WATERING THE SHAMBA

Current Public and Private Sector Activities
for Small-Scale Irrigation Development

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WATERING THE SHAMBA

Current Public and Private Sector Activities for Small-Scale Irrigation Development in Kenya

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WMS Report 40

CONTENTS

Executive Summary vi

Chapter 1. Review of Past and Present Irrigation Development 1
Introduction 1
Past and Current Irrigation Development Activities 1
Private Sector Efforts 1
Public Sector Irrigation 4
Public Institutions Involved in Irrigation 7
The National Irrigation Board (NIB) 7
The Regional Development Authorities 8
The Ministry of Water Development 9
The Ministry of Energy and Regional Development 9
The Ministry of Planning and National Development 9
The Scientific Research Division of the Ministry of Agriculture and Livestock Development 10
The Irrigation and Drainage Branch and its Provincial Irrigation Units: Ministry of Agriculture and Livestock Development 10
Sources of the Funds for IDB and PIU Operations 14
The Netherlands Government 14
The European Economic Community 15
The World Bank 15
The Norwegian Agency for International Development and Danish Agency for International Development 15
Overseas-Based Nongovernment Organizations 16
Volunteer Organizations 16
The Kenya Government 16
The Constraints to the IDB and PIU's Efforts 17
Conclusion 18

Chapter 2. Economic Aspects of Small-Scale Irrigation Development 19
Small-Scale Irrigation and the Political Economy of Kenya 19
Variability of Food Production 20
Foreign Exchange: Export Crops and Import Substitution 22
Rural Income Levels and Regional Economic Development .. 23
Implications for Special Groups: Gender and Clan/Tribe Issues 24
Potential for Increased Production 25
Hypothetical Rates of Irrigation Development 27
Intervention: Finding the Appropriate Combination of Private and Public Sector Involvement 30

Technical and Institutional Change 30
Agribusiness Linkages: Input Suppliers and Marketing Channels 32
Guiding the "Invisible Hand": Requirements for an Effective Private Sector Involvement 36
Market Failure 39
Government Failure 40
Analyzing Economic Factors Related to Public Investment in Small-Scale Irrigation 43
Analyzing the Economic and Financial Implications of Irrigation Development 43
Relationships with Other GOK Policies and Programs 49
Operational Suggestions for Effective Private Sector Involvement in the Development of Small-Scale Irrigation in Kenya 50

Chapter 3. Water Users' Organization 53
Introduction 53
An Analysis of the Current State of Water Users' Organizations 54
Typologies and Characteristics of Schemes 54
Functions of Water Users' Organizations 62
Gender Issues 68
Suggested Strategies for Strengthening WUOs 69
Major Constraints in WUOs 69
Strengths and Potential for Building Efficient WUOs 74
Suggested Measures to Increase the Effectiveness of WUOs 75
Concluding Remarks 77

Chapter 4. Analysis of Engineering Aspects of Small-Scale Irrigation Systems 80
Agricultural Setting 80
Agroclimatic Zones and Opportunities for Irrigation 80
Irrigation: Extent and Nature of Technology 81
Technical Issues: Water Capture and Conveyance 82
Experiences of Local Farmers' Groups 82
Assistance by Government and Nongovernment Agencies 85
Technical Issues: Water Use 88
Complexity of the Production System 88
Water Use Efficiency 89
Summary 91

Chapter 5. An Analysis of Technical Manpower Needs and Training Activities in Support of Small-Scale Irrigation Development 94
Background 94
Republic of Kenya Development Plan 1976-80 94

Manpower—Requirements 95
Present Staff of the IDB/PIU Program 95
Shortage of Irrigation Development Manpower 96
Coping with the IDB/PIU Manpower Shortage 97
Training 100
Training Professionals 100
Farmer Training and Extension 104
Donor Involvement in Training 107
Staff Development and Retention 107
Some Training/Recommendations 108

References 109

Appendix 1. Organizations and People Contacted 112

Appendix 2. Selected Bibliography 115

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EXECUTIVE SUMMARY

E. Walter Coward, Jr.

PURPOSE OF THE STUDY TEAM

The Water Management Synthesis II (WMS-II) project, in response to a request from the USAID/Kenya Mission, undertook an anlysis of the small-scale irrigation sector in Kenya during November-December, 1985. As defined by the Mission, the team was directed to focus on the following:

1. analysis of past experiences of the Government of Kenya (GOK), other donors, nongovernment agencies (NGOs), and local entities in the design, operation and management of small-scale irrigation schemes in Kenya;

2. assessment of the economic viability of small-scale irrigation schemes in Kenya;

3. development of guidelines and recommendations to be used by USAID in formulating policies and programs supportive of small-scale irrigation in Kenya; and

4. recommendations on areas and mechanisms whereby USAID can best assist the development of new, and improvement of existing, small-scale irrigation systems.

The following discussions constitute the team's effort to deal with this assignment. This executive summary reviews the analysis and outlines guidelines and recommendations for possible donor support to small-scale irrigation development in Kenya. The chapters that follow deal with history of past experiences, economic issues, the important matter of private water users' groups, engineering dimensions of the situation and, finally, the current and needed training activities.

INTRODUCTORY FACTS

A basic agro-climatic fact in Kenya is that annual potential transpiration exceeds annual precipitation in virtually the entire country: everywhere, if crops are to be grown year-round, they need more water than rainfall provides (World Bank, 1982). Thus, there is a high probability that crops will experience periods of moisture stress during their growing periods, that some crops will not be grown at all, and that at some times during the year lands will be fallow because of a lack of rainfall. This situation is more acute in some places and at some times than others. To deal with this basic climatological reality farmers and governments, past and present, have created a multitude of farming systems, some of which employ irrigation facilities. Farmers in the Kerio Valley built their own hydraulic works centuries ago, the British Colonial Government built various "furrows," the

Kenyan Government is at work building irrigation facilities today, and individual farmers and groups of farmers continue to invest in developing irrigation works.

It is estimated that in Kenya at present less than 50,000 hectares are irrigated. Most of this is on large-scale private farms with approximately 23,000 hectares of irrigated land for use on high value crops such as coffee and pineapples. The next largest component is the resettlement projects operated by the National Irrigation Board with approximately 10,000 hectares of irrigated land in total. Finally, the small-scale irrigation component is estimated at 1,000 hectares —which appears to be an exceedingly low figure.

Kenya faces the dual problems of a rapidly growing population and a swiftly increasing labor force—both pressing on the agricultural sector for employment and livelihood (see Chapter 2). While the agricultural economy grew at an annual rate of 2.7 percent during the 1972-79 period, this rate will not be sufficient to cover either future food supply or rural employment requirements. Since there are no frontier lands to be exploited, increased employment and food production must occur as the result of more intensive use of the presently available land—much of which is constrained by water scarcity.[1]

It is these facts of political economy and ecology that act as inducements for irrigation development—the GOK has set a target of 200,000 hectares of irrigated land by the year 2005. And many in Kenya see opportunities for perhaps half of this to be in the small-scale sector. Increased irrigation on large farms will proceed with little public assistance as these operators make their own investment decisions. There is little interest on the part of the GOK or donors in expanding the activities of the National Irrigation Board in its present form because of the high costs of both construction and operation and the necessity of appropriating lands for public management. Even the President of Kenya has spoken in favor of small-scale, simple irrigation systems that would both create employment and increase food production.

THE MOSIAC OF SMALL-SCALE IRRIGATION

The picture of small-scale irrigation in Kenya has a mosaic quality: it is composed of numerous small pieces, many of which are unique while others share one or more features. Part of the variation arises from the diverse ecological settings in which the schemes occur—both the humid seacoast and the semi-arid Taveta region of Coast Province, areas adjacent to the Mau escarpment in Rift Valley Province and in the rainshadow belt surrounding Lake Victoria, for example. These ecological settings are characterized by different soils and rainfall patterns, but all are settings in which small-scale irrigation facilities have been introduced (see Chapter 4).

History also has contributed to the mosaic quality of the image. The small-scale systems of Kenya are remarkably diverse in their beginnings (see Chapters 1 and 3). Some, such as those in the Kerio Valley and in the Taita Hills, have origins so distant as to be unknown. Others have a more proximate genesis—beginning with the furrow of a former white settler or having been initiated by the Colonial government as a means to occupy detainees. Still others have only recently been created by a government or NGO project or by a group of farmers newly formed to

purchase the land of a former large farm. A particular system may have a complex history of local development followed by repeated government assistance in divergent forms and by different agencies. Implicated in these varied histories are diverse land tenure arrangements—some of which act as disincentives for investment in irrigation facilities.

Finally, small-scale systems take on complex and highly varied textures because of the dissimilar production goals of water users between, and within, schemes (see Chapter 4). In some, irrigation is used primarily to ensure subsistence production of staples, such as maize and sorghum, or to produce rice, some of which may be consumed and some sold. In others, the basic purpose may be production of vegetables for local or export markets. And, of course, in many, cultivators may have objectives different from those of their neighbors, and systems may swing rhythmically between one purpose and another depending upon the season. Moreover, in some systems irrigation water may have a single use while in many others it brings water not only for the crops but for livestock and domestic needs. In addition, the texture of the small-scale systems is highly variable because each is set in the context of a larger production system in which the irrigators also act—one that may involve livestock, rainfed crops, and perhaps even off-farm employment.

Thus, to speak generally of small-scale irrigation in Kenya is, of necessity, to speak with a great deal of imprecision. Accurate accounts and appropriate public policies both require additional and continual specification along the lines discussed above.

In all these diverse settings, the common result of irrigation is some change in production outcomes. While we lack carefully documented facts regarding the impact of irrigation on production (see Chapter 2), anecdotal information suggests that cultivators with land served by these hydraulic facilities typically produce more, in the long run, than nearby cultivators with land dependent upon natural rainfall. The presence of irrigation reduces the risk of crop failure due to drought, allows alternative crops to be grown, and/or enables cultivators to utilize a slice of time normally unused because of the absence of rainfall. Moreover, irrigation development often is the catalyst for increasing farmer use of improved seed, fertilizer, and pesticides (see Chapter 2).

CURRENT DEVELOPMENT OF SMALL-SCALE IRRIGATION

Small-scale irrigation systems in Kenya are defined with regard to three features: (1) the amount of land irrigated is 500 hectares or less, (2) the land irrigated is not state-owned, and (3) the operation and maintenance of the irrigation facilities lies with the local users. Such facilities are being developed by individual farmers, groups of farmers, nongovernmental organizations (NGOs), government organizations such as the Ministry of Agriculture and Livestock Development (MOALD), the Ministry of Water Development (MWD), and various regional development authorities or through some combination of these entities. Private sector credit for irrigation development is very limited due to various technical uncertainties (see Chapter 2).

Currently, one significant combined effort is that involving the MOALD and private farmer groups (sometimes with a complementary role being provided by an NGO). The Irrigation Drainage Branch (IDB) of the MOALD has been designated by the GOK as the agency responsible for assisting farmers in developing or improving small-scale irrigation facilities (see Chapter 1). The IDB, with significant foreign assistance, implements its activities through newly established Provincial Irrigation Units (PIUs).

THE IDB/PIU APPROACH

The IDB/PIU program has evolved from a series of prior experiences with irrigation development in Kenya dealing with both large- and small-scale schemes —many of which have been unsuccessful. However, that portion of the IDB/PIU activities directly assisted by the Dutch government is based on an approach that represents a significant departure from previous strategies.[2] The basic components of this new approach include (see Chapter 1)

1. Responding to requests from private users' groups already involved in irrigation in some manner. The utility of this approach is that government need not persuade farmers to make radical changes in their farming systems: it deals with groups that already have some irrigation experience. It is also assumed that these groups have some degree of organization to have practiced irrigation and to have come forward with their request for assistance. Finally, this approach means that many, but not all, of the present PIU activities are focused on the improvement or rehabilitation of existing facilities.

2. Designing and constructing low-cost technological facilities. This approach is consistent with existing preconditions: the limited investment resources of both the water users and the government, the modest technical skills of the PIU staff, and the capacities of the water users who will be responsible for subsequent operation and maintenance. Special emphasis is given to the construction of facilities with low recurrent costs—operational costs to be borne by the private users' group.

3. Implementing project planning, design and construction through provincial/district-based technical teams. Given the dispersed nature of the irrigation schemes and the frequently time-consuming and costly means of transportation to project sites, there is a clear advantage in having the technical teams of the PIUs based close to field operations.

4. Placing responsibility for managing the irrigation facilities with the private users' groups and farm management decisions with the private land owners/operators. Unlike small-scale irrigation strategies in some other countries, the Kenyan approach does not assume that in the post-construction phase of the project agency staff will need to remain on-site to operate and maintain the irrigation facilities. After project completion, facilities are turned over to private sector groups for routine operation and management. Likewise, unlike the strategy used in the National Irrigation Board schemes, land ownership and farm management decisions remain with the private owners/operators and are made by some government agency. While the

private users' groups are responsible for the costs of operation and maintenance, the GOK makes no attempt to recover development costs.

5. Using irrigation development as a means of increasing rural employment and food production. Some earlier efforts at small-scale irrigation development in Kenya were confounded by an emphasis on short-range goals of famine relief and settlement in the arid zones. The PIU approach emphasizes the development of irrigation for food production—both subsistence and market sale.

* * * * * * * * *

In brief, the IDB/PIU strategy is one of providing limited government assistance to groups of private farmers who are already settled on their lands and who have demonstrated an interest in and experience with some manner of irrigation. During the planning, design and construction phases the IDB/PIU provides technical and financial assistance while the water users contribute labor. No attempt is made to recover these costs from the water users. In the post-construction phase, the private users group is responsible for all routine costs of operation and maintenance and is the day-to-day manager of the facilities. Government continues to be involved through the provision of extension services and as a last resort when extraordinary repairs or maintenance are required.

This makes the present IDB/PIU strategy significantly different from the more costly and more highly centralized strategy that has been used by the National Irrigation Board or that appears to characterize the strategies of the Lake Basin Development Authority and the Kerio Valley Development Authority. It also differs significantly from the original small-scale irrigation development projects in the arid zones, involving the settlement of pastoralists, that were costly and largely ineffective.

Irrigation Technologies

Given the diverse ecological settings in which irrigation is practiced, it is not surprising that existing systems utilize a variety of water sources and irrigation technologies (see Chapter 4). However, the most common arrangement is what is referred to in East Africa as the **furrow system.** Furrow systems are gravity-flow schemes that divert surface water from a spring or stream into (typically) unlined canals that convey the water supply to the fields where water is applied in small basins or otherwise spread by gravity. Diversion structures may be of temporary construction (earth embankments, stone or brush weirs, and so on) or more permanent masonry structures. In contrast to the furrow systems, some small-scale irrigation utilizes machine equipment—for example, to capture the water supply (pumps lifting surface or ground water), to convey the water to the fields (closed pipe systems), or to apply the water to the crops (sprinkler systems of various types).

In the interests of reducing construction costs and maximizing the ability of the private users' group to operate and maintain the irrigation facilities, the

present IDB/PIU approach stresses the use of low-cost irrigation technology with an emphasis on furrow systems. If pump systems are installed by the IDB/PIU, they are designed to be simple and low-cost (though some donors have proceeded with much more elaborate and costly mechanized systems such as the German project in Mitungu and the World Bank-funded village irrigation projects in the Lower Tana River Basin).

Agency Staff

MOALD staff working with small-scale irrigation are either assigned to the headquarters unit, the IDB, which is located within the Land Development Division (LDD), or to one of the Provincial Irrigation Units which operate under the joint direction of the IDB and the Provincial Director of Agriculture (PDA). Increasingly, PIU staff are being assigned to the district level where they work in coordination with the office of the District Agricultural Officer (DOA).

The IDB/PIU staff are primarily trained in engineering although the IDB staff does include an economist and some PIUs have agriculturalists on the staff (see Chapter 5). The engineering staff includes people with three levels of formal training: (1) agricultural engineers (with B.Sc. degrees from the University of Nairobi), (2) technical officers (who are graduates of colleges such as Egerton or Jomo Kenyatta), and (3) technical assistants (who are graduates of technical high schools). Given the newness of the IDB/PIU set-up, nearly all the PIU staff are young, recent graduates just gaining field-based knowledge. Many experienced engineers left the MOALD when the new Ministry of Water Development was established.

To illustrate one PIU staffing pattern, consider the case of Coast Province. There is a small PIU team at the provincial headquarters—an Officer-in-Charge (who has provincial duties other than the PIU), a B.Sc. agricultural engineer, and two technical officers. In addition, there are small teams in each of the province's districts—Subaki, Kwale, Tana River (including a team working with the World Bank-funded Village Irrigation Program) and Taita-Taveta. In Taita-Taveta District the team includes a graduate agricultural engineer, two technical officers, and two technical assistants.

The Kenyan staff of the IDB/PIU is now supplemented by a number of expatriates (see Chapter 5). About a dozen Dutch technicians are assisting in the activities of the IDB and the PIU in Nyanza and Rift Valley provinces. In addition, other assistance is being provided by German, Danish, Italian, and FAO specialists.

Finally, PIU staff are involved to a large extent in the full range of activities associated with project development: inventory of existing systems, prefeasibility studies and planning of projects, design of the works to be constructed, and both supervision and construction of those facilities. In some cases, consulting firms, often foreign, have been engaged to complete some of these tasks. But this appears to be the exception rather than the norm (see Chapter 1).

Private User Groups

As noted above, a component of the IDB/PIU strategy is that of assisting private user groups that are "organized" and practicing some form of irrigation (see Chapter 3). In certain areas, these groups have origins distant in time and typically organize their joint irrigation tasks along kinship lines. Many may be in a state of transition, adapting to new internal or external circumstances. As part of the process of receiving government assistance, these traditionally organized groups, which have no legal standing, may be asked to take the form of legal entities based on new principles of organization, as discussed below.

A second type of private user group has more recent origins—sometimes emerging from groups formed for the purchase of land, from groups connected for the purpose of specialized crop production, or even groups formed specifically in response to potential irrigation assistance from the government. These groups are generally organized on more contractual principles and have legal status under present GOK laws. They are usually organized as "harambee" groups rather than as formal cooperatives (see Chapter 3). Most such groups have been established only in the past few years.

Regardless of the origin of the private users' groups, receiving assistance from the government commits the group to

1. become involved in the construction phase of the project—primarily mobilizing labor and sometimes local materials for construction;

2. take responsibility for operating the system after construction—allocating and distributing water, managing disputes and so on;

3. mobilize labor and materials and managing finances for the purposes of repairing, maintaining or replacing the irrigation facilities; and

4. manage marketing activities (often a critical function because of the high value and high perishability of the crops being produced and the poor marketing infrastructure available to the producers).

This imposing set of organizational tasks may exceed the experience and capacity of either the traditional or newly created private users' groups.

Constraints and Limitations of Present Efforts

At the national level, the IDB/PIU program of small-scale irrigation development is the most important source of public assistance available to private user groups wishing to develop irrigation capacity. Thus, we turn our attention to analyzing that program. The prior discussion has summarized the major elements of the program and emphasized the strengths of the IDB/PIU strategy. Here we discuss five important constraints to program success.

1. **The strategy as presently implemented nets a very small annual increase in irrigated hec'arage.**

Since establishment of the PIUs in 1979, approximately 2,000 hectares of small-scale irrigation have been developed under the Dutch-sponsored Small-Scale Irrigation Development Program (SSIDP) (see Chapter 1). Three factors seem to account for this slow pace of development——even when keeping in mind that the total effort is a relatively new one. First is the modest size of the IDB/PIU staff, the frequent turnover in staff and the dispersed pattern of project implementation ——few people scattered over a number of distant project sites. A second factor is the breadth of tasks for which the IDB/PIU staff are responsible——all phases of project development from feasibility studies and initial planning to design and ultimate construction. While there are some advantages to staff having a continuous and comprehensive involvement with a single project, it does mean that an already small staff is spread across a number of complicated technical tasks. A third factor, related to the above two, is that the present strategy makes little use of private sector firms to implement any of the development tasks identified above. There has been some use of international consulting firms but practically no involvement of local architectural and engineering consultants or construction firms.[3]

2. The GOK is providing very few funds for project implementation thus also limiting the pace of small-scale irrigation development.

At present, nearly all funds for project implementation, as distinct from funds for staff salaries and support, come either from foreign assistance or through the Rural Development Funds being administered by the District Development Committees (DDC), as part of the new district-focus program.[4] Dutch assistance for small-scale irrigation for the period 1984-87 provides approximately $895,000 for project implementation.[5] No figure is available for the total amount of DDC funds allocated to small-scale irrigation——though during the field visits PIUs frequently mentioned that they were being asked to assist the DDCs in assessing the feasibility of certain projects and being given responsibility to implement various projects funded by the DDCs. MOALD provides funds primarily for Kenyan staff salaries; often little remains for staff support in the field. A not insignificant portion of GOK funding in this area covers the GOK component of foreign technical assistance costs (housing and other support for expatriate staff).

3. The private users' groups responsible for scheme operation and maintenance are fragile social organizations.

Working with private users' groups to strengthen existing organizations or to create new ones is a complex task. Its execution requires staff trained in organizational techniques and assigned to this specialized task. At the present time, such staff are absent from the IDB/PIU structure, though in some cases agriculturalists are being asked to assume this job.

Because the IDB/PIU strategy requires that farmers be "organized," or organize themselves, before receiving assistance and because there frequently is some group action during the construction period, it is easy to assume that the organizational element of the strategy is in place. Most of the "groups" associated with the IDB/PIU schemes are either very new or are old groups taking on very new functions. In either case they are largely untested by adversity. Their apparent success to date should not be taken as an indication that current efforts at group

organization are sufficient. Based on experience elsewhere, we believe that present procedures are not sufficient and that the fragility of many of the present groups will become apparent as they encounter normal and unusual difficulties in the operational phases of the projects.

Finally, it should be noted that the private users' groups are being asked to assume a wide range of functions, including activities which are not related directly to irrigation management (see Chapter 3). Sustaining the organizational capacity to manage the irrigation facilities is already a large task; adding various other tasks, such as marketing, may be overwhelming. Considerable empirical evidence suggests the likely failure of this approach.[6]

4. Inadequate attention is being given to the range of technical alternatives possible for creating small-scale irrigation facilities.

As mentioned above, the present IDB/PIU strategy gives high priority to development of low-cost, gravity-fed irrigation works (see Chapter 4). While we do not disagree with this approach, we must also note that there are regions where good soil and water resources exist, but irrigation cannot be provided using gravity systems. One important example of this situation is the rainshadow belt bordering Lake Victoria. In brief, it is difficult to envision a small-scale irrigation sector in Kenya without a significant pump component— pumps owned and operated by individual farmers as well as groups of small farmers.

Today's aversion to pump technology derives from a number of earlier difficulties with introducing irrigation pumps in the arid zones for famine relief purposes. Problems with prior programs included the installation of overly elaborate technology, the decision to work with cultivators without prior irrigation experience, the remoteness of the project locations and so on. While these experiences are not to be ignored, neither should they preclude efforts to develop sound pump introduction strategies in ecological and socioeconomic contexts that are more promising than the arid, pastoral regions previously chosen.

Currently, the IDB/PIU strategy is unduly cautious with regard to pump technology and giving insufficient attention to creating appropriate programs and strategies to encourage the greater use of pumps in selected regions.

5. The present IDB/PIU development strategy is not complemented by needed programs of research.

There are two important gaps. First, there is little research on a range of soil-plant-water and other agronomic and agricultural engineering issues. Research on irrigated agriculture and the effective agricultural use of the irrigation facilities being created is nearly missing (see Chapter 2). Although the MOALD's Scientific Research Division does have an Irrigation and Drainage Research Section, the section is staffed by only a few junior scientists and generally is without its own research agenda.

With the increase in irrigated agriculture now occurring, there will be increasing demands for irrigation-oriented research in Kenya. Farmers using irrigation and agricultural staff assisting them will be in need of research-based

information regarding appropriate irrigation-based farming systems, crop water requirements and so on.

The second major gap concerns the lack of efforts (project monitoring, applied research, basic studies) to examine past strategies and programs for the purpose of identifying successes and failures and pinpointing needed modifications and corrections (see Chapter 2). Currently, the IDB/PIU structure has little capacity to learn from what it has been doing to improve its future activities.

GUIDELINES AND RECOMMENDATIONS

The macrodevelopment problems of Kenya require attention to large issues such as rural employment, food production, and generating foreign exchange. While small-scale irrigation alone cannot solve any of these problems, it can contribute to the amelioration of all three. Presently, its contribution is modest because of the slow pace at which irrigated lands are being created or improved. Still, there is a sound underlying strategy to the work now being undertaken by the GOK as well as a basic organizational infrastructure with which to work. There are possibilities for donor assistance to small-scale irrigation development in Kenya along the following lines:

> Assistance to the existing IDB/PIU base that would enable it to grow modestly in staff size, improve program and staff quality, and develop the capacity to more effectively utilize various nongovernment partners.
>
> Assistance to important nongovernment entitites to improve their capacity to contribute to small-scale irrigation development (groups such as private users' groups, NGOs, local architectural and engineering firms, local construction firms, credit institutions, and research and training organizations.

The team believes that the best way to promote small-scale irrigation development in Kenya is through a combination of private groups and public sector agencies.

Consistent with these general guidelines, and deriving from the analysis of the present small-scale irrigation situation, the following more specific lines of action are suggested for consideration.

1. **The IDB/PIU should be assisted to develop policies, strategies, and operational procedures that would allow them to mobilize the engineering talent now found, or potentially to be located in, local architectural and engineering and construction firms.**

Such firms are significant implementors of the planning, design and construction activities of other GOK ministries such as Water Development and Public Works. This action is recommended as a means for significantly increasing the engineering manpower working on small-scale irrigation development without calling for a dramatic increase in the size of the IDB/PIU bureaucracy (see Chapter 5). These private sector firms could assume some of the functions now being performed by the IDB/PIU, such as system design or construction. But it also would require the continuation of important functions by the IDB/PIU such as

establishing design standards, supervising construction and quality control, and so on. While advocating this approach, it is also important to identify the following problems that would require solution to avoid negative outcomes:

a. Firms will require both incentives and time to develop the needed technical experience and competence to be effective in this sector. While a number of local firms have significant engineering and construction experience, few have specific experience with small irrigation works;

b. The use of private firms must not reduce or displace the role of the private users' groups in project initiation and early development. The lesson learned elsewhere is that early and continued farmer involvement is necessary if farmer groups are expected to be the responsible entities in the post-construction period. This fundamental principle cannot be violated if private firms are part of the development process just as it cannot be ignored when the PIU team is planning and implementing projects;

c. Involving private sector firms will reduce, but not eliminate, the need for a staff increase in the IDB/PIU structure. In addition, there will be a need for improvement in the support facilities and equipment available to IDB/PIU staff if they are to effectively manage this process by mobilizing, supporting, and supervising an active cadre of A&E and construction firms working in multiple sites.[7]

2. The GOK should be provided with additional funds for small-scale irrigation project implementation.

As noted previously, nearly all present MOALD funding for this sector goes to salary support for Kenyan staff and GOK obligations associated with the support of foreign technicians. In addition, some project implementation funding is now being provided through the DDCs. One approach would be to consider the provision of funds to the Rural Development Fund, designated for expenditure in support of small-scale irrigation development. This would be consistent with Kenya's present district-focus strategy, and would place planning and budgeting decisions regarding irrigation priorities close to point of implementation.

Since such additional funds in the hands of the DDCs would increase demand for technical support from the IDB/PIU staff, this action would need to be complemented by the action implied in the first suggested action. The two are highly complementary and one without the other would accomplish little.

3. The IDB/PIU, NGOs, and other appropriate groups should be assisted in strengthening their capacity to support the creation and enhancement of viable private users' groups.

One strength of the present IDB/PIU strategy is its reliance on private users' groups to operate and maintain the irrigation works. However, the present capacity of the IDB/PIU to implement this component of the strategy is limited. Some NGOs (for example, the National Christian Council of Kenya, NCCK) are also working with this issue and are reported to be developing useful approaches. There are also a few prototypical efforts joining the IDB/PIU and the Kenyan Freedom

from Hunger Council, with the latter providing input for farmer organizations' efforts. Three activities would contribute to implementing this suggested line of action:

a. Support for basic studies investigating the range of indigenous private user groups in Kenya. Some preliminary work has been done on such groups in the Kerio Valley (Ssennyonga, 1983) and in the Taita Hills (Fleuret, 1985). This work could be extended and parallel studies conducted in other regions with indigenous experience such as West Pokot, the Kajiado District, and the Mount Elgon region;

b. Support for applied studies documenting and analyzing past government and NGO experience with creating new user groups or assisting existing groups. There is a need to assess varied efforts and to draw lessons from them. Such work could have the positive effect of anticipating possible problems with the present approach and averting future difficulties;

c. Support for pilot and test models for assisting private users' groups that involve alternatives to the present IDB/PIU approach such as the use of NGOs to implement the organizational activities, the use of appropriately trained staff from another governmental organization such as community development, or IDB/PIU recruitment of trained "catalysts" to act as a bridge between the private users' groups and the entities implementing project planning, design and construction.

4. The IDB/PIU, in conjunction with appropriate private firms and NGO entities, should be assisted in designing and testing a comprehensive approach for accelerating the installation and use of irrigation pumps in selected areas with available ground or surface water supplies.

While much can be done to develop small-scale irrigation facilities based on gravity-flow systems, significant irrigation opportunities will be precluded unless effective strategies for pump irrigation can be designed and implemented. Such strategies will need to include a mix of actions by the IDB/PIU and other governmental organizations as well as private sector supply firms, credit institutions, and private farmers or private users' groups.

Implementing a comprehensive program of pump irrigation in selected areas would allow some economies of scale in investigating the nature of available water resources, in providing a significant demand for input suppliers to respond to, in planning and implementing programs for necessary farmer training, in establishing arrangements for the sale of produce, and so on. A foreign donor could play a useful role in assisting the GOK and private sector firms to plan such a strategy and provide the technical assistance and financial resources to implement the approach through an initial phase. Such an initial phase program should also include monitoring and evaluation activities to provide both in-process program modifications and establish guidelines for subsequent phases of the work.

5. The GOK and appropriate private sector entities should be assisted in planning and implementing needed research, training activities and policy discussions in support of small-scale irrigation development.

A recent ISNAR report on agricultural research in Kenya gave second highest priority to soil/water management research. The report suggests that this research should be concerned with increasing productivity and environmental security in the high and medium potential areas and for extending productive agriculture to the more marginal semi-arid and arid areas. If this is to occur, the capacity of the present modest Irrigation and Drainage Research Section of the MOALD must be strengthened. If donor assistance for agricultural research in Kenya does not now include support for this section, it should. Support should also be made available for private sector research efforts dealing with small-scale irrigation issues.

In addition to this support for the agricultural research, there is a need to support research for past program implementation experiences, both governmental and nongovernmental, and to devise improved approaches for implementing small-scale irrigation development. There is a need to increase the capacity of IDB/PIU and NGO staff implementing small-scale irrigation projects to identify such study needs, to participate in the interpretation of study results, and to translate findings into training materials and new operational guidelines and procedures. However, it is not assumed that the IDB/PIU or NGO groups would develop the capacity to conduct such studies. What is needed is effective linkages between the program implementors and experienced research groups who could effectively conduct the needed research. Much of this work could be done by collaborating with Kenyan researchers in various university settings and, in some cases, by contracting with local private firms to conduct specific studies.

Such studies would provide useful input for the development of staff training materials and would constitute a basis for informed dialogues with politicians and policy-makers regarding the potentials and requirements of small-scale irrigation development. Development of these research capacities would further strengthen the capacity of the GOK to be effectively connected with the new International Irrigation Management Institute.

Given the set of five recommendations discussed above, it might also be useful to comment on suggested locations and/or types of small-scale irrigation development to which USAID/Kenya might given priority.

As noted in recommendation 4, the team believes that at present insufficient attention is being given to the potential for pump-based, small-scale irrigation facilities. This is especially unfortunate for locations such as the lake basin area surrounding Lake Victoria, which is a region of high population density with limited possibilities for the development of gravity irrigation systems. A focus on small-scale, pump-based irrigation in this region would provide a specific setting in which USAID could work to accomplish the objectives of several of the recommendations discussed above—involvement of private sector firms, strengthening of assistance to private users' groups, and increasing the capacity of the IDB/PIU program.

Notes

[1]World Bank, Irrigation Sector Report (1982:6). For a concise overview of the large development picture and the possible employment effects of more rapid irrigation development program see Toksoz (1981).

[2]One can see the emergence of several of these approaches in Kortenhorst (1983).

[3]For another view on the slow pace of irrigation and drainage development in Kenya, see Toksoz (1981).

[4]Toksoz (1981) estimated that approximately 70 percent of the costs of irrigation development in Kenya, both large- and small-scale, was being provided by donors.

[5]While other donors are providing funds for small-scale irrigation that are channeled through the IDB/PIU structure, we emphasize the Dutch assistance because this effort is most fully integrated with "normal" IDB/PIU activities rather than taking the form of a "special project" as seems to be the case with the World Bank-funded Village Irrigation Program in the Tana River District. This project, while being implemented in Coast Province, seems to have only nominal contact with the Coast PIU.

[6]See Cynthia C. Veneracion, Beyond System Management: Irrigators' Associations in Nonirrigation Activities, Manila: Development Academy of the Philippines, 1984.

[7]It should be noted that it is reported that the MWD designs and constructs practically all of the rural water supply systems being built by the Ministry. Furthermore, it has been stated that even with this public sector involvement the MWD has been behind in its targets because it lacks the qualified technicians to manage implementation.

Chapter One

REVIEW OF PAST AND PRESENT IRRIGATION DEVELOPMENT

Leo A. Arao

INTRODUCTION

Kenya is a country approximately 583,000 km^2 in size with an estimated population of 19 million. Approximately 80 percent of the population live largely by agriculture which constitutes about 35.3 percent of the Gross National Domestic Product (GDP). Productive agriculture, however, is practiced on only 20 percent of the total land mass, the so-called high and medium potential lands with adequate and reliable rainfall. This area carries about 70 percent of the total population. At present, the per capita availability of high potential agricultural land is estimated at 0.49 hectares. Given the rapid annual population growth (estimated at 3.9 percent), the shortage of good agricultural land is bound to become more acute and will be further dramatized by periodic episodes of severe regional drought and ensuing food shortages. Irrigation is one way by which Kenya both can increase the supply of good agricultural land and intensify its use to realize increased productivity per unit of land. In the following sections, stages of irrigation development in Kenya and the various institutions involved are described.

PAST AND CURRENT IRRIGATION DEVELOPMENT ACTIVITIES

Private Sector Efforts

Private irrigation constitutes approximately 60 percent of the total irrigated land developed to date. These systems can be conveniently classified into three main categories:

1. Large-Scale Commercial Systems
   a. Slave Trade Period Systems
   b. Current Large-Scale Commercial Systems

2. Small-Scale Commercial Systems

3. Small-Scale Communal Systems

Large-Scale Slave Trade Period Commercial Systems. A long time ago, even before the arrival of the Portuguese in the East Coast of Africa, large-scale irrigated rice plantations had already been established in the coastal strip of Kenya. It is not clear who introduced the crop there, but it is thought that it may have come from China through Oman which had strong trade links with China. Alternatively, the Chinese, who had also established similar links with Malindi, may have brought rice seed directly into the area which the Arabs, using slave labor, cultivated extensively for consumption and export. There is evidence that rice was indeed a major export commodity alongside cloves (Cooper, 1981). Following the abolition of slavery and a series of successive slave rebellions, labor became scarce and rice production on irrigated land in the area declined considerably. Only a few irrigation systems remain, scattered here and there, from Vanga to Lamu. It is this long tradition of rice production on irrigated land along the coast that explains the existence of several local rice varieties which have been supplied to IRRI in the Philippines to study.

Current Large-Scale Commercial Systems. This sector comprises largely supplementary sprinkler irrigation employed mainly by transnational firms to produce high value cash crops like coffee and pineapples (e.g., pineapple canners (DelMonte) in Thika and the coffee estates in Central Province). In some areas with abundant water supplies, such as the Lake, Naivasha, Mwea, and Kibwezi areas, horticultural crops, including flowers, french beans, chilies, and some exotic

vegetables, are grown under irrigation for export. These systems range in size from several hundred to well over a thousand hectares.

Small-Scale Commercial Systems. The earliest attempts at formal small-scale commercial irrigation appear to have started during the construction of the Kenya-Uganda railway. Between 1901 and 1905, some Indian coolies who had worked on the railway were allocated about 30 hectares each in the Kibwezi-Malindu area to utilize water from local springs and rivers to produce horticultural crops to be supplied to the railway crews. Following the completion of the railway, the effort became unprofitable. Most of the Indian laborers were either repatriated or turned to retail business, and these systems were abandoned.

The current small-scale commercial systems have been established only in recent years. These range in size from 1 to 50 hectares, or slightly higher. They are either company or individually owned and are used to produce high value cash crops such as onions, french beans, tomatoes, chilies, and some exotic vegetables for export. Grapes and alfalfa are also grown by some firms in the Naivasha area. The systems are mainly sprinkler-based, but where feasible the gravity method is employed, as in the Loitokitok area in Kajiado District of Rift Valley Province.

Small-Scale Communal Systems. Historical accounts of communal irrigation in Kenya go as far back as 400 years ago. Notable among these groups are the Elgeyo-Marakwet, West Pokot, Tana Delta, and the Taita Hills systems, the so-called traditional irrigation systems. The available evidence suggests that these systems were developed not only to enable the local people to produce staple food crops in an environment in which rainfed agriculture was precarious, but also to enable watering of livestock. This is most notable in Elgeyo-Marakwet where an intricate system of irrigation furrows was developed through the joint effort of the

local communities. In the Tana Delta, on the other hand, flood irrigation is made possible when the river overflows its banks due to blocking of its flow by high incoming tides. In these systems, production of the staple crops is the main objective although small quantitites of high value vegetables such as tomatoes and onions are grown for cash income.

These systems are communal, in that they are developed by the joint efforts of the community members who have also evolved an organizational mechanism that controls the maintenance of the furrows and the distribution of water. However, they must be considered as private in the sense that each farmer owns his or her piece of land, under any of the various land tenure systems that exist, and independently plans farming activities as long as his or her actions are in line with the communally established principles. In addition, the irrigation facilities belong to the private water users.

Public Sector Irrigation

Government-assisted irrigation, so-called public irrigation, was started by colonial agriculturalists sometime in the early 1930s and has continued to be pushed since independence (1963) in the form of a successive series of programs implemented through a number of agencies. Following is a review of public irrigation since its initiation to the present.

Small-Scale Irrigation (1930s-1940s). Although not explicitly stated in any public document, in the 1930s and 1940s small-scale rice irrigation was developed to feed British troops in East Africa. Through the Chief's Act, thousands of Kenyans were mobilized to reclaim the swamplands in the coastal strip of Kenya and in Nyanza Province, then including the present Western Province. One such drainage effort was the "Agembo Canal," a 28-kilometer long canal built along the

southern edge of the Miruka Swamp in Kisumu District (Arao, 1984). By building canals of a rudimentary nature, local farmers were able to irrigate their individual plots, and records show that rice yields up to 5 tons/ha. were obtained. This and other colonial land development projects brought about 3,000 hectares of land under rice cultivation in the Kano and Nyakach locations, making it an important area of rice production in the country during the 1940s. Due to a variety of reasons, mainly technical, many of these systems have ceased to exist, leaving only a few scattered here and there where rice production still goes on despite some technical difficulties.

The African Land Development Organization Irrigation Program (1940s-1960). The ALDEV, as it was popularly known, was established in 1945 (Sessional Paper No. 8 of 1945). Its main objective was to coordinate ". . . activities of the departments responsible for land use and development in the African areas . . ." (Blundell, 1962), then dubbed Native Reserve Lands. The thrust of the ALDEV's program was soil conservation. The irrigation systems developed by the ALDEV appear to have come about as off-shoots of specific soil conservation efforts. For example, the development of limited irrigated areas for rice production in Mwea Division, Kirinyaga, as an extension of the original stock limitation and grazing control scheme, later gave birth to the famed Mwea Irrigation and Settlement Scheme (5,700 hectares). Some ALDEV irrigation systems (i.e., the Yatta Furrow) were initiated in the 1950s to provide productive employment for the Mau Mau detainees (Blundell, 1962). The following is a list of the systems developed under the ALDEV program:

Taveta Irrigation Development (1946-1961)
Ishiara Irrigation Scheme (1949-1960)
Yatta Furrow System (1953-1961)
Perkerra Irrigation Scheme (1954-1961)
Tana River Irrigation Schemes (1954-1961)

Mwanda Nyika Overhead Irrigation Scheme (1957)
Mwea Irrigation Scheme (1958-1961)
Endo Irrigation Scheme (1959-1961)
Makajini (1959)
Embobut Furrow (1960-1961)
Arror Furrow (1960)

The Colonial Administration greatly stimulated irrigation development in Kenya through its irrigation programs and thus laid the foundation for post-independence irrigation activities.

Mau Mau Period Irrigation Systems (1952-1960). In 1952, the indigenous Kikuyus, whose lands had been alienated during the 1920s to make room for British settlers, took up arms and launched the Mau Mau Resistance Movement to force the Colonial administration to return their lands. As an interim solution, the administration, using labor provided by Mau Mau detainees, built a number of irrigation schemes to settle some of the landless as tenants. The hope was that this would ameliorate the vexing political situation. The systems developed under the campaign include Perkerra (198 ha.), Mwea (1st phase - 500 ha.), and Hola (864 ha.). Under the program, the Ishiara system and some schemes in Taveta were also rehabilitated using detainee labor. Although politically motivated and controversial, the program nevertheless helped to stimulate the growth of the so-called large-scale public irrigation sector.

Arid Lands Irrigation Development. In the early sixties, the arid and semi-arid regions of Kenya experienced severe droughts which decimated about 70 percent of the livestock. Given the importance of livestock as the main source of livelihood and cash income for the inhabitants, the consequent food shortages and a severe state of destitution compelled the Kenya government, with assistance from friendly governments and some international charitable organizations, to provide famine relief as an interim solution. As a long-term solution, several small-scale

irrigation systems were developed by the Kenya government and a number of NGO's, with financial and technical assistance provided by the FAO/UNDP and various overseas-based humanitarian organizations. Churches already established in the regions also developed systems and ran them independently. A limited number of destitute families were settled in these schemes to subsist by growing staple foods as an alternative to pastoralism. The following systems were developed under this program:

Garissa District Cluster

1. Ist Farm
2. Hodan
3. Mbala Mbala
4. Sankuri
5. Umoja

Isolo District Cluster

1. Bulesa
2. Garfasa
3. Garba
4. Iresa Boru
5. Korbesa
6. Maka Dakaa
7. Merti

Tana District Cluster

1. Hewani
2. Wema

Mandera District Cluster

1. Border Post-I
2. Dimtu
3. Jandandu
4. Harere
5. Kalaliyo
6. Rhamu
7. Shantole

Turkana District Cluster

1. Amolem
2. Julut
3. Kaputir
4. Katilu
5. Loyapat
6. Turkwell

PUBLIC INSTITUTIONS INVOLVED IN IRRIGATION

The National Irrigation Board (NIB)

The NIB is a statutory board established by an Act of Parliament in 1966. Its functions as stated in the Act are

1. to conduct research and investigations into the establishment of irrigation schemes;

2. to raise funds for the development of schemes;

3. to coordinate and plan settlement;

4. to design, construct, supervise, and administer the schemes;
5. to determine the number of settlers to be accommodated in the schemes;
6. to promote the marketing of crops grown on the schemes;
7. to provide for processing of produce grown on the schemes;
8. to award bursaries or scholarships for the study of irrigation; and
9. to make regulations for the day-to-day running and administration of the schemes.

Upon its establishment, the NIB took over the operation and management of the Perkerra, Mwea, and Hola schemes built during the Mau Mau disturbances and which had been managed by the Ministry of Agriculture. Since then, the Board has initiated two schemes, Ahero Pilot Irrigation Scheme (840 ha.) and West-Kano (870 ha.), and inherited the Bunyala Scheme (213 ha.) developed by the FAO/UNDP. The Board also built Bura-West (6,700 ha.).

The Regional Development Authorities

The regional development authorities—Kerio Valley Development Authority (KUDA), the Lake Basin Development Authority (LBDA), and the Tana and Athi Rivers Authority (TARDA)—have all built or are currently building a limited number of pilot irrigation systems with a view to studying the feasibility of irrigation development in some localities in their respective regions. The KUDA has built the Sigor Scheme, of some 350 hectares. The LBDA is currently building a scheme of about 2,300 hectares in the reclaimed part of the Yala Swamp, and the TARDA has developed a scheme of 22 hectares in Kibwezi and plans to build a commercial scheme of some 13,000 hectares to be operated by private farmers, each allocated about 100 hectares of land. At this juncture it is not clear how far these regional authorities plan to be actively involved in irrigation development.

The Ministry of Water Development

The Ministry of Water Development has a small-scale irrigation section within it. The rationale for establishing the section is not clear. So far, however, it has limited its activity to acting as the "water-undertaker" for the Yatta Furrow and the Njoro Kubwa Canal in Taveta. This involves maintaining these canals for their users for a some limited fee. Apart from these activities, the section has carried out several technical studies in connection with proposed irrigation projects. Moreover, it has built a drainage canal in Taveta and taken an active part in the construction of a flood protection dike at the mouth of the Nzoia River in Western Province.

The Ministry of Energy and Regional Development

This ministry is involved in irrigation development in a limited way through the Turkana Rehabilitation Programme (TRP) attached to it. The objective is to rehabilitate the Turkana Region using funds provided by external organizations, and its activities consist of a food-for-work program. That is, it uses these funds to provide food to destitute families in the region in return for work on several projects, including irrigation. The workers maintain canals on existing irrigation systems built earlier by FAO/UNDP. Construction of water-harvesting structures also provides active employment under this program. The activities of the TRP are likely to continue only if external funds continue to be available.

The Ministry of Planning and National Development

Involvement in irrigation by this ministry appears to be limited to coordination of an ongoing program to rehabilitate about fifty furrows of the Elgeyo-Marakwet Traditional Systems. The Semi-Arid Lands Development Unit (ASAL)

attached to the Rural Development Section of the Ministry carries out this coordination through its expatriate and local technicians.

The Scientific Research Division of the Ministry of Agriculture and Livestock Development

With a view to promoting elements of scientific research in irrigation, a small section (originally called Irrigation and Drainage Research Project, currently known as Irrigation and Drainage Research Section) was established within the Scientific Research Division of the Ministry of Agriculture and Livestock Development in 1980. It conducts studies relevant to soil-plant-water relationships and salt problems. This may be done for the schemes upon request. It envisions a greater role in the study of farming systems for the schemes.

The Irrigation and Drainage Branch and its Provincial Irrigation Units: Ministry of Agriculture and Livestock Development

The Irrigation and Drainage Branch (IDB) of the Ministry of Agriculture and Livestock Development is the most important public entity charged with irrigation development in the country at present. In the following sections, the IDB's institutional framework, its irrigation strategy, and the constraints to it are discussed.

Establishment of the IDB. In 1977, a small unit, dubbed the Small-Scale Irrigation Unit (SSIU), was established within the then Land and Farm Management Division (LFMD), subsequently renamed the Land Development Division of the Ministry of Agriculture. The stated objectives of the unit were

1. to establish an institutional framework for the planning and implementation of small-holder irrigation and drainage projects with the participation of small-holder farmers outside the areas of NIB operation; and

2. to set up an irrigation policy unit to formulate a new and more aggressive irrigation policy for the whole country.

The establishment of the SSIU ushered in a new era in irrigation development in Kenya, in the sense that small-scale irrigation, which until then was only informal, was finally given official recognition as an activity worthy of support.

In 1979, the FAO/UNDP, which had been managing the systems developed earlier under the Arid Regions Irrigation Development (ARID) program, abruptly withdrew from this responsibility. The SSIU took over those responsibilities along with its original mandate and the unit was renamed the Irrigation and Drainage Branch (IDB).

Also in 1979, with a view to being more effective and efficient, decentralized and Provincial Irrigation Units (PIUs) were established. The PIUs are based at the respective provincial headquarters and are answerable to the Provincial Director of Agriculture (PDA) for administrative convenience, but are also answerable to the Land Development Division Headquarters in connection with technical matters and budgetary preparation. Given the current trend, with a bias toward the development of relatively small-scale irrigation systems, the IDB's role therefore is critical to irrigation development in general.

At the headquarters, the IDB is composed of the following components:

- The Head (Administration)
- Agronomy Section (Irrigation Agronomy Studies)
- Economics Section (Project Identification and Formulation)
- Hydraulic and Design Section (Engineering and Design)
- Training Section
- Central Registry (LDD Registry Facilities)

At the provincial level, each PIU is intended to have the following sections:

- Officer-in-Charge (Administration)
- Identification and Survey Section
- Implementation Section
- Extension and Evaluation Section

The IDB/PIU Strategy and Program. Past experience in Kenya has shown that irrigation development can be extremely costly——$5,000 to $10,000 per hectare. Moreover, experience has shown that systems conceived only from an engineering and agronomic point of view and implemented with no beneficiary participation always are regarded by the users simply as government projects, and not their own. Water users expect government to maintain these projects. As a consequence, many systems which seemed to take off successfully, rapidly collapsed. With a view to developing systems with a better chance of success, the IDB adopted a strategy with the following objectives:

1. To keep the cost of irrigation development to an absolute minimum by employing low-cost technology as much as possible and by inducing farmers to contribute toward this development by providing at least one or two days of free labor;

2. To involve the farmers in the planning and construction of "their" system in order to educate them on the function of the various structures in order to enable them to operate and maintain the system on their own afterwards, and to impart some sense of ownership and control;

3. To emphasize the organization of farmers into water users' associations able to carry out routine operation and maintenance activities. (Hence a policy to assist the schemes where the farmers are already collectively irrigating); amd

4. To limit the agency's role to technical design and construction, enabling it to move elsewhere after construction.

Faced with numerous systems which were not functioning efficiently, the IDB/PIU program has focused largely on the rehabilitation of existing systems.

Project Preparation Process: The Functions of the Various Sections within the IDB and its PIUs. An irrigation project goes through a number of stages in the course of its evolution. When the PIUs were established, their first task was to inventory all existing systems in order to note their locations and conditions, and to assess the full irrigation potential in their area of operation. Once an existing system or a potential project is identified, preliminary data are collected to give

an indication of the general character of the area with regard to agriculture, socioeconomic factors, hydrology, and topography. The Identification and Survey sections of the PIUs carry out these activities, sometimes with the assistance of the Economics, Agronomy, and Hydraulic and Design sections based at the headquarters. If and when a potential donor is identified to fund the scheme, a more detailed topographic survey is carried out and a preliminary design produced. This information is subsequently compiled as a document for application to the donor. Since the schemes are relatively small, a donor may wish to provide funds for the implementation of a number of schemes as a package (e.g., the Small Rice Rehabilitation Project at Awach, involving the rehabilitation of four schemes). The application to the donor is submitted through the MOALD to the Treasury. A series of successive bilateral negotiations follows, which may eventually culminate in the signing of an agreement between GOK and the willing donor. It takes an average of one and a half to two years from prefeasibility studies until funds are made available for project implementation.

Project Implementation. In the case of a relatively large project, the donor may insist that the project be implemented by an experienced international engineering firm identified through tender bids. Normally, such contractors come from the donor country or, in a few cases, from a third country. When a tender has been awarded, the successful contractor sends its technicians to carry out the task. This is the arrangement for implementing the Small Rice Rehabilitation Programme in Nyanza Province by NEDECO, a consortium of Dutch consulting engineering firms. In the case of smaller projects, implementation may be by a local contractor or by the PIU in charge, depending on the technical nature of the project. Non-complicated projects are now being implemented more and more directly by the PIUs. Moreover, the present practice is that even when an

international company is carrying out the implementation, the beneficiaries are required to provide an input of one or two days free labor as a contribution toward the development of "their" project. The project also may employ them for other labor required. Coordination is carried out by the Officer-in-Charge of the PIU.

SOURCES OF THE FUNDS FOR IDB AND PIU OPERATIONS

IDB and PIU operations are financed largely from external sources. The Kenya government also provides limited funds for implementation and pays the salaries of all the local staff employees. Kenya's contribution towards the development of a specific project is normally agreed upon between the government and the external donor. The following is a summary of the sources of funds for IDB and PIU irrigation programs.

The Netherlands Government

In the early years the funds for SSIU's operations were provided mainly by the Government of the Netherlands which had helped found the unit. Dutch technicians manned all the technical units within the SSIU and the PIUs. Expatriate personnel at the headquarters then consisted of a team leader, an agro-economist, a civil engineer, a water management engineer, and an irrigation agronomist, each of whom had a local counterpart. In the course of time, Training, Logistics, and Coordination sections were established. Each PIU had a Dutch engineer——the so-called Provincial Engineer, an adviser to the Officer-in-Charge. The Dutch program, which is known as the Small-Scale Irrigation Project (SSIDP), is currently in its third phase (1983-86). At the end of phase two (1981-83), the expatriate posts of agronomist, water management engineer, agro-economist, and program coordinator were turned over to local professionals in these disciplines.

The European Economic Community (EEC)

A number of irrigation schemes have been rehabilitated With EEC assistance. The EEC classifies its projects into two categories: micro projects—relatively smaller, low cost projects (i.e., the Isiolo Cluster of Schemes in Isiolo District) —and macro projects costing over KShs. 50 million* (i.e., the Small Rice Irrigation Project at Awach in Kisumu District). It should be noted that the EEC only provides the necessary funds.

The World Bank

The Village Irrigation Project (VIP) is being developed largely with World Bank funds, most of which were used for the purchase of earth-moving machinery and for the construction of the infrastructural facilities (i.e., staff housing, offices, a workshop and so forth). The Dutch government supplied the technicians and also contributed toward maintenance of the machinery. In total, the project cost about KShs. 40 million, against only approximately 164 hectares of irrigated land developed to date.

The Norwegian Agency for International Development and Danish Agency for International Development

These two agencies finance irrigation development in Turkana and Garissa districts, respectively. NORAD has been involved in irrigation since the seventies. DANIDA has only recently gone to Garissa District to rehabilitate a number of existing schemes. The project still is termed 'Pilot Irrigation,' and has a budget of only KShs. 8 million. Belgium, Italy, and Japan are other countries currently contemplating involvement in irrigation development.

Overseas-Based Nongovernment Organizations (NGOs)

A number of overseas-based charitable organizations assist by providing funds through their local counterparts such as the Freedom from Hunger Council for National Development and the National Christian Council of Kenya (NCCK) which, in turn, channel these funds to irrigation projects. The funds obtained helped a great deal in the development of the earlier ARID program schemes for which FAO/UNDP provided the technical personnel to implement the projects. The NGOs include a number of Kenyan churches which also depend on overseas sources to fund their projects. Technical design and construction of NGO systems is currently done by PIUs and/or the respective regional authorities.

Volunteer Organizations

Technical assistance to PIUs comes also from some international volunteer organizations (i.e., the U.S. Peace Corps, Japan, and the Netherlands volunteer organizations). The volunteers are attached to the PIUs to assist mainly with extension work. Japan supplies mainly civil engineers, surveyors, and rice agronomists.

The Kenya Government

The Kenya government's contribution toward actual irrigation development has hitherto been modest. This is understandable in that the government, with its limited resources, cannot adequately provide for the development of sectors for which it already bears a heavy burden in meeting recurrent expenditures.

It should be noted that the GOK is responsible for the personal emoluments of all the local staff who support the IDB and its PIUs in various capacities. It also provides the cost of housing for expatriate staff. The Kenya government, moreover, contributes to irrigation by making funds available through the District

*In late 1985 the exchange rate was approximately US $1 = 16 KShs.

Development Committees (DDCs) which in turn distribute the funds to specific projects within the district, according to need.

THE CONSTRAINTS TO THE IDB AND PIU's EFFORTS

The achievements of the IDB to date suggest that the branch is still handicapped in a number of ways. It has developed only about 2,000 hectares of irrigated land since it was established in 1977. Although the constraints to the IDB's efforts are complex, some of its notable problems appear to be

1. Haphazard programs due to lack of a clear national irrigation policy that sets out a well-defined course of action. Many IDB projects are selected not on the basis of economic and technical feasibility but rather due to political factors;

2. Lack of manpower with sound experience in irrigation, notably engineers who can design and supervise construction of a workable irrigation system;

3. lack of comprehension of appropriate approaches to this development (i.e., implementation of projects on the basis of assumed feelings and wants of the farmers);

4. Inadequate social science input help develop the organizational capacity of the farmers with a view to creating effective water users' associations which are capable of managing and maintaining their own systems, so as to make them economically and socially viable enterprises. Experience shows that this is the common cause of the inefficiency and failure of many government-promoted small-scale systems;

5. Administrative and logistical shortcomings due to the location of many schemes in remote regions with poor transport and communication services;

6. Lack of research and follow-up of operational projects to collect the relevant data on past experiences to be analyzed and used as a basis for future planning of systems which have better chances of success;

7. Too much dependence on external sources of finance which take nearly two years before being made available due to elaborate bilateral discussions between GOK and the donors;

8. Badly organized training of the senior and junior staff;

9. High turnover of experienced staff due to unattractive terms of service. Many qualified technical staff leave for the private sector where career prospects are more promising.

CONCLUSION

Kenya has a relatively long experience with irrigation which constitutes a strong foundation for further irrigation development. Yet this reality has been repeatedly denied in the irrigation literature, foreign observers in particular suggest that lack of an irrigation tradition is a major constraint in Kenya's irrigation efforts. No doubt, major setbacks have been experienced in the course of this undertaking. But if the causes were carefully investigated and analyzed objectively, the conclusion that would be reached is that the lack of clear national policy and a tendency to ignore the role of the social sciences in irrigation appear to be the major handicaps to orderly and timely irrigation development. If these constraints are overcome, Kenya can successfully develop its irrigation potential, estimated by some to be approximately 540,000 hectares, within the next thirty years, so as to be able to fulfill her broad objective to be self-sufficient in food production.

Chapter Two

ECONOMIC ASPECTS OF SMALL-SCALE IRRIGATION DEVELOPMENT

Richard J. McConnen

SMALL-SCALE IRRIGATION AND THE POLITICAL ECONOMY OF KENYA

One of Kenya's major economic and development challenges is to provide more jobs for its rapidly growing population and its even more rapidly growing labor force. The USAID FY 1986 Kenya Country Development Strategy Statement (CDSS) states that Kenya's 1982 population of 18.1 million will double by the year 2000 and the labor force is projected to increase from 6.4 million in 1980 to 14.5 or 14.6 million by the year 2000. While both the manufacturing and service sectors will provide some badly needed new jobs, the required investment per job restricts the ability of the manufacturing sector to provide new jobs, and the number of jobs that will be provided by the service sector will depend on consumer income which in turn will depend on the jobs generated in the nonservice sectors. The restrictions placed on government expenditures by both economic realities and by external agencies such as the IMF seriously limit the number of new jobs that can be provided by the public sector. Most of the new jobs which need to be created in Kenya will have to be generated by the private sector. Kenya's private sector is largely agricultural and many of the jobs needed to match Kenya's growing labor force will have to be provided by agriculture.

Both the 1983 World Bank Report on Kenya and Diana Hunt's The Impending Crisis in Kenya (1985) point out that agriculture can only provide added jobs if there is an intensification of agricultural production in terms of both the level of output and the labor used in that production. The 1983 World Bank Report on Kenya lays stress on the importance of the selective division of existing large-scale

farms as a means of bringing about this type of intensification. One additional method of intensifying agriculture is to expand the land irrigated in those areas where either the amount or the variability of available moisture now limits the intensification of agricultural development. In the case of subsistence farmers —who tend to be very risk averse—irrigation development may be necessary if agricultural intensification is to take place. In discussing the farmer adoption of high yield rice varieties in Asia, Barker et al. (1985:97) state,

> Areas that were already well irrigated were the first to benefit from the spread of the new improved rice varieties. Risks associated with rainfed rice discouraged cash expenditures for chemical fertilizer. Thus, in most cases, access to irrigation has become a precondition for the use of modern inputs. Even today, rainfed areas of Asia have largely been bypassed by the benefits of modern technology.

While rice is particularly sensitive to moisture stress, the same general principle relating to soil moisture is relevant for most attempts to intensify agricultural production.

Variability of Food Production

One of the standard reasons for irrigation development is to provide a form of drought relief for rainfed agriculture. The two basic types of drought (or moisture stress) are (1) short-term drought caused by delayed rainfall during an interval when the crops are susceptible to moisture stress and (2) long-term drought which is characterized by a reduction of the total moisture available during a cropping season to a level significantly lower than the normal moisture which serves as the basis for the prevailing farming system. The long-term drought may last for more than one cropping season.

To provide relief from short-term drought, the irrigation system need only be capable of providing replacement for the delayed rainfall. Such a system may also be used as a basis for providing more water than that provided by normal rainfall.

The principal purpose of the traditional community-managed systems in the Kerio Valley appears to be short-term drought relief. The area is isolated and food production in excess of subsistence needs seems to have little or no perceived value. Thus, it was reported that during years with high rainfall and high levels of production from rainfed agriculture, the irrigation schemes would not be used. Since there are no man-made storage facilities as part of the Kerio schemes, they provide relief from long-term drought only to the extent that stream flows reflect delayed flows from the watershed. It was reported that there have been drought years when little or no irrigation was possible in the Kerio Valley and near total irrigated crop failure resulted.

Long-term drought relief can be provided by irrigation only to the extent that water can be stored from one cropping season to the next. In the case of most surface streams, there is some natural storage from either one cropping season to the next or at least from the early part of the cropping season to a later part of that season. It is likely that most small-scale irrigation systems in Kenya can at best provide short-term and perhaps intermediate-term drought relief. Except for some ground water schemes, it is not likely that small-scale irrigation schemes in Kenya can provide a great deal of long-term drought relief.

However, on closer evaluation, there may be exceptions to this. For example, some of the large springs on the slopes of Mt. Kilimanjaro, such as the spring used as a water source for the Njukini scheme, could provide long-term drought relief. Provision of long-term drought relief by irrigation is an important potential benefit, particularly in Africa, but the team was not able to give adequate attention to this matter. Greater attention would need to be given to this issue before designing an intervention program with the objective of long-term drought relief.

Foreign Exchange: Export Crops and Import Substitution

Agriculture provides about 44 percent of the value of Kenya's exports. While the outlook for the market for agricultural exports is generally not encouraging in the immediate future, the long-term outlook is more promising. In any case, it is likely that Kenya will have to continue to place heavy reliance on agricultural exports as a means of generating foreign exchange. These international markets will probably become even more competitive than they are today. While prices will be an important determinant of Kenya's ability to compete in such markets, the capacity to control the quantity, quality, and timing of production are, and will continue to be, important determinants. Irrigated agriculture can contribute to Kenya's competitiveness in such a market. Once again, the Njukini scheme represents just one example of these principles at work in present day Kenya.

Perhaps much more important is the food sufficiency problem which will be faced by Kenya as the result of population growth. In order to maintain the 1978-80 self-sufficiency ratio of 96 percent, agricultural production would have to double between 1980 and 2000. This would mean that agricultural production would have to increase by about 3.5 percent per year. Between 1972 and 1977, the estimated average increase in agricultural production was about 2 percent. If the income effects for Kenya's growing middle class were taken into account, the required increase in agricultural production would be even greater. With a higher level of base production required for the future, the impact of droughts on rainfed agriculture will be more severe than in the past in terms of food relief requirements. An alternative to increased domestic food production is, of course, food imports. It is for this reason that irrigation development, which can contribute towards both higher-level and, if properly developed, a more drought-tolerant domestic food production, should be viewed as a means of providing import substitutes.

Rural Income Levels and Regional Economic Development

Irrigation development which results in more intensive farming systems will result in increased rural income. While the impact on rural per capita income will of course depend on comparative changes in rural population, conditions in rural Kenya are such that increases in both employment and per capita rural income will result if additional successful small-scale, community-managed irrigation schemes are developed. The impact on rural incomes depends not just on irrigation development, but also on what happens to agribusiness development. Good irrigation provides the means for farmers to exert much more control over the quantity, quality, and timing of agricultural production. This, in turn, provides the basis for building both processing industries and markets for fresh agricultural products which can serve modern urban areas. While agribusiness development depends on many factors in addition to the agricultural production base, irrigation development can provide one of the necessary conditions that must be met if agricultural processing and fresh produce businesses are to be developed. In the case of the Njukini scheme near Taveta, production for the export market would not be possible without the control over quantity, quality, and timing of production which was made possible by irrigation.

Depending upon the availability of adequate water, suitable land, and farmers capable of managing farming systems based on irrigation, irrigation development can be the basis for regional development. The goals of such regional development may be either to contribute to the general economic development of the country or bring about the development of a particular region of a country for social and political reasons. There are many places throughout the developing world where irrigation has been a key component of successful regional development programs. The usefulness of irrigation development for this purpose in Kenya depends on the goals of the Kenya government.

Implications for Special Groups: Gender and Clan/Tribe Issues

It appears that the Kenyan government has developed a concern for special groups such as rural women and particular clans and tribes. The Nyandusi scheme in Nyanza Province is an example of the successful use of irrigation to help a women's group participate in the development process. In the minds of the Nyandusi participants, the principal success of the scheme was reflected in its ability to generate cash income although the added food produced for domestic use was welcomed. When asked, the participants stated that the two major benefits were (1) fewer fights with their husbands because they didn't need to continually pester their husbands for money for things like school fees and (2) healthier children because they could afford to buy more high protein foods such as eggs. Several other groups of women in the same area are presently in the process of working with NGOs to develop schemes similar to the Nyandusi scheme.

The success of such schemes depends on many factors, particularly the organizational skills of the women's group, but irrigation once again plays an important role in terms of providing the basis for such development. The same general situation applies with regard to tribes and/or clans. For example, the schemes in the Kerio Valley, used by the Marakwet and the Pokot peoples, appear at present to be used principally as a means of producing subsistence food needs. If the road system was improved so that these peoples had better access to markets, the existing irrigation schemes would probably be used more intensively. In this particular case, irrigation would provide the Marakwet and Pokot with an opportunity to improve their economic status. Whether or not they would take advantage of this opportunity is open to question. It is this question which would need to be carefully considered before any significant investment in new irrigation developments would be made for such purposes. This is a particularly important issue given the widespread failure of irrigation schemes where success depended on

tribal people changing their basic life style. As long as constraints are recognized, there are situations in Kenya where irrigation development can be a means of contributing towards the accomplishment of development objectives established for rural women and certain tribes and clans.

Potential for Increased Production

The purpose of this section is to present a procedure for developing quantitative estimates of the potential impact of the development of community-managed, small-scale irrigation schemes on Kenya's food security/sufficiency status. While the FAO estimated that Kenya's food self-sufficiency ratio for the 1978-80 period was 96 percent (Moris and Thom, 1985), the average index of food production per capita fell to 86 for 1981-83 (1974-76=100; Table 6, World Development Report, 1985). While Kenya's agriculture has done a relatively good job of feeding the population, there is a basis for concern about the future because of Kenya's rapidly growing population, limitations on the availability of additional arable land, and the slow-down in the rate of increase of yield per hectare. One possible means of contribution toward an increase in food production is to increase the area of irrigated land.

There are different estimates of the area of land presently irrigated in Kenya and significantly different estimates about the area which is potentially irrigable. One estimate places presently irrigated land in Kenya at 34,000 hectares with approximately 23,000 hectares of high value crops such as coffee and pineapples and 10,000 hectares of irrigated land in resettlement projects operated by the National Irrigation Board (Toksoz, 1981). In Kenya: Growth and Structural Change (Table 10, p.337) the area in irrigation schemes is reported at 8,728 hectares. Moris and Thom cite a recent FAO estimate of 49,000 irrigated hectares with

21,000 hectares in modern schemes and 28,000 hectares in traditional or small-scale schemes (1985:3).

The potentially irrigable land has been estimated to be 350,000 hectares by the FAO, but figures as high as 600,000 hectares have been reported. The Kenyan Ministry of Agriculture and Livestock Development has used a figure of 200,000 hectares as a target for future development of irrigated land. Moris and Thom (1985) point out that in most countries, the estimate of the area of potentially irrigable land increases as that country gains more experience in irrigation development. It seems reasonable to use the FAO estimates as working figures and to conclude that no more than 14 percent of the 350,000 hectares of the potentially irrigable lands are now irrigated.

The implication of this conclusion is that from a technical and resource standpoint, the potential for further irrigation development in Kenya is considerable. Comparison of this potential with the best estimate of the current rate of development of new irrigation schemes strongly suggests that the amount of irrigated area in Kenya will not be limited in the immediate future by the availability of irrigable land, but rather by (1) the perception of decision makers in both the private and public sectors about the desirability of expanding the area of irrigated land in Kenya, and (2) the availability of the capital and the technical and managerial capacity to develop more irrigated land.

The current rate of development of land in new schemes with some government involvement has averaged about 150 hectares per year. On the other hand, the team visited one scheme which so far had had no government help and which had developed 121 hectares (300 acres) over a period of five years. Development of irrigated land in Kenya currently averages between 200 and 400 hectares per year. However, a high proportion of projects visited by the team entailed the replacement of previously existing diversion structures which had

ceased to function. Development of irrigated lands net of those projects involving the replacement of old structures may be no greater than 100 hectares per year. Even if the net new development is two to three times this level of magnitude, two implications must be considered: (1) the annual level of development may be so low that the assumption of the existence of a learning curve with regard to irrigation development that will lead to an increase in the rate of net new development (discussed below) may need to be reconsidered, and (2) the current rate of development is so low that if such a rate continues, even by the year 2000, irrigation will have no significant impact on either the amount of food produced or the number of jobs provided by Kenya's agriculture. Implied in this discussion of the rate of development of new irrigated land is the current problem of maintaining existing irrigation schemes.

Irrigation development can increase productivity in four ways: (1) the area of cropland can be increased, (2) the cropping intensity can be increased—generally by permitting either additional or more intensive crop production during the dry season, (3) the yield of existing crops can be increased, or (4) a shift to the production of more valuable crops can occur. Because of the projections for the increased supply of labor and the increased demand for food, as well as the availability of irrigation water and suitable land, it is highly likely that there will be some increase in production from irrigated land in Kenya in the future even if no public irrigation intervention program is developed. However, unless a program is developed, the considerable potential of irrigation to contribute to achieving Kenya's development goals will not be realized.

Hypothetical Rates of Irrigation Development

Since irrigation development involves a learning process and assuming there will be a tendency to develop the most suitable irrigation schemes first, the basic

form of the nonintervention time pattern of development is indicated by the solid line in Figure 1.

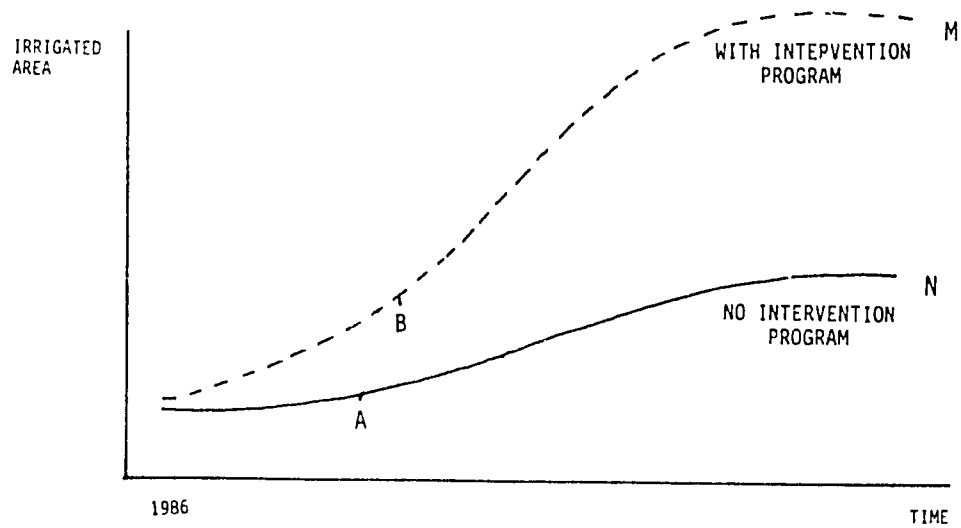

Figure 1: Intervention and Nonintervention Strategies of Irrigation Development.

As experience is gained in irrigation development, both (1) the perception of the value of irrigation development and (2) the capacity to develop new and improved existing irrigation schemes will increase, first slowly and then more rapidly (e.g., after Point A on the nonintervention learning curve). This increase in the rate of irrigation development reflects the learning which can be expected to take place as the result of farmers and government gaining experience with irrigation development. This cumulative experience is a function of taking advantage of the interaction between the increased demand for food and jobs and the availability of suitable land and water resources. The rate of irrigation development can be expected to increase until the potential sites for new irrigation developments become less desirable and finally development will slow down and eventually stop at a level indicated by N. If irrigation development efforts are met with failure because of bad design, poor implementation and ineffective organization, the learning curve may be essentially flat. There is a danger that this

situation could come to pass in Kenya unless the current rate of irrigation development increases.

An appropriate irrigation intervention program would result in a time pattern of development indicated by the dotted line in Figure 1. If such an intervention program is appropriate, the time pattern of development will have two characteristics which will distinguish it from the nonintervention time pattern. First, learning will take place more quickly and a higher rate of development will occur earlier in the development process and a higher level of development will be reached at each point in time. Second, the resources can be used more efficiently, and that the upper level of development (indicated by M) will be higher than the level N which would occur with nonintervention.

Figure 1 presents the general conceptual nature of irrigation development in Kenya. Given the forces at work in Kenya, some irrigation development will undoubtedly take place without an appropriate intervention program; the present irrigation program will probably result in an increase from the estimated 49,000 hectares presently irrigated to less than 60,000 hectares irrigated by the year 2000. Even this modest level of development (60,000 hectares) would require that the current rate of net new development increase by nearly five times. The purpose of an intervention program would be to bring irrigation development about more rapidly and to increase the likely upper level of development.

The MOALD has established a goal of 200,000 hectares of irrigated land by the year 2000, but it is unlikely that such a goal can be achieved. One of the principal purposes of developing an appropriate irrigation intervention program would be to (1) establish a realizable goal for irrigation development and (2) specify alternative combinations of resources and conditions required to realize such a goal.

INTERVENTION: FINDING THE APPROPRIATE COMBINATION OF PRIVATE AND PUBLIC SECTOR INVOLVEMENT

Both Kenya's Fifth Development Plan and the AID program have the goal of promoting greater private sector involvement in the economic development process and the approach to small-scale irrigation development advocated herein is consistent with that general goal. Small-scale systems as used in this report refers to "community irrigation systems" as opposed to "agency-operated systems." However, if a private sector small-scale irrigation development program is to be successful, a limited and appropriate public sector involvement is usually required. A large public sector involvement will almost always mean that the system will tend to become "agency-operated"; this usually means either the failure of a small-scale irrigation scheme or operation at levels far below the scheme's potential.

A key to the success of a small-scale irrigation program is to find the appropriate combination of private and public sector involvement: a combination in which the public sector involvement will encourage rather than frustrate private involvement. When small farms are involved, as is largely the case in Kenya and much of the developing world, the ability of farmers to form effective private water user groups is also crucial. The purpose of this section is to outline the basic principles that must be considered in structuring the appropriate combination of private and public involvement for a particular site. No attempt will be made to discuss these principles in detail, as they are generally well-known, but an effort will be made to use examples related to small-scale irrigation in Kenya to illustrate the principles.

Technical and Institutional Change

Hayami and Ruttan state, "Institutions are the rules of a society or of organizations that facilitate coordination among people by helping them form

expectations which each person can reasonably hold in dealing with others" (1985:94). They argue that the demand for new rules (or institutional change) can be generated by changes in the technical and economic conditions faced by the society or organization. Many of the examples they use to illustrate this relationship involve irrigation. The desired response is appropriate changes in rules for operations in the private sector, often in the form of redefined property rights which will ". . . promote more efficient resource allocation through the market" (1985:97). In discussing the role of nonmarket institutions in promoting effective market systems, they state,

> institutional changes . . . have contributed to the development of a more efficient market system. Institutional changes of this type are profitable for society only if the costs involved in the assignment and protection of rights are smaller than the gains from resource allocation. If the costs are very high, it may be necessary to design nonmarket institutions in order to achieve more efficient resource allocation (1985:103).

In the case of small-scale irrigation schemes, private sector nonmarket institutional changes will often involve private water user groups. Hayami and Ruttan point out that,

> Group action to supply public goods . . . may work effectively if the size of the group involved is small, . . . If a large number of people are involved in the use of a public good, . . . it is more difficult to regulate their resource use or to prevent free riders by means of voluntary agreements. Action by a higher authority with coercive powers, such as government, may be required to limit free riding (1985:104).
>
> The supply of major institutional innovations involves the mobilization of substantial political resources by political entrepreneurs and innovators—— institutional innovation depends critically on the power structure of balance among vested interest groups in a society (1985:107).

Hayami and Ruttan point out that both the type of institution and technology developed will influence the way in which agricultural resources are used.

> For a new technology to be an effective instrument for agricultural development it must be consistent with changes in the conditions of factor supply and product demand in the economy. In view of strong population pressure on land, as discussed earlier, it

is vitally important, in consideration of both efficency and equity, to develop agricultural technology that is biased toward saving land and using labor or at least is neutral with respect to the use of labor. From available evidence in the LDCs as well as the historical experience of Japan, Taiwan, and Korea, it appears that the new seed-fertilizer technology is biased in land-saving and fertilizer-using and is more or less neutral in scale and in the use of labor.

Yet it appears that credit, extension, and related rural institutions have often been biased with respect to scale in many countries and have directed the new technology toward a labor-saving pattern of economic organization in rural areas. In the absence of adequate institutions to facilitate cooperation among small farmers, irrigation which is vital to the introduction of new technology, has been controlled by larger scale farmers who could install their own tube wells. The larger farmers have had better access to new knowledge and low interest loans from cooperative or government credit agencies. These advantages have lowered the cost of capital investment and encouraged mechanization. The small farmers, however, have often been subject to severe capital rationing.

In contrast, traditional village communes in Japan (and the pao-cha system in Taiwan) were effective means of diffusing new knowledge and of mobilizing communal labor for the construction of irrigation facilities and small waterways and reservoirs and the building of other forms of social capital such as roads and schools. The village communal system provided the basis for the development of water-use and marketing cooperatives and for agricultural associations that promoted extension services through the national prefectual-local networks.

If new agricultural technology is to be guided in a land-saving and labor-using direction, new institutions have to be developed or existing institutions reformed to reverse the institutional bias in favor of larger farms and toward the substitution of capital for labor. The institutional innovations should in turn be complemented by research to generate technical changes, which raise the returns to institutional change at the community level (1985:426-427).

Agribusiness Linkages: Input Suppliers and Marketing Channels

Irrigation and Input Suppliers. If irrigation permits the use of more intensive farming systems, there will be a considerable impact on agricultural supply businesses. First of all, intensification is not likely to be successful unless it is supported by an infrastructure which can supply those inputs—fertilizer, diesel

fuel, insecticides, etc.—required by such a system. Second, the derived demand for inputs can serve as the basis for developing viable agribusinesses in the private sector. The farm implement businesses which have developed around Nakura are an example of the impact of such a derived demand. In addition to the added demand for general agricultural inputs generated by irrigation development, there is a derived demand for specialized inputs. An example would be the demand generated by irrigation schemes based on groundwater for pumps, pump services, well drilling rigs, etc. Based on interviews with a limited number of firms, it is clear that the private sector in Kenya is capable of satisfying the demand for such inputs, but special efforts by the government would have to be made to decrease the hurdles faced by such businesses in the form of difficulties and uncertainties associated with import licenses for replacement parts, etc.

While credit is available from several sources for irrigation development, there are some special problems. During an interview, the manager of a large lending organization in Kenya was asked what would have to take place if his organization were to have more successful loan applications from the private sector for irrigation development. He said his organization would need (1) a source of sound advice on the technical aspects of the proposed development including water availability, equipment specification, water needs, etc.; (2) a reliable supply of equipment such as pumps and spare parts so that a well-designed irrigation scheme could be operated on a sustained basis; (3) expert agro-economic assistance to determine if the scheme would be viable over a period of time with regard to markets and its continued ability to sustain production; and (4) more reliable data about the expected yield response from irrigation. (The manager added, "Of course, this is a general problem in Kenya. Too much of the data is subjective.")

The manager believed that his organization had enough technical skill to do the required feasibility studies, but the team had no evidence that the people who

would do such studies had a full understanding of the subject matter——a requirement that must be satisfied if good judgment calls are to be made on loan applications. While it was apparent that such organizations did have funds which could be loaned for private sector irrigation development, it appeared that loan officers did not feel that they had the confidence needed to make such loans. When this occurs, it may mean either that the loan applications are not a good risk and the loan should not be made or that the loan officers do not have the knowledge needed to help the applicant to develop a better proposal or enough confidence in their appraisal of the application to recommend that a loan be made.

Irrigation and Markets. As mentioned earlier, it appears that added production from irrigation in the Kerio Valley is perceived to be of little value once subsistence food requirements are met. This is only an extreme case of an issue faced by all irrigation schemes; it is not enough to produce more, it is necessary for the added production to have value. Therefore, the marketing of output from irrigation schemes is of crucial importance. The Njukini scheme, near Taveta ——which was mentioned earlier——is apparently a very successful scheme. There can be little doubt that one of the important reasons for success, along with a reliable source of adequate water, hard-working farmers, and good soil, was the fact that the farmers on the scheme were able to establish a market contact that gave them access to a high value export market. If the farmers on the Njukini scheme had perceived that the market for their production was no better than that which existed for the Kerio Valley, it is highly unlikely that the Njukini scheme would have ever been developed any more intensively than the schemes which were observed in the Kerio Valley. The team also visited what appeared to be a very successful pump scheme called Ugambe on the shore of Lake Victoria (discussed in detail in Chapter 3). The scheme was operated by a women's group which produced

and marketed vegetables. The group successfully bid on tenders for fresh vegetables from schools, hospitals, and prisons. While the production systems and the operation and maintenance of the scheme were well done, it appears that the successful marketing program contributed a great deal to the success of the scheme. Once again, marketing played a key role in the success of an irrigation scheme.

The markets which farmers perceive to be available for their output depends on both the actual markets which are available—or can be made available—and the knowledge farmers have of these markets. If an irrigation system is to be successful in more than directly meeting the subsistence needs of the farmers operating the system, a market must exist for the added production resulting from irrigation. However, the ability to sell the production is not enough. Prices must be high enough to cover the added costs due to irrigation and to provide an adequate profit to the farmers. This fact is generally well understood, but those encouraging the development of new irrigation schemes must resist the temptation merely to project whatever type of market is necessary to demonstrate the financial viability of a new irrigation scheme. Dependence on a high value market, which may either be ephemeral or nonexistent, can lead to the failure of a new irrigation scheme as surely as bad technical design, bad project implementation, or bad operation and maintenance. As demonstrated by the examples of Njukini and Ugambe discussed above, the development of a good marketing program can also be the basis for the success of new irrigation schemes. There is a clear danger, however, in depending on relatively "thin" markets such as those used by the Njukini and Ugambe schemes as the basis for justifying a large number of new schemes. <u>If a significant portion of the potentially irrigable area in Kenya is to be developed, most of that development must be justified on the basis of the production of basic food crops.</u>

Guiding the "Invisible Hand": Requirements For An Effective Private Sector Involvement

If the private sector is to allocate resources efficiently—that is, there is no other way to use resources so as to make society better off—certain conditions must exist. Five of the conditions often cited are discussed below.

1) **Well-Informed Decision Makers.** Producers and consumers have a difficult time acting in their own interest (however they perceive those interests) unless they can estimate how alternative courses of action will influence their well-being. In the case of small-scale irrigation, decision makers must be well enough informed about alternative likely future chains of events so that they can perceive how small-scale irrigation can help them to achieve their goals for the future. Except for a few innovators, farmers form their perceptions of technologies by observing concrete examples of successful adoptions. Bureaucrats, in deciding what constraints to either impose on or remove from the private sector face the same dilemma. The ability of the private sector to contribute to the development of small-scale irrigation in Kenya would be greatly enhanced if more decision makers were better informed with regard to the potential of small-scale irrigation alternatives. Decision makers cannot form realistic perceptions of alternative futures which can serve as the basis for decisions and commitments unless they are better informed than most appear to be today.

2) **The Role of Property Rights.** In order for the marketplace to achieve efficient allocation of resources, decision makers must be assured that the agreements they reach with other parties can be enforced with a reasonable degree of certainty and at a reasonable cost. The marketplace cannot generate an efficient allocation of resources unless there is a well-defined system of property

rights. Throughout the world, successful irrigation development has required either de facto or de jure rights to use water resources. This is necessary not only to insure that the irrigator can recover any capital investment that has been made, but also to make the farmer feel certain enough about future water availability to be willing to shift to a more intensive farming system.

Kenya apparently has a legal basis for establishing water rights, but the team was not able to gain full understanding of the nature and operation of the property rights attached to water. Individual water users and private water user groups need to have their rights to use water clearly defined. Such rights need to provide protection from infringements, not only by other individuals, but also by the government itself. In order to capture the full potential of the water resources of a country when the supply of water is scarce relative to potential demand, water rights have to be as well-defined and enforced as property rights to land.

3) **Freedom of Entry—and the Exit of Inefficient Producers.** The marketplace cannot guarantee efficient resource allocation unless it is reasonably easy for new entrepreneurs to enter the marketplace. The principal purpose of this criterion is to prevent the development of monopoly power which will lead to the inefficient use of resources. In the case of small-scale irrigation, the principal purpose of this criterion is to ensure the efficient use of irrigation resources. Efficient resource use also requires that inefficient farmers must have an incentive to transfer their resources to potentially more efficient farmers. This, of course, argues for the need for well-defined property rights for both land and water and the ability to transfer those property rights to new owners.

4) **Lack of Monopoly Power—"A Nation of Shopkeepers."** The purpose for restricting monopoly power is to eliminate any price setting power and to make

certain that prices are established by the conditions of supply and demand. In the case of small-scale irrigation, its significance is more limited and lies in denying government the ability to set charges where private user groups have no recourse but to pay such charges. For example, in the case of the Mwea scheme, tenants are charged KShs. 2,200 per acre to cover the costs of operating the system. While imposing such charges may be justified on both a financial and an economic basis, the government will have no incentive to keep costs as low as possible unless such costs are subject to negotiations. One of the important functions of private user organizations is to deny agencies the unlimited use of the power to set prices when the level of user fees is established. If as many O&M functions as possible become the responsibility of private user groups, there will be a built-in incentive for users to keep those O&M costs as low as possible while still maintaining an effective irrigation system. The same is usually not true when irrigation schemes are "agency operated."

5) **Risk and Uncertainty**. Most farmers, and particularly small farmers, are risk averse. If the level of risk and uncertainty is high, the marketplace will often not yield an efficient allocation of resources. The most commonly discussed source of risk and uncertainty for agriculture is nature. In some settings, irrigation can be a means of decreasing such risk and uncertainty. Risk averse behavior is particularly important when shifts from extensive to intensive farming systems are contemplated because there is a larger potential for loss based on the greater level of inputs called for by most intensive farming systems. If farmers perceive the risk and uncertainty they face as excessive, an efficient allocation of resources will not take place.

Market Failure

All of the above conditions can be satisfied and we may still experience a "market failure"—that is, resources could be used in some other way and society would be better off. In most cases, the impact of market failure can be minimized by establishing an adequate system of property rights, by considering equity issues when deciding who will have access to resources and in some cases by imposing appropriate nonmarket regulations on the use of some resources. The two most commonly discussed reasons for market failure are the existence of (1) public goods and (2) externalities.

1) Public Goods. Public goods exist when a condition of "non-excludability" exists. That is, a person cannot be excluded from using the goods even if that individual refuses to pay for the use of the goods. The classic example of such a public good is national defense. More relevant examples for the discussion at hand are agricultural research in the United States and cloud-seeding to increase rainfall. From the standpoint of the well-being of society, private firms will invest too little in public goods because they cannot capture all the benefits generated by their investments. (This is obviously related to the issue of property rights.)

Private water user groups must have the power to exclude potential users from a scheme unless those users pay the necessary user fees. Kenya laws and customs seem to be able to deal with problems which might exist with water as a public good within a particular irrigation scheme. It is less certain that Kenya laws and customs can deal with the public goods character of the water resources found within either an entire river system or a common groundwater acquifer.

2) Externalities. Externalities are often given as one of the major reasons why pollution occurs. The polluter does not bear the full cost of pollution, and he

tends to produce more pollution than is optimum for society. Resources will be more efficiently allocated if the costs of pollution are "internalized" within the decision making process. There can be significant externalities in the development of common groundwater aquifers, and a marketplace approach to development may result in too many wells being developed and too much water being pumped. This can occur because the pumping of "well A" can result in a drawdown of "well B," but the operator of "well A" does not consider the increased costs to operate "well B" when he decides how much water to pump. In such cases, some nonmarket regulation of either well spacing or pumping schedules is usually necessary to achieve the efficient use of resources. In Kenya, externalities will probably exist in some cases involving groundwater development and can also exist in the case of surface water unless property rights in connection with surface water are defined.

Government Failure

When market failure occurs, the common response has been to turn to government. The literature on public choice points out why government action is often unlikely to result in an efficient allocation of resources—efficient in the sense that no other allocation of resources would make society better off. Three commonly cited principles which seem relevant to small-scale irrigation development in Kenya are (1) rational ignorance and special interests, (2) the voting paradox and Arrow's Impossibility Theorem, and (3) the bias in favor of alternatives with short-time horizons.

1) **Rational Ignorance and Special Interests.** An individual can be rationally ignorant about an alternative when the costs of becoming informed about the alternative are greater than the expected benefits of becoming informed. For example, most citizens in the democracy are not well enough informed about most

legislative proposals to evaluate how those proposals will influence their well-being. Special interests which will be significantly influenced by a particular proposal are more likely to be informed about that proposal and will voice their opinions. When politicians hear no views from individuals who would be opposed if they understood the proposal, but do hear from the special interests, they tend to act on such a proposal in ways which may not be in the best interest of the country.

Such a phenomenon also applies in a bureaucratic setting when the bureaucrats are responsive to political forces. Public sector proposals on irrigation are apt to be complex, particularly those which have to do with institution building, and small farmers who could benefit from such proposals are apt to be rationally ignorant. Busy politicians and bureaucrats, who may have the best interests of such small farmers in mind, are also likely to be uninformed. Such a state of rational ignorance may persist because it is costly to become informed about complex irrigation system development.

One way to decrease the negative impact of rational ignorance is to decrease the cost of becoming informed. If, after careful analysis, it is determined that a particular proposal for irrigation development involving the public sector would be in the national interest, it may be necessary to develop an information program to inform not only farmers, but also politicians and bureaucrats about the proposal. However, informing people about complex ideas may be difficult when reliance is placed on the use of conceptual presentations. Some more concrete examples may be required if the information program about the potentials of irrigation development is to be effective.

2) **The Voting Paradox and Arrow's Impossibility Theorem.** This elaborate phrase deals with a very simple principle. Even in a perfect democratic society where all people are well-informed and rational, there is no guarantee that public

sector involvement will yield the solution which is best for society——which means there is no alternative allocation of resources which would make society better off. This occurs because political preferences unlike money are expressed in ordinal rather than cardinal terms. Even though this is an esoteric idea, it has practical implications for the development of irrigation schemes. For example, expressed political and bureaucratic preferences may favor scheme A over scheme B. However, scheme B may be much more effective in achieving the development objectives of increasing both food production and employment opportunities. This does not mean that public sector activities cannot be effective. It does mean that political leadership must sometimes be exercised if public sector irrigation activities are to be effective development actions.

3) **Bias In Favor of Alternatives With Short Time Horizons.** Because of the nature of the political process, there is a tendency towards a bias in favor of alternatives characterized by (1) clearly identified benefits which are likely to occur in the near future and (2) costs which are difficult to perceive and which will occur in the more distant future. This also implies a bias against alternatives with both immediate and easily understood costs and diffuse future benefits. Proposals having the characteristics of the first type of alternative are likely to be selected over proposals with high initial costs and delayed benefits even if the present value of net benefits would be significantly higher for the latter type of proposal.

By nature, irrigation schemes almost always involve initial costs and delayed benefits. Until policy makers and politicians gain a perception of the basic nature of irrigation schemes, if irrigation development is to be promoted, it may be necessary to concentrate on irrigation technologies which have both relatively low initial cash costs and a short implementation period. Small-scale, community-managed irrigation can be designed with these characteristics in mind. For

example, irrigation technology can be selected which will permit the conversion of local seasonal labor surpluses into capital, minimize immediate foreign exchange implications, and shorten the time between the occurrence of initial costs and first benefits. Not only are such irrigation schemes more likely to win local support, they may also be consistent with the concept that there is an evolutionary pattern to the development of an irrigation society.

ANALYZING ECONOMIC FACTORS RELATED TO PUBLIC INVESTMENT IN SMALL-SCALE IRRIGATION

Analyzing the Economic and Financial Implications of Irrigation Development

Gittinger (1982:16) points out that there are differences between the financial and economic analysis of projects even though both types of analysis are complementary. Financial analysis is concerned with estimating the financial well-being of each participant in the project including individual farmers, public agencies, and other private groups. It is concerned with estimating both the financial ability and the incentives for an individual or a group to participate in a project. In contrast, economic analysis is concerned with estimating the impact of a proposed project on the total economy. In financial analysis, market prices usually are used, while in economic analysis, efficiency prices or "opportunity costs" are used. In a perfectly competitive market, market prices and efficiency prices would be the same. However, price subsidies, taxes and market imperfections will cause these two types of prices to differ. While economic analysis is concerned with a project's impact on society, project participants will make decisions on the basis of how their individual well-being will be influenced.

Financial analysis can be thought of as an analysis of constraints on participants. For example, a particular project might make society significantly better off, but because of price regulations a farmer may be unwilling to

participate and available agency budgets may prohibit the necessary participation of a public agency. In such a case, project implementation would not occur even though implementation would be desirable from the standpoint of the total economy. The reverse can also occur: a project may be implemented which is not in the best interest of the economy but is in the best interest of those special interests which will make the decisions on project implementation.

When there is a likelihood that market prices are distorted and/or nonmarket constraints exist, both financial and economic analyses of potential irrigation schemes need to be performed. There are indications that many such constraints exist in Kenya, but only a few will be discussed here. For example, the price farmers receive for cotton appears close to the economic price, but there are long delays in payments to farmers. An irrigation scheme whose success is based on increased cotton production would probably be viewed by farmers as financially undesirable.

Based on the team's limited investigations, it appears that credit rationing places limitations on strictly private sector irrigation development. It is hypothesized that a principal reason for this constraint is the limited ability of credit organizations to analyze and process loan applications for irrigation developments. It is also likely that a severe financial constraint exists in the public sector as the result of an inability to shift resources into agencies such as the IDB even if it could be demonstrated that such a shift would be beneficial to the total economy. While such problems are not unique to Kenya, their existence places serious constraints on the operational assistance which may be recommended as a result of financial and economic analysis of potential irrigation schemes. As the result of conducting both economic and financial analyses, such constraints can be identified, their costs estimated, and, perhaps, a start be made on removing them.

The team was not able to obtain any examples of either financial or economic analyses of small-scale irrigation schemes. The absence of such studies is not

unusual for countries at Kenya's stage in the development of irrigation resources. However, to move the development process along in a rational manner, it is important that such studies be initiated. While the information provided by such studies in determining the feasibility of specific schemes is important, the contribution such studies can make towards learning what constitutes viable irrigation schemes for Kenya is of much greater value. Such studies can be used as the basis for establishing a monitoring and evaluation system whose primary purpose is to determine what can be learned from a particular scheme. This knowledge can then be used to improve other schemes. Thus, it is important that more information be gathered on the economic characteristics of irrigation schemes in Kenya and it is recommended that the first stage of collecting this information be based on a survey of a limited number of operational small-scale irrigation schemes. If appropriate, comparable information should be collected for associated rainfed areas. This will permit a "with" and "without" comparison with regard to irrigation. The information collected needs to permit the construction of a cropping calendar and enterprise cost budgets for each of the major crops.

To estimate benefits, information on yields, quality, prices and marketing costs will have to be collected. Estimation of costs will require collection of information on inputs used, prices paid, credit sources, taxes, etc. This information could be gathered by interviewing farmers. However, it may also be necessary to develop a simple farm record system, perhaps based on the type of system used by the USAID-funded EWUP in Egypt. In either case, it will be necessary to train and work with Kenyan enumerators and supervisors.

Because of the potential importance of irrigation development as a means of generating new jobs, a labor calendar for the main crops needs to be constructed. In addition, it would be desirable to construct a water application calendar, since an important secondary use of the information of such a study would be to design

improved methods of water use. To be effective, such a study team would have to involve people with skills in addition to agricultural economics. The information provided by such a study would be part of the information normally provided by a WMS-II Joint Field Study and such information would not only be of value to those who must allocate development funds, but also to those concerned with developing a strategy for irrigation development in Kenya.

Alternative Criteria and Methods for Analysis. There are long and still unresolved arguments about the best criteria for evaluating projects such as proposed irrigation schemes. While there is much evidence to support the use of a net present value criterion, the information requirements for such an analysis are considerable and probably excessive at this stage in the evolutionary process of irrigation development in Kenya. The team was not able to find good information on single year changes in production which could be expected, let alone a time series of costs and benefits which would occur as the result of irrigation. The first analysis should probably be as simple as possible and based on a partial budget analysis of average annual costs and benefits. (The goal should be to move beyond such simple analysis as quickly as possible, but the first attempts at analysis of alternative irrigation schemes in Kenya should probably be kept simple.) In operational terms, the goal should be to develop partial budgets, based on empirical evidence, which allow the comparison on a "with and without" irrigation basis using average annual costs and benefits derived from Kenya experience.

The analysis of public agency involvement in irrigation development has often posed special problems because of the difficulties in defining appropriate decision-making criteria. While the use of some sort of net benefit criterion is conceptually justified, it presents many operational problems. It was out of such frustrations that the general interest in cost-effectiveness analysis developed. Cost-effective-

ness analysis is concerned with finding the minimum cost of achieving specified objectives. This approach is not without problems, but at this time in the process of irrigation development in Kenya, it seems like a productive approach for agencies such as IDB to use. The analysis focuses attention on (1) specification of objectives and (2) cost control. The ability to deal with both of these issues will encourage the development of responsible management programs. Standard benefit-cost analysis still needs to be done, but this is probably best done by either outside contractors or more centrally placed agencies. While the situation may prove to be different in Kenya, in the rest of the world, when benefit-cost studies are done by line agencies, there seems to be a tendency for the creative generation of benefits rather than effective cost control.

Recurrent Costs and Cost Recovery. No easy solutions have been discovered anywhere in the world permitting government irrigation schemes to devolve to farmers' responsibility for paying current operating costs and repaying of capital costs, while at the same time providing for the efficient use of the resources involved. Programs have been developed which would allow the agency to receive payments to cover operating costs and sometimes to recover capital costs, but the impact of such programs on the economic effectiveness of the scheme has not usually been considered. The team visited the Mwea scheme operated by the NIB which does have a payment program to cover recurrent costs, but was not aware of either a companion program for cost control or an analysis of the economic and social impact of the payment program. There is no guarantee that a cost recovery program which is satisfactory from a financial standpoint for a public agency will be satisfactory for either the farmers involved or for the total economy. In light of these potential problems and their potential impact on economic efficiency, three operational suggestions should be considered in dealing with current costs and capital cost recovery in Kenya.

First, emphasis needs to be placed on defining the objectives which a public irrigation agency is to achieve. Two advantages can grow out of such an effort: (1) the agency can implement a cost-effectiveness program, and (2) the desirability can be assessed of contracting with private sector firms to achieve those objectives which can be handled by contracts. Several sites the team visited, which involved the diversion of stream flows to farmer-managed schemes, provide an example of the possible division of responsibilities between the private and public sectors. Responsibility for designing and constructing the diversion structure could be contracted out to a private firm while the construction of the water distribution system could be the responsibility of a public agency or NGO. This division of responsibility is probably necessary because the distribution system can be built in part with contributed farmer labor and because the goal is not only to construct the distribution system, but to also help form a viable farmers' organization to operate and maintain the scheme once it is completed.

Second, if water charges are to encourage the efficient use of water as well as serve as a basis for cost recovery, such charges must be leveled on a volumetric basis. This is not practical when many small farmers are involved. An alternative is to sell water on a volumetric basis to either water user associations or to a federation of such associations. The associations can then levy average charges on a land area basis and the farmers can understand that if the group uses less water, their land charges will decrease. Such a system will not only encourage farmers to use water efficiently, but it will also encourage the association to maintain and operate the system in ways which encourage the efficient use of water.

Third, the key to such development is the formation of effective water user associations which are capable of accepting a great deal of responsibility for operating and maintaining the system. Not only can such organizations be designed to reduce financial demands on government and hence decrease the need to collect

taxes, they can also promote a system which will encourage the formation of an operation and maintenance system which will be efficient in terms of the costs and benefits of resource use.

Relationships with Other GOK Policies and Programs

An intervention program for small-scale irrigation in Kenya can be designed and implemented so that it can either reinforce other effective GOK policies and programs or provide incentives for improving the effectiveness of those programs and policies. If the intervention program is related to other policies and programs, the intervention program will also become more effective. If this reinforcement can be provided at a reasonable cost, it should be incorporated into any intervention program. Some of the GOK policies and programs of which the team is aware and which are candidates for consideration are discussed below.

It was stressed earlier that a successful small-scale irrigation intervention program will require some public sector involvement even if such involvement entails no more than establishing the "rules of the game" needed for effective private sector involvement. However, because of both the limitations placed on the growth of the public sector and the comparative advantage of the private sector in performing many tasks, the GOK has announced it will place greater emphasis on harnessing the capabilities of the private sector to contribute to the economic development process. Not only can an effective small-scale irrigation development program contribute to furthering such a program, but a high degree of reliance on the private sector and severe limitations on the management role of the public agencies are required if small-scale irrigation schemes are to be effective.

The GOK has announced a policy of decentralizing government, and one indication of this policy is the "district focus program." Once again, such a policy

is consistent with an effective small-scale irrigation development program. Not only is it important that much of the control of such schemes be in the hands of local people, but it is important that the schemes be developed in ways which are consistent with site-specific characteristics. Any construction contracts which must be let for such small-scale irrigation projects will generally be small and they could be handled by local firms and would thus contribute to the growth of viable local firms using local management and labor. Strong local farmers' organizations are a requirement for effective small-scale irrigation systems, and these organizations can contribute towards the development of viable local communities. Such organizations can be the basis for scheme participants to contribute labor towards the construction of small-scale irrigation systems. This is one way in which seasonally surplus labor can be converted into capital—that is a surplus resource converted into what for Kenya is a very scarce resource.

Small-scale irrigation schemes provide a means of shifting towards a more intensive agriculture which will be labor- rather than capital-intensive. Such farming systems are also capable of producing commodities such as fresh produce and specialty crops where it is not easy to substitute capital for labor in the production process. It is these kinds of commodities which may permit Kenya to enjoy a comparative advantage in the international market. Such a program could therefore not only contribute towards the achievement of food sufficiency but also strengthen the role of Kenya agriculture as an earner of foreign exchange.

Operational Suggestions for Effective Private Sector Involvement in the Development of Small-Scale Irrigation in Kenya

There are no precise operational rules for optimum private sector involvement in the development process. The general guidelines suggested here are based on two principles: (1) public sector involvement should be restricted to those cases

where it is undeniably clear that such involvement is called for if the general development goals are to be achieved, and (2) the effectiveness of the private sector in contributing towards the achievement of general development goals will depend on the particular institutions which establish the rules for the operation of the private sector. Eight suggested guidelines are presented below which should be used in determining effective private sector involvement.

1. The degree of involvement of private entrepreneurs in irrigation development will depend on their perception of how such involvement will contribute to their well-being. It does seem clear that large-scale, agency-managed schemes are not in favor because of the concrete lessons provided by the past failures of many such schemes in Kenya and elsewhere in Africa. In fact, there is vague suspicion of all irrigation because of such failures. At present, there seems to be no widely held clear perception in either the private or the public sector about the potential role of small-scale irrigation in Kenya's development process. If this perception is changed, the change must be based on reasonable expectations. Because of the complex nature of community-managed, small-scale schemes, these expectations must be based on concrete examples of success which can be used to illustrate the conceptual issues involved.

2. Well-defined property rights for both water and irrigated land must exist which will permit both (a) a reasonable degree of certainty about the control of the key resources involved as a basis for planning for the future and (b) a system of incentives which will encourage the transfer of property rights from the less efficient to more efficient managers.

3. Risk and uncertainty must be reduced to acceptable levels. Information must be gathered and provided to decision makers on the relative risks of irrigated and rainfed farming systems. Because of year-to-year variation in water supply for irrigation in many parts of the world, the physical size of irrigation systems should

be restricted to reduce risk to an acceptable level. Development of small-scale, community-managed irrigation schemes in Kenya should be based on an analysis of the impact on risk and uncertainty as well as expected values.

4. Public and quasi-public sector agencies cannot be permitted to extract all or even the majority of the economic rents generated by the irrigation schemes. If this occurs, farmers will have no incentive to make such schemes productive. Irrigation requires some public sector involvement, but such involvement should be kept at a minimum and the emphasis should be placed on such agencies providing a well-defined set of services at minimum cost. For reasons discussed earlier, such behavior is not to be expected by public agencies under most "rules of the game."

5. Public sector involvement requries close scrutiny because of the opportunity and temptation for such involvement to serve other than general development goals. There is no automatic incentive to prevent such misdirection of programs from occurring. Emphasis needs to be placed on achieving such definable objectives as target unit costs, operating efficiency levels, etc.

6. If public goods—e.g., some groundwater acquifers and surface streams —cannot be converted to private goods by redefining property rights, there must be appropriate public sector regulation consistent with achievement of general development goals.

7. When externalities exist, such as those involved in pumping from a common groundwater acquifer, appropriate nonmarket regulation consistent with achievement of general development goals will be required.

8. Irrigation must be thought of as a process rather than as an event. The technology appropriate for today may not be appropriate for tommorrow after farmers, politicians and bureaucrats learn more about irrigation. The irrigation institutions which are developed need to provide enough security so that decision makers will gamble on the future, but flexible enough so that they can change when there are changes in the factor supply and produce demand relationships.

Chapter Three

WATER USER ORGANIZATION

J. S. Ssennyonga

INTRODUCTION

This presentation on water users' organizations is based on several assumptions and propositions, some of which should be made explicit. First, emphasis is on analysis rather than programmatic and prescriptive issues. Second, all the schemes covered under this analysis are private. They were started spontaneously by private individuals, albeit acting in concert. Even though they receive assistance out of public funds, this is done on the mutual understanding between the owners and the agencies assisting them that, at the completion of the projects, the schemes will be turned over to the communities which will manage them on their own. This underlines the need to ensure that water users' organizations (WUOs) have the institutional and human resource capacity to run the schemes.

Third, it is widely held that the single most important source of failure in irrigation development is in the area of inappropriate local organization. Fourth, the issue of organization has gained more prominence with the government's adoption of the policy to assist only those water users who are organized and at their express request.

Fifth, facilitating the building of efficient WUOs is Kenya's strong tradition of working together symbolized by the term Harambee (pulling together), engraved in the national coat of arms. It is estimated that about 10 percent of national development revenue is mobilized through self-help projects which local communities identify, plan, and implement. This tradition enables local communities to force the government to respond to their initiative rather than the other way

round. Already the Irrigation and Drainage Branch (IDB) and its Provincial Irrigation Units (PIUs) are unable to respond to all the requests by WUOs.

To the best knowledge of this writer, no comparative study of WUOs has been undertaken in Kenya and detailed information on individual schemes is available only in a few instances; we do not even know the full extent of community irrigation in the country. This study therefore relies heavily on material collected during the team's field visits to various regions of Kenya. All of the systems referred to in the following discussion were visited during the team's travels. Because of this limitation, generalizations are both tentative and minimal. The material presented in this chapter is arranged around two themes: analysis of the current state of local organization and the identification of constraints and potential for further development. The analysis of farmers' organizations covers three major issues: typologies/characteristics of schemes, functions of WUOs, and gender issues.

AN ANALYSIS OF THE CURRENT STATE OF WATER USERS' ORGANIZATIONS

Typologies and Characteristics of Schemes

Several criteria are used to categorize the various schemes. These are origins, primary goal, form of organization and management structures, technology, ownership of water, land, and physical structures, as well as water use. Although the schemes do not fall into neat categories, two broad types can be identified.

Clan-Based Organization Systems. These schemes were started by clan groups during the precolonial era; the oldest of these, the Kerio Valley system goes back 300 years; the original Il Chamus systems in the Lake Baringo basin, were started in the 1880s; and others include the Vanga and Taita schemes. These are

largely organized according to clan-based principles, and are based on rudimentary technology. The communities constructed them and own them, and they also own the land communally. Although the central government owns all water resources by law, and permission to abstract water from them must be sought, precolonial systems predate this law and the communities do not even know of its existence, nor do they have water permits. Water uses (domestic consumption, irrigation, and livestock production) are, by design, integrated. The communities allocate water and mobilize communal labor according to egalitarian principles.

Bureaucratic Systems. Many of the systems discussed under this heading were started during the colonial era (e.g., Mitungu, Ishiara, Awach-Kano, Kore I & II, Taveta) but an even larger number were built in the post-independence period (e.g., New Mutara, Gataraka, Nyandusi, Ugambe, Njukini, Eldome, etc.). All are organized on bureaucratic principles—formalized roles and affiliation to modern institutions such as banks or government ministries. In many cases, the physical structures were designed and constructed by outside engineers, some using modern technology. In most cases, land ownership is problematic. Irrigation is principally for cash crop production—cotton, horticulture, rice, etc. Water is used exclusively for irrigation. In general, all government-assisted schemes approach this model.

Ownership Rights. In general, under clan-based organization individual ownership rights derive from birth into a clan which corporately owns the irrigation system and the irrigated land. But even in this case there are exceptions, the most notable being at Vanga where the Wanga people who own the land do not cultivate or irrigate it, but instead rent it to the Digo, the irrigators. In Wundanyi, land is registered under individual title deeds, but originally a communal land tenure

system was in force. In the Kerio Valley, rights and claims to canal ownership by the various clans and lineages are justified on the principle of furrow construction and, in the case of land, original seizure of unoccupied or unclaimed land.

In the bureaucratic schemes, formalized membership procedures have been introduced. A membership fee is often levied and land ownership is a complex issue. At Mitungu, farmers were given 10 to 15 acres of land; at Gataraka, each farmer paid KShs. 1,200 per 4 acres of irrigation land; at Njukini, the farmers formed a land-buying company——shares were bought at KShs. 4,000 each. At Nyandusi, the farmers acquired land on a ten-year (1983-93) lease from three local landowners. In Taveta, a large estate alienated from communal lands to a colonial settler was subsequently sold to a Greek landlord now growing sisal. The communities are clamouring for the return of their land. At Ishiara, the land was donated by local communities to the Embu County Council for the purpose of irrigation development but the irrigators, resentful of their tenant status, are pressing for individual land title deeds. In Kisii, some of the valley bottoms being drained are registered under the Kisii County Council and complex land tenure arrangements have to be negotiated. The Gataraka and New Mutaro schemes have the problem of absentee landlords. The Yala scheme is plagued by unresolved land claims on the part of the communities that owned the land prior to its flooding at the beginning of this century.

Irrigation Goals. As stated earlier, clan-owned systems emphasize subsistence production while modern ones are cash crop-oriented. However, in both cases, irrigation is an adjunct to the rainfed farming system which is itself often complementary to other production systems such as livestock, fishing, and other off-farm activities. It is therefore a situation of chain complementarity. Among the agro-pastoralists of the the Kerio Valley and Lake Baringo basin, herding

activities make an important contribution to subsistence. In Kajiado, Narok, and other pastoralist areas, the irrigators are in some cases recent immigrants from agricultural regions and have neither traditional water rights nor water permits. Where the irrigators are former pastoralists, they are regarded as "pet communities" established by outsiders at the expense of the larger pastoralist communities with traditional land and water rights from time immemorial (see Schwarz, 1982).

In areas settled by agriculturists, the complementary productive activities include fishing (at Vanga and the lacustrine area of Lake Victoria) and urban wage employment, especially in Taita and Nyanza. The distribution of cash crops is as follows: cotton (Mitungu); rice (Lake Victoria-Alungo, Anyiko, Awach Kano, Kore, Maugo, Nyachoda, Nyakach, Oyani, Wasare); horticulture (Ishiara, Aguko, Miruti, Nyangera, Seka Bondo, Nyandusi, Sinyanya, Ugambe, Njukini), bananas (Taveta schemes). Among the bureaucratic schemes, Eldume is exceptional in its emphasis on food production. This is true mainly because the area has been on famine relief.

Organizational Structures and Models. The dichotomy between clan-based and bureaucratic systems is most striking at the level of organizational structures and models. In the former type, the clan is the basis of irrigation organization, that is, clan principles of social organization are applied to the O&M of irrigation.

Clan organization in the context of irrigation O&M has the following characteristics. There is no water bureaucracy, and many functions are carried out during the elders' meetings. Among the Taita, this is known as the **Chikao Cha Vadaida**, the sitting or gathering of the Taita citizenry. However, in recent years the trend is towards bureaucracy. For example, Fleuret (1985) records that in the Mwatate River irrigation systems of the Taita Region, there is a water users' council or committee (**njama ya mkua**), to which representatives are elected by consensus, the chairman by vote.

In the Kerio Valley, O&M functions are carried out in the water meeting or gathering, **kokwo ber** (**kokwo** means traditional elders' meeting; **ber** is water). Every water user must attend the kokwo ber in which decisions are reached by consensus. Il Chamus precolonial irrigation was organized through the elders' council (**lamaal**), but today the irrigation council is referred to as the committee and is dominated by younger members (Little, 1985:10). This departure from the traditional political organization represents a shift toward irrigation bureaucratization.

The current bureaucratic systems have clearly defined leadership roles and formal procedures for electing officials. There is an hierarchical authority structure, and some form of division of labor exists, albeit with minimal role specialization. The strategy appears to be one of evolving a minimum number of roles (chairman, secretary, and treasurer) while relying on structural specialization and division of labor. At present no salaries are paid to office holders.

Formalization occurs at two levels. At the institutional level, the WUOs register themselves as self-help groups with the Ministry of Culture and Social Services (MCSS). This confers on the group the status of a legal entity enabling it to open a bank account, and to qualify for official assistance from government and donor agencies. The MCSS statutes governing self-help groups come into force once a WUO registers itself. The point to note here is that role incumbents are also fully involved in their daily household commitments from which they derive their livelihood.

Specialization is most developed at institutional levels. The most notable example is the farmers' cooperatives (FCOOPS) which deal with financial and marketing matters. There is a tendency to share disciplinary responsibility with the government administration.. The organization model currently evolving is one of two parallel but complementary structures at each scheme. The water users'

committee (WUC) deals with administrative matters while the farmers' cooperative (FCOOP) handles financial and marketing matters. Each of these structures have three vertical levels——the scheme, the group, and the block (section or lateral). The affairs of the scheme and the various groups under it are managed by a committee consisting of the chairman, secretary, and treasurer as well as representatives. The lowest level (block, section, or lateral) consists of a group of farmers usually sharing a lateral.

Members of a block or section send representatives to the group committee, these then elect officials from among their ranks. At each scheme there are several groups, each of which is registered with the MCSS. Each group in turn sends representatives to the scheme committee which also elects its officials from among the group representatives. This organizational model is paralleled by the cooperative structure. Worth noting is the relationship between farmers' organizations and government administration. At Mitungu, the District Officer is the chairman of the farmers' steering committee. In Taita-Taveta, a paragraph in the 1984 annual report states that the irrigation officer has the power to dissolve the farmers' organization if in his opinion it is not performing its duties well. If WUOs wish to retain their independence and freedom, they may find that these institutional arrangements somewhat compromise this objective.

Spatial and Demographic Size. Information on the spatial and demographic size of clan-based systems is just beginning to come out albeit on a limited scale and in only a few instances. For the Vanga scheme, information is available only on spatial size; total irrigation area is 400 ha. and consists of five noncontiguous units ranging between 65 and 115 ha. each; there are five canals, one per unit, constructed on a common river. Working through 40 percent of Rugenyi's (1982) uncoded survey material, this writer calculated that the average number of

families per furrow is just over 13 (13.3); the range is 3 to 35 families per furrow. A glance through the survey shows no direct relationship between water volume and length of furrow on the one hand, and user population size on the other. In the Kerio Valley, population distribution per canal, or diversion, is determined by a combination of several factors, chief of which is furrow construction. But not all clans which enjoy or claim ownership rights did actually construct the furrow(s) in question. Three variables are identified: original furrow construction, its extension at subsequent dates, and, in some cases, physical contest.

Another complicating mechanism is the water allocation system which distinguishes between water uses. The Kerio Valley communities evolved a peculiar settlement pattern whereby residences are perched along the escarpment while cultivation and herding activities are carried out in the valley floor. Canals pass through the residential areas of clans which do not own them. One may draw water for domestic needs and water animals from the most convenient canal regardless of ownership. But water used for irrigation is strictly regulated on the basis of canal ownership or special access arrangements. As a result, a household may draw water for domestic needs from more than one water source and may irrigate from an altogether different canal. Again, because of complex land tenure and water rights arrangements, some households may irrigate from more than one canal. This complexity is compounded by the dynamics of water sources. A sizeable proportion of households also rely on natural water sources, some of which are seasonal. There is a seasonal switch from one water source to another. This also applies to canals. There are, for example, cases where groups of clans owning a canal use the water in alternate years.

Defining the number of households or persons who "depend" on a particular furrow is not, therefore, a straightforward matter. Cappon (1984), who has carried out a survey on 48 water furrows in the upper Kerio Valley, suggests the figure of

222 households or 1,000 persons per canal. According to this writer's work, at 10 of the 48 furrows studied by Cappon, averages for two seasons and combined water uses are 254 households, or 1,080 persons per canal.

Calculation of irrigated area also poses problems, mainly because of the system of shifting cultivation and the fact that if the crop grown during the long rains is good, people do not bother to grow a second one. Acreage under cultivation varies substantially from one year and season to the next. Cappon (1984) provides figures for three years (1981-1983). The aggregate average is 350 acres per furrow. Total irrigable area in the survey location is 38,375 acres or 800 acres per furrow. Of this, only 16,800 acres (44 percent) are irrigated.

Size of the bureaucratic schemes is determined largely by the IDB or donor agencies. These officials determine both the demographic and spatial size on the basis of several criteria. Some criteria are based on organizational and management theory. For example, IDB water bureaucrats hold the view that a functional size for a "group" should be between eighteen and forty farmers. If the number falls much lower than eighteen, a few strong and articulate members may push their individual or collective interests above those of the group. In practice, however, groups average between forty and fifty members. Engineering factors have a greater determining role. However, there is a mutual feedback between technology and social organization in that engineers consult local communities before finalizing their designs in order to accommodate local organizational peculiarities. Labor dynamics also play an important role in the determination of farmers' social units, including farmers' labor output on the basis of gender, commitment to other economic activities as well as crop requirements.

The distribution pattern of size of schemes and lower level units is actually skewed. Women's vegetable schemes in Nyanza, with the exception of Ugambe (with a membership of 260 farmers) on the average have 42 members, the range

being 35 to 60. Rice schemes are much larger. The average at nine schemes in Nyanza Province is 213 members. Only one has less than 70 members, and the largest has 550. Each farmer in the rice schemes is allocated only 0.4 ha. of irrigated rice land.

At Mitungu, water for the present command area is not a limiting factor, but only 450 ha. out of 820 ha. of irrigable land were included in the scheme. The present scheme left out farmers who were in the older scheme. Considerations taken into account were manageability, technology (sprinkler system), and land tenure. Altogether, there are 300 farmers divided into nine groups; each group has a committee and sends one representative to the scheme committee—the Farmers' Steering Committee. Nyandusi has one of the most elaborately designed spatial patterns. On the basis of land quality by zone and the estimated labor output of a female farmer, the 41 member scheme, on just 4 ha., is divided into ten blocks. Each farmer has a plot (20 x 7 meters) in each of the ten blocks. This enables the farmer to spread risks equally. While the land nearest the lake has better soils, it becomes waterlogged during the wet season.

Functions of Water Users' Organizations

Water Allocation. Under the clan-based systems, it may be recalled, water is allocated during public meetings. It has also been stated that in Wundanyi some of the systems are moving towards bureaucracy. In the Kerio Valley the kokwo bers, during which water is allocated, are convened by the elders of the various segments of the WUO in a descending order according to three variables: size of water conveyance structures, segmentation level in the WUO, and time. The largest kokwo ber deals with allocation at the canal level; distribution is to clans, and the meeting is held about once a month. The kokwo ber at the clan level allocates water at the level of a canal section or a diversion; the shift is one to two weeks.

Finally, the lineage kokwo ber allocates water at the in-field level and for six-hour shifts at the household level. It should be noted here that the organization of water allocation and communal labor is regulated on the egalitarian principle of equal time regardless of status or landholding size.

Water allocation rules cover all the various uses. The rules for domestic water rights in the Kerio Valley have already been stated. In Wundanyi, the rules permit an individual to divert water to his homestead after the harvest when no one is using the water for irrigation. He may use the diverted water for domestic needs, watering his animals or irrigating grass for animal feed. Animals are not watered from the furrows.

Water allocation in the bureaucratic systems is largely determined by engineering design: the laterals, in-fields, type of technology, etc. The decision whether to irrigate simultaneously, diurnally, or nocturnally is also largely dependent on technological factors. WUOs have only a residual role to play turning on and off the water; during periods of water scarcity they decide on the method of allocating water.

In some cases important decisions were made without consulting water users. For example, at Mitungu the Ministry of Agriculture is reported to have unilaterally restricted each farmer to the use of only one hydrant. Although some farmers have as much as 20 ha., only 2 ha. may be irrigated. At Eldume, each farmer is given four hours of irrigation time per day and all the laterals operate simultaneously. At Alungo, each block (seven blocks in all) is allocated a seventh of the water. Even in the case of bureaucratic organization, therefore, egalitarianism is strictly adhered to regardless of the criteria used. On the other hand, where there are no technological, water, or land limitations, the viability of introducing an additional charge for farmers wishing to irrigate more land should be considered.

Organization of Communal Labor. Clan-based systems operate on large time and water budgets mainly because of their reliance on rudimentary technology. The components of the water conveyance system are almost always temporary structures requiring periodic replacement or repair. The head weirs of the Vanga systems have to be wholly rebuilt every year between September and November. And, as in all clan-based systems, labor for this construction is contributed.

In the bureaucratic systems, policy is not consistent. In most of the PIU-assisted schemes, all communal labor is included in the calculation of the initial investment costs and, in some cases, it is valued at as much as 25 percent of these costs. At Alungo, a PIU/Dutch-assisted scheme, farmers were not paid for their communal labor on the 800-m. dike but their labor on the cut-off ditch was paid. At Eldume, another PIU/Dutch-assisted scheme, in order for one to gain membership at least two conditions have to be met: one is a fee of KShs. 350 per head, the other is the contribution of 40 man-days of free labor. By contrast, the Kerio Valley Development Authority (KVDA) pays farmers for their canal rehabilitation work at the rate of KShs. 10 per day per worker. The wisdom of paying cash for work on communal systems is criticized by local elders who regard the money motive as potentially eroding the foundation principles of furrow maintenance.

Maintenance Work. What has been said above applies in substance to this topic as well. In addition, it is ironic that the installation of reliable conveyance structures at clan-based systems may in some cases throw out of balance existing arrangements between clans which own land and water furrows and those which have access to these resources in return for maintenance work. The more reliable the water conveyance system is, the less need there is for labor to maintain it.

In the bureaucratic systems, a maintenance fee is often levied on the basis of acreage or capitation. For example, at Mitungu, each farmer contributes KShs.

500 per ha. a year; if equipment (hydrants, sprinklers, etc.) breaks down on a farmer's plot, he/she has to raise an additional sum of money to meet the repair charges. At the Nyandusi scheme, each farmer pays KShs. 100 per plot. Since each farmer has ten plots, total levy per annum per farmer is KShs. 1,000, or one-sixth of the total revenue from the ten plots.

Other maintenance tasks include routine inspection of the physical structures. At the Ishiawa scheme, an additional committee member is elected to inspect the canals regularly. He reports cases of farmers who fail to clean the section of the lateral at the head of their farms. Where motor technology is adopted, skilled training is required for the daily maintenance of the system. At Nyandusi, a group of six women operate the pump with remarkable success. Given the commitment by the donor agencies and PIUs to hand over O&M to the WUOs, this aspect will have to be given careful attention. The issue of technology choice and water users' training will be crucial.

Marketing. PIUs/donor agencies have so far left this vitally important task squarely on the shoulders of WUOs. Although in many cases this aspect is dealt with by the FCOOPs, in practice, farmers have had to fend for themselves. As expected, the results contrast sharply between those few individuals, or schemes, with good arrangements and links with outside marketing institutions and those whose knowledge of markets does not go beyond their locality.

The women's vegetable schemes on the northern shores of Lake Victoria have achieved a measure of marketing success. Eleven groups have formed an autonomous marketing body, the Utonga Horticulture Crops Marketing Coordinating Committee (UHCMCC) which coordinates the marketing activities of the member groups. The UHCMCC has won tenders to supply vegetables to steady

markets such as government institutions which collect the crops at the farm level on a regular basis.

The acid test for even the currently successful schemes has yet to come. First, it remains to be seen whether these WUOs will be able to deliver the produce at the right time and of required quality and quantity. Second, changes in the demand and supply mechanisms, particularly in overseas markets noted for their volatility, may pose stiff challenges. Producers of crops with stable local markets such as rice may have fewer headaches in the long run.

Two other marketing issues need mention. First, WUOs are adverse to joining the National Cooperative Union (NCU) under the Ministry of Cooperatives. The exception is the Mitungu scheme. The NCU is notorious for unjustifiably long delays before paying farmers for their crops. Cases of embezzlement have also been uncovered in recent years. Second, the viability of even the FCOOPs has been questioned by some analysts on the grounds that they were introduced by the state to promote its own interests in ensuring a comfortable income from crop monopolies imposed on the farmers. These FCOOPs facilitate the maximization of the quantities to be delivered to world markets. They are also subjected to rigid regulations over which farmers have little or no say and are therefore militating against the ideals of free WUOs managed by the farmers themselves (Kortenhorst, 1983:34).

Financial Management. The FCOOP is the structural financial arm of WUOs. It has already been stated that the water users' group and co-op each operate two separate (savings and current) accounts. Then there are the various levies such as the maintenance and membership fees. Where membership is large (Mango 550, Mitungu 450) the volume of financial transactions is great. Apart from the need to keep good accounts, accurate information has to be passed on to members. Where

savings accumulate, the right investment decisions have to be made. This situtation of rising financial complexity requires not only integrity but a certain degree of professional competence on the part of leaders.

Legislation. WUOs also enact bylaws which bind members only. This prerogative is conferred on WUOs by virtue of their registration with the MCSS. Among the bylaws are those which regulate discipline, particularly matters of communal labor.

Maintenance of Discipline and Enforcement of Rules. In the clan-based systems, the traditional authority structure embodied in the institution of elders is the vehicle for enforcing O&M rules and discipline. Breaches of prescribed conduct are punished according to clearly promulgated procedures. For example, among the Keiyo of the Kerio Valley the fine for failure to turn up for communal labor is one goat. The situation in modern bureaucratic systems is not altogether uniform. Some WUOs have laid down clear sanctions while others have opted for enforcing discipline through existing government administrative procedures. A case in point is the application of the Chief's Standing Order Act which empowers the local chief to prosecute in a court of law any person who fails without good cause to turn up for communal labor at self-help projects.

Resolution of Conflicts. There are bound to be conflicts of interest, e.g., between upstream and downstream water users. At Njukini, the farmers began the scheme by opening up irrigation plots downstream then gradually expanded upstream. There are also seasonal water fluctuations. In the Eldume scheme, water shortages occur during the dry season; at Ishiara, only a quarter of the farmers irrigate during the dry season. In agro-pastoralist areas, there are trade-

offs between crop and livestock production. In the Kerio Valley, small stock are left to graze unattended in the valley where crops are grown. This is still a largely unresolved issue.

Gender Issues

Considerable evidence (Okoth-Ogenda, 1976; Nasimiyu, 1985) points to the erosion of women's economic and land rights by the introduction of individual title deeds and cash crops, among other factors. Although land was traditionally passed on from one generation to the next through males, other family members had well-defined and secure land rights. With the introduction of individual land title deeds, the law recognized the rights of the male title deed holder and ignored his wife's and children's interests. Under the traditional production systems, the disposal of crops was the wife's exclusive domain; she allocated the proportions of the harvest for immediate consumption, tide-over stocks and seeds. The attraction for cash income from crop sales lured men into this domain, leaving women as mere producers.

Viewed against this background, the introduction of exclusively female irrigation schemes can be seen as a significant if limited step to offset some of the economic losses women have suffered in this century. The SSI program of the IDB alone supports seven women's vegetable schemes in Nyanza Province. However, membership and spatial size are very small; the seven schemes have a combined membership of only 514 on 42 ha. These schemes have introduced radical elements in the household economy since the women are directly paid in money from their crop sales without the intermediacy of their husbands. At Nyandusi, the women expressed sentiments of joy that they have fewer domestic quarrels with their spouses, and that they have a better balanced diet now that they can buy food items they themselves do not produce. In short, irrigation gives them economic

power not accorded to them in rainfed or male-dominated irrigation farming systems.

In cash crop-oriented schemes the general pattern is one of female exploitation. They provide the bulk of labor but have little or no say on how the money from sale is spent. The issue of women's rights especially in schemes where land is not yet adjudicated should be given careful attention. The implications of female labor allocation in chain complementarity also calls for examination. Irrigation schemes receiving government or donor assistance are, for the most part, located in high fertility regions such as Nyanza Province. Child care, household chores, food preparation, fetching water, and collection of fuel wood all fall on women's shoulders. More often than not, irrigated fields are some distance away from rainfed fields. This time and space dichotomy compounds the food versus cash crop conflict. Women also contribute labor in the livestock production sector which is important at most of the schemes. There is, therefore, need to study the basis on which women are currently allocating their time and labor.

SUGGESTED STRATEGIES FOR STRENGTHENING WUOs

In conformity with the analytical character of this study, consideration is limited to only those issues which flow directly from the preceding analysis. Emphasis is also placed on agency-assisted schemes.

Major Constraints in WUOs

Below, several important constraints to the effective formation and functioning of WUOs are identified and discussed.

1. WUOs Not Equal to the Tasks. Analysis of the FWUOs has shown that government/donor assistance has entailed the rapid expansion of the number and

complexity of tasks which WUOs have assumed. Apropos to this is the fact that these organizations have only come into existence during the last five years or so; the performance of WUOs has not therefore been tested.

Although training of the WUO leaders has not been analyzed, an impressionistic assessment indicates that except in a few cases achievement in this line is below the requirements for the kind of challenges and responsibilities these leaders have assumed. In one instance, a committee member complained that some officials cannot interpret bylaws they themselves enacted. How realistically can these leaders be expected to do well in financial management, marketing and the like?

2. Inadequate Leadership Roles. It has also been shown that the numerical expansion of functions is not matched by a corresponding rise in leadership roles. As a result, one finds the same three officials—chairman, secretary, and treasurer. The current strategy of operating through a structural division of labor typified by the creation of co-ops does not appear to solve the problem.

3. Marketing and Financial Arrangements. Both the IDB/PIU bureaucrats and farmers concede that marketing is a bottleneck for WUOs. Complicating the matter is the fact that most of the bureaucratic schemes are cash crop-oriented, and many depend on overseas markets notorious for their instability. Since even the government's own organs created to stabilize cash crop prices are not doing well, it may be a case of ill-placed optimism to expect unassisted farmers to fare better.

4. Ill-defined Irrigation Goals. It is fair to assume that irrigation goals should be consistent with both the stated national objectives of economic and

social development on the one hand, and the specific goals of agricultural production on the other. The Kenya government sessional paper (1981) drawing attention to the threatening specter of chronic shortages in all the principal food stuffs also reiterated the government's determination to achieve self-sufficiency in the production of these staples. The government also recognizes the grave unemployment problem. Agriculture is the principal source of rural cash incomes as well as national foreign exchange earnings. The achievement of these objectives is made more difficult by an annual population growth rate of 4 percent and scarce agricultural resources. The policy of emphasizing cash crops at irrigation schemes does not appear to be in accord with the priority order established by the government. Even if policy neglects food production, pressed by the growing demand for food, the farmers at the schemes will themselves effect a crop substitution. If this happens, many of the present O&M arrangements will be thrown out of balance.

5. Lack of Information on Chain Complementarity. There is no reliable information on the relationships among the various productive activities in chain complementarity. There is, for instance, a vacuum in our understanding of the perceived and inherent opportunity costs of irrigated and rainfed agriculture, agriculture in general, fishing, and herding. The opportunity costs are envisaged in terms of labor, time, and attendant physical mobility, as well as capital and other investment.

6. Unresolved Land Issues. A disturbing finding is that systems without land problems are the exception rather than the rule. Most unsettling is the fact that in many of these schemes, irrigators either do not own the land or have insecure use

rights. Given the policy of turning over O&M to the WUOs, the question then arises, what if the current land arrangements fall through?

In areas where land has not yet been registered under individual title holders, a whole range of new issues will emerge. As has been the case elsewhere in the country, land registration is accompanied by severe social and family conflicts as land and resource scarcity become exposed so sharply. Households begin to realize that fuelwood, house construction materials, and grazing resources are circumscribed. In many cases, equity is not adhered to. The position of women who provide the bulk of labor has also been analyzed. Their position is even more precarious as women do not traditionally own land. Male chauvinism may lead landlords to take a jaundiced view and demand lease renewal at terms unfavorable to women.

7. Lack of Trained Staff to Assist WUOs. No concrete measures have been taken to strengthen the WUOs. This is partly due to the fact that the IDB/PIUs have no properly trained personnel to offer this service. Two constraining factors were identified in this regard.

(1) There appears to be a misconception of the role that the agencies assisting WUOs should play in strengthening farmers' local organizations. Some water bureaucrats envision this as falling within the ambit of the extension service and expect the gap to be filled by recruiting more extension personnel from the agricultural training institutions. The problem is of a different order of magnitude. None of the training institutions in the country offers the type of skills needed by those responsible for assisting WUOs. Ideally, one should have basic training in social science with special emphasis on irrigation O&M.

(2) The present staff structure and establishment do not facilitate the recruitment of social scientists in the Ministry of Agriculture and Livestock Development (MOALD).

8. Fragmentary Information on WUOs. In the overwhelming majority of cases, no systematic information on WUOs has been collected. PIUs also admit that they have no systematic procedures for identifying viable water users' organizations. Given the situation whereby only a small proportion of requests for assistance (in Nyanza, unassisted groups outnumber assisted one by two to one) can be met; in the absence of reliable criteria for selecting groups, the possibility of leaving out WUOs with greater potential cannot be ruled out.

9. Peculiar Problems at Clan-Based Systems. Clan-based schemes pose challenges peculiar to their cultural, environmental, and agronomic circumstances. The Vanga and the Kerio Valley systems have the disadvantage of being located in isolated geographical settings. Vanga is in an economically inactive area. The social and economic status of the Digo, the irrigators in Vanga, is also a hindrance to expanded irrigation production. With the abolition of the slave trade, the Arab landowners who depended on slave labor bequeathed the land to the Wanga, but the latter do not till the land, instead they rent it to the Digo. The Kerio Valley suffers from extreme physical, economic, and community isolation. Engulfed between two steep ranges, it has no reliable roads and no means of private or public transportation along its entire 160-km. length. It is thus futile to promote production beyond household subsistence needs, since there is no outlet for surplus production.

Despite this disclaimer, however, there are cases which call for immediate assistance just to sustain production at subsistence level. At Vanga, for example, erection of a permanent head weir would considerably reduce the large labor budget. In the Kerio Valley, the KVDA and ASAL programs are providing for some essential rehabilitation work.

Although catalytic agents are at work (the need for cash to finance school education, pay health bills, and buy processed food stuffs such as cooking oils, maize flour, sugar, etc.), there is a need to raise the people's perceptions and aspirations to levels beyond their current subsistence life styles. This is no doubt a subtle and long-term problem. These constraints are not insurmountable, given the existence of a solid base upon which to build efficient WUOs.

Strengths and Potential for Building Efficient WUOs

There are a number of factors that can contribute to the development of effective WUOs in Kenya. These include the following:

1. **Harambee Tradition.** The lively Harambee movement is itself a glowing tribute to Kenyan leaders who transformed traditional African values for cooperation in productive activities into a dynamic force for modern development. The observed willingness by farmers to work together owes a lot to this tradition.

2. **Clan-Based Principles of Social Organization.** Although clan-based principles of social organization have been severely eroded, they still operate to varying degrees. One of these is the egalitarian principle applied at all the schemes to regulate labor contribution and water allocation. Its strict application has preempted the fermentation of feelings of disaffection among members.

3. **Sound IDB/PIU Policy Towards WUOs.** Three measures have been singled out for praise: these are willingness to work with existing WUOs, making the presence of farmer organization a precondition for assistance, and the decision to give the responsibility for O&M back to the farmers at the completion of the project phase. This contrasts sharply with government policy in public irrigation

where the state created, owns the systems, and runs all the O&M functions. One may also cite the case of several Asian countries where once the government steps in to assist, it also takes over the O&M of the schemes and does not plan to leave.

4. The Character of Immigrant Farmers. A feature of many of the schemes is the numerical and administrative dominance of immigrant farmers or of farmers who were not either resident or farming in that area—Mitungu, New Mutaro, Gataraka, most of Taveta schemes, etc. Part of the success at these schemes is attributable to the group dynamics and individual characteristics of the farmers. As a rule, they were pushed to the schemes by land hunger in their natal or original homelands. They also possess considerable agricultural skills, a readiness to adopt innovation, and useful links to marketing institutions.

Suggested Measures to Increase the Effectiveness of WUOs

Seven measures should be undertaken to increase the effectiveness of WUOs.

1. Social Scientists to Assist WUOs. One of the most urgent measures is the recruitment of social scientists capable of assisting WUOs. The institutional and conceptual difficulties associated with this recommendation should, no doubt, be addressed first. The IDB/PIU may opt for cooperation with NGOs, private organizations, and existing training institutions in this regard.

2. Research. Right now very little is known about any of the vital aspects of WUOs, chief among these being the relationships among the principal economic activities in chain complementarity and labor allocation.

3. Training Farmer's Leaders. Training services for the current leaders of water users would greatly enhance their performance but they should be geared primarily to the pragmatic needs of the officials, varying, as they do, with the individuals' backgrounds and local settings.

4. Increase in Leadership Roles. The present minimalist approach to leadership roles should be reconsidered. More especially, the idea of entrusting marketing and financial matters to the flawed FCOOPs may have to be scrapped in favor of a single amalgamated WUO at each scheme.

5. Better Marketing Arrangements. In order to strengthen the marketing component, IDB may consider cooperating with specialized agencies, including private organizations, offering reliable marketing services.

6. Secure Land Rights. O&M should not be handed back to WUOs with insecure land rights. In future, prior to giving assistance, evidence of satisfactory safeguards for land rights should also be made one of the conditions for assistance.

7. Multifaceted Strategies for Clan-Based Systems. Finally, the case of disadvantaged clan-based schemes calls for special consideration. Prior to direct and/or significant investment in irrigation, measures to tackle the most crippling obstacles to social and economic development should be taken. These include the construction of all-weather roads, provision of public means of transport, and other aspects of infrastructure development. In the intervening period, stop-gap rehabilitation work should also be considered. The more difficult task of uplifting the aspirations and lifestyles beyond the subsistence mode of production should also be seen as a key to the creation of the right climate for increased production.

CONCLUDING REMARKS

This analysis has focused mainly on the current status of farmers' organizations and, to a lesser extent, the constraints, strengths, and strategies for building more efficient local organizations. This has been done within a framework which emphasizes two aspects of organization, namely the relationships among the various forms and structures as well as contextuality.

In the context of organizational forms and managerial structures, irrigation has been portrayed as a complex process for which the coordination of activities of individuals and groups interacting at several levels of organization is a key concept. At the highest structural level are the water bureaucrats, in Kenya the IDB/PIU/Donor agency officials. These are, in turn, ordered in parallel and vertically ranked structures. Engineers work hand in hand with agronomists and administrators; all of these specialists fit in hierarchically ranked job groups. Below these are the water user groups. At the lowest level are the individual farmers, each of whom pursues his/her private interests but has nonetheless to cooperate with other water users. The performance of these group operations entails the creation of appropriate leadership roles and social units such as the block, group, and scheme.

The criteria for creating and determining the forms and functions of each of these organizational structures have been presented as the byproduct of the interplay between the specific historical, environmental and cultural settings on the one hand, and the conceptual models applied by the designers of irrigation on the other.

The first section of the study on the typologies and characteristics of WUOs revealed a mosaic of contextual variation. The history of Kenyan irrigation includes some accounts of distant ancestors who pioneered furrow construction and others of recent acquisitions of water furrows left behind by departing colonial

settlers. Patterns of land ownership and water rights are equally intricate. In some cases, migration accounts legitimize ownership; in others, present-day land tenure reflects a legacy of slave/master relations; while in yet other instances, cash payments ensure membership and ownership rights.

Further elements of organizational diversity are manifested in the application of different organizing principles. Schemes built on clan-based principles are acephalous, have nonhierarchical structures, and diffuse roles. In contrast, those organized on bureaucratic principles are characterized by hierarchically arranged structures and formalized roles based on specialized tasks. These principles and structures ultimately reflect differences in the forms of social organization and social systems. The dichotomy contrasting clan-based and bureaucratic systems illustrated this aspect.

The final dimension of irrigation organization to be highlighted here is its relationship to larger totalities. This has been discussed under the shorthand chain complementarity and at two levels. At one level, irrigation is a component of an agricultural system complementing rainfed agriculture. In this connection two issues have been raised. First, it is a vital task of irrigation organization to bring in line the goals of irrigation with those of national development in general and agriculture in particular. Second, it has been pointed out that there are potential conflicts both within and among the various organizational levels. This is the element of "interests."

The individual farmer can pursue monetary gains at the expense of his/her food needs. The same farmers may in the next instance eat up all of the crop and jeopardize the group interest of supplying the quota agreed upon with marketing institutions or outside buyers. Similarly, the state or donor agency may plan irrigation in such a way that its foreign exchange interest override those of the farmers.

The second level of chain complementarity places irrigation in the context of other economic sectors such as livestock production, fishing, and other off-farm activities. Here the concept of opportunity cost is useful precisely because farmers have to make decisions on what proportion of their time, labor, and other forms of investment to allocate to these activities. It has been observed that little information is available on this issue.

This systems approach is necessary for an understanding of irrigation, for just as the weakest link determines the strength of a chain, so it is in the case of irrigation. The links that bind the individuals and structures at the various organizational levels are all individually important. Strengthening WUOs therefore means that we have first of all to understand how each link works, what kind of task it can perform, and in which context.

Chapter Four

ANALYSIS OF ENGINEERING ASPECTS OF SMALL-SCALE IRRIGATION SYSTEMS

Ramchand N. Oad

AGRICULTURAL SETTING

Agroclimatic Zones and Opportunities for Irrigation

In spite of the vast size of the country——583,000 sq. km.——Kenya has about 8 million hectares of land with good soils. Of this land area, only about 20 percent is of high and medium potential for reliable rainfed cultivation (Toksoz, 1981). Another 40 percent receives too little rain and is only suitable for grazing. The rest of the area has marginal rain and is drought prone.

The topography and soils pattern in Kenya are very complex because of striking differences in altitude, land forms, geology, and climate. In general, the high and medium potential agricultural lands tend to be at higher elevations (6,000-8,000 ft.); the low-potential lands are located in the foothills and in the valley plains (altitude 2,000-4,000 ft.). Much of the high- and medium-potential land is concentrated in the central and western highlands. These areas are densely populated and produce the majority of the the food and cash crops of Kenya. Corn, beans, coffee, and tea are the predominant crops.

In Kenya, reference is frequently made to areas of the country with high and low agricultural development potential. It must be noted that this potential for development derives from the existing agroclimatic classification of the land by the Ministry of Agriculture and Livestock Development (MOALD, 1982). The high-, medium-, and low-potential agroclimatic zones are defined primarily by availability of reliable rainfall for crop growth. The classification system does not take

into account the surface and subsurface water that can be made available through irrigation development. It is therefore not necessary to limit irrigation development efforts to the areas with "high agricultural potential" only; irrigation itself may transform a "low potential" area into a "high potential" area.

For many years, rainfed agriculture enabled Kenya to produce sufficient crops to meet domestic consumption. With rapidly growing population——4 percent per annum——pressure is beginning to mount on Kenya's limited arable land. Except at very high altitudes, agriculture based on rainfall is unstable and mostly of a subsistence nature because of large spatial and temporal variation in rainfall. Mean annual rainfall varies from over 1,500 mm in the central and western highlands to less than 200 mm in the northern and eastern lowlands (MOALD, 1982). The yearly precipitation falls in two rainy seasons that are separated by a dry season. The long rainy season is between April and August, and the short rainy season lasts from October to December. Both durations are not long enough to support intensive agriculture without supplementing rainfall with irrigation water supplies.

Irrigation: Extent and Nature of Technology

The amount of land currently under irrigation in Kenya is small by comparison with the total area of good agricultural land. The presently irrigated area is roughly 34,000 ha. Most of this area is in the private sector——23,000 ha. ——particularly in large-scale plantations producing high value crops such as coffee, fruits, and vegetables. In the public sector, about 10,000 ha. are managed by the National Irrigation Board as settlement schemes and small-scale irrigation schemes cover approximately 1,000 ha. (Toksoz, 1981).

The concept of small-scale irrigation in Kenya appears to be similar to the village-based irrigation schemes of Southeast Asia. Technology employed makes

maximum use of local manpower and materials. This is desirable because the farmer groups are usually expected to operate and maintain the irrigation systems by themselves. The small-scale irrigation schemes grow a variety of crops such as corn, sorghum, beans, and other vegetables, most of which are locally consumed. In comparison, large-scale private plantations use irrigation to produce cash crops such as coffee, fruits, and vegetables. Given the subsistence nature of some small-scale irrigation, it is logical for those farmers to adopt a technology that is less capital-intensive and probably more labor-intensive. Commercial schemes, both large and small, can afford more sophisticated technology, such as pumps and sprinklers, to obtain water control with minimum labor requirements.

TECHNICAL ISSUES: WATER CAPTURE AND CONVEYANCE

Experiences of Local Farmers' Groups

In Kenya, one is constantly amazed at the variety of ecological settings in which small-scale irrigation is practiced. In the delta reaches of the Tana, Sabaki, and Umbe rivers along the coast, irrigated rice is grown by capturing the high stage river water. Ingenious use is made of spring water to irrigate vegetable and fruit crops in the hot plains of Taveta. In the Taita hills (elevation 7,000 ft.), runoff in small streams is captured by diversion weirs to grow a variety of food crops. In the hot Kerio Valley, tremendous amounts of labor and elaborate techniques are employed to capture surface runoff in mountains and convey it to the valley plains to water subsistence crops such as sorghum, maize, and beans. Along the shores of Lake Victoria, a few groups of farmers pump lake water to grow high-value vegetable crops. It is hard to agree with the argument that Kenya lacks a tradition of irrigation.

By far the most common method of capturing river flow is by diversion weirs. Diversion weirs in small-scale irrigation schemes are modest structures. Farmers

build brushwood dams that are washed away periodically at times of high flows during the rainy season. When built by government or nongovernment external agencies, these diversion weirs are of either masonry or concrete structures. In both farmer- and government-built weirs, an attempt is made to divert only a fraction of the river flow. The diverted flow is then conveyed to the lands usually by means of open earth channels.

It is reported that some small-scale schemes were abandoned by farmers and now are being rehabilitated/upgraded through government assistance. Based on the field visits, it appears that many of the abandoned schemes (e.g., New Mutaro, Ishiara, and Eldume) are located in the lowland plains. There are some valid technical reasons for this farmer response. First, many of the rivers in the lowland plains being tapped by farmer groups are large. For example, River Molo (Eldume scheme), River Lumi in Taveta, River Aror in Kerio Valley, and River Thuchi (Ishiara scheme) all carry a minimum discharge of about 10 m^3/sec (350 cusecs). Where erosion causes a continuous drop in riverbed and water surface elevation, it is extremely difficult for local groups to construct and maintain brushwood weirs.

Second, as a consequence of rather intensive rainfed agriculture in their catchment areas, the rivers carry a heavy silt load, particularly during flood stage. Since no control gates are provided at the head of the intake canal, it is not possible to prevent large quantities of silt from entering the canal and being deposited there. Continued desilting of the delivery canals and rebuilding of weir structures strains farmers' resources and may contribute to the breakdown of their local organizations. External assistance, government or nongovernment, can be very effective for the well-being of small-scale irrigation schemes by funding engineering works for diverting river water.

At higher elevations, as in the Taita Hills, natural streams tend to be small and numerous and relatively free of silt. In these cases, it is possible for farmer

groups to construct and sustain diversion schemes utilizing local technical skills and construction materials. As these systems are sustained for long time periods, they can achieve a high degree of sophistication in capturing and utilizing irrigation water. For example, in the Taita Hills, diverted flows are small and difficult to convey directly and apply to the fields. Thus, the diverted flow is continuously stored in a tank and released into the delivery channel at a greater flow rate when farmers need to irrigate.

Low-lift pumps are another means of capturing river water. Water can be lifted by small, centrifugal pumps driven by diesel engines that can irrigate small land units of 5 to 20 ha. per pump. It is desirable to keep the area irrigated small, and therefore the number of farmers in a group relatively small for ease of system management. Many professionals interviewed during our field visits, particularly the Dutch group, were negative about the use of pumps at this stage of development. They argued that pumps require capital investments that are beyond the means of small-holder farm groups, that pumps are difficult to maintain and repair, and that farmers simply do not have the technical expertise to manage pump irrigation schemes. However, in some situations, such as the shore belt along Lake Victoria, pumps would be ideal to lift lake water and support small-holder irrigation groups. Also, pumps can be effectively utilized on larger rivers where weirs would be very expensive.

The evidence in the field is that pumps are being used primarily by relatively rich, individual farmers who have the capital to acquire a pumping unit. Repair and maintenance service is provided by the pump dealers. It is rare, however, to see a group of small-holder farmers organized around a pump. One example is the Nyandusi irrigation scheme (shores of Lake Victoria) organized by a group of women farmers. The Ministry of Agriculture initially provided and installed the pump and designed the water distribution system. Pump operation, maintenance,

water distribution, and all other management functions are now performed by the women's group itself. The scheme grows high-value vegetable crops, pays all fuel and maintenance bills, regularly saves funds to buy a new pump when the present one expires, and results in considerable savings for all members.

Small earth dams to store spring water and divert it into conveyance canals provide another source of irrigation water. As constructed by farmers, the earth dams do not have a relatively impermeable core. Consequently, water seeps through the body of the dam. Furthermore, no filter or drain is provided at the downstream toe of the dam. The seepage water continuously erodes the downstream section and eventually the dam breaks after about four years of its construction. Farmers in Njukini scheme reported that it takes a tremendous amount of labor to dam the spring flow and still it is not possible for them to completely stop the seepage.

Assistance by Government and Nongovernment Agencies

Analysis of farmers' experiences indicates that they face technical problems while capturing water for irrigation, for example, constructing weirs to divert water. In 1977, the Ministry of Agriculture initiated the Small-Scale Irrigation Development Project (SSID) with the assistance of the Government of the Netherlands. This program was later formalized into the Irrigation and Drainage Board (IDB) of the Land Development Division (see Chapter 1). The main engineering thrust of the IDB is to rehabilitate the schemes by constructing a concrete or masonry weir. In some cases, an intake control gate and distribution structures are also provided in the main delivery canal.

The IDB approach for assisting small-scale irrigation has three desirable features.[1] It has operational staff at the provincial (Provincial Irrigation Unit, PIU) and district level. The provincial and district staff are in close contact with

farmers and, therefore, can effectively incorporate farmers' needs in system design. IDB/PIU emphasizes use of technology that is simple, low-cost, and can be managed by farmers' groups. This is important as the local communities are expected to manage the irrigation technology after construction is completed. Last, all engineering activities including feasibility studies, design, and construction are frequently done by the PIUs. In these cases, no contractors are involved, and the presence of PIU at all stages of system development usually results in better farmer participation.

During field visits, no major technical deficiencies were observed in the engineering design and construction of the physical structures. There is potential for improvement in technical skills of professional staff and in the provision of support services such as proper survey and design equipment and transport facilities. By far the major problem with the IDB/PIU activities is that the pace of development is painfully slow. The PIUs were established in 1979, and by the year 1985 have developed about 850 ha. with Dutch assistance. This translates into an average development rate of approximately 150 ha. per year; a more optimistic goal would be 250 ha. per year.

The policy paper of the Ministry of Agriculture (MOALD, 1981) outlines a program which envisages the development of 200,000 ha. under irrigation over a 25 year period. The policy paper suggests that in the public sector, 100,000 ha. are to be developed by the NIB, 65,000 ha. by the IDB/PIU, and the balance by the private sector. At the present rate of development of 250 ha. per year, IDB/PIU will require 260 years to develop 65,000 ha.; 130 years to develop half of the target area.

The major reasons for the slow pace of development are that the IDB has very limited funds and professional staff. The professional staff at the central level consists of only four persons; the total number of irrigation engineers at

provincial and district level is estimated to be about thirty. There is a constant turnover of these professionals as they seek better jobs in NIB, Ministry of Water Development, and various basin development authorities (MOALD, 1985). The irrigation engineers are assisted by a limited number of Technical Officers (TO) and Technical Assistants (TA).

Another factor that explains the slow pace is very limited funds available. The IDB/PIU program is heavily dependent on foreign donor funding, in particular, the Government of the Netherlands and the European Economic Community (EEC). The "ideal" project development process begins with a group of farmers seting up a "project committee" and, along with the local Chief, or Sub-chief, introducing the project to the District Development Committee (DDC). After DDC approval, the project proposal is sent to the Ministry of Economic Planning and Development (MEPD). If selected by MEPD, the project is put on the priority list which essentially means that the Ministry will now look for foreign donors to fund the project. The search process from project approval to final funding can take a long time; New Mutaro Irrigation Project was approved in 1978 whereas its funding came in 1982.

Two options to increase the pace of irrigation development are (1) to increase the capacity of the IDB/PIU, and (2) to increase the capacity in the private sector in addition to increasing capacity in the public sector (IDB/PIU).

The second alternative appears to be superior since it may not be politically feasible, or even desirable, to enlarge a government bureaucracy beyond a certain limit. It is doubtful, however, that the existing local engineering firms have any experience directly related to irrigation system design and construction. Involvement of private engineering firms may also result in decreased opportunities for farmer participation in irrigation system design and construction.

The existing policy of direct involvement by the PIUs in feasibility studies, design, and construction is desirable. Therefore, most of the capacity building in the public sector should occur at the provincial and district level. Greater technical capacity within PIUs will be necessary to effectively monitor the work of private engineering firms. It would also be consistent with the 1984 national policy of District Focus (see discussion in Chapter 2). According to this policy, development funds for a project can go directly from the treasury to the district under the responsibility of the district officer of the concerned ministry; for example, the District Agricultural Officer for an agricultural project.

TECHNICAL ISSUES: WATER USE

Complexity of the Production System

An irrigation scheme can be divided into two systems for the purpose of engineering analysis: the water capture and delivery system and the water use or production system. If the water delivery requirements are known, design and analysis of the water capture and delivery system is a fairly standard application of the principles of hydraulic engineering. Design and analysis of the production system cannot be approached with a set of standard principles primarily because there can be no "typical" production system. This is particularly true of the farming systems in Kenya that are served by small-scale irrigation schemes.

The farmer and his or her family are involved in many different activities in which each member plays a specific role (see Chapter 3). These activities in a subsistence production system are based on the principle of spreading the risk of failure as much as possible. Farmers use irrigation water to grow a variety of subsistence and cash crops. For example, on a two-acre farm in the Ishiara scheme, the farmer was growing corn, groundnuts, cabbage, tomatoes, mango trees, and some sugarcane. Canal water is also extensively used for livestock and

for domestic purposes. In addition to farming and raising livestock, male family members may seek off-farm employment; in many instances, it was reported that women contribute significantly to the total agricultural labor force.

In many parts of Kenya, multiple production activities make labor more scarce a resource than land and water, and the farming system is more likely to be based on optimizing productivity per unit of labor than unit of land or water. Analyzing such a production system by using engineering concepts of water use efficiency requires great caution; the objective of farmers' cultural practices may not be to maximize water use efficiency.

This is not to say that the farmers do not value irrigation water. On the contrary, great emphasis is placed on maintaining equity of water distribution among various users. In every irrigation scheme visited, there existed a water users' association that supervised water distribution (see Chapter 3). The assistance program of the IDB/PIU usually provides gated turnouts in the distribution channels to control intake to the farmers' fields. Control gates are also provided at the head of the distribution channels at intake points from the main delivery canal. It appears that the water user groups request and appreciate the availability of appropriate technology to support their organizational efforts.

Water Use Efficiency

Efficiency of water use at the farm is highly variable. The variability seems to be influenced by the relative importance of irrigated agriculture in the total production system, and the availability of markets for cash crops. Where market conditions are favorable, irrigation water is primarily used to grow cash crops such as vegetables and fruits. In such cases, irrigation water is efficiently utilized. Where conditions of limited labor for irrigation combine with marketing problems, irrigation water may be used for subsistence crops such as maize and sorghum.

In the Kerio Valley, for example, livestock raising seemed to be a major activity, while irrigation is used to grow subsistence crops such as sorghum and maize. Marketing of cash crops is difficult because of the lack of good roads in the area. Land preparation is minimal; land is barely cleared of the existing weeds and bushes. Water is applied to large basins by flooding. Fertilizers are not used since enough land is available to shift the irrigated block once every three years. This "shifting irrigation" is an example of substituting land for capital, and the practice may help maintain natural soil fertility when artificial fertilizers are not used.

The Nyandusi irrigation scheme is an example of very intensive use of water and land resources. Four hectares of land support a group of forty-one women through intensive cultivation of high value vegetables. Ingenious use of organizational rules and tools has made it possible to sustain the system for about three years now. A small 20 lps. capacity pump lifts water from Lake Victoria. It is then delivered through a pipe to ten blocks of land, each block having a control valve discharging water into an open channel at the head of the block. From the head channel, water is applied to small basins in the block by gravity. Within the basins, furrows and ridges are made for cultivating vegetables. Each of the members has a piece of land in all ten blocks; the land area of each piece being about 140 square meters. As such, all members have an equal interest in irrigation facilities and water distribution in all ten blocks. Further, the classical problem of head, middle, and tail is avoided.

In most of the irrigation schemes, water application and use is by gravity flow, even when pumps and pipes are used to capture and deliver water. Only in one scheme (Mittingu) are sprinklers used to apply water to the land. In Mittingu, the sprinkler design is justified on the basis of soil texture being too light. Construction of the system has just been completed, and it is too soon to say whether farmers will be able to sustain this high level of technology on their own.

Given the complexity of the production systems and the range of water use practices, a phased type of irrigation development policy is desirable. Following this policy, initial emphasis would be on development of the water capture and delivery system. However, this may not result in an immediate development response in the production system in the form of high water use efficiency. The change in the production system may require further internal changes in labor use, resource allocation, roles and tasks of community members, and external changes such as government pricing policies and marketing of cash crops. Much time and effort is required for the production system to develop at a pace that suits the capacity of the local people.

SUMMARY

In Kenya, irrigation technology, land use, and the cultural practices of farmers show a large variation because of striking differences in climate, land topography, altitude, and soils pattern. In general, small-scale irrigation supports agriculture that is largely subsistence-oriented. Maize, corn, beans, and vegetables are predominant crops grown in small-scale irrigation schemes.

Technology employed by farmers in small-scale irrigation is simple, low-cost, and makes maximum use of local manpower and materials. Partial diversion of river flow by modest brushwood weirs is the major source of irrigation water. Use of pumps to lift river water is increasing and is largely practiced by individual rich farmers to grow high-value crops such as vegetables and fruits. Pumps and sprinklers are also used by large-scale, commercial plantations to grow coffee and other high-value vegetable and fruit crops. In future, pumps should play an important role in small-scale irrigation systems. Groundwater irrigation is not yet considered and no reliable data are available concerning the feasibility of using groundwater for irrigation.

Farmers' experiences with diversion weirs have been variable. In the highlands, where streams are relatively small and silt free, farmer groups have succeeded in constructing and maintaining weirs on their own. In the lowlands, where rivers tend to be large and carry large amounts of silt, farmers have had less success with diversion weirs and system maintenance.

The small-scale irrigation development program, initiated by the Irrigation and Drainage Branch of the Ministry of Agriculture and largely dependent on external donor funding, has been quite successful in assisting farmers to obtain better water control at diversion points. Their approach, based on using low-cost technology, involvement of PIUs and farmers in all phases of the schemes' development, and system management by local farmers' organizations is desirable. However, the pace of development under the program has been very slow primarily because of limited funds and the limited number of technical personnel. To increase the pace of irrigation development, the capacity of both public and private sectors needs to be greatly expanded.

At the farm level, water use patterns are complex. Irrigated agriculture is only a part of the total production systems which are characterized by multiple activities. A farmer and his family may be simultaneously involved in irrigated agriculture for cash crops, rainfed agriculture for subsistence crops, raising livestock, and off-farm employment. Therefore, it can be expected that irrigation development at the farm level will be undertaken with caution. Farmers should be allowed to build on their own experiences with water management on the farm, and to develop at a pace that suits their capacity.

NOTES

[1]The IDB approach appears to be consistent with several recommendations such as: E. Walter Coward, Jr., 1984. "Improving Policies and Programs for the Development of Small-Scale Irrigation Systems." Water Management Synthesis II Project Report 27, Cornell University, Ithaca, NY; and H. W. Underhill, 1983. "Small-Scale Irrigation in Africa: Guidelines." Draft, Irrigation and Drainage Paper, FAO, Rome.

Chapter Five

AN ANALYSIS OF TECHNICAL MANPOWER NEEDS AND TRAINING ACTIVITIES IN SUPPORT OF SMALL-SCALE IRRIGATION DEVELOPMENT

Francis Gichuki

BACKGROUND

Whether a program of development can be achieved depends to a large extent on the availability of trained and experienced manpower. In many developing countries, otherwise sound plans have foundered because of a shortage of skilled manpower and failure to take vigorous steps necessary to alleviate the shortage.

Republic of Kenya Development Plan 1976-80

In Session Paper No. 4 of 1981 on food policy, the Kenya government envisaged the development of 200,000 hectares of irrigated land by the year 2006. The analysis of Kenya's irrigation development indicates that while much has been achieved in the last few years, much still remains to be done. One of the major constraints is the lack of well trained and experienced personnel in the GOK's irrigation program exacerbated by the high rate of attrition to the private sector and to other parts of the public sector. This calls for comprehensive and systematic manpower planning to determine the size and composition of the skilled manpower force needed and the identification of ways to retain them in service.

To develop and sustain irrigation projects requires organizations with the capacity to plan, design, implement, operate, and manage activities in the irrigation sector. These irrigation-related activities include assessing irrigation potential, drainage basin planning, irrigation project identification, feasibility

studies and design, financial management and construction, assisting farmer organizations, operation and maintenance of the project, research, training and extension, and concern with marketing.

Manpower—Requirements

The manpower requirements of an organization depend on the irrigation activities it conducts. This chapter will confine itself to the IDB/PIU units involved in small-scale irrigation development (see Chapter 1).

The general consensus is that Kenya is lacking in the quantity and quality of manpower needed for the irrigation development envisaged by the GOK. This is exemplified by the heavy component of technical assistance in the projects of the donor agencies. For example, 80 percent of the Netherlands Phase II contribution to the Small-Scale Irrigation and Drainage Project is spent on technical aid while the remaining 20 percent is spent on implementation.

Present Staff of the IDB/PIU Program

The IDB is charged with responsibility for planning, designing, and implementing small-scale irrigation and drainage projects. The lack of sufficient qualified staff and frequent staff changes have frustrated IDB's efforts to cope with the increasing number of project activities.

As discussed in Chapter 1, the responsibilities of IDB are carried out at the provincial level by Provincial Irrigation Units (PIUs). Due to the scarcity of manpower, districts with high potential for irrigation are given priority of staffing and funds. The IDB/PIU staffing pattern at present is as shown in Table 5.1.

Table 5.1: IDB/PIU Staffing Pattern

Designation	HQ	Province					
		Coast	Eastern	NE	CP	RVP	NY
Kenyan Staff							
Post-graduate	1	1	1		1	2	1
B.Sc.	2	2	2		2	4	3
TO	1	8	6		5	11	4
TA	2	11	14		11	16	4
Expatriate Staff (Dutch)							
Team Leader	1						2
Land and Water Management	1						
Civil Engineer	1						
Training	1						
Logistic	1						
Provincial Irrigation Engineer						1	1
Agronomist							1
Irrigation Extensionist						1	
Volunteers						2	

Shortage of Irrigation Development Manpower

Kenya's agricultural development after independence was centered on the high potential areas, formerly occupied by white farmers. Because of the large farm sizes in these areas and the lack of farm mechanization experience among African farmers, an initial emphasis in agricultural engineering was on farm mechanization training. In the mid-1970s, a major campaign for soil conservation required that manpower development for agriculturalists and engineers deal with this need. It was not until the late 1970s that the role of irrigation in agricultural development was realized and manpower development efforts were begun. It is for these reasons that the IDB/PIU finds itself with staff shortages at all levels.

Coping with the IDB/PIU Manpower Shortage

The farmers' requests for IDB/PIU technical assistance are increasing as the potential for irrigation in various parts of the country is realized. To deal with this increased demand with the present shortage of trained and experienced manpower, the IDB/PIUs might utilize a combination of the actions discussed below.

1. **Efficient utilization of the existing personnel.** While it is true that the shortage of trained and experienced manpower is a bottleneck in irrigation development, efficient utilization of existing staff can help alleviate this bottleneck. To illustrate this point, an analysis of engineers required to meet small-scale irrigation development targets for the period 1984-2003 is shown in Table 5.2. This shows the number of engineers that would be required for development of the proposed irrigation hectarage assuming varying levels of staff productivity.

Table 5.2 Requirements for Engineering Staff

Period	Proposed Development (hectares)	Engineer Productivity (hectares/yr.)	Engineers Required: IDB/PIU alone	Engineers Required: IDB/PIU and Private Sector 50/50
1984-88	8,000	5	320	160
		25	64	32
		50	32	16
		100	16	8
1989-93	14,000	5	560	230
		25	112	56
		50	56	28
		100	28	14
1994-98	19,000	5	760	380
		25	152	76
		50	76	38
		100	38	19
1993-2003		Same as 1994-98		

A number of actions could be taken to increase the productivity of the engineers. These include

1) using engineers only for engineering tasks;
2) improved support services; e.g., availability of support facilities, sufficient technical assistance from TOs and TAs;
3) training (on-job and formal);
4) incentives designed to increase productivity and retain them in service, e.g. promotion prospects;
5) working on a cluster of projects rather than projects scattered throughout the province (implementation by district-based technical teams).

2. Use of the private sector. With proper coordination, involvement of the private sector in the development of small-scale irrigation projects also can help alleviate the manpower shortage and accelerate the pace of development. Private sector firms may have the advantage of being cost-effective and being able to provide additional personnel in the irrigation sector as and when needed (assuming an ample supply from the training institutions). Their flexibility in manpower deployment would be useful especially now that the government has a budget ceiling that is constraining the number of jobs available in the IDB/PIUs. Greater private sector involvement could drain the public sector of the same experienced manpower but its working environment could increase their productivity. The disadvantages of private sector involvement include the lack of Kenyan firms able to undertake this task, their inexperience in working with farmers in certain activities and the need to increase the PIU's supervisory activities. Table 5.2 shows the requirement for engineers assuming a 50/50 mix of government and private sector involvement.

3. Accelerated training. The Government of Kenya has recognized the importance of education in economic development for a long time. This is exemplified by free primary and college education and the creation of more technical colleges and universities. The emphasis of Kenya's educational

curriculum is now related to the occupational requirements of rural inhabitants. This will provide much needed technical support to agriculture and other rural development activities at all levels. (Further discussion of specific training activities for irrigation development will be covered under training).

4. **Hiring expatriate staff.** With the acute shortage of experienced staff in irrigation development, expatriate staff will still be needed at least for the next five years. The Kenyan staff should therefore work closely with the expatriate staff who provide on-job training. The cost is high, but inevitable, considering Kenya's lack of irrigation manpower.

5. **Proper coordination among various agencies.** Presently there are many agencies involved in irrigation development. For example in Nyanza Province, the PIU, LBDA, MWD, and several NGOs are involved in irrigation development. Coordination of their activities so that different agencies specialize in certain geographic areas, or irrigation development activity, and later share the information with other agencies, would reduce the magnitude of the manpower shortage. Traces of this cooperation were seen in Nyanza where the LBDA specializes in overall Lake Basin Irrigation Development Planning and PIU is heavily involved with implementation. Involvement of District Agricultural Officer's (DAO) staff in project identification, prefeasibility study, and extension service would also relieve the pressure on PIUs.

6. **Expeditious provision of implementation funds.** Usually there is a long delay between the project feasibility studies and the final implementation. This is caused by bureaucratic delays in the allocation of funds for the project. For example, New Mutaro Womens' Groups made their application for assistance in

1978 and did not get funding until 1982 and the project (100 hectares) was completed in 1985.

TRAINING

Training Professionals

Population growth is creating an ever increasing pressure on land and is pushing people to areas outside the high-potential zones. Irrigation can play an important part in reducing the risk of food production in these areas. However, it was not until 1976 that attention in Kenya was paid towards specialized training in soil and water engineering. To deal with the increasing demand for irrigation development personnel the Ministry of Agriculture's Land Development Division has prepared a projection of training needs (Table 5.5 shows the 1984/87 staff training projections). To date a wide variety of training programs in irrigation engineering are offered at various levels. This following discussion reviews training institutions in Kenya and points out their weaknesses and strengths.

1. **University Training**. The University of Nairobi, Department of Agricultural Engineering, started a B.Sc. program in Agricultural Engineering in 1977. This B.Sc. program has about 20 contact-hours of soil and water engineering studies in the second year and 55 contact-hours in the third year. Those specializing in soil and water engineering receive an additional 50 contact-hours of advanced soil and water engineering studies. Due to the previous emphasis in agricultural mechanization, the soil and water engineering specialization did not attract many students. However with the present emphasis in irrigation development, the trend is changing (Table 5.3).

Table 5.3 University of Nairobi, B.Sc. Students in Agricultural Engineering

Year	Students	Students in Soil and Water Option	
		Number	Percent of Total
1983	16	7	44
1984	25	10	40
1985	15	7	47
1986	14	7	50

In 1976, the Department of Agricultural Engineering responded to the Ministry of Agriculture's demand for specialists in soil and water engineering. At that time the Ministry's irrigation training priority was in the area of management, operation, and maintenance of large schemes as opposed to its present priority of planning, design, and implementation of small-scale projects. The Department launched a one-year, post-graduate diploma program for B.Sc. Agriculture holders with two areas of specialization (Irrigation and Soil Conservation). Being a Diploma program rather than an M.Sc. program, it did not attract the best students, and, as a result, there was a high dropout rate. The number of students in this diploma program is shown in Table 5.4. The Department of Agricultural Engineering is now phasing out the post-graduate diploma program and will launch (1986) two M.Sc. programs, one for Irrigation Engineers and the other for Land and Water Management Specialists. This will help reduce the gap between the demand and supply of manpower oriented to irrigation design and research.

2. **Technical Level Training**. Technical staff required for irrigation development are grouped into two categories: Technical Officers (with three years post-high school technical training) and Technical Assistants (with two years post-high

Table 5.4: University of Nairobi; Post-Graduate Diploma in Irrigation/Soil Conservation: Enrollment and Output 1976-83

Year	Number of Students and Sponsoring Organizations						Number of Successful Participants			
	Ministry			Tanzanian						
	Agriculture	Water	NIB/PIU	Govt.	Other	TOTAL	Irrigation	Soil Conservation	Fail	Discontinued
1976-77	2	1	3	4	-	10	9	-	1	-
1977-78	8	-	-	2	-	10	3	5	2	1
1978-79	9	-	1	-	-	10	7	3	-	-
1979-80	10	1	-	-	1	12	8	3	-	1
1980-81	9	-	1	-	2	12	3	6	3	-
1981-82	6	-	-	-	1	7	-	4	-	3
1982-83	10	-	-	-	-	10	10	-	-	-

school technical training). Presently the institutions training technical officers are Egerton College, Jomo Kenyatta College of Agriculture and Technology, and Kenya Polytechnic. Institutions training technical assistants are Embu Institute and Bukura Institute.

Egerton College has been training technical officers for the Ministry of Agriculture since independence. These officers are, therefore, extension service oriented and serve as a good link between the farmer and technology. Jomo Kenyatta College of Agriculture and Technology and Kenya Polytechnic are oriented more towards design and construction. The technical assistant training institutions have different areas of emphasis. These areas include agricultural extension, water resources, survey, technical drawing, civil works, etc.

3. **In-service Training**. Most formal training programs are not well equipped to prepare engineers for the specific assignments they will undertake. This is especially true in small-scale irrigation development where formal design data are limited. In-service training is therefore expected to bridge this gap by preparing engineers to design technically sound and economical small-scale irrigation systems based on a modest collection of formal data and a high input of locally provided information and experience. The IDB/PIUs, with the help of the Dutch government, have embarked on an ambitious program of upgrading staff through in-service training. This training is specifically oriented to small-scale irrigation schemes with emphasis on low-cost technology. The training program pursues three lines of activities: 1) Preparation of manuals, demonstration materials, etc., 2) Training courses and seminars, and 3) On-the-job training.

Training courses for the technical staff are divided into two categories: senior and junior staff training. The courses offered cover such topics as soils, plants and water, field level water management, scheme water management, and

investigations and measurements. Each topic is covered in one to two weeks and is offered at the provincial level for both senior and junior staff. Courses offered specifically for senior staff include scheme identification and evaluation, scheme design, hydraulic structures, and farmer participation and extension. They are all field oriented and last one week each. In addition, seminars for decision makers at the district and division level, as well as for irrigation and extension staff, on both guidelines for small holder irrigation and water supply and distribution and irrigation methods for small holders, are being organized and implemented.

The expatriate staff are also charged with the responsibility for training the Kenyan counterparts on the job. Local staff who have several years of experience also help orient new graduates on various ways and means of going about their day-to-day activities. A good working relationship is the key to the success of such a training program. In all the areas we visited there was evidence of an effective on-job training program.

Farmer Training and Extension

The success of small-scale irrigation schemes also depends on the involvement of the community that owns and manages it. Proper training on community resource mobilization, organization and management of water users' associations, on-farm water management, operation and maintenance of the delivery system, crop water requirements, irrigation scheduling, agronomic practices, record keeping, financial management and marketing are indispensable. The IDB/PIUs, District Agricultural Officers, Ministry of Cooperative and Social Services, and NGOs are currently tackling one or more of the above mentioned training activities for farmers.

Table 5.5 IDB/PIU Staff Training Projections

Design/Post/Cadre	Total No. to be trained	Total No. in Post	Where to train		Duration (Year)	Source of Finance	Distribution				Proposed Courses (Specify)
			Local	Outside			84	85	86	87	
1. Agronomy	7	19	Nairobi	Common-wealth countries, U.S.A., Others	1-2	GOK-Local	1	2	2	2	M.Sc.
2. Agro-Economics	1	1	"	"	3	"	-	-	1	-	Ph.D.
	10	22		"	1-2	"	1	3	3	3	M.Sc.
3. Agricultural Engineering	11	6	"	"	1-2	"	-	-	-	1	Ph.D.
	18	35	Egerton		1-3	"	5	5	4	4	M.Sc.
	45	123	JKCAT		2-3	"	3	14	14	14	B.Sc.
	25	60				"	6	6	6	7	Diploma
4. Mechanical Engineering	4	15	Nairobi Univ.	Common-wealth countries, U.S.A., Other	1-2	"	-	-	2	2	M.Sc.
	6	34	"	"	1-2	"	1	1	2	2	B.Sc.
5. Mechanisation	5	24	"	"	1-2	"	-	2	2	1	M.Sc.
	10	25	"	"	2-3		-	3	3	4	B.Sc.
6. Soil & Water Management	5	12	"	"	1-2	"	-	2	2	1	M.Sc.
	10	25	Egerton	"			-	3	3	4	
7. Land Surveying	2	5	Kenya	German	2-3	"	-	-	1	1	N.H. Diploma
	10	25	"	"	3	"	-	3	3	4	Diploma
	12	44	"	"	3		-	4	4	4	Technical Certificate
8. Draughtsman	24	30	Kenya		2-3	"	-	8	8	8	Technical Certificate
	14	18	Poly.		2-3	"	-	4	5	5	Ordinary Diploma

Table 5.5 continued

Design/Post/Cadre	Total No. to be trained	Total No. in Post	Where to train: Local	Where to train: Outside	Duration (Year)	Source of Finance	Distribution 84	85	86	87	Proposed Courses (Specify)
9. Instrument Engineering	6	20	Kenya Poly.		1-2	GOK-Local	-	2	2	2	Technical Certificate
10. Hydraulic/Civil Engineering	2	18	Nairobi	Commonwealth Countries U.S.A. Others		GOK Donor	-	-	-	1	M.Sc. B.Sc.
	12	15	"	"	3		-	4	4	4	B.Sc.
	15	20	"	"	3		-	5	5	5	Diploma
11. Soil/Water Engineering	4	25	Nairobi	U.S.A.	1-2	GOK Donor	-	4	3	3	M.Sc. /P.G.Diploma
	10	42	Uni.	Common-wealth	2-3	"	-	4	3	3	B.Sc.
12. Staff Training Administration	1	3	"	"	1-2	"	-	1	-	-	M.Sc. Agric. Education
13. Instrument Tech.	3	8	Kenya Poly.	-	1	"	-	1	1	1	Technician Certificate
14. Fitter Turner	20	120	MTC		1/2	"	-	6	7	7	Trade Test 111-11-1
15. Plant Mechanic	40	90	MTC	-	2-3mo.	"	-	16	16	16	Basic Training
	40	50	Staff	-	3mos.	"	-	13	13	14	Trade 11-1
	6		T. School		2mos.	"	-	2	2	2	Specialist Certificate
16. Motor Vehicle Mechanic	40	120	MTC Staff Training		2mos	GOK	1	13	13	14	Trades 111-11-1
17. Plant Operator.	40	250	In-service staff training	MTC	2mos 3mos	"	-	13	13	14	Specialist Trade Tests 111-11-1
18. Levellers (Farm Mapping)	40	250	In-service Survey of Kenya		3mos.	"	-	13	13	14	Trade Test 111-11-1

Donor Involvement in Training

Donor contributions to training local staff will have a lasting impact. Most, if not all, of the training institutions were established with the help of donor agencies, the major donors being USAID and the Netherlands. USAID helped in Africanization of the faculty at Egerton College after independence and has now just completed a major expansion program. The Government of the Netherlands helped in staff development and provision of facilities and equipment of the departments of Crop Science and Agricultural Engineering at the University of Nairobi. Other donor agencies have also helped by providing scholarships for local and foreign study.

Staff Development and Retention

Manpower development and training are vital components of personnel development and utilization but do not necessarily guarantee increased productivity. To create and sustain a high level of productivity, trained manpower must be adequately remunerated and provided both with a scheme of rewards that recognizes service and hard work and a working environment with adequate facilities for effective performance. These conditions will help reduce the high staff turnover that the IDB is currently experiencing.

To maintain the staff morale it is important to have a program of professional development. The Ministry of Agriculture and Livestock is mandated to develop agriculture and as such the professional development and scheme of service is designed for professional agriculturalists. This can frustrate engineers who also are given the title of agriculture officers. They miss the recognition of being engineers which is given to their fellow engineers in other Ministries and in the private sector. Recently, a scheme of service for engineers has been introduced in the MOALD and is expected to help retain them in service.

While a scheme of service exists for University graduates, Technical Officers (TO) and Technical Assistants (TA) have been left out in the cold. Only a limited number of TAs are upgraded to TOs by training them at Egerton College, Jomo Kenyatta College of Agriculture and Technology, or Kenya Polytechnic. An even smaller number of TOs get upgraded due to the competition for university placement and rigid entry requirements in the University of Nairobi (enrollment is mainly A-level school leavers) and limited scholarships for overseas training. It is hoped that Egerton College will undertake this vital task of upgrading TOs when it attains university status in 1986.

Some Training/Recommendations

The following two suggestions derive from the prior analysis:

1. Manpower development is a major investment and would only be meaningful if such manpower was adequately deployed, motivated, made productive, and adequately supported and rewarded. This strategy will help alleviate the manpower shortage and reduce Kenya's dependance on expatriate staff.

2. The question of the manpower shortage should be carefully analyzed to determine the role the private sector, other government agencies, and NGOs can play in alleviating this shortage, and also to determine changes in education curriculum and specialized areas of training. Kenyan consultants and contractors should be lured into small-scale irrigation development so as to develop local expertise.

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APPENDIX 1:
ORGANIZATIONS AND PEOPLE CONTACTED

1. Ministry of Agriculture and Livestock Development

   a) Headquarters (Nairobi)
      Mr. G. Mwangi, Deputy Planning Officer
      Mr. Were, Head, Crops Division

   b) Irrigation and Drainage Research Section
      Mr. P.N. Mugwanja, Deputy Officer in Charge

   c) IDB (Headquarters - Nairobi)
      Mr. Osoro, Head
      Mr. Van Gessel, Dutch Team Leader
      Mr. P. Scholtema, Training Officer

   d) Lakipia District Agricultural Office
      Miss Ann Nyaga, Land Development Officer
      Miss Ann Marie, Dutch Student

   e) PIU (Rift Valley)
      Mr. Knopps, Privincial Irrigation Engineer
      Mr. N. Nyaga, Deputy Officer in Charge PIU
      Mr. Bakker, Irrigation Extensionist

   f) PIU (Nyomza Province)
      Mr. L. Munyikombo, Officer in Charge PIU
      Mr. S. Povel, Provincial Irrigation Engineer
      Mr. D. Giithae, Agricultural Engineer
      Mr. O. Olhieng, Agricultural Engineer
      Mr. Begien, EEC (Small Holder Rice Scheme)
      Mr. B. Kuichangh, Extension Officer PIU
      Mr. O. Oremo, Advisor, Nyandusi Irrigation Scheme

   g) PIU (Coast)
      Mr. J. Machoki, Officer in Charge PIU
      Mr. B. Otieno, Agricultural Engineer
      Mr. M. Mbogo, Agricultural Engineer
      Mr. D. Mulagui, Senior Technical Assistant (Wundanui)

   h) Mitunggu Irrigation Scheme
      Mr. Grimm, Project Manager
      Mr. Njuguna, Co-Project Manager

   i) NIB (Mwea)
      Mr. Modha, Manager
      Mr. Kobe, Irrigationist

2. Ministry of Water Development
   Mr. Jos. Kalders, Head of Irrigation Section

3. Lake Basin Development Authority
   Mr. D. W. Nasokho, Chairman
   Mr. B. Obura, Managing Director
   Mr. D. Mshila, Planning Officer
   Mr. A. O. Omoto, Agriculturalist
   Mr. J. Mbugua, Irrigation Engineer
   Mr. O. Oduk, Irrigation Engineer

4. Tana River Study Team
   Dr. Scudder
   Dr. Peter Little
   Dr. Shem Migola

5. Training
   Dr. Peter Misiko, Egerton College
   Mr. D.B. Thomas, University of Nairobi
   Mr. P. Lenshink, University of Nairobi

6. NGOs
   Mr. P. Kimura, NCCK
   Mr. M. Mbugua, General Secretary KFFHC

7. Financial Institutions
   Mr. P.N. Gitau, Kenya Commercial Finance Corporation

APPENDIX 2:
SMALL-SCALE IRRIGATION IN KENYA —A SELECTED BIBLIOGRAPHY

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WATER MANAGEMENT SYNTHESIS PROJECT REPORTS

WMS 1 Irrigation Projects Document Review

Executive Summary
Appendix A: The Indian Subcontinent
Appendix B: East Asia
Appendix C: Near East and Africa
Appendix D: Central and South America

WMS 2 Nepal/USAID: Irrigation Development Options and Investment Strategies for the 1980's

WMS 3 Bangladesh/USAID: Irrigation Development Options and Investment Strategies for the 1980's

WMS 4 Pakistan/USAID: Irrigation Development Options and Investment Strategies for the 1980's

WMS 5 Thailand/USAID: Irrigation Development Options and Investment Strategies for the 1980's

WMS 6 India/USAID: Irrigation Development Options and Investment Strategies for the 1980's

WMS 7 General Asian Overview

WMS 8 Command Area Development Authorities for Improved Water Management

WMS 9 Senegal/USAID: Project Review for Bakel Small Irrigated Perimeters Project No. 685-0208

WMS 10 Sri Lanka/USAID: Evaluation Review of the Water Management Project No. 383-0057

WMS 11 Sri Lanka/USAID: Irrigation Development Options and Investment Strategies for the 1980's

WMS 12 Ecuador/USAID: Irrigation Sector Review

WMS 13 Maintenance Plan for the Lam Nam Oon Irrigation System in Northeast Thailand

WMS 14 Peru/USAID: Irrigation Development Options and Investment Strategies for the 1980's

WMS 15 Diagnostic Analysis of Five Deep Tubewell Irrigation Systems in Joydebpur, Bangladesh

WMS 16 System H of the Mahaweli Development Project, Sri Lanka: 1980 Diagnostic Analysis

WMS 17 Diagnostic Analysis of Farm Irrigation Sysems on the Gambhiri Irrigation Project, Rajasthan, India: Volumes I-V

WMS 18 Diagnostic Analysis of Farm Irrigation in the Mahi-Kadana Irrigation Project, Gujarat, India

WMS 19 The Rajangana Irrigation Scheme, Sri Lanka: 1982 Diagnostic Analysis

WMS 20 System H of the Mahaweli Development Project, Sri Lanka: 1983 Diagnostic Analysis

WMS 21 Haiti/USAID: Evaluation of the Irrigation Component of the Integrated Agricultural Development Project No. 521-0078

WMS 22 Synthesis of Lessons Learned for Rapid Appraisal of Irrigation Strategies

WMS 23 Tanzania/USAID: Rapid Mini Appraisal of Irrigation Development Options and Investment Strategies

WMS 24 Tanzania/USAID: Assessment of Rift Valley Pilot Rice Project and Recommendations for Follow-On Activities

WMS 25 Interdisciplinary Diagnostic Analysis of a Work Plan for the Dahod Tank Irrigation Project, Madhya Pradesh, India

WMS 26 Prospects for Small-Scale Irrigation Development in the Sahel

WMS 27 Improving Policies and Programs for the Development of Small-Scale Irrigation Systems

WMS 28 Selected Alternatives for Irrigated Agricultural Development in Azua Valley, Dominican Republic

WMS 29 Evaluation of Project No. 519-0184 USAID/El Salvador, Office of Small-Scale Irrigation - Small Farm Irrigation Systems Project

WMS 30 Review of Irrigation Facilities, Operation and Maintenance for Jordan Valley Authority

WMS 31 Training Consultancy Report: Irrigation Management and Training Program

WMS 32 Small-Scale Development: Indonesia/USAID

WMS 33 Irrigation Systems Management Project Design Report: Sri Lanka

WMS 34 Community Participation and Local Organization for Small-Scale Irrigation

WMS 35 Irrigation Sector Strategy Review: USAID/India; with Appendices, Volumes I and II (3 volumes)

WMS 36 Irrigation Sector Assessment: USAID/Haiti

WMS 37 African Irrigation Overview: Summary; Main Report; An Annotated Bibliography (3 volumes)

WMS 38 Diagnostic Analysis of Sirsia Irrigation System, Nepal

WMS 39 Small-Scale Irrigation: Design Issues and Government Assisted Systems

WMS 40 Watering the Shamba: Current Public and Private Sector Activities for Small-Scale Irrigation Development

WMS 41 Strategies for Irrigation Development: Chad/USAID

WMS 42 Strategies for Irrigation Development: Egypt/USAID

WMS 43 Rapid Appraisal of Nepal Irrigation Systems