in the last season due to a continuing tough stance taken by GKF management over payment of its share by farmers and increasing discrimination by GKF in the selection of potentially viable DTW. However overall crop area increased with a substantial amount of non-rice crops. For this coming season it is expected that both well numbers and crop areas will increase. There is a growing acceptance by farmers of GKF's share arrangements, and a realisation that water and services must actually be paid for. There has been particular resistance in the ex-BWDB well areas where BWDB water fees were not only extremely low (covering only 7% of O and M costs), but non-payment was widespread, with only 24% of fees being collected (Parker, 1992).

The viability of GKF operations in the 1992/3 cropping season was adversely affected by a sharp fall in rice prices. Growth over some years in rice production has resulted in the gradual increase in the level of national self-sufficiency, with Bangladesh becoming a marginal net exporter. This underlying growth in production had a sudden impact on prices in late 1992 and 1993 when a series of bumper harvests combined with the effective collapse of government support buying. In addition wet weather during the 1993 boro harvest meant that the crop was difficult to store or market. At this time prices were reported to be a low as half of those in the previous boro season, although statistics collected by IFDC suggest a fall of around 30%. Although it is likely that prices will recover to some extent as farmers respond by reducing input levels and the area of irrigated paddy, it is likely that prices will, in the medium term, remain depressed.[1]

[1] World Bank Projections suggest a surplus of rice production over demand growing from 5-6% now to over 15% by the end of the decade. before starting to decline about 5 years later. If trade and exchange rate policies are adjusted, this could allow rice prices to fall by about 15% so stimulating a 12% increase in consumption. The prices used in the financial projections in this paper represent a 17% decline from mid-1992 budget assumptions.

Table 2: GKF Operations

Crop	1989/90	1990/1	1991/2	1992/3	1993/4 (plan)
No. DTW operating	534	629	541	496	647
			Crop area (acres)		
Rabi season					
boro paddy	20,936	25,328	19,325	15,424	20,000
aus paddy	213	86	240	429	250
wheat	50	172	1,407	3,205	4,000
soyabean	0	6	0	950	2,000
pulses	0	6	49	139	400
oilseeds	0	3	37	223	450
cotton	0	0	7	20	10
other (veg.etc.)	19	67	302	317	1200
sub-total	21,218	25,715	21,530	22,072	28,310
Kharif season					
aman paddy	284	446	3,558	15,192	18,000
Perennial crops					
sugarcane	0	2	175	2,861	5,000
bananas	0	25	84	43	200
sub-total	0	27	259	2,904	5,200
Total rabi	21,218	25,742	21,789	24,976	33,510
Total kharif	284	473	3,817	18,096	23,200
Grand total	21,502	26,188	25,347	40,168	56,710
Rabi acres per DTW	39.1	40.9	40.3	50.3	51.8

This fall in prices has reduced the income GKF obtains from its crop share so the area of paddy needed for a Primary Farm to break-even has increased. Even if prices recover to Tk4.56/kg, the area of boro needed to cover PF overhead costs of Tk40,000 is 42 acres. This compares with the 29 acres needed when prices were Tk5.50 as assumed in budgets made prior to the fall in paddy prices (see Figure 1). Although 42 acres is compares favourably with the 1992/3 average irrigated area of 50 acres, an additional Tk46,300 per primary farm is needed to cover other GKF management and administration costs at the unit, regional and headquarters levels. This increases the area of boro required total overheads to about 90 acres – well above the target set in the UNCDF project of 60 acres per DTW. These calculations are based on boro grown on heavier soils: much of the area has lighter soils which require more irrigation water. Although GKF has tried to reduce its operations where soils are lighter, the extra irrigation cost on light soils means that 75 acres would be needed to cover PF overheads and 163

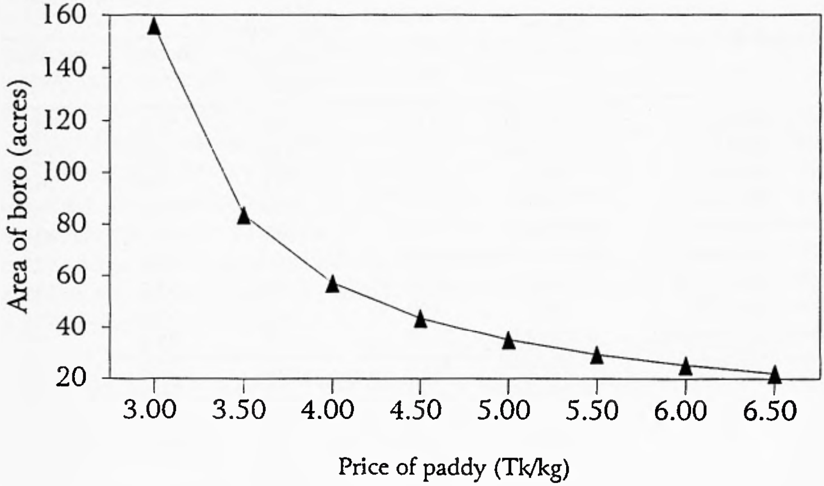

Figure 1: Area of boro to cover Primary Farm Overhead Costs (assumes share of 448kg/acre, overhead cost f Tk40,000/year)

acres to cover total overheads.

GKF continues to operate at a loss and will find it difficult to sustain its operations unless it is able to increase its income. Although it covers its variable costs on the production of irrigated boro (Table 3), net income per acre is too low to cover overhead costs on current command areas, and it would be both expensive (in terms of improved distribution systems) and impractical (given the poor siting of many wells and land tenure/institutional factors) to enlarge command areas to grow sufficient boro to cover total overheads. One option to increase GKF income would be to increase the share of the crop taken as a water charge. However analysis of overall costs and returns indicates that the current 12 maunds (448kg) per acre water charge splits both variable costs and income 70% to the farmer and 30% to GKF (see Table 3). Any increase in water charges would mean that GKF would get a disproportionately large share of income relative to its contribution to total costs, and farmer resistance would result in a fall in the irrigated area. Another possibility is to increase the total crop area per primary farm by producing aman paddy outside the main irrigation season. Although a substantial area of aman is now produced (GKF supply inputs

Table 3: Summary of over crop gross margins and GKF share income

Taka per acre	Share system	Overall gross margin	GKF margin over variable cost	Share of farmer	
				income (%)	var. cost (%)
Boro - heavy soil	12 maunds	3518	953	76.1	78.3
Boro - light soil	12 maunds	1459	530	70.6	72.4
Boro - heavy soil	30%	3518	1371	70.4	76.9
Boro - light soil	30%	1459	469	70.4	71.1
Boro - heavy soil	20 maunds	3518	384	60.1	40.3
Boro - light soil	20 maunds	1459	-40	51.0	37.7
Boro - heavy soil	45%	3518	706	55.5	38.9
Boro - light soil	45%	1459	-435	55.6	36.4
Aman (unirrigated)	6 maunds	3758	-14	85.9	73.0
Aman (irrigated)	12 maunds	3414	642	71.8	63.6
Aus	10 maunds	1474	23	76.5	59.3
Sugarcane	60%	18758	10680	40.4	37.1
Maize - hybrid	60%	1720	896	40.6	39.2
Maize - composite	50%	1085	679	50.8	53.8
Wheat	13 maunds	247	-2	46.2	43.3
Soyabean	60%	5017	3355	40.0	48.9
Mustard	60%	2547	1939	40.0	54.0
Banana	60%	21024	13367	40.0	45.1
Potato	65%	2197	852	35.0	30.6

(note: one maund = 37.5kg)

and, if rainfall is inadequate, supplementary irrigation), the profit for GKF is limited as it does no more than breakeven on the supply of inputs while irrigation is often not needed. The other alternative, that GKF is pursuing, is to grow other crops which yield a higher income per acre.

Non-rice crops that are widely grown in north-west Bangladesh include pulses, oilseeds (mustard) and wheat. Mustard and pulses are normally grown on residual moisture with minimal inputs and the potential for GKF involvement is limited. Wheat does benefit from irrigation, but recent crops have suffered from widespread sterility and yields have been low. Wheat prices have also been depressed by the fall in rice prices, and it is even less profitable for GKF than boro paddy. GKF is therefore looking to develop other alternative crops that are not now widely grown. These include sugarcane, maize, soya beans and bananas. These crops can generate more income per ha for both farmers and GKF, and enable GKF to cover its overhead costs within a realistic area of PF.

If a PF grows a mix of 80% boro and 20% soya beans (assuming a flat rate share of 446 kg/acre for boro irrigation and a proportional 60% for soya bean water and inputs) then the area required to breakeven can be sharply reduced. Figure 2 shows that if only boro is grown, irrigated from a DTW, about 40 acres is needed to cover farm overheads and 90 acres to cover total overheads. However if a mix of 80% boro and 20% soya beans are grown the breakeven areas drop to 27 and 60 acres.

Crop diversification is even more important on light soils. Figure 3 shows that 75 acres of boro would be needed just to cover farm overhead costs. Although the combination of 20% soya, 80% boro would cover farm overheads on under 40 acres, to cover total overheads would need over 75 acres, and a more appropriate combination would be 30% soya and 70% boro (as shown in Figure 3) which cover farm overheads in 29 acres and total overheads in 63 acres.

Other non-rice crops other than soya beans could also be grown. The profit margins for sugarcane and banana suggest that only a few acres would be needed to cover total overheads. On the other hand maize is little more profitable than boro.

GKF as a Multi-Function Organisation

Although GKF has always aimed to have a broad role in agricultural development, the rationale behind its establishment was the existence of a large number of DTWs and the need to find a competent organisation for their operation. From the outset GKF provided crop inputs of seed and fertiliser in addition to water, so effectively taking on the roles of credit agency and input supplier. The objective here was to provide a package of inputs for irrigated paddy to those farmers who could not otherwise afford them, and who might therefore not be able to participate in the irrigation. This would both constrain irrigated areas and be less equitable. However in practice GKF has found it difficult to charge a large enough share to cover the cost of these inputs, and farmers resist paying more. The proportion of paddy to which inputs are supplied has fallen from over half the boro crop in 1990/1 to only 7% in 1992/3. In practice farmers do not appear to use less inputs if they have to fund them from their own or other non-GKF sources.

However GKF firmly sees its future as an MFO. Although for the boro crop it is increasingly just providing water, falling paddy prices mean it is giving an increasing emphasis to non-rice crops. However inadequate technical advice, a poor supply of seed and other specialised inputs, as well as a lack of assured market outlets, constrains the development of potentially profitable non-traditional crops such as maize, soya and

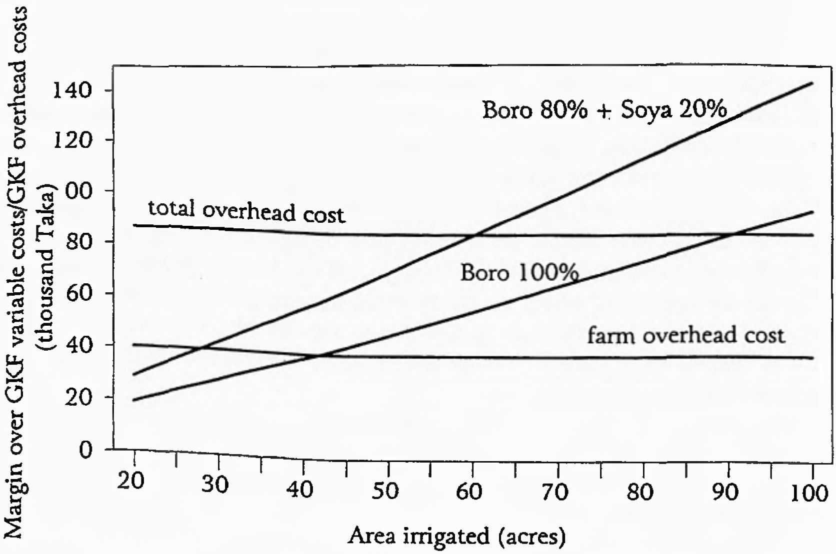

Figure 2: Area of crops to breakeven - heavy soil for one primary farm

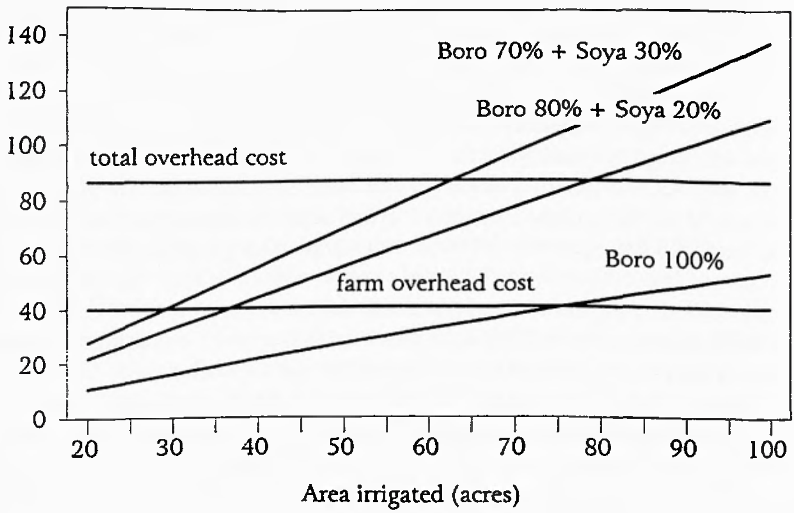

Figure 3: Area of crops to breakeven - light soil for one primary farm

sugarcane. To overcome this GKF must provide farmers with a wide range of services.

To promote sugarcane production GKF has made direct marketing arrangements with sugarmills which have established buying depots for GKF's exclusive use. GKF has also bought in the Sugar Cane Research Institute to assist in introducing improved production methods (especially regarding crop establishment) which means that yields are almost twice the average for Bangladesh. GKF has made a major effort to introduce maize and soya beans: both new crops to most farmers. This has involved the import of hybrid maize seed from Thailand, soya seed multiplication and procurement of soya inoculum as part of a comprehensive input/technical advice package, that also included the supply of maize shellers and crop sprayers. Demonstration plots have been established in cooperation with the Crop Diversification Project of the Ministry of Agriculture.

Previous efforts in Bangladesh to popularise maize and soya have floundered on the problem of marketing. There is no tradition of processing and consuming these crops at the village level and, with only small volumes produced, it has not been worthwhile for traders and processors to become involved. This is a 'chicken and egg' situation in that there was no market, without which farmers were unwilling to produce, while lack of production meant there was no trade. GKF has unblocked this log jam by offering farmers in advance a guaranteed price for any part of the farmer's share of the crop that they wish to sell. GKF has thus been able to market a significant volume. Maize has been sold to modern sector poultry farms, which may mean organising transport to Dhaka. Although maize prices have also been depressed by the overall fall in grain prices, its yield potential is better than that of wheat. The volume of soya beans produced is still too small to interest oil extraction industries, but GKF have found that, by parboiling and drying soya beans in a rice mill, it is able sell the crop for fish and poultry feed and for confectionary. There is a ready market and the processing cost is low. Net returns are little, if any, below that if oil had first been extracted.

Non-rice crops require much less irrigation than boro, and irrigation is less of a central issue in their production. These crops grow best on lighter soils and the heavy soils (which are best for paddy) in many DTW commands may not suit them. On such PFs non-rice crops are best grown on higher ground with lighter soils away from the DTW command area using a STW to provide irrigation water. Although STW are relatively less efficient in terms of energy use, they are cheap to buy and their small size means they can be moved between well-heads to irrigate an area of up to 30 acres.

Lower energy efficiency is of less significance when only a small quantity of water is being pumped.

The use of STW to grow non-rice crops enables the crop area of a PF to be expanded with enlarging the command area of the DTW, which may be difficult in terms of topography or expensive if lined channels or pipes are needed. The numbers of STW operated by has grown sharply as the following figures show:

	number of STW
1989/90	22
1990/1	52
1991/2	98
1992/3	268
1993/4 (planned)	295

In addition to diversifying into non-rice crops, GKF is expanding PF activities into the fields of aquaculture and livestock production. It has taken over a number of fish ponds located at PFs on a lease or share basis, and is stocking these ponds which previously were almost all disused. The area of ponds in 1992/3 was 70 acres and it is planned to increase this to 302 acres in 1993/4. GKF has also purchased some cattle for milk and meat production, but this activity is at a pilot stage.

Linkages with farmers and other organisations

GKF is planning to establish farmer committees at each PF. However where these do exist they seem to have little control of management decisions and, for practical purposes, the key decision-maker at the PF level is the farm manager who is a GKF employee. To a large extent the relationship between farmers and GKF is that of a customer and supplier, and farmers appear to perceive GKF as an external organisation much like BWDB and BADC.

GKF, as part of GB, has wider social objectives that are, to some extent, aimed at the rural poor rather than at participating farmers. Grameen Bank was created to assist this group and owners of more than half an acre are excluded from its primary credit and group activities. To assist this target group GKF is planning to hand over the operation of some DTWs to groups of landless poor. These people would then sell water, or enter into share cropping arrangements with farmers and landowners. To date 33 groups have been formed and 15 DTW are now operated by them (or earmarked for operation as the groups are still undergoing training). GKF, through GB, has also funded the redemption of mortgages on an area of 120 acres. This land can now be farmed again by its owners who had lost possession when they raised the mortgage to borrow money.

GKF grew out of GB and, as many of its staff have a rural banking rather than agricultural background, GKF has had to look elsewhere for the expertise it needs. It claims to have had some difficulty in getting general agricultural advice from agricultural extension and soil science organisations, and prefers to enter into contracts with specialised agencies for specific services. It has had such agreements with the Bangladesh Livestock Research Institute, the Crop Diversification Project of the Ministry of Agriculture, and the Sugar Cane Research and Development Institute. Many of its technical staff are provided via a contract with a Bangladeshi consulting company, Kranti Associates, who have in turn obtained staff on secondment from government organisations such as BADC and Bangladesh Agricultural Research Institute.

GKF is likely to continue moving away from its role as an irrigation water supplier towards that of a broader multi-function and contract farming organisation. To survive it needs to be commercially viable and irrigation of paddy does not generate sufficient income to cover its overhead costs. The supply of groundwater for irrigation purposes is something that can be done by privately owned STW. Although GKF can write off the original cost of its DTW, and DTW are more energy efficient than STW, these advantages have to be set against GKF's considerable overhead costs.

Some of GKF's activities compete with those of other organisations, such as banks, the Department of Agricultural Extension, BADC seed production farms and private traders involved in input supply and crop marketing. However GKF has found itself able to compete, partly through more efficient management, and partly because of the integration of it's activities. In particular the formal banking sector has not been effective as a supplier of agricultural credit in Bangladesh, and is dogged by problems of collateral and difficulties in supervising many small loans. By tying credit to an irrigation contract, and by maintaining close contact via the primary farm manager, GKF has not required formal security and has generally been able to recover its due share of the crop from the farmer.

The agricultural extension service has been accused of not having good contact with farmers and not being able to provide them with relevant advice. GKF not only has better contact with (albeit a limited number of) farmers, but it also has a direct financial incentive to provide the best advice possible.

Conclusions

In conclusion it is worth mentioning that GKF is not the first attempt to establish an irrigation based MFO in Bangladesh. The original model for the operation of DTWs installed by BADC was that of a multi-purpose farmers' cooperative. Farmers groups were to be formed (known as 'KSS') which were to hire/own and operate the DTW. In turn these groups were to be members of a higher tier cooperative union (the Thana Central Cooperative Association – TCCA). These organisations had originally been conceived as the 'Comilla model' of development and expanded as 'Integrated Rural Development Projects' in the 1970's and 1980's. They channelled loans for fertiliser and other inputs from commercial banks to farmers and were to act as input suppliers and marketing agencies. Although heavily supported by a specialised government agency, the Bangladesh Rural Development Board, the farmer-members of the KSS lacked the management skills and cohesion to form genuine cooperatives, and most collapsed when they defaulted on loans.

GKF's future role would seem to be in the development and promotion of new crops where farmers need a complete package of know-how, inputs and, most important, market outlets. The private sector does not have the resources and is not prepared to take the risk, while government organisations have been unable to efficiently undertake the trading role (and in any case such trading is no longer seen as a government activity in Bangladesh as in many countries). Irrigation may well not always be a central part of GKF's activities. Farmers could supply their own water using STWs. Alternatively, for crops with limited water needs, manually operated tubewells and pumps can help small farmers maximise the returns to their labour inputs.

Parallels can be drawn between this path that GKF is going down, and other organisations. Tobacco companies in Bangladesh and other countries provide a similar input/market service to contracted farmers. In Zambia Lintco, a parastatal, was set up to develop smallholder cotton production, and later has moved into a similar venture in soya beans. Unless market outlets are highly specialised and controlled by an MFO such as GKF, once a new crop has been popularised, private buyers and input suppliers may find it worthwhile to compete, and may benefit from having lower overhead costs. In such a situation GKF may need to move on to develop other new crops, such as horticulture for processing or export, or develop its own food processing facilities. Alternatively it may choose to place more emphasis on its social rather than commercial role by assisting the poor earn a living from agriculture, and move closer to it's parent organisation.

There seems to be a growing interest in the development of organisations, such as GKF, that are able to provide farmers with a range of services on a commercial basis. Such 'agribusiness' is often viewed as a more appropriate route for delivery of services than traditional government agencies which not only place a burden on public resources, but may also be less responsive to the needs of farmers. However to survive agribusiness organisations like GKF need to be commercially viable in the face of competition from subsidised or free services from government agencies, and services offered by private traders with minimal overhead costs. To survive in this environment organisations may need to find and exploit market niches where their higher levels of management input can find sufficient rewards.

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IRRIGATION MANAGEMENT NETWORK

DESIGN FOR WATER USER ASSOCIATIONS: Organisational Characteristics

Michael M Cernea and Ruth Meinzen-Dick

Network Paper 30

April 1994

Network papers in this set:

Newsletter April 1994

28 *Multifunction Irrigation Organisations: Advantage or Handicap* by Parmesh Shah and Meera Kaul Shah

29 *Grameen Krishi Foundation - A Multifunction Organisation* by Edward Mallorie

30 *Design for Water User Associations: Organisational Characteristics* by Micheal M Cernea and Ruth Meinzen-Dick

31 News from the Field

32 Prospects for Multifunction Organisations to Improve Irrigated Agriculture: A Call for Information from Network Members

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Design for Water User Associations: Organisational Characteristics*

Michael M Cernea and Ruth Meinzen-Dick**

Contents **Page**

* The present paper is a chapter from a forthcoming broader study about the World Bank's lending for irrigation over a period of 16 years (FY 1975-1990) and its experience with water user groups. The full study is entitled: 'Building Organization Capacity for Irrigation and Water User Associations in World Bank Projects'.

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Design for Water User Associations: Organisational Characteristics

Michael M Cernea and Ruth Meinzen-Dicks

This paper analyses how Bank-financed irrigation projects deal with the basic organisational characteristics of water user associations (WUAs) in their design and approach. It assesses whether these organisational characteristics are taken into account and what projects must do to increase the support provided to their establishment or strengthening. It also discusses the relative benefits of relying on organisations that already function among water users as opposed to attempting to establish new ones. While the research and conclusions presented in this paper are developed from irrigation systems, many of the organisational principles apply also to other types of resource management projects in which local resource users are expected to work with an outside government or private agency (see Cernea, 1989; Ostrom, 1990).[1]

The contextual and organisational characteristics examined in this section of our review are:

- pre-existence of water user organisations;
- new organisations;
- membership criteria;
- size of the base unit;
- federating base units;
- role specialisation;
- accountability;
- linkages with irrigation agency.

Investing or Disinvesting in Existing Organisations

WUA development under irrigation projects varies, depending on whether the project seeks to strengthen *existing* organisations or to help create *new* ones. Three types of situations have been encountered: those in which projects (1) work with existing irrigation associations, (2) build upon other types of local organisations to which water-related functions are added, or (3) attempt to create new WUAs.

The present review covers 16 years of Bank lending for irrigation, from FY 1975 to FY 1990. Table 1 indicates that nine appraisal reports from 1975, sixteen from 1984–6 and five from 1990 (representing 39, 36, and 55 per cent of total projects, respectively) mentioned the pre-existence of WUAs in the project areas and thus had, in theory, the opportunity to build on established organisations. The use of existing WUAs, however, should not be an automatic step. The adequacy and capacity of the area's existing traditional organisations need to be assessed before deciding whether to rely on them, whether they are in need of re-adaptation or strengthening, or whether to encourage the establishment of new WUAs.

Sociologists and anthropologists, when consulted, generally tend to recommend that designers of new projects build upon existing organisations, provided that equity goals are not seriously compromised by maintaining the traditional setup (Uphoff, 1986). Indeed, where water users' associations are already functioning, they can be expected to have legitimacy and a certain level of expertise in irrigation system management. Nevertheless, seven of the nine projects approved in 1975 for areas in which WUAs predated the project did not include them in the new programmes (one of these seven projects planned for the establishment of new WUAs, and six staff appraisal reports (SARs) made no provisions for involving WUAs in the project effort).

Table 1: Building upon pre-existing WUAs

	FY75	FY84	FY85	FY86	Total FY84–86	FY90
Total projects	23	13	18	14	45	9
SARs reporting existing WUAs % of total cases	9 (39)	3 (23)	8 (44)	5 (36)	16 (35)	6 (55)
If WUAs exist, SARs building on WUAs	2	3	5	5	13	4
Building on WUAs	1	0	0	0	0	4
No plans for WUAs	6	0	3	0	3	2

Greater recognition of the potential value of pre-existing WUAs is apparent in 1984–86 projects, where only three out of sixteen projects with pre-existing WUAs made no provision for their inclusion. In 1987, all four projects with pre-existing WUAs reincluding them, and in 1990 four out of five SARs did so.

If there are no valid reasons to avoid existing users' organisations, then neglecting them – either by giving them no role in the new development or by bypassing them to create new associations – amounts to *disinvestment* in valuable institutions. Given the time, expense, and risks involved in establishing new local organisations, failure to build upon existing WUAs where feasible is a self-defeating weakness in project resource allocation, equal to losing available organisations capacity and 'solidified' human capital. In past years, unfortunately, many development projects have bypassed or even helped disrupt such long-standing organisations (Coward, 1991). Such neglect has even been more evident in the practice of domestic water agencies in various developing countries and has been resisted by Bank specialists.

Disinvestment in existing WUAs may sometimes even backfire by causing active opposition to the project from local WUAs. In the 1975 Philippines Tarlac Irrigation Project, for example, the existing communal irrigation systems already irrigated over 2,600 hectares within the area to be covered by the new project. The project appraisal report made no provisions for involving these existing communal irrigators' societies in the project. A few years later, the project completion report (PCR) found that, because of the neglect of their societies, farmers within the communal irrigation systems had refused to join the irrigation project. Thus, this obvious disinvestment in, and rejection of, existing WUAs led to a shortfall of almost 10 per cent of the area the Tarlac project intended to cover and to a loss of potential benefits. The lesson learned from the PCR and from the country agency from this and similar cases, is:[2]

> . . . to make fuller use of Irrigator Associations and [to]. . . work on a program which would develop the capability of water management technicians to interface successfully with Irrigator Associations (PCR, para 17).

The principle of working with existing WUAs may seem obvious. Its implementation, however, is not necessarily easy. First, traditional WUAs may often be informal groupings, without legal status or official recognition. A second problem arises if existing WUAs are not functioning well (e.g., if they are inactive, conflict-ridden or dominated by a few wealthy landholders). In two projects in West Africa (Niger Irrigation and Senegal River Polders projects), the traditional forms of social organisations were deemed at appraisal to be inappropriate: they were dominated by chieftains using them for personal gains and were unsuitable for efficient agricultural production.

Where there have been no pre-existing irrigation associations, Bank planners have sometimes looked for other active local organisations able to take on irrigation functions. Such examples have occurred in Bank projects in Mauritania and Turkey. Bank projects have also relied on, for example, *panchayats* (local government councils) for small-scale systems in India and Nepal; multipurpose co-operatives in Bangladesh; and tribal-based groupings in the Republic of Yemen.

This approach may require some assistance/training for members in water and system management, but it avoids many of the delays and ground-breaking problems of establishing new organisations with local legitimacy. The major precaution in such cases is to ensure that the organisation's capacity is *not overloaded*. Experience has shown that consultations with leaders and members should ascertain their agreement on the proposed tasks under the new project and assess whether the leaders will have time, interest and resources to devote to irrigation activities.

Investing in New Organisations

In situations where no appropriate farmer organisations can be identified 'on the ground', irrigation projects must initiate the creation of WUAs. This occurs primarily, but not exclusively, in new irrigation systems: often, WUAs are also needed in previously irrigated areas, in which users have not organised themselves.

The last year of the period under review, FY 1990, perhaps best illustrates the various ways in which Bank development investments trigger the establishment of new WUAs in a kind of hands-on method, with explicit provisions for organisation building. The Brazil Irrigation I Project (SAR, January 1990) will create, in new settlements, six irrigation districts described as 'private associations' under Brazilian law, encompassing all beneficiary farmers and thus supporting the simultaneous formation of both administrative structures and farmers' groups on the new lands. The Bangladesh Water Systems (BWDB) Rehabilitation Project (February 1990) will help establish a similar kind of grouping, called inlet committees. Additional irrigation inlets would be constructed only after inlet committees have been formed and beneficiaries have agreed to make land available and to undertake all earthworks for the inlets and field canals. The same project will promote the creation of associations of landless labourers, helping them enter the water market and purchase (through NGOs) low-level pumps and minor irrigation equipment. Comparable features are contained in projects approved in 1990 in Somalia (Farahaane Irrigation Rehabilitation Project), Mauritania (Gorgol Irrigation Rehabilitation Project), China (Hebei Agricultural Development Project), and Nepal (Bhairawa Lumbini Groundwater Irrigation III Project).

The projects under which substantial investments in grassroots organisations have been made and in which the formation of new WUAs has occurred on the largest scale are the two On-farm Water Management Projects (OFWM) in Pakistan: OFWM Stage I, started in FY 1981, and OFWM stage II started in 1985. These projects will be continued under Stage III, approved in FY 1991. The establishment of a water user association for each individual *chak* (watercourse) covered by the project was made a condition of starting civil works on the watercourse. Because users have a strong interest in getting the canals lined, the response was prompt and on a mass scale. Over 15,000 WUAs were organised in Pakistan during the 1980s, a performance unequalled by any other projects (for details, see Byrnes [1993, forthcoming] and Cernea and Meinzen-Dick [1992, forthcoming]. This, of course, required important investments in organisation building. The investments paid off to a great extent during the construction works themselves, as the new WUAs mobilised considerable labour by their membership and thus assumed part of the capital construction costs.[3]

However, experience with the OFWM projects has revealed unexpected difficulties and setback with WUAs: during civil works, WUA members are enthusiastic and WUAs function at their peak. Subsequently, however, many WUAs become inactive and fail to maintain the installed works, although this causes members to lose some of the benefits for which they worked so hard. This may be a consequence of uneven roles given to WUAs, in particular their insufficient involvement in the decisions about water allocation and distribution.[4]

Generally, the evidence from many projects shows that WUAs can be built:

1. either on the organisational foundation offered by pre-existing forms of farmer organisations; or
2. as new forms of association, created by technologically induced institutional needs.

In many, though not all Bank assisted projects, investing in farmer organisations has been co-ordinated with investing in the technical and physical infrastructure. Project designs often specify that tertiary system construction should only take place where WUAs have been established. This allows farmers to participate constructively in the design and development of the system. However, this requires considerable advance preparation, for community organisers need lead time to help WUAs form and develop if they are to usefully contribute to the construction or rehabilitation project.

Indeed, to properly design and create such organisations, sound social engineering is as necessary in these projects as good technical engineering. The use of institutional organisers is an effective tool for developing new WUAs, as demonstrated by programmes in the Philippines (see de los Reyes and Jopillo, 1989; Illo, 1989) and Sri Lanka (Uphoff, 1986). With adequate guidance, these agents act as catalysts in bringing farmers together for WUAs, without imposing a particular structure or type of leadership on the groups. Organisers have also been useful for strengthening existing farmers' organisations in projects working with community irrigation systems (see Manor, Patamatamkul and Olin, eds., 1990).

Membership Recruitment

There are four alternative principles that may govern how water users arrange themselves into organised groups:

1. hydrological: field neighbours sharing water from a common facility, such as a turnout or watercourse;
2. residential: village neighbours, such as those from a given settlement;
3. social unit: membership in user groups based on primary ties, such as kinship;
4. ownership: membership based on joint investment.

The present review has found that the *hydrological principle* has been predominant in Bank projects with WUAs. Table 2 indicates that over 70 per cent of all SARs that specified the type of membership in WUAs mentioned the users grouped around a certain type of irrigation facility. There is also a visible increase in the prevalence of this principle from 1975 to 1984–6 and to 1990. Only six cases specified residential neighbourhood, and three cases were organisations based on other membership criteria, including kinship-based tribes (e.g. Wadi Al Jawf project in the Republic of Yemen) and investment-based co-operatives (e.g. Bangladesh Barisal Irrigation Project).

When WUAs are composed of adjacent field cultivators, the users have a common interest in the operation and maintenance of that section of the irrigation system. The benefits of collective action and the settlement of local disputes over water can thus be largely contained within the group. For these reasons, this constructive principle has been recommended both in the sociological literature on WUAs (see Coward, 1980) and in most Bank-assisted projects.

Membership based on residential neighbourhood or kinship is sometimes appropriate if forms of multipurpose social organisation (e.g. tribes, local government or functional co-operatives) also become involved in irrigation management. Such arrangements do lack the directness and focus of a water-specialised organisation and often may not include all the irrigators along a watercourse, thus having a somewhat limited mobilisation capacity. But there are trade offs. Multipurpose organisations may have the advantage of pre-existing on the ground and of established authority lines, roles and rules. They may also link water management to other agricultural activities, marketing, tree planting etc., or may provide a voice in system management to members of the community who depend on the irrigation system in other ways, such as for domestic water supply or employment.

Table 2: Definition of membership in project-related WUAs

	FY75	FY84–86	FY90	TOTAL
Total number of projects	23	45	9	77
Projects with WUAs	11	35	7	53
Projects specifying membership	7	22	7	36
Membership defined by:				
Field neighbourhood	4	16	6	26
Residential neighbourhood	1	5	1	7
Other	2	1	0	3

The principle of ownership can be the basis for membership or can reinforce ties among WUAs. Joint investment and property rights are recognised as a powerful cohesive force (Coward, 1991). This ownership can be established either at the outset of irrigation development (e.g. pump groups under a tubewell) or by transferring ownership of existing facilities to WUAs, as in the turnover program for small scale irrigation systems in Indonesia (see Helmi and Vermillion, 1990).

The relative merits of the possible approaches, or of a combination of them, should be weighed for each irrigation project faced with developing a strategy for organisation building.

Size of the Base Units

Size is an essential structural characteristic of any organisation, and choices have to be made at appraisal time among various size options for the envisaged WUAs.

Size refers to two characteristics: number of members in a WUA and command area. How large the lowest-level water users' organisation should be will depend on topography (e.g. the layout of the irrigation system), technology (the conveyance technology used), and socioeconomic variables (e.g. the average farm size in the system). The size of base units specified in the SARs reviewed ranged widely, from 8 hectares under the Gujarat Medium Irrigation II Project in India, to 1,000 hectares, which is the typical upper limit for base-level WUAs cited by Uphoff (1986:69–74). For some

Latin American countries, Plusquellec reports in recent papers much larger sizes, up to several thousand hectares, because the average size of the family farm, to begin with, is in the tens (or sometimes hundreds) of hectares.

If base WUAs are too large, it is difficult for farmers to meet, because their numbers are too great. Large size compounds the organisational and managerial tasks, sometimes beyond the capacity of the local leaders. The Bangladesh Barisal Irrigation PCR noted that in the interests of standardisation, two cfs pumps were procured rather than one cfs as intended. However, because of the potential command area of two cfs pumps was approximately twice that of the smaller pumps, it was more difficult to organise all the farmers who were to receive water.

Although this makes maintenance of project low-lift pumps easier for BADC, it is not in the best interests of the farmers and those trying to form farmer groups: large groups are difficult to form and the more suitable on cfs pumps have not been readily available (PCR 5.17).

A similar problem in which the technology did not provide for workable base units was dealt with in the command area of the Nepal Narayani Irrigation Project by extending the distribution network down to the 50-hectare level because the existing system had an 'administratively impossible farmer grouping of 900 units' (SAR). The Tunisia Irrigation Management Improvement Project also planned to reduce the size of WUAs from 300 hectares to the size of small pumping schemes or the tertiary units in larger schemes.

Other adjustments of groups' size may be appropriate to make the boundaries of WUAs coterminous with other existing local organisations. The Morocco Souss Groundwater Project began with units of 16 hectares served by a single hydrant, but allowed for these groups to expand to 50 farmers to coincide with the service cooperatives.

Based on his review of the literature on collective action, Addison (1986:46) concludes that the costs of maintaining an organisation, particularly in terms of conflict resolutions and information management, will increase with the size of an organisation. There are no economies of scale to be expected in this respect. Groups should be large enough, however, to accomplish the designated tasks by collective action. The median size of approximately 40 hectares found in the examination of Bank-sponsored projects appears to offer a reasonable compromise between these two factors, as also suggested may recommend a target size or range for base-level WUAs, but the farmers themselves are best able to determine the exact boundaries of actual units. Therefore, flexibility in the actual size of each unit must be allowed.

WUA Federations

The next step in the self-organisation of water users, beyond the watercourse level, is to create associations of WUAs, on a territorial basis. Federations are organisational structures in which base-level irrigation groups are members of a higher-level association, itself encompassing a larger part of the same irrigation system. Again, Bank projects may either include such federations – when they already exist – in their strategy, or be instrumental in promoting their creation, when it appears ripe and necessary.

Is aggregate organisation of WUAs desirable? Although small groups of irrigators who share water from a common source are optimal for carrying out many ongoing activities at the level of their section of irrigation system, other tasks arise that require a higher level of organisation. Examples include water acquisition or allocation decisions, maintenance of facilities that serve several groups, or resolution of water conflicts among base-level WUAs. In many systems these tasks are performed exclusively by government agencies. A federated organisational structure allows WUAs to become involved in many of these activities (see Freeman, 1990). Ostrom (1990:101–102) finds such a 'nested enterprise' to be characteristic of enduring, complex institutions to deal with common property rights because it allows them to deal with the different problems arising at different levels (e.g. tertiary distributaries and main canals).

By and large, the present review found that federated WUAs are still not common among Bank-assisted projects. Some increase in the use of this organisational pattern is shown in Table 3. In 1975 only two projects, or 18 per cent of those with WUAs, specified such an arrangement as already existing or to be developed during the course of the project. In 1984–6, twelve projects, or 34 percent of those with WUAs, had some form of federation. For example, in the Sri Lankan Major Irrigation Rehabilitation Project, field channel committees send representatives to distributary channel committees, which in turn are represented on a project management committee.

Table 3: Provision for WUA federations in project appraisal reports

	FY75	FY84–6	FY90	Total
Total number of projects	23	45	9	77
Projects with WUAs	11	35	7	53
Cases specifying federations	2	12	3	17
As % of projects with WUAs	(18)	(34)	(43)	(32)

WUA federations offer advantages to both agencies and farmers. Federated WUAs enable farmers to exercise their rights and responsibilities in system management and conflict resolution to a greater degree. Representatives are clearly designated, and linkages between agency staff and farmers can be more easily established at several levels. The government agency can rely firmly on an apex organisation to devolve some of its excessive responsibilities, and farmers receive a more powerful voice in negotiating with the state's service agencies. In large-scale systems in the Philippines, Bellekens reports 'Some of the Irrigation Associations federated *among themselves* and formed apex organizations to improve their status with the NIA management and obtain contracts for maintenance of laterals' (1986:20). Organisations that include representatives of each lower-level unit (e.g. distributary or lateral channel councils, in which every field channel is represented) may even be able to address some head–tail distribution problems within the organisation, as intended in the Maharashtra Composite Irrigation III Project.

One reason for the low frequency of WUA federations is that federating WUAs entails additional transaction costs. Such costs limit the ability to establish multilevel farmer organisations. Furthermore, the empowerment of farmers through such bodies can present a perceived or actual threat to agencies' control of the main system. The establishment of users' federations is not actively pursued by state agencies. For farmers, the costs in terms of time and other resources required to assume higher-level WUAs will become active will depend on the balance of advantages and costs, as well as of the level of conscious understanding by users that stronger organisations is in their own interest.

A realistic way of building a federated WUA structure within the project framework is to plan for phases of organisational development, beginning with base-level groups. Starting with grand federation plans when there are not yet stable watercourse-level WUAs is premature and ill-advised. New levels of organisation should be added only after farmers and agencies have gained some experience working together, with a clear commitment to building higher orders of WUAs. Furthermore, establishing mixed system management committees (essentially similar to those existing in Chinese irrigation systems) that would include both agency representatives and representatives of the irrigators' apex organisations will provide powerful organisational tools for improving system performance.

Role Specialisation

The activities of WUAs may be performed either by the entire membership or by a set of leaders and specialists. Some tasks (e.g. clearing channels) are best done by an entire group effort; others (e.g. operating a pump) are more efficiently done by a selected and specialised individual. Technology and local custom are major factors in selecting the mode of operation. Where role differentiation occurs (president, treasurer, water masters, etc.) the specific definition of needed leadership roles depends on the size of organisations and the range of functions WUAs are to perform.

For structural purposes, it is possible to distinguish two broad categories of local leaders and roles: organisational and technical. Organisational leaders are those who are primarily concerned with organisational tasks such as decision-making, communication, conflict management, and resource mobilisation. Their ranks may include hereditary chieftains, traditional village elders, or elected officers and representatives chosen by the farmers.[5] This category of leadership provides coordination within the local organisations and contact with the outside, including government agencies and other farmer groups.

Those in technical roles within the structure of WUAs are directly involved in the manipulation of the physical facilities or water in an irrigation system. These people can be either farmers who are responsible for irrigation tasks, or employees of the WUAs. Examples of such roles include pump operators and common irrigators who open and close the water gates to each field, such as the traditional *sarrafs* in the Wadi Al Jawf Project.

In some instances there may be overlap between organisational and technical roles, with the same individuals fulfilling both. The technical leadership discussed here includes only those who are chosen and/or employed by the farmer organisations (not the technical roles of agency staff).

Among the project appraisal reports examined, seven from 1975 and sixteen from 1984–6 specified some type of leadership role in WUAs' structures. Table 4 shows the breakdown of these cases across years and between organisational and technical roles. Somewhat surprisingly, organisational roles are discussed in appraisal reports more than twice as often as technical ones in each period.[6] This was unexpected because Bank appraisal reports are written primarily be staff who are technical specialists.[7] Also noticeable is the absence of any mention of the basic roles to be performed in over half of the projects that do involve WUAs (and in nearly 70 per cent of all projects). This reflects an insufficient depth of consideration of these structural issues in appraisal reports. Without some definition of the roles of WUA leaders and representatives, it is impossible to plan for precise activities and for operational linkages between farmer organisations and agency staff.

One conclusion from this analysis is that project planners should attempt to explicitly recognise leadership role needs to be included in the overall project design.

Accountability

Structured accountability of WUAs to their membership is the most crucial principle or organisational structure for the long-term viability of the organisations and should underlie all efforts for WUA development in projects. This principle has two dimensions: accountability to water users rather than to the agency, and accountability to all members, not just a subset such as large farmers or those in one part of the system. If accountability is not ensured, farmers cannot be expected to participate in the organisations by providing their time or other resources, and WUAs will be weak, without active support from their members.

Ensuring the accountability of WUAs to the farmers begins in project conceptualisation of the role of local organisations. Water users; associations must be seen as belonging to the water users, not as an unpaid extension of the irrigation agency. They are to be a forum for farmer participation, not a means of extracting resources from farmers or forcing them to perform certain tasks. The attitude expressed in one appraisal report the '[t]he main purpose of WUAs is to organise farmers' contributions of labour and cash for OFWM (on-farm water management) on a watercourse basis' (Pakistan Left Bank Outfall Drain Stage I Project SAR 5.06) should be avoided.

Table 4: WUA Leadership roles defined in project appraisal reports

	FY75	FY84–86	FY90	Total
Total number of projects	23	45	8	77
Projects with WUAs	11	35	7	53
Projects with leadership roles specified	7	16	3	26
As % of projects with WUAs	(64)	(46)	(43)	(50)
Organisational leaders mentioned	5	15	2	22
Technical leaders mentioned	2	7	1	9

Note: Six projects in 1984–6 specified both organisational and technical leadership roles.

Accountability to members should also be build into the organisational framework of WUAs. Definitions of membership and leadership are primary mechanisms for establishing this accountability (Coward, 1980:205–10). Membership definitions affect whether all farmers served by a facility are included in the organisations. Leaders should be selected by the farmers, not appointed by the agency. One of the clearest statements of this type of accountability is found in the appraisal report for the West Bengal Minor Irrigation Project in India:

> Beneficiaries will have direct access to staff responsible for the various activities and, in particular, the (pump) operator can be checked by both his direct supervisor (the Panchayat Committee) and the farmers he serves (SAR 5.14).

Conversely, 'progressive farmers' or others chosen by officials should not be made heads of the organisations. Neither should the organisations be dominated by officials. For example, the Maharashtra Composite Irrigation III Project in India included two government employees – a canal inspector and a village extension worker – as members of even the lowest-level outlet committees for each 24-hectare unit. The attendance of these government personnel at meetings of the base-level WUAs would both place a strain on their time, as well as limit the farmers' sense that the WUAs are their own, not an arm of the government. Where the required leadership skills are not available locally, projects should include training to strengthen them. The Niger Irrigation Rehabilitation Project provided perimeter directors on an interim basis, but ensured their accountability to the WUAs by making it clear that 'after project completion, each cooperative would decide whether or not to hire its own manager, either the former perimeter director or someone else of the co-operatives choice' (SAR 3.15). Therefore, in the interest of job security, it behoved the directors to meet the interests of the farmers.

The specific mechanisms for selecting leaders can be left to the farmers; they may use formal elections, selection by consensus, or traditional hereditary roles. It is important that the decision be made locally and that leaders be in touch with other members to allow informal social sanctions to reinforce accountability.

Projects should explicitly avoid interference from the agency or other project authorities in the management of WUAs. Decisions regarding what the associations are to do, and especially how they are to proceed, should be left to the farmers to the greatest extent possible. It is not enough to try to create a 'sense of local ownership' in WUAs; the organisations must belong to the water users in fact. Only in this manner can we expect strong farmer support for irrigation associations to emerge and be sustained. Evidence from Bank-assisted projects confirms Ostrom's (1990:101) findings that 'if external government officials presume that only they have the authority to set rules, it will be very difficult for local appropriators to sustain a rule-governed CPR [common property resource] over the long run'.

In some instances, independent WUAs will not produce the same results the agency would desire, or will not produce results at the desired time. Strong farmer organisations may even be perceived as a threat to agencies and to their staff's monopoly over the operation of the system. This was noted as a problem in the Colombia Irrigation Rehabilitation II Project, whose SAR stated that 'at present most water users' associations function more as a body for voicing criticism or requests to HIMAT's district management, without showing much interest in the actual management of their district' (Annex 1.15).

Unfortunately, farmer involvement is still seen by some irrigation agencies as interference in the system, without recognition for the potential contributions, or for the validity of farmer concerns. Encouraging more constructive interaction between agencies and WUAs may require bureaucratic reorientation, as was carried out in the National Irrigation Administration in the Philippines (see Korten and Siy, 1989). Moreover, WUAs cannot be expected to act uniformly throughout the entire project. For this reason the Niger Irrigation Rehabilitation Project obtained assurances that the project agency would not start rehabilitation work on perimeters until the 'cooperative has approved internal statutes consistent with the model satisfactory to IDA' (SAR 8.01d). Such provisions make the WUAs accountable to the agency and IDA, however, not strictly to their membership; this undermines their adaptability to local conditions or the needs of farmers. Some internal statutes may be necessary for the provision of credit to farmers, but the imposition of rules for other irrigation activities should be avoided. Although allowing WUAs to make decisions, with some resulting lack of uniformity throughout the project, is generally perceived as a problem for agency staff, it is also one of the strengths of involving WUAs: irrigation management can be tailored to local conditions far more effectively than by central agencies alone.

Conclusion

Two important conclusions emerge from this analysis of organisational structure in WUAs. On the one hand, project preparation and appraisals should pay more attention to the structural characteristics of WUAs. Greater efforts should be made to identify existing organisations and learn how they work. General parameters of organisation such as membership recruitment, size of base units and federations, and type of leadership roles (particularly when agencies will need to interact with local leaders or representatives) should be carefully considered. However, to ensure accountability of the WUAs to the farmers and to allow organisations to be tailored to local conditions, flexibility also must be built into the project framework and agency dealings with WUAs. The process of tailoring to local conditions should begin by giving farmers themselves a voice shaping the organisations.

Endnotes

1. For an examination of the results of local participation in various USAID-assisted projects, see Finsterbush and Van Wicklin, 1989.

2. Another telling case was the Rural Development Project in Mindoro Province, the Philippines, for which the SAR required a comprehensive plan for improving the existing, traditional WUAs in Mindoro, which managed and owned the communal irrigation systems.

3. For a well-documented description of the benefits and costs of WUA development in the Philippines, see Bagadion and Korton, 1991.

4. This analysis is offered by Hervé Plusquellec, irrigation engineering adviser, World Bank. WUAs' decreased activity and organisational viability after completion of canal lining have puzzled many specialists and have been explored in several analyses. Little consensus, however, has been reached, and the SAR for the 1991 State III project, noting that this situation is 'difficult to understand', incorporates provisions aimed at studying its causes and correcting prior weaknesses.

5. Advanced WUAs in Colombia even employ lawyers to represent them (Laeyendecker, personal communication), while some indigenous _zanjeras_ in the Philippines include a cook as part of the WUA staff (Ostrom, 1990).

6. Treasurers or accountants, such as those specified in the Niger Irrigation Rehabilitation Project, could be considered technical personnel because of their specialised skills. In this analysis, however, they are considered in the capacity of functional leadership because they deal with organisational management, especially resource mobilisation, rather than with water or the physical facilities.

7. The frequency with which organisational roles are cited may be the result of an automatic assumption that any organisation requires a president, vice president, secretary and treasurer.

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NEWS FROM THE FIELD

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

Network Paper 31 April 1994

Network papers in this set:

Newsletter April 1994

28 *Multifunction Irrigation Organisations: Advantage or Handicap* by Parmesh Shah and Meera Kaul Shah

29 *Grameen Krishi Foundation - A Multifunction Organisation* by Edward Mallorie

30 *Design for Water User Associations: Organisational Characteristics* by Micheal M Cernea and Ruth Meinzen-Dick

31 News from the Field

32 Prospects for Multifunction Organisations to Improve Irrigated Agriculture: A Call for Information from Network Members

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ISSN: 0951 189X

NEWS FROM THE FIELD

Contents **Page**

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 km², 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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Farmers' Views on the Management of Irrigation Schemes in Nigeria

S.A. Ogunwale, P.R. Maurya and J.J. Owonubi[4]

Introduction

Most irrigation schemes in Nigeria are developed and managed by either the state or federal government. In all designs, the government owns the water impounding and distribution structures while the farm lands could be owned by either the government or the farmers or a combination of both. The government does not only operate and maintain these schemes but provides the agro-support services such as land preparation, seeds, fertilizers and chemicals to farmers. Farmers virtually have no roles to play except to divert water from the channels and operate their respective farm plots. Very few farmers' groups were actively concerned with irrigation water management and system maintenance. Existing groups are either full of inactive, limited membership or informal associations to obtain Government-supplied agricultural inputs.

The government has been very benevolent in operating and managing schemes. The interaction between the farmers and government could be classified as benevolent patron-client relationship. The governments (especially, federal) have partially withdrawn from providing funds and services since 1988, and the managing agencies are expected to be self-sufficient and self-sustaining. The dwindling operating funds over the years and the government's abrupt withdrawal have contributed to the serious deterioration of most systems' structures and have resulted in the low-level performance of many schemes.

This paper will discuss the nature of the benevolent patron-client relationships that have emerged between the irrigation system agencies and the farmers in some schemes. In addition, farmers' views on the irrigation systems' role expectations, role performance and capabilities will be examined. Illustration will be drawn from large-and small-scale schemes in Kano and Sokoto States.

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Systems' designed management roles and role performance

Most irrigation schemes were developed, operated and maintained by the government agencies, both at the state and federal levels. Usually, the government owns the water impounding or lifting, conveyance and control structures, and in some cases the farm plots which are allocated periodically to the farmers. The government does not only own, operate and maintain the irrigation schemes, but provides the agro-support services such as land preparation, seeds, fertilisers, chemicals, and assists in marketing produce.

In all, little was expected of the farmers other than to divert water from the tertiary canals or ditches into their farm plots, manage their respective farm plots and pay the irrigation water charges. Indeed, most irrigation projects were designed to have strong and efficiently organised and well-staffed authorities to operate and maintain the scheme and avail the agro-services and inputs to the farmers (NEDECO, *et al*, 1970).

Due to the dominant rôle of government in the operation, maintenance and production in the various schemes, farmers have become highly dependent and a pattern of paternalistic patron-client relationships have developed.

Existing systems' performance

The yearly dwindling of operating resources and the 1988 government (Federal) abrupt withdrawal from operating and management of the large schemes have contributed to systemic deterioration of irrigation structures and acute low-level performance of many schemes. The common features of poor performance include:

i) high cost outlay per hectare; project cost ranges from 765 in Upper Benue to 5,770 in Sokoto-Rima (Table 1);
ii) frequent breakdown of pumps and sprinkler lines and poor availability of spare-parts;
iii) major deterioration of water conveyance and controlling structures;
iv) inadequate maintenance of major diversion structures. Over 75% of these are full of silt and weeds reducing water flow in canals to less than 30% of design capacity.
v) conversion of drainage channels and reservoirs and road networks into farm lands by farmers;
vi) wanton irrigation misbehaviour of blocking of canals, cutting of embankments, illegal lifting of water by pumps or siphons and breakage of control structures;
vii) non-fulfilment and discontinuity of institutional agro-support services to the farmers;

viii) general apathy, no or slow response to farmers' complaints on water inadequacies and structural defects;

ix) reluctance of farmers to take initiatives to organise themselves to maintain structures even in the face of evident obstruction of water flow; and

x) persistent expectations by farmers that system maintenance and other agricultural production support would be undertaken by the government agencies, even with little observable capacity for these.

Table 1: Proposed Federal government financial allocation to River Basin Development Authorities (RBDAs) during the Fourth Development Plan Period (1981-85)

	Name of RBDA	Estimated Total Project Area (Ha)	Financial Allocation	
			Total (N m)	Per Unit Area (N/Ha)
1.	Anambra-Imo	40,400	105	2,599
2.	Benin-Owena	28,640	132	4,609
3.	Chad-Basin	134,000	172	1,269
4.	Cross River	76,800	80	1,042
5.	Hadejia-Jama'are	82,900	127	1,532
6.	Lower Benue	74,056	102	1,377
7.	Upper Benue	154,300	118	765
8.	Niger	110,650	146	1,319
9.	Niger Delt	313,500	85	2,711
10.	Ogun-Oshun	41,,100	154	3,528
11.	Sokoto-Rima	103,470	597	5,770

Source: Adopted from Okigbo (1981);
Notes: N = Naira (1992: N19=$1); m = million

Other features include the misconception, and distrust, of the Authorities' management policies as they affect irrigation, water charges, input distribution and administration, and land allocation. The Nigerian irrigation system managers, especially in large-scale schemes, are well versed in the technical planning and logistics for construction, but they lack 'the social background that is necessary to effect the integration of the users into planning, design, construction, operation and maintenance processes' (Donaldson, 1987).

Farmers' Views on System Management Roles

Field observations have tentatively indicated that farmers viewed the availability of other agricultural inputs and services (especially fertilisers, tractors and harvesters) as more important to them than irrigation water or irrigation systems' effectiveness. Also, the farmers in general have no interest in participating in system maintenance or accepting responsibilities in system management because they pay their irrigation water charges. The water charges of 1000 Naira per ha per year were normally considered too expensive especially when tail end water supply is erratic and agricultural production support services under-perform.

Farmers perceive that the job that has been most effectively done by the Authorities is the collection of water charges. On the other hand, the most neglected roles were the procurement of fertilisers, provision of adequate tractor-hiring services and non-supervision of water allocation and distribution within the sectors and blocks. the functions of water is more difficult to perceive by farmers than those of other crop production inputs as 'what really determines the rate of adoption of an innovation is the adopter's perception of profitability and not objective profitability' (Roger, 1962).

Farmers' views or perceptions have been affected by the benevolent-patron-client relationships that have been built in by the governments in most irrigation systems. Perception pertains to information received from the environment (Koontz, *et al.,* 1980). Major production environments of the irrigated land farmers had been government supplied inputs and services to the farmers. These had resulted in over-dependence of farmers on government agencies for their farming operations. The extent of dependence on the government could be illustrated with Gumuma farmers' perceptions of the project authority as the one to maintain even the structures immediate to farmers' plots (distributary canals (DCs) and field channels (FCs). Fifty-three percent and 50% of the respondents felt that the authority should maintain the DCs and FCs, respectively, and charge the farmers for this later (Table 2). Over 30% felt that each of these should even be done free by the authority. In either of the two structures, farmers' groups were minimally perceived to have any maintenance role.

Table 2: Farmers' perception of who should maintain the distributary canals (DCs) and field channels (FCs), Gumuma Irrigation Project (1990)

Who should maintain		Maintenance of DCs No.	DCs %	FCs No.	FCs %
a.	Project Authority, free of charge	13	36	12	33
b.	Project Authority, charge farmer	19	53	18	50
c.	Farmers' group labour used	3	8	4	11
d.	Farmers' group money used	1	3	1	3
e.	Individuals who need water	0	0	1	3
	Total	36	100	36	100

In addition, farmers were asked to which, out of the cooperative societies, individual farmers, group of farmers and the project staff, would be most effective and efficient in performing 21 irrigation activities. They mostly perceived that project staff should perform these activities now and in the future (Table 3).

In order to understand the underlying factors for farmers expecting the project authority to perform these activities, they were asked of the degree of training necessary for them to be able to perform some of the irrigation activities. The study indicated that they perceived training to be very necessary. Even for the least complex and technical irrigation tasks, like tractor acquisition for land preparation, deciding on type of crop to plant, draining excess water from their field, over 60% perceived that training was required (Table 4). Training was thought to be necessary for all irrigation activities and the same response trends had been indicated by farmers in the Kano River project and a host of other projects in N-W Kano and Sokoto States.

In all, the involvement of farmers in managing most irrigation schemes has been very informal and almost non-existent. Thus, system management role expectations of farmers now and in future, have largely been on project authorities. Farmers' perceptions have been controlled not only by their irrigation backgrounds but by their own problems and interests.

Table 3: Farmers perceiving the Project Authority as the most effective and efficient to perform some specified irrigation activities now and in future, Gumuma Irrigation Project

	Irrigation Activity	Effective and efficient programme: Present		Future	
		No	%	No	%
a.	Irrigation site surveying	22	61	29	81
b.	Irrigation system plan design	32	89	29	81
c.	Service/access road construction	32	89	27	75
d.	Service/access road maintenance	28	78	24	67
e.	Dam construction	35	97	32	89
f.	Dam maintenance	34	94	32	89
g.	Canal construction	35	97	32	89
h.	Main canal maintenance	30	83	27	75
i.	Maintaining farm ditches/other canals	25	69	20	56
j.	Deciding on the amount of water entering a farmers plot	30	83	25	69
k.	Operating/regulating the project water control instruments	35	97	32	89
l.	Maintaining the water control instruments	35	97	32	89
m.	Scheduling the time for farmers to irrigate their plots	35	97	32	89
n.	Draining excess water from farmers' plot	16	44	16	44
o.	Deciding on the amount of money the farmers should pay as irrigation fees	34	94	28	78
p.	Collecting the irrigation fees from the farmers	34	94	32	89
q.	Land preparation before planting	30	83	26	72
r.	Tractor acquisition for land preparation	31	86	30	83
s.	Tractor maintenance	34	94	31	86
t.	Deciding on type of crop to be planted by farmers	32	89	27	75
u.	Levelling of plot	14	39	17	47

* About 25% of the farmers perceived that the farmers' group would be most effective and efficient in future for this activity.

** About 44% and 47% of the farmers perceived that the farmer himself (as individual) will be most effective and efficient, now and in future, respectively, for this activity.

** 58% and 50% of the farmers perceived that the farmer himself (as individual) will be most effective and efficient now and in future, respectively, for this activity

Table 4: Farmers Perceptions of the degree of training necessary on some irrigation activities (Gumuma Irrigation Project 1990)

	Irrigation Activity	Degree of training necessary								
		v. necessary		necessary		unnecessary		v. unnecessary		Total
		No	%	No	%	No	%	No	%	(N)*
a	Irrigation site surveying	25	83	2	7	3	10	0	0	30
b	Irrigation system plan design	26	87	1	3	3	10	0	0	30
c	Service/access road construction	20	68	4	14	5	17	0	0	29
d	Service/access road maintenance	19	69	6	21	4	14	0	0	29
e	Dam construction	20	69	3	10	6	21	0	0	29
f	Dam maintenance	18	62	6	21	5	17	0	0	29
g	Canal construction	17	59	7	24	5	17	0	0	29
h	Main canal maintenance	17	59	7	24	5	17			
i	Maintaining farm ditches/other canals	17	61	5	18	6	21	0	0	28
j	Deciding on the amount of water entering a farmers plot	19	61	5	17	6	20	0	0	30
k	Operating/regulating the project water control instruments	20	71	5	18	3	11	0	0	28
l	Maintaining the water control instruments	20	71	5	18	3	11	0	0	28
m	Scheduling the time for farmers to irrigate their plots	20	67	8	27	2	7	0	0	30
n	Draining excess water from farmers; plot	19	70	6	22	2	7	3	11	27
o	Deciding on the amount of money the farmers should pay as irrigation fees	21	75	3	11	4	14	0	0	28
p	Collecting the irrigation fees from the farmers	20	77	3	11	3	11	0	0	26
q	Land preparation before planting	22	76	5	17	1	3	1	3	29
r	Tractor acquisition for land preparation	19	68	5	18	4	14	0	0	28
s	Tractor maintenance	19	68	6	21	3	11	0	0	28
t	Deciding on type of crop to be planted by farmers	23	70	4	12	2	6	4	12	33
u	Levelling of plot	19	63	5	17	3	10	3	10	30

* The cases where respondents indicated multiple responses were making N to be less than 36

Accordingly, factors affecting people's perceptions of reality are 'background, past experiences, values, expectations, interests, attitudes and rigid views' (Koontz *et al.*, 1980) about nature of people and structures they deal with. What the farmers perceive may not necessarily represent the real world because they have tendencies to see things from their own perspectives. Nonetheless, the perceptions of the real or unreal situations do affect the behavioural dispositions of farmers in operating in irrigation schemes. Thus, the subsequent implications on improved involvement and participation in systems management.

Implications of Farmers' Perceptions on Systems' Management

Role perceptions usually dictate role expectations and performance by both the project authorities (management) and water users in any irrigation scheme. Accurate perception or roles is important in assessing situations in daily operations and management of the systems. Where role expectations are inadequately defined or are substantially unknown, role ambiguity exists, because farmers are not sure of how they should act in situations of this type. Research has shown that where role conflict and ambiguity exist, dysfunction results do occur (Davis, 1977) and water users are lax and irresponsive.

From this perception study, the relative advantage of availability of irrigation water to farmers is less than that from agricultural production inputs, especially fertilisers and tractor-hiring services. Mobilisation of farmers for active participation will be easier when done around their own expressed felt or real needs.

In all, some basic social, cultural and design changes would be needed (Maurya and Kuzniar, 1988) in order to ensure successful management of the nation's irrigation schemes. To sustain efficient and effective performance in the existing and potential schemes, it is recommended that there should be:

i) maximum use of existing social and administrative structures in an adaptive manner by creating a cadre of village or community irrigation workers as an arm of the Community Development Associations presently active in most communities;
ii) re-orienting and re-activating of the existing governmental services to provide direction, training and contact with the community while encouraging and emphasising water users' group formation and initiatives in system management;

iii) periodic identification of farmers' needs, "choosing the sequence of improvement and deciding how they will be implemented" (Donaldson, 1988);

iv) responsiveness to local initiatives and delegation of some irrigation water management responsibilities to the water users; from simple ones to the more complex tasks; and

v) choosing of community focal points within the sectors or villages in the schemes so that each sector or village will have ascribed irrigation system personnel or operators for contact point between the authorities and the community water users.

Conclusion

The more the involvement and participation of water users in system management, the cheaper and the more effective the operations and maintenance of irrigation schemes. Project authorities have to encourage water users' group formation using the existing functional social groupings and institutional agricultural roles and services perceived to be of higher relative advantage than irrigation water use *per se*. The provision of such roles and services to the farmers would provide entry point and sustained interest in participation in system management. These, coupled with education and training in basic system's tasks and operations will reduce and eventually eliminate the prevailing dependency of farmers on the government for irrigation system management and irrigated agricultural production. With the elimination of dependency, role expectations in irrigation systems will be appropriately perceived. This will improve and increase the readiness of the irrigation authorities to share system operations' responsibilities and enhance water users accepting such responsibilities and taking initiative on others.

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Micro-Catchment Rain Water Harvesting in Western Thar Desert, India: A Sustainable Production Alternative

Bhanwar Dan Bithu[5]

Abstract

With little rainfall and growing population pressure, Western Thar desert is very short of water. However, in adapting to the harsh and variable physical environment the Thar agro-pastoralists have developed principles and strategies for managing the land, water and natural vegetation resources. Micro-catchment rainwater harvesting is an interesting alternative to arid zone reclamation by irrigation and drainage. The paper discusses the benefits of micro-catchment water harvesting (MCWH) and soil trap techniques in the loessial soils of Western Thar desert with much higher available soil moisture and nutrients and reduced soil salinity resulting in 40 to 150 percent higher production.

Introduction

Sustainable development in western Thar desert requires a decentralised but coherent effort for the delivery of goods and services aimed at promoting traditional environment supportive agriculture. The diversified agricultural production under MCWH system increases yields and income and reduces risk.

The erratic and spatially variable rainfall in western Thar desert limits agricultural production. For sustaining levels of production conservation of soil, water and natural vegetation resource base, through total catchment management which involves the coordinated use and management of land, water, vegetation and other physical resources in a catchment is required to ensure minimal degradation and erosion of soils and minimal impact on water yield and quality. Ecological agriculture under the MCWH system in the arid desert region is not only an alternative but also a necessity imposed by the need for self-sufficiency and sustainability.

However, intensive irrigation in the region results in the depletion of natural grasses and other vegetation, water logging and soil salinity. The ground water is generally brackish and the ground water potential is fairly

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low, as such it cannot be economically developed. Therefore, proper evaluation of the MCWH and soil trap systems in the arid region is necessary for optimal sustained production.

Study Area

The area is situated in western Thar desert region of Rajasthan, India. The surface land scape is of dunes and interdunal plains. The dunes are generally 15-40 metres high. They are usually longitudinal and oriented SW-NE. The plains are flat to gently undulating, and lack surface drainage. The desert plains contain occasional dry rivers which disappear in the sandy plains.

The soils of the area are generally deep calcareous wind blown fine-sandy to loamy-fine sands. The dunes have wind blown sand deposits. The sandy plain soils are aeolian and loessal sands. They have a high infiltration rate and high wind erosion hazard. They are generally deep but are impeded by a lime concretion barrier in the sub-soils. The desert plain soils are generally shallow to deep calcareous fine sand to fine sandyloam with underlying geological barrier of massive calcium carbonate or gypsum or clay or rocky substratum (Soil Survey, 1972).

The area has rich desert vegetation wealth. The dominating trees are khejri (*prosopis cinerarea*), khejra (*prosopis spicigera linn.*), babul (*acacia arabica*), jal (*salvadora oleoides*) and Rohida (*tecomella-undulata seem*), the dominating shrubs are phog (*calligonium polgoinedes linn.*), and kheep (*leptadeniaspartium wight*) and the dominating grasses are seven (*lasiurus sindicus*), and ganthil (*eleusine compressa*).

The drainage of the area lies towards the Sutlej and Sindh rivers. The surface drainage of the plains is restricted by the dunes. The desert and sandy plain having geological barriers at moderate to shallow depth have impeded vertical drainage. The region has an arid climate with hot and dry summer and cool and dry winter. The annual rainfall is extremely variable and ranges from 100mm to 200mm (Soil Survey 1972).

Data Collection

Present day subsistence farming in western Thar desert region is prone to an alarming degree of land degradation and desertification. The earlier diversified agricultural production by the nomadic agro-pastoralists was a strategy for increasing yields and reducing risks. A comprehensive socio-economic plus traditional agro-technical approach was and is the only realistic frame of reference in which the interactive and interlocked problems of depleting soil moisture and nutrients and increasing soil salinity can be appreciated effectively.

Development with environmental protection can be achieved with rational management of nature, energy and resource conservation, application of ameliorative and non-waste technologies, thrifty use of the ecological resource base, and reversal of environmentally ill-conceived human activities. Intensive irrigated agriculture may be undesirable in the arid zones from an environmental point of view or may not be the best solution because of the cultural background of the local population. Already an area of about 1900 km^2 is water logged in Indira Gandhi Canal Project stage I Area and about 3500 km^2 is potentially vulnerable to water logging in stage II Area, (RGWD, 1991; Bithu, 1981). Rain water harvesting can therefore be a cost effective and sustainable alternative to arid land reclamation by irrigation and drainage (Boers *et al*, 1986). The advantages of rain water harvesting have been well documented by Issar, who states that water sheds of up to 10 hectares produce about 5 to 10 m^3/ha of annual runoff annually (Issar, 1977). Although low intensity and short duration rainfall of the loessal soils of western Thar desert region does not result in big runoff on large catchments, such soils are effective producers of run off on micro-catchments.

Under the micro-catchment water harvesting systems, overall surface runoff is reduced as a consequence of maintaining infiltration rates and surface storage. Run off velocity is reduced due to increased flow tortuosity created by the bushes and grasses and their litter in contact with the soil (Fairburn *et al.,* 1986). The roots of the bushes and grasses enhance percolation of rain water which in wet years recharges the ground water. The infiltrated rain water in the basin area is stored in the soil and surface evaporation is minimised due to capillary break in the dry loose top sands.

The natural trees, shrubs, and grasses of the MCWH system in the region serve as nature's groundwater provisioning mechanism through the root system andherefore enhance groundwater recharge and soil productivity (Bithu 1989). Table 1 shows the effect of the natural MCWH system on groundwater recharge and land productivity. Table 2 shows effect of the MCWH system on two desert crop yields.

Soil moisture analysis

Root zone soil moisture analyses have been conducted from the bare loessial soils and from the sand plains with the natural MCWH system (rich growth of *Lasiurus sindicus* and *Calligonium polgonoides* at an average spacing of 5 metres). The root zone soil moisture and salinity data from the bare and vegetated (MCWH) land are given in Table 3.

Table 1: Effect of MCWH system on groundwater recharge and land productivity - Ghantiali village

S. No.	Year	Type of watershed	Shallow groundwater depth below ground level (m)	Desert millet (*pennisetum claudium*) yield (kg/ha)
1.	1964	water shed with good growth of natural shrubs and grasses under the natural MCWH system	10.67 to 12.2	500
2.	1984	depleted shrubs and grasses, bare ground	15.24	200

Table 2: Dryland crop yields - Sinthal village (Bithu, 1989)

S.No.	Dry land crops	Yield in kg/ha	
		Year 1942 natural MCWH system	Year 1982 destroyed shrubs and grasses
1.	Desert millet *(Pennisetum claudium)*	1000	700
2.	Moth*(Phaseolus Aconitifolius)*	800	500

Table 3: Soil moisture and salinity status.

S.No.	Ground status	Root zone soil moisture in basin area (%)	Gradually developed soil salinity in basin area (%)
1.	Bare soil	5	0.7
2.	Bare soil	6	0.5
3.	Bare soil	6	0.5
4.	MCWH system	10	0.15
5.	MCWH system	11	0.13
6.	MCWH system	12	0.11

The vegetated land under MCWH system has increased infiltration particularly in the basin area and consequent effective leaching of the salts. The bare and devegegated land has crust formation, reduced infiltration, higher run off and consequent ineffective salt leaching. The higher root zone soil moisture and reduced soil salinity contributed to higher crop yields under the MCWH system. Figure 1 shows a typical micro-catchment water harvesting system with catchment area A and basin area B.

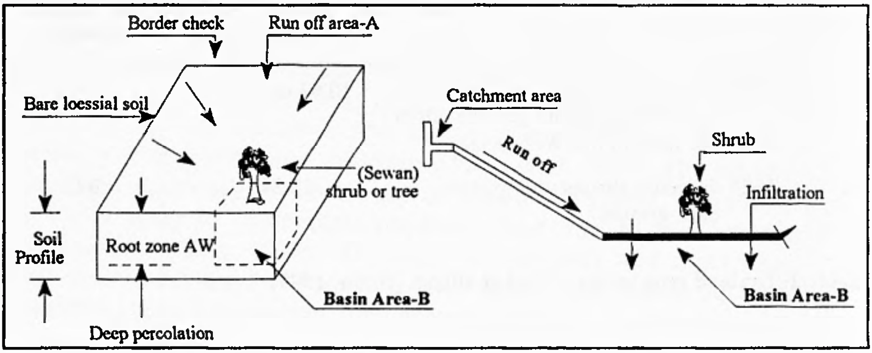

Figure 1: Micro catchment consisting of catchment area-A and basin area-B

Such micro-catchment water harvesting or rain water capture systems were well developed in western Thar desert region in the beginning of the century but now stand redundant due to continuing abuse and neglect. The author has seen two such systems in the region where excellent trees, shrubs and grasses grow, and where wells for cattle watering had been developed.

The loess soils of Western Thar desert are situated on geological barriers. In such areas the accumulation of water behind a small dam of clay or any other comparatively impermeable material causes infiltration into the soil and formation of a perched lens of ground water on the underlying impermeable layer. In such soil trap dams, the runoff water is stored in specially built or natural soil or sand reservoir instead of an open body of water (Issar, 1977). The drainage from the soil reservoir is restricted by the dam and the underlying geological barrier, and evaporation is minimised by the sand mulching action of the top dry loose sand. The stored water can be used by the grasses, shrubs, trees and field crops.

Excellent seven (*Lasiurus sindicus*) grass lands have developed in the region on the moisture conserved, through the rain water harvesting and the natural soil trap systems (Bithu, 1989). Because of the availability of the soil moisture the grasses have survived droughts and the pastures tend to become non brittle. On intensive irrigation the grasses and shrubs slowly

Table 4: Irrigation and draining costs (12 Ha plot cost in US$)

S.No Cropping pattern	Cost of OFD works lined land shaping		Cost of future drainage and/or soil reclamation	Total cost	Annual amortised cost and annual O&M	Annual benefits excluding cultivation costs	Net annual benefits	Benefit cost ratio
	Water course	MCWH system						
1. Field cropping under surface irrigation practice	7400	1400	16200 (needed after 50 years)	25000	3032	8600	5580	2.85:1
2. Field cropping under sprinkler irrigation practice	7400	2600 (sprinkler system)	16200 (needed after 100 years)	26200	4627	13000	8373	2.81:1
3. Rainfed agriculture under MCWH system moth (*Phaseolus Aconitifolius*), Guar (*Gyamopsis Psorasoides*) yield 600 kg/ha	-	2000	-	2000	302	7000	6698	23.18:1
4. Pastures with supplemental sprinkler irrigation in drought years	7400	2000	-	9400	1594	17676	16543	11.09:1

disappear followed by high perched water table and soil salinity. The complex geological drainage situation of the region makes post-irrigation drainage very difficult and costly. The economic evaluation of irrigated agriculture, rainfed agriculture under MCWH system, and pasture dry land farming with supplemental protective irrigation in drought years is given in Table 4. The table shows the desirability of combating the drought through protective supplemental irrigation making every year a good rainfall year, and environmental and economic superiority of rainfed farming under the MCWH system (Bithu, 1993). Thus dry land and live stock farming under MCWH systems, aided by supplemental protective irrigation if and when needed, is the appropriate drought coping and environmentally sustainable strategy in the Western Thar desert region.

Figure 2 shows the subterranean dam or soil trap system in the Western Thar desert region.

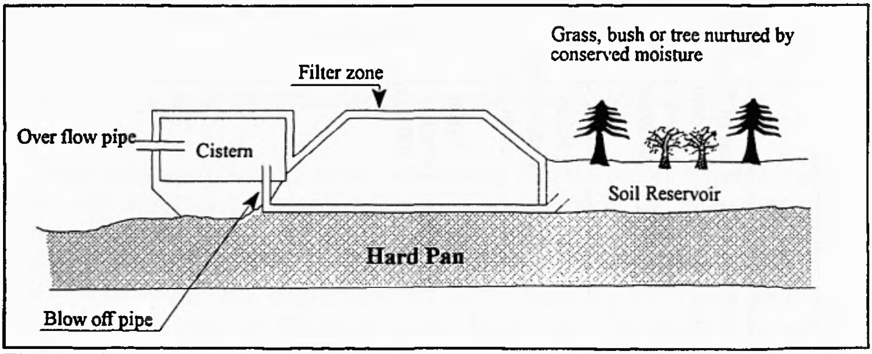

Figure 2: Longitudinal section of underground dam with cistern

Conclusions

Root zone soil moisture and shallow ground water recharge is higher under the micro catchment water harvesting system than under bare soil, under the MCWH system the crop yields increase by 40–50% due mainly to availability of higher soil moisture and nutrients: the salt-free rain water leaching under the MCWH system is more effective than on the bare soil. Rainfed agriculture and dryland farming or livestock farming in pastures with supplemental protective irrigation aided by the MCWH system are environmentally and economically sustainable and are more remunerative than the conventional (canal) irrigated agriculture in the region.

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IRRIGATION MANAGEMENT NETWORK

PROSPECTS FOR MULTIFUNCTION ORGANISATIONS TO IMPROVE IRRIGATED AGRICULTURE
A Call for Information from Network Members

Network Paper 32

April 1994

Network papers in this set:

Newsletter April 1994

28 *Multifunction Irrigation Organisations: Advantage or Handicap* by Parmesh Shah and Meera Kaul Shah

29 *Grameen Krishi Foundation - A Multifunction Organisation* by Edward Mallorie

30 *Design for Water User Associations: Organisational Characteristics* by Micheal M Cernea and Ruth Meinzen-Dick

31 News from the Field

32 Prospects for Multifunction Organisations to Improve Irrigated Agriculture: A Call for Information from Network Members

Please send comments on this paper to the author or to:

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Comments received by the Network may be used in future Newsletters or Network papers

ISSN: 0951 189X

Contents **page**

PROSPECTS FOR MULTIFUNCTION ORGANISATIONS TO IMPROVE IRRIGATED AGRICULTURE

A Call for information from Network members

Local organisations are acknowledged as a critical force in supporting rural livelihoods. In irrigation development and rehabilitation there has been strong promotion of irrigation organisations whose primary functions are in operations and maintenance, either directly or through paying service fees. However, irrigated agriculture requires a number of other functions including:

- supply of agricultural inputs (such as seeds, fertilisers etc.)
- organisation of other production factors (such as labour, capital)
- marketing/ensuring contract production

Rural livelihoods require yet other functions, including:

- input supplies and marketing for other crops and livestock products
- management of domestic water and sanitation
- environmental management
- management of local affairs
- broader political representation

It is not uncommon for irrigation organisations to take on some of these other functions, either formally or informally to become 'multifunction' organisations. Equally, it is not uncommon for more general local organisations to be present, within which irrigation management is only one component. Sometimes, however, functions remain separated, with different functions coordinated by representatives of different groups within a settlement.

Multifunction organisations (MFOs) are not new in irrigated agriculture. They have always been in existence, even if not formally created or recognised as such. They are often used as a basis for NGO-initiatives, and have been promoted specifically under cooperative programmes. However, the interest in the development of such organisations has grown, as financial reforms and state disengagement have increased interest in decentralisation and privatisation.

Despite the growing interest, and a lot of historical activity, very little is documented of irrigation organisations who mesh additional functions, even though their organisation may assist production, and provide incentives for co-operation that help to reduce conflicts and disagreements over water supply. In reverse, failure of effective organisation of other functions, or interference in them, often destabilises irrigation management. Such organisations may be used or expected to take up other functions by their members.

As explained, such interests are not new. Historically, many functions were just performed as necessary within a community on the decision of representatives. It is with commercialisation, high input agriculture, bureaucratic nation-state development and state penetration that functions have been both developed and separated. In the 1960s and 1970s there were many experiments in the development of co-operative organisations in agrarian reform programmes. Many of these experiments had a chequered history. What can be learned from these experiences, and what will be different in new decentralisation land privatisation initiatives to prevent such experiences being repeated?

This short mailshot is a request for network members to send in their comments, or short papers if available. We highlight the following points to initiate discussion. However, please write in with additional points, or feel free to disagree.

- Do you know of local organisations with responsibilities for irrigation operations that also take on other functions? Why have they taken on this multiplicity of functions, and how well does it work? We have a very poor understanding of what organisations do and how users perceive their functions, as opposed to how they are legalised or described by researchers.
- To what extent can irrigation organisations be conceptualised in isolation from other local organisations/institutions? What additional resources and agencies enable this 'multiple function' approach to work? What are the special challenges for regional and national support agencies in this multifunction approach?
- Some countries have experienced a number of political administrative reforms, together with a range of special assistance programmes. What have been the experience of changes in joint performance of functions over time, as different organisations, and different political and economic pressures have been present? How often do we find organisations from historically distinct periods still playing a role?

- From MFOs known so far, what are the links with the state and the reorganisation of state agencies ? Do MFOs exist because of state initiatives (e.g. co-operatives) or in spite of the state (ie. as a response to state inadequacies or incompetence and persistence of older cultural norms). Or is it increasing links with non-government agencies, or with private companies involved in contract farming, that are a source of change?
- If there are different organisations managing two or more functions, how well do they cover these different activities? For example, is it the presence of dynamic individuals who in effect create multifunction organisations? In reverse, when settlements have different group activities serviced separately, do certain individuals end up important in all of them? In some cases, membership of irrigation organisations may be different from other local governance or agricultural formations. How is this resolved?
- Do MFOs appear when there is less of a tradition of irrigated agriculture, or mixed farming predominates? Or do they appear because of other pressures on the irrigated farming system?
- Where do MFOs originate, from the grass-roots or from above? Where they do appear, is there a history of functionally-oriented co-operation, or co-operation based upon kinship, affinity etc? In what ways do they function differently from single-purpose organisations?
- For effective action, there is a need to balance the specific focus of single function organisations with the desire to extend the scope of local organisations. To what extent are MFOs a response to the lessons learnt from local co-operation based around a specific function?

The 'community' is perhaps the word most commonly used in development policies and programmes (except, perhaps for the 'household'). The term community is a particularly malleable concept that has strong connotational meaning, and consequently political dimensions. Assumptions are often made about the nature of 'communities' that exist, as well as those that interventions wish to create. A community forms a key component in the strategies of political linkages of many nation states. Sometimes new concepts of 'community' may not be very relevant to local conditions. Conversely, people may use old and new concepts of community very effectively to obtain resources from the state.

The use of concepts of community has particular ramifications in irrigation and water management. On the one hand, the users of infrastructure are often considered to be a community, or expected to form as collective organisation (even though there may be great differentiation within this community). On the other hand, communities may manage rights to land and water, which may or may not conform to the institutions the state may wish to be present for those land and water sources.

If you have any additional comments about how concepts of ‘community’ are being used (positively or negatively) by local people or agencies please send them to us.

Please circulate this to colleagues for further comment. We would appreciate replies by the end of November, but please still write to us after that date if you have comments.

Richard Friend and Linden Vincent
Irrigation Management Network
October 1993

Kanda Paranakian
Faculty of Social Sciences, Kasetsart University

I know the water users organisations that take on other functions besides irrigation operations. The reason is that availability of water alone is not sufficient for farmers to increase agricultural products. They need other inputs such as credit, agricultural extension services, product incentives, transportation and marketing facilities. How well it works depends on either its leadership, or government officials' strong commitment on agricultural development projects, or both. In some irrigation projects, private companies provided seed, fertiliser, pesticide, and production incentives through the water user organisations.

From a user's perspective, the organisation should have multiple functions. Some water user groups collect membership fees for fund raising. This group fund can be used for irrigation maintenance and to provide its members with low interest rates. To the researchers, registered organisations become legitimate. However, the organisational objectives of groups are sometimes not clear. For example, the WUA aims at involving farmers in operation and maintenance activities and promoting the maximisation of water use. This second objective is broad and can be differently interpreted. Some organisations specifically indicate what kind of benefits the members should get.

Irrigation organisations can be conceptualised in isolation from other local organisations/institutions only when they are involved in irrigation project operation and maintenance. Other agencies under the Ministry of Agriculture and Agricultural cooperatives, the financial institutions and the private companies enable multiple function approaches to work.

We rarely find organisations from historically distinct periods still playing a role. With economic, political and social changes in the country, the organisations' leaders requested technical assistance that allowed members participation. For example, the People's Irrigation Organisation in Northern Thailand (where cash crops have been introduced) requested that the Royal Irrigation Department replace the bamboo irrigation structure with a concrete one, so that the members spend less time on repair and maintenance. Again, with the government intervention, the organisational leadership is important for the members' commitment and involvement in organisational activities.

Multifunction organisations (MFOs) exist because of one, or all, of the following factors:

i) members seek help or services from the government agencies in addition to that already provided;
ii) the government encourages farmers to join co-operatives;
iii) members are encouraged to join private companies' contract farming in irrigated areas;
iv) in some irrigated areas, non-government agencies also involve farmers in contract farming.

If there are different organisations managing two or more functions, whether they cover these different activities well or not depends on their links with either the government or the private companies or the non-government agencies. It seems that MFOs appear because of the pressures on the irrigated farming system.

MFOs can originate from either the grass roots or from above. If they originate from the grass roots, there is more potential for sustainable organisational development. MFOs are not necessarily based upon kinship or affinity.

MFOs are a response to lessons learnt from local co-operation based around a specific function when irrigated agriculture is strongly promoted and services are delivered to the members in time.

Phil Woodhouse
Institute for Development Policy and Management, University of Manchester

With respect to multifunction organisations I'm afraid I haven't enough time to think through properly what I wanted to say, but it appears to me that the 'groupements' about which I wrote in Senegal were moving towards this type of organisation. If so, an important characteristic is the 'nesting' of different types of function. That is, different functions are conducted most effectively on different scales. For example, field-level water management appeared to be conducted by groups of maximum 20–30 members. Many such groups would then belong to a much larger organisation responsible for commercial functions, such as negotiating credit with the bank, negotiating fertilizer purchase with traders, arranging transport of rice to mills. I could discern an intermediate level of organisation which was related to pump ownership, or occupation of a land served by a secondary part of the irrigation infrastructure.

The essence of this type of organisation is a kind of federal relationship at all levels.

Norman Uphoff
Cornell University, Institute for Food, Agriculture and Development

I think that you are pursuing a very useful issue. Might I suggest you see pages 139–141 of the book *Local Organisations* that Milton Esman and I wrote (Cornell University Press, 1984) and which must be in the ODI library? In that study, we examined, quantitatively, the correlation between single vs multiple functions and overall effectiveness of local organisations. Contrary to the prevailing view in the literature, which stress the advisability of single functional organisations (e.g. WUAs), we found a positive relationship between performance and number of functions. I won't try to repeat the discussion and explanation offered. See also pages 223–224 on why it appears best to start with a single function but then to branch out when, and as, members want to achieve a wider range of goals.

The sample of 150 cases analysed in our study included a wide spectrum of local organisations. Seventeen, or a little of 10% were irrigation associations.

I wish that I had time to respond to your question in some detail with our experience in Sri Lanka. My book on the work in Gal Oya, *Learning from Gal Oya: Possibilities for Participatory Development and Post-Newtonian Social Science* (Cornell University Press, 1992), goes into some detail on this but not in a summary way. Evidence of farmer initiative to branch off into other areas (like pest control, savings and loans, bulk purchases of fertiliser, etc.) are found throughout Chapters 4–9. I comment on some of the things done by farmer associations in irrigation schemes in Polonnaruwa district as well.

An example unique enough that I should write a bit about it for you concerns on of the farmer association in Polonnaruwa, started under USAID's Irrigation Systems Management Project.

The association at Giritale with about 2,000 members concluded that for too long, farmers have been disadvantaged by the court system. Whenever disputes over land, inheritance, loans or whatever, were taken to courts, it took years to get a decision, and only real beneficiaries were the lawyers.

By a process I know nothing about, farmers decided that all disputes among farmers should be settled by their organisations. Any dispute would initially be taken to the Farmer-Representative for the farmers' field channel (or to the relevant FRs if the farmers involved cultivated on different field channels).

Farmer–Representatives, I should note, are chosen by consensus (unanimity) from among the farmer cultivating on a particular field channel. They are unpaid, and serve in what is called a 'honorary' capacity.

If the FR (of FRs) cannot work out a mutually agreeable solution, the dispute is to go to the Distributary Canal Organisation, which is made up of all the FRs whose field channels get water from a given distributary canal. They hear the case and make a recommendation.

If the parties cannot agree with this decision, the case goes to the Project-level Committee, made up of representatives of the various DCOs. Again the case is to be heard and decided. The purpose is to seek some reconciliation of the parties, by arriving at what others think is the fairest resolution of the conflict.

I do not know how far this has gone. It was thought this would spread to other farmer organisations initiated as part of our programme. I know there are a number of people in Sri Lanka who could furnish more information on this issue.

Donald E Campbell
FAO, Rome

Regarding multifunction organisations, which include irrigation, Indian experience is very limited. The principle examples I am aware of are in association with a cooperative sugar factory, where the cooperative supplies all inputs and markets the product. It also buys water wholesale (at the head of a distributary) and distributes it to members. This has worked well, the communally-owned factory being the pole around which the enterprise revolves. There have also been a few pumped-lift group co-operatives, lifting water from a major canal and distributing it to members. One notable case (in Maharashtra) sponsored by a dynamic community leader went as far as pooling holdings to facilitate water distribution. It was a complete service cooperative and even had its own extension service. I believe members eventually had problems obtaining credit for communal land development works — a consequence of pooling their titles. It was set up in the early 1970s and I am not sure whether it still functions.

From limited conversations I have had, it seems that multifunction organisations which include irrigation distribution have not caught on in India. They have had enough difficulties with service cooperatives without adding the problems of water distributions, unless, as discussed above, there is a strong common element such as sugar processing.

About twenty years ago, in West Bengal, there was a major venture into cooperative irrigation, primarily from tubewells, I believe. Sponsored by the then Chief Minister, it set out to be an answer to the problem of fractionation of holdings and the unwillingness of Bengali farmers to undergo land consolidation. The landholders became, in effect, shareholders in the enterprise, in return for submerging their titles into the common pool. The enterprise, call CAD, in this case Community Area Development, undertook all activities associated with irrigated agriculture in the area and the initiative had high-level sponsorship. Some of your Bengali readers may have more information.

Bryan Randolph Bruns
Independent Consultant Sociologist, Thailand

I will be interested to see what results you get from the mailshot on multifunction organisations. In Indonesia there is interest in this issue. I think it will be valuable if we recognise that irrigation management may be a sideline task of other organisations and does not always have to stand on its own. This can reduce the institutional overhead required for management activities.

However, I am concerned that we still lack good methods and indicators for facilitating the development of sustainable organisations in irrigation. Concern with multipurpose organisations could distract from promoting better irrigation performance. It would be much too easy to repeat the 'checkered' and disappointing experiences of government driven co-operatives, while neglecting the core irrigation tasks.

A related concern is how to enable irrigation organisations to take on additional tasks without imposing them as a universal requirement. To the extent that there are efforts to facilitate organisations working on additional tasks, are there ways to offer a menu of choices to farmers to consider? How can assistance respond to locally identified needs rater than imposing a single package.

In relation to co-operative experiences generally, and experiments in the Philippines more specifically, I think we need to be very aware of the dangers of developing organisations which are dependent on cheap credit or other subsidies which are unlikely to be available in to long run.

I would be particularly interested in information you receive regarding irrigation organisation activities in contract farming. This seems to be a potentially important area for improving farmer incomes, but raises crucial questions of how to balance the interests of farmers and external organisations.

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Maharashtra State, in India, is one of the pioneer states in using the co-operative sector on a large scale in various facets of development activities, such as agriculture, irrigation, sugar factories, dairy, industry and housing. The co-operative movement in Maharashtra is found to be most successful in its achievements.

The farmers' organisations in irrigation water management for strengthening the 'farmer–government partnership' is a present accelerated due to government initiative. These organisations are single purpose co-operative water users' societies in the Command Areas of Maharashtra state, formed for flow–irrigation systems. Distribution of water to the farmers as per a pre-determined and pre-intimated schedule and collection of water charges from farmers is the major function of these organisations. At present there is moderate financial support by the Government to these organisations by way of management subsidy and maintenance grants. Though these organisations are formed as single purpose societies, it is argued that these organisations should have multiple functions in irrigation-related activities.

The concept of multifunction organisations in irrigation water management is based on inputs involved in irrigated agriculture such as labour, seeds, fertiliser, insecticides and pesticides, water and credit. At present these inputs are provided to the farmers through different organisations in the rural areas. The present approach of multifunction organisations will be just like an 'umbrella approach' wherein it is expected to provide all the directly related inputs for irrigated agriculture by the cooperative water users' societies. This will result in both savings to the costs incurred by the farmers as well as the services being available at their fields.

It is necessary to undertake research studies for identification of gap and lacunae in the present functioning of these organisations and then, slowly, various other functions can be entrusted to these organisations.

There are two very old organisations functioning in the Maharashtra state since 1935–36 in the field of irrigated agriculture. The long experience — of about 57 years — of these two prominent organisations, serve as cases supporting the statement of multifunction concept of farmers' organisations. These two organisations are:

i) The Sanvatsar Vibhag big — Bagayatdar Credit Cooperative Society, at Lonkar Vasti; Sanvatsar, Kopargaon, Ahmednagar, Maharashtra India. On Godavari Left Bank Canal.
ii) The Saswan Mali Society on Nira Right Bank Canal at Malinagar, Malshiras, Solapur, Maharashtra, India.

The Savatssar Society

The Sanvatssar Society is a successful and ideal example of multifunction organisation in irrigation water management which was established in 1935. This organisation has various departments such as Foodgrains Department, Oil Department, Irrigation Water Distribution, Credit Department and Implements and Equipment Department. The Society earns profit from these various functions and thereby has a solid economic footing. An example can be quoted: the Society maintains and repairs the 'field channels' of farmers at the Society's cost and no charges are recovered from farmers for this activity. (Here, it is necessary to note that other societies do not have such free service to members of organisations as the Sanvatsar Society.) The well-being of farmers is the main object of the Society and the profit from multiple activities is used for the benefits of farmers. The other features of this Society are that the majority of the members (nearly all) belong to only one caste, i.e. Mali caste (gardener) with a high range of homogeneity amongst them. The CCA of the Society is about 400 acres with 127 members. The major crops grown are sugarcane, horticulture crops and foodgrains. The Irrigation Department has fixed the blocks for these crops and water is supplied by the Irrigation Department (Government) on volumetric basis to the Society. The water charges on volumetric basis levied by the government are comparatively less than water charges on usual crop-area basis. The Society distributes water to each member and therefore there is surety of water to every member.

The important historical reference for the formation of Sanvatsar Society is that, during the period of 1935-36 a well known economist of national repute, vis the late Dr Dhananjayrao Gadgil, provided guidance to this Society at the time of formation during British Rule.

The Saswad Mali Society

The total area under the Saswad Mali Society is about 5000 acres and the Society was registered on 17th November 1932 as a joint stock company with the British Government in India. This Society, at present, is successful, with a sound economic footing. The Society takes water on a volumetric basis from the Irrigation Department and distributes to each member on a volumetric basis.

Recently, the Society executed an agreement with the Government for supply of water for a period of 18 years. The blocks are fixed by the Irrigation Department for the crops of the members of the Society. The Society is directly working under the Saswad Mali Sugar Factory Limited at Malinagar. The Society has developed very good infrastructure to facilitate its work which includes residential quarters for the staff at the location of concerned distributary head.

There is a marked difference between the two old Societies mentioned above and the recently formed co-operative water users' societies. The difference is that the two old co-operative societies are registered as Credit Co-operative societies whereas the recently formed 40–50 co-operative water users' societies are registered as Non-credit Service Co-operative Societies, under the Co-operative Act (1960).

There is a need to have an integrated and consistent policy by different government departments, viz. Irrigation, Cooperation, Agriculture etc. as well as in the concerned acts (Co-operative Act, 1960 and Irrigation Act, 1976) so as to develop the recently formed Non-credit Service Co-operation water users' societies as 'multifunction' organisations to achieve the overall development and well-being of rural people.

Note: the views expressed above are the personal views of the authors.

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Prospects for Multifunction Organisations to Improve Irrigated Agriculture in Lesotho

Historical Perspective of Irrigated Agriculture in Africa

Small scale irrigation has been a common phenomenon in Africa. However, despite huge investments, the establishment of large scale irrigation projects/settlements/schemes has not yielded good results. As a consequence, a major reappraisal was undertaken of the tens of billions of dollars spent on irrigation schemes in the Third World during over three decades (Pearce, 1987). There have been engineering as well as the organisational failures. the engineering failures of big irrigation schemes led farmers to distrust the reliability of the water on offer. However, the major cause of that has also been the management. In effect pre-independence colonial style management destroyed the viability of indigenous institutions, and replaced it by a cluster of western, centralised and hierarchical institutions. In the post-independence period, rather than reverting back and restoring the local institutions, the new rulers were not prepared to relinquish power (Horst, 1983). Moreover, an element of non-accountability, and availability of generous aid packages and loans, in a way insured the continuity of the pre-independence colonial system even during the post-independence era.

The colonial powers developed their irrigation technology (Horst, 1983) to address their own objectives. However, free people have questioned colonial approaches (Horst, 1990). In the meantime, the sophistication of technology increased, while an improvement in the management level lagged behind. As a consequence, today a big gap lies between the level of technology and the level of management. Other events, notably piling-up debt, and donor insistence on structural adjustments came into effect, has forced governments in many developing countries to:

i) transfer certain parastatal functions to producers linked to the reorganisation of co-operatives and farmer groups;
ii) shift agricultural input supply and sale to the private sector;
iii) reduce funding of parastatal development agencies; and
iv) remove subsidies on agricultural inputs, and review pricing policies.

Under the prevailing circumstances it is helpful to look into the prospects for multifunction organisations to fill the vacuum and improve irrigated agriculture management.

Experiences in Lesotho

Local organisations with responsibilities for irrigation operations that also take on other functions Co-operative societies generally operate various irrigation schemes. The societies collectively receive pumps, irrigation equipment, loans for seasonal inputs, and market their produce at the farm gate as well as in the urban centres. The size of the societies ranges from a very few to around 300 members. At the moment most of the big societies have already collapsed, whereas the small ones are still surviving. The major reasons for the demise of large co-operative societies have been:

- fighting over sharing of the profits;
- members unwilling to share work equally;
- societies were too big to be without problems;
- co-operative societies emerged in response to foreign donor assistance; and
- apart from the timely financial gains there were no solid objectives to keep the members together.

To offset the above experience, the surviving co-operative societies have evolved a new system of land allocation to the individuals, periodical collection of funds and bulk purchase of seasonal inputs, and collective hiring of transport for external marketing of individual produce. These approaches are informing new government initiatives to make co-operative societies more sustainable.

Linkage between irrigation organisations, other local organisations /institutions and government
In almost every case each irrigation scheme is linked to the government for technical and financial assistance, advice and training.

Links between multi function organisations and the government
Most co-operative societies are multi function organisations, and all of them are directly or indirectly supported and sustained by the government. In the truest sense many only exist due to government support. The government constituted a high power task force (Anon., 1992) towards the end of 1992 to:

- establish causes of the failure of irrigation schemes;
- suggest the ways and means to revive the defunct schemes and strengthen the functional ones; and
- develop a training programme to strengthen the groups.

Performance of multifunction organisations
Some co-operative societies are primarily meant to serve irrigation farmers and dryland farming at the same time. As mentioned earlier, almost all multifunction organisations are marred by innumerable problems. Poor management has been the serious constraint.

Multifunction organisations and tradition of low key irrigated agriculture There are many multifunction organisations in the form of co-operative societies. Locally, these are called the 'multipurpose co-operative societies for dryland farming. They operate jointly on the following lines:

- bulk purchase of inputs to client demand;
- marketing of each individual's produce through collective hiring of transport;
- share liabilities; and
- normally all the problems and conflicts solved by the Registrar, co-operatives under the country's cooperatives law.

Origin of multifunction organisations
Cooperative societies originated at the village level as democratic bodies. The force behind this movement has been Lesotho's highest literacy rate in Africa. Moreover, most households in rural areas are *de facto* female headed because a substantial number of male family members have been working in the mines of the Republic of South Africa. So the women played a crucial role in this movement. Through the formation of co-operative societies people came together to achieve what they might not have achieved individually.

Lessons learnt from the co-operative movement in the rural area
Obviously well-managed and successful co-operative societies had a multiplication effect on the movement, and badly run cooperatives scared people away from the idea. As pointed out above some cooperative societies are genuine, grass root institutions while others are opportunistic groupings to lay their hands on assistance either from the government or the foreign donors.

Unfortunately, the rural disadvantaged are normally left out because to be a member one has to pay an admission fee, and then buy the shares ranging from M 5.00 to 100.00 each.

Discussion

The management problems faced by government managed irrigation schemes in the Third World are much bigger than one could imagine. At the same time there are examples of irrigation systems well managed by the farmers. This has prompted interest in the emergence of multifunction organisations to fill the management vacuum created by the respective governments' disinterest in the running of the irrigation schemes; and to comply with structural adjustment schemes to the farming community. However, if multifunction organisations are allowed to emerge from the grass roots, and operate independently, they may prove to be a very dependable option.

Co-operatives are almost everywhere in a state of crisis. Either they have just been probed or are being probed for mismanagement and corruption. There seems to be some light at the end of the tunnel because very independent cooperative societies such as reported in Lesotho may be an answer for the future. Smaller units (co-operative societies) are manageable. This is because the size of the capital being handled is relatively tiny; discrepancies are liable to come to light quickly individuals have an option to market their produce at will; business at small scale reduces the extent of financial risk; and back-up from the Ministry of Agriculture, Cooperatives and Marketing in the form of training proves more effective for the smaller units. There is a likelihood that honeycomb-structured cooperative societies might be relevant to the management of large irrigation schemes, whereby the water supply and levying of water rates would rest with some sort of central body.

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Existing Farmer Organisation
Farmer organisations in Nigerian irrigation projects are not fully developed. The existing organisations such as cooperative societies, self-help groups, community development associations and other associations are limited to a handful of villages and some are actually family groupings. The societies are normally involved in input (mainly fertilizer), distribution and some

maintenance at field channel levels. Survey indicated that 46% of the farmers interviewed were members of one of the co-operative and self help groups in KRP to procure farm input other than water. Village heads, village religious leaders (Imam) and a few rich, influential farmers are the main driving forces of a village community. Therefore, farmers grouping could be worthwhile based on the water boundary (Water Users Association/Co-operative), providing some active role to existing village leaders and attaching some of the incentive to the water users group members such as farm input procurement and distribution.

Farmer Constraints in System Management

Constraints to farmer participation in the operation and maintenance of large scale irrigation projects in Nigeria include: lack of appropriate institutional framework for participation; the advance and inappropriate technology involved; and the poor performance of the project (as discussed before). Large scale irrigation projects in Nigeria have been imposed and followed a 'revolutionary path' which is aptly described as a 'development without human face of the type "dam the river, damn the peasants"' (Ogunwale and Maurya, 1990; Kolawale, 1989). Large scale irrigation projects were simply imposed and conceived essentially on the basis of civil engineering criteria, and without adequate knowledge of all other relevant agricultural production and socio-economic parameters (Maurya et al., 1989). Omo-lokun (1978) described this approach to development as technocratic, economic and authoritarian based on several assumptions that technological innovations per se would sufficiently be attractive enough to automatically stimulate effective farmer participation. Based on this assumption, farmers were simply left out of the plan conception, planning and design stages. They were not sufficiently informed as to why their land was exploited, and what their future role was expected to be in the operation and maintenance of the project. Consultants' reports merely pushed the issue of farmers' involvement aside, and consequently, have not designed a suitable institutional framework for their anticipation (Adams, 1983).

Farmers' Perceptions of System Management Roles

Field observations have indicated that farmers (except tail end of water conveyance) perceived availability of other agricultural inputs and services (especially fertilizers, tractors and harvesters) as more important to them than irrigation water or irrigation systems' effectiveness. Also, the farmers in general have no interest in participating in system maintenance or accepting responsibilities in system management because they pay their irrigation water charges. The water charges of 1,000 Naira/ha/year were normally considered too expensive especially when tail end water supply is erratic and agricultural production support services under-perform.

Farmers perceive that the job that has been most effectively done by the authorities is the collection of water charges. On the other hand, the most neglected roles were the procurement of fertilisers, provision of adequate tractor-hiring services and supervision of water allocation and distribution within the sector[1]. The utility of water is less well understood by farmers compared to the value of other crop production inputs.

Farmers' perceptions have been affected by the benevolent patron–client relationships that have been built up by the governments in most irrigation systems. This resulted in over-dependence of farmers on government agencies for their farming operations. The extent of dependence on the government could be illustrated with Kano River Project farmers' perceptions that the project authority should even maintain the structures adjacent to farmers' plots, distributary canals (DCs) and their field channels (FCs). 47 (15%) of the respondents felt that the authority should maintain the DCs and FCs, respectively, and charge the farmers for this later. Over 30% felt that each of these should even be done on a charge basis by the authority. Farmers' groups were perceived to have a maintenance role only at FCs level. However, upstream users felt that they themselves (or in a group) could maintain the DCs and FCs.

In addition, farmers were asked to select which group from members of cooperative societies, individual farmers, groups of farmers and the projects staff, would be most effective and efficient in performing irrigation activities. They mainly thought the project staff should perform these activities now and in future. Farmers also perceived that most of the activities could be effectively performed by the cooperative society if the authority withdraws from its maintenance (Table 1).

Implications of Farmers' Perceptions on Systems' Management

Farmers perceive the relative advantage of irrigation water to be less than that from agricultural production inputs, especially, fertilizers and tractor hiring services. As a result, generating improved farmers' participation in systems' operation and maintenance will be more effective if the perceived irrigated agricultural production tasks with high relative advantage are considered as the felt, or real, needs of the farmers. Mobilisation of farmers for active participation will be easier when it centres on their own expressed felt or real needs. In all, some basic social, cultural and design changes would be needed in order to ensure successful management of the nation's

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[1] The area covered by a lateral canal, which carries water from the main canal.

Table 1: Farmer perception of the possibilities of management of irrigation activities by various organisations

	Activity	*Total No.*	*Farmer himself %*	*Farmer Group %*	*Co-op Society %*
a.	Service/access road maintenance	140	5	11	84
b.	Dam maintenance	124	4	6	90
c.	Main canal maintenance	134	6	16	78
d.	Maintaining farm ditches/canals	173	25	35	40
e.	Deciding on water use in the plot	159	35	18	47
f.	Operating water control devices	148	10	12	78
g.	Maintaining water control devices	147	7	13	80
h.	Water scheduling in plots	173	36	21	42
i.	Draining farmers' plots	175	57	12	31
j.	Deciding on water fees	159	8	19	73
k.	Water fees collection	143	6	10	84
l.	Land preparation before planting	182	43	9	48
m.	Tractor acquisition for use	182	30	7	63
n.	Deciding on type of crop	187	52	12	36

irrigation schemes and it is recommended that there should be:

i) maximum use of existing social and administrative structures in an adaptive manner by creating a cadre of village or community irrigation workers as an arm of the Community Development Associations presently active in most communities (Ogunwalo and Maurya, 1990);

ii) choice of community focal points within the sectors or villages in the schemes so that each sector or village will be allocated irrigation system personnel or operators to provide contact points between the authorities and the community water users;

iii) re-orientation and re-activation of existing governmental services to provide direction, training and contact with the community while encouraging and emphasising water users' group information and initiatives in system management;

iv) identification of farmers' needs from time to time, 'choosing the sequence of improvement and deciding how they will be implemented' (Donaldson, 1988);

v) responsiveness to local initiatives and delegation of some irrigation water management responsibilities to the water users; and

vi) rehabilitation and design modification to meet the farmers needs (Maurya et al., 1989).

The more the involvement and participation of water users in system management, the cheaper and the more effective the operations and maintenance of irrigation schemes (Lowdermilk, 1985; Vermillion, 1987). Project authorities have to encourage groups to provide complementary services to the supply of irrigation water. The allocation of such roles and provision of services to the farmers would provide an entry point for sustained interest in participation in system management. Coupled with education and training in basic system's tasks and operation this will reduce and eventually eliminate the prevailing dependency of farmers on the government for irrigation system management and irrigated agricultural production. With the elimination of dependency, role expectations in irrigation systems will be appropriately perceived. This will improve and increase the readiness of the irrigation authorities to share operational responsibilities and enhance water users capabilities.

Proposed Joint Management Structure

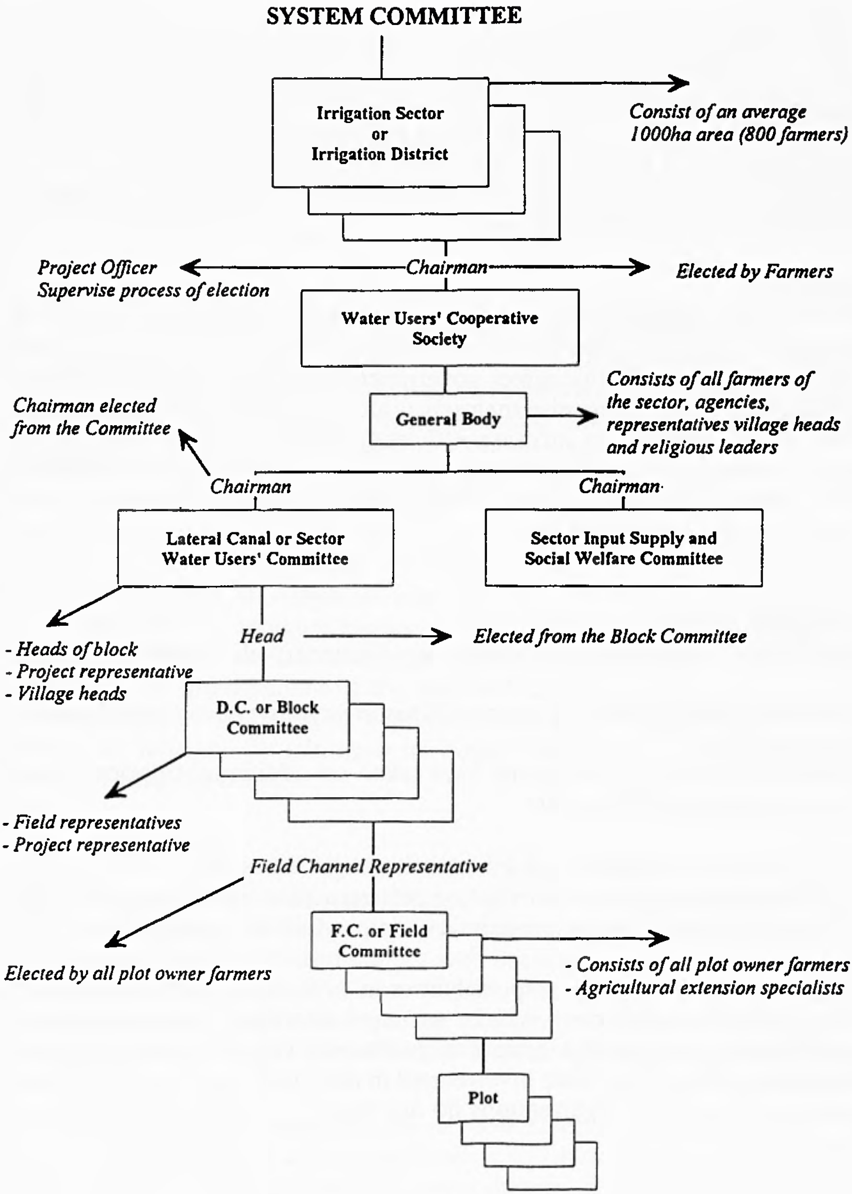
A large scale irrigation project is divided into several zones each of which is further divided into sectors (or irrigation districts), which is served by lateral canals fed by the main canal.

A sector (average 1000 ha irrigated area) is divided into blocks, which are served by the distributary canal fed by the lateral canal. A block (about 100 ha) is divided into fields (6 ha irrigated area) and fields into units or farmer plots. Farmer plot size varies from 0.3–10 ha. The majority of farmers of a sector live mainly in one or two nearby villages, and at least one of them hosts a cooperative society.

Based on the study farmers could be grouped in existing extended village co-operative society (to cover a sector or irrigation district) on water boundary basis (sector or lateral canal water users' must be members) to shoulder operation and maintenance responsibility at sector level (see Figure 1).

Farmers experiencing water shortages (mostly of tail ends) would like water users' associations to be formed for equity in water distribution. However, the co-operative societies preferred by the farmers are in short supply of other farm inputs. Considering all the above, a model is proposed for testing that incorporates the RBDA (River Basin Development Authority), existing co-operative, farmer water user groups and other agencies involved in irrigated agriculture (Figure 1).

The proposed management turnover model from the basis for incorporating existing RBDA's limited staff, village leaders and the village cooperative society and provide additional responsibility of water users associations. The proposed group may require to change the name from


SYSTEM COMMITTEE
Irrigation Sector or Irrigation District
Consist of an average 1000ha area (800 farmers)
Project Officer Supervise process of election
Chairman
Elected by Farmers
Water Users' Cooperative Society
General Body
Consists of all farmers of the sector, agencies, representatives village heads and religious leaders
Chairman elected from the Committee
Chairman
Chairman
Lateral Canal or Sector Water Users' Committee
Sector Input Supply and Social Welfare Committee
- Heads of block
- Project representative
- Village heads
Head
Elected from the Block Committee
D.C. or Block Committee
- Field representatives
- Project representative
Field Channel Representative
Elected by all plot owner farmers
F.C. or Field Committee
- Consists of all plot owner farmers
- Agricultural extension specialists
Plot

cooperative society to Sector Water Users' Co-operative Society (SWUCS). Apart from the general body which consists of all sector farmers as members, SWUCS will have two main functionary committees, namely input procurement, distribution and social welfare committee, and water users' committee. Water users' committees will have block and field committees to manage at various levels. The functions of various committees and groups; responsibilities of chairmen, heads and leaders; and the process of organising the farmers have bee worked out.

Conclusion

Farmers and irrigation project authorities have realised the need to reorganise the management structure of Nigerian medium-large scale irrigation projects. To this effect government has already taken action to encourage farmers to organise themselves and has approve rehabilitation of some of the projects to increase efficiency and easy to manage by the farmer. However, some aspects (such as lack of well defined irrigation policy, and testing some of the management turnover modalities at pilot levels) remain unattended to.

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Have local organisations with responsibilities in irrigation operations also taken other functions?

We find that many organisations have taken on additional responsibilities. These responsibilities include:

- cooperative marketing for horticultural produce;
- soliciting for funds for irrigation infrastructure improvements;
- soliciting for funds for seasonal crop production input loans.

They have taken on these responsibilities in order to serve their members better and raise additional income to cover operation and maintenance costs. These organisations have not performed very well as a result of increased workload and their involvement in activities that require skills and knowledge that most organisations do not have.

To what extent can irrigation organisations be conceptualised in isolation from other organisations?
Irrigation organisations can be conceptualised in isolation because irrigation services are provided to a part of the community whose land is under command. Although irrigation farmers may have other things in common with non-irrigation farmers, e.g. the desire to improve roads or health services, irrigation services only benefit irrigators directly and hence an irrigation organisation does not endeavour to provide services which would benefit non-irrigators.

The additional resources required to enable multiple function approach to work include trained community leaders and organisation staff.

Challenges for regional and national support agencies lie in the identification of additional functions that are relevant and desirable, creating awareness of the benefits of such functions and training leaders and irrigators on how to take advantage of the new structures.

Experience of changes in joint performance over time
Although there has been major political changes in the country, the impact has not been felt at irrigation scheme level. National Irrigation Board continues with its tenancy farmer system and dictates the changes for irrigation support services despite the tenants desire to have a say in the operation and management of the National Irrigation Board.

The economic pinch being experienced by tenant-farmers is providing additional impetus for changes in policy rules and regulations of the National Irrigation Board.

Links with the state and the reorganisation of state agencies
Most of the multi function organisations are closely associated with the co-operative movement. In the past the co-operative movement was controlled and regulated by the government but with liberalisation government control on cooperatives is reduced.

The link with NGOs and private companies especially those which purchase farm produce on contract are increasing for the benefits of both.

Different organisations managing two or more functions
It is dynamic individuals who create multi function organisations to cater for their interests as well as those of other irrigators. Dynamic individuals may end up being in a number of different organisations so long as they have interest in the activities of these organisations.

Why do MFOs appear?
MFOs predominate where mixed farming demands the services of different functions and where marketing and availability of inputs constrains the performance of irrigated agriculture.

The origin of MFOs
MFOs can originate from the grass-root or from above depending on the forces behind additional functions. When the need for additional organisations is identified by outsiders willing to help the group solve their problems they may initiate the process of creating MFOs.

Summary

Some Network members sent in papers and reports that are already published.

Inga Jungeling sent her paper 'Improving Management of Small-scale Irrigation Schemes', IIMI Sri Lanka Country paper No.5 (1989). This paper examined the role NGOs had played in communities with tank irrigation in Hambankota district, Sri Lanka. NGOs had become involved in tank rehabilitation, together with a range of other activities in communities. However, they often had not taken systematic improvements in irrigation management or the outputs from irrigated agriculture as a systematic objective in their programmes. The paper documents the decision-making process of an NGO. It also looks at the context in which decision-making takes place, especially both government and NGO policies to assist the rural population in general and the performance of small-scale irrigation systems in particular.

Kerry J. Byrnes of LAC-Tech, US Department of Agriculture, sent his paper 'Water Users Associations in World Bank Assisted Irrigation Projects in Pakistan', World Bank Technical Paper 173 (1992). This report reviews the experience of Pakistan's On-farm Water Management Programme in working with and through World Bank-assisted projects. The study shows how the organisation of farmers had had a significant effect on achieving and maintaining local improvements. However, there were still significant variations in the persistence and dynamism of organisations. The objectives of WUAs were focused strongly in resource mobilisation for improvements and maintenance. If WUAs are to become sustainable catalysts for agricultural and rural development, and not temporary project implementation vehicles, then many changes in approach and support will be necessary.The report includes a section discussing options for 'multi function organisations', but stresses the need for flexibility of approach. While demands for greater range of actions should come from the WUAs it might be helpful to have a 'special projects' programme that examined proposals, assessed their viability and ensured assistance went to well-established WUAs.

Some conclusions on prospects for MFO development and dynamic local institutions

There is a great diversity in organisational forms for water management, and how arrangements for irrigation operations overlap with organisation of other activities.

Irrigation needs collective action and organisation in ways that many other activities do not. However, people of authority may be common across activities.

Collective action depends on perceived advantages. Traditions in the scope of group action in different activities influence persistence of collective action, and also responses to change in requirements for collective action.

MFO's have developed both for service provision and for the planned control of production; the former have been much more successful than the latter.

Local land development and general village empowerment is a third area of work for MFO's, although irrigation may remain managed by a specific sub-committee .This is a prominent area of work by NGO's. They have often promoted a range of functions in village programmes, with a view to more control and integration in livelihood strategies and developing institutional capacity. However, idealised notions about how communities should function and what features groups should integrate may be as problematic for local people as weak or highly atomised single-purpose organisations (see contributions from network members).

The optimal approach in organisational development is to build on a single need which is identified and work from that (see contributions from network members).

Single purpose organisations are more likely because of the division of labour between tasks, and variable access to natural resources by people in a particular territory. They are also encouraged by the sectoral approach of the government agencies liaising with them.

The need for services under new commercial opportunities can promote membership in regional-level organisations which play multiple roles in livelihood support.

The evolution of dynamic MFO's has emerged in conditions of freedom in association, in affiliation between groups and in deployment of finance. Equally withdrawal from MFO's is highly likely if their requirements interfere with livelihood options. This freedom of action is more important than availability of financial/managerial resources, although the latter are important in the speed and direction of evolution.

The competence of MFO's in planning, finance and liaison is a critical factor in their acceptance.

It is unrealistic to expect multiple functions to be organised entirely in one settlement. Freedom to decide wider spatial associations in organisation of services will encourage more evolution of MFO's.

Participation in organisations improves when people have a clear sense of their rights, benefits and responsibilities, and a sense that irrigation infrastructure belongs to them in reality: also that they do really belong to the group managing the infrastructure. It also improves where people obtain more representative performance from associated agencies. Sometimes it may also be improved when the organisation supplies other personal needs such as status, identity and broader political representation.

The dynamism of organisations, and dynamics of organisational change (in functions and structure) depends on the actions of the body vested with general authority, although dynamic individuals may have temporary influence on the scope of activities integrated together in a settlement.

Irrigation groups may manage the natural resources of their catchments as well as their production. However, just as they need external assistance in new livelihood strategies, they also need advice on land management problems triggered by forces beyond local control. This has to be seen as advice, sensitively evolved, not as instruction.

Conceptual models to study local-centre relations in water management

The accompanying work has illustrated three key themes:

a) the scope and nature of local resource management organisations may have originated from both the range of tasks necessary to get rewards from collective action, and also from the variable basis to group relations underpinning collective action, and their need to gain entitlements to use land and water resources. However, increasingly they also reflect and legitimise the power relations that the contemporary leadership has established within the broader sphere of state intervention.

b) Irrigation can be considered a form of 'landesque' capital where investments generate more benefits from the land. At issue, who determines rights to access benefits from this 'landesque capital', as well as who has rights to obtain these benefits. Local institutions can differ in whether they have 'clan- or territory-based' rights operating to maintain the welfare of a group and its descendants, or individual rights accruing to particular membership households. Collective action occurs not only in engineering-based tasks in construction, operation and maintenance but also in rule - conformance and conflict resolution. The nature of management arrangements may reflect needs and roles in conflict resolution and general management, not only in providing resources for maintenance.

Tension between community and state emerges because the state alters arrangements, either by granting new rights or by failing to uphold older right which allow new elites privileged access. The state can also fail to allow new arrangements wanted by groups. While the state may take up a role in managing resources between communities, its real interest may be to manage water to encompass new demands elsewhere, leaving discontent between and within organisations.

[Editor's note - some of the comments in this summary arise from two pieces of work prepared as working papers for planning future IMN activities:

Working Paper No. 7: Diversity and change in local water management institutions.
Paper 1. What's in a name? Organisations and Institutions involved in the management of irrigation - Richard Friend and Linden Vincent
Paper 2. Irrigation Organisations in Thailand - Richard Friend
Paper 3. Village and State in Rural Water Management in Tanzania - Christopher Southgate]

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