

XI WATER MANAGEMENT

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Water management
Review, irrigation, agricultural growth, self-sustaining systems,
resource base

SVENDSEN, M.

Sustainability in irrigated agriculture.

entwicklung + ländlicher raum, 24, 3, pp. 12-15, 1990

This article attempts to bring some focus to the discussion, particularly as it concerns irrigated agriculture, by suggesting some central features which characterize sustainability and identifying two significant dimensions which help to define it. Sustainability is a systems' concept, applying to a set of elements which interact in some regular and interdependent fashion. In this context, it refers to productive systems - those generating outputs valued and used by people. Moreover, sustainability is, by its nature, a feature of a dynamic system, since it implies a statics or balance among opposing forces or trends.

With respect to irrigated agriculture, three broad topical areas are suggested as a first-level classification of sustainability issues. firstly, the sustainability of past rates of growth in production and productivity. This goes beyond a focus on a particular irrigation system or system type and ties sustainability firmly to the economic well-being of the nation. It also allows examination of a wider range of trade-offs between the pace of new system construction and the long-term rates of change in production for existing irrigation schemes.

The second area is that of self-sustainability. This is a topic focused explicitly on policies and institutions and contains two nested levels of generally. The first level relates to the sustainability of the functioning of irrigation systems. It is suggested that the matrix of institutions and incentives that control irrigation systems is, in many cases, the limiting factor in performance and that concern for sustainability should approach this constraint directly, as well as through new operational rules and technology. The second level concerns the whole of the change process. The longer range answer to the challenge of sustainability is the development of a set of institutions which work together to provide the capacity to deal with change - assessing and evaluating evolving situations and problems and developing solutions to them.

The third area of concern is the interaction of irrigation with the physical resource base. This set of issues includes those most traditionally associated with problems of sustainability in irrigation - waterlogging, salinization, and reservoir siltation. And while these are clearly pressing problems, it is likely that to develop and implement solutions to them, the net must be cast more widely to include the institutional and policy framework as well.

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90 - 11/21

Water management
Review, developing countries, tropics, management systems, water
delivery, farmers, water users, water allocation

BARROW, C.

Systems of water management in the tropics.

In: Water Resources and Agricultural Development in the Tropics,
Ed. C. Barrow, Longman Scientific & Technical, Longman Group UK
Ltd., Longman House, Essex CM202JE, England, ISBN 0-582-30137-8,
1987, pp. 102-133

A typical water resource/agricultural system might comprise six subsystems 1) goals and objectives; 2) the core of the system, or the input-output mechanism; 3) decision making, and controllable inputs to the core; 4) exogenous factors or uncontrollable inputs (e.g. weather, the state of the world economy; price levels), 5) outputs or outcomes; and 6) evaluation of outputs or a feedback-and control unit.

The six subsystems could also be subdivided; for example, the core (2) could be divided into demand and supply components. The demand component could be further subdivided into agricultural, domestic, industrial. The supply component could be subdivided into sources (of water and salinity), the conveyance system and the disposal system for removing excess water and salts.

The water resources/agriculture management continuum has a number of levels: the national; the regional (watershed/river basin); the subregional (project); the subproject (water user's group, irrigation district, village unit and so on); the individual water user; the field or plot level.

The irrigation management or development of rainfed cultivation decision variables and environmental conditions are generally considered first, then, exogenous variables are related to target variables.

Some users acquire water by contract or agreement, i.e. they agree supplies from a supplier in exchange for payment, goods, services or an undertaking to market produce through a specific channel. When users have direct access to water, authorities can have considerable difficulty monitoring and controlling water use. They may be able to tax produce, tax the farmer on the hectare he sows or irrigates, restrict size and number of pumps owned, issue licences and/or control fuel and electricity supplies, but more often water consumption is loosely controlled. However, where a supply authority conveys water to a group of users by canal or pipeline, or where groundwater is deep and can only be exploited with government-sunk boreholes, control of water use is possible. Canal supplies in particular can be adversely affected by poor management and by the misbehaviour of water users when management is slack.

The article refers in particular to the:

- Managing irrigation supply/conveyance systems
 - . Water delivery
 - . Scale of irrigation management
 - . Interaction between government and farmers
 - . Communications between water supply authorities
- Administrative structures:
 - . Bureaucratically-managed water allocation
 - . Case-study of the Senegal River Delta
 - . Community-managed water allocation
 - . Bureaucratic-community-managed water allocation
 - . Paying for water supplies

Although a large part of funds spent on developing water resources to improve agriculture has been spent on irrigation projects supplied by canal conveyance and distribution systems, many of the farmers of developing countries depend on natural rainfall, shallow groundwater or the diversion (and sometimes small-scale storage) of water from springs, streams or rivers flowing through or past their land. Cultivators with direct access to a stream, spring, river or well have little or no dealings with supply authorities and enjoy therefore considerably more independence.

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Water management

Review, book, Africa, Sahel, Senegal, irrigation techniques, CTA

DIEMER, G. and E. VAN DER LAAN

Irrigation in the Sahel - The crises of irrigated areas and the haalpulaar course. (L'irrigation au Sahel - La crise des périmètres irrigués et la voie haalpulaar)

Ed. Karthala 22-24 Boulevard Arago, 75013 Paris, France in association with CTA, Postbus 380, 6700 AJ Wageningen, Pay-Bas, ISBN 2-86537-193-X, 1987

A number of recent studies on the evaluation of the development aid in Africa come to the conclusion that, very often, the efforts of development do not produce lasting results. For social sciences, one of the main reasons for this state of affairs lies in the frequent inadequacy of technical assistance to the systems of production applied by rural African population.

The authors of this book give an illustration by describing the irrigation techniques in the Sahel. Far from limiting themselves to only one aspect, they show equally by recalling the village irrigation systems in the valley of Senegal. An occidental technique has no chance of working unless the local population has the possibility of integrating it in its own socioeconomic frame.

"Irrigation in the Sahel" has a very special meaning for this region with limited physical potential, because the irrigation as it is described in the book contributes to a lasting solution i.e. the nutritional problem of a fast growing population. The book should be read by those who take decisions, technicians and those who distribute funds.

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Water management
Latin America, Dominican Republic, on-farm water management,
project, USAID, DESFIL

HANRAHAN, M.

On-farm water management in Dominican Republic.

The DESFIL Newsletter, IV, 1, 1990, 2 p.

The On-Farm Water Management Project is an initiative sponsored by USAID and carried out in collaboration with the Instituto Dominicano de Recursos Hidráulicos (INDRHI), a government agency in the Dominican Republic. The project, which was instituted in 1983, has sought to strengthen Dominican capacity to plan and manage irrigation systems, increase the productivity of irrigated agriculture, and rehabilitate lands adversely affected by waterlogging. Targets are the Azua (YSURA) and Santiago (PRYN-I) irrigation systems, which total 14,400 hectares and serve 6,000 farm families.

By the early 1980's, INDRHI had recognized the benefits of turning over portions of the irrigation systems to users, but early attempts to implement the transfer fared poorly. By late 1986, USAID, emphasizing privatization and democratic participation, linked the formation of water-user organizations to transfer, providing impetus to a process already acknowledged by the government.

To accomplish its objectives and foster privatization and democratization, the project (1) made improvements to irrigation and drainage infrastructure in the two irrigation systems; (2) assisted in the formation of local organizations with the capability to manage the systems; (3) facilitated turnover, by which responsibility for operations and maintenance was transferred from a public sector agency to private sector associations of irrigators known locally as Juntas de Regantes; and (4) provided technical assistance, equipment, and machinery in support of the first three activities.

By 1990, the project had fostered the formation of two juntas, 12 associations, and 234 nuclear groups in which grassroots control and democratic participation were the rule.

With important exceptions, the irrigation and drainage infrastructures are now complete. Timely and reliable water deliveries are being made to most parcels in the irrigation system. For many farmers at the tail end, this has meant that constraints on water delivery were eliminated as the principal limitation to agricultural production. Approximately 300 hectares were brought under irrigation for the first time.

Coincident with an increase in the area reliably served, the project achieved a decrease in the amount of water delivered to Azua. The effects were an increase in efficiency of water use and improved conditions in the water table in the lower portions of the system. The reduction in the volume of water delivered, together

with improvements in the drainage facility that are of direct benefit to 800 hectares in both systems, is estimated to have improved 2,000 hectares that were previously waterlogged. In the future, this change is expected to augment the productive area inside the scheme, abate salinity, and positively affect the productivity of the land.

The project has important implications for institutional arrangements appropriate to smallholder management of on-farm water. Future USAID support to the Dominican Republic's irrigation sector is expected to emphasize transfer of the control of systems to water-user organizations and democratic empowerment, following the project model. INDRHI is expected to support this change and to refocus its attention on the technically exacting tasks of constructing and managing dams, large impoundments, and main canals. Meanwhile, the water-user organizations of the project are still embryonic, in spite of their impressive achievements. These organizations are likely to require attention, including limited, highly focused financial support, for some time to come.

Abstract from DESFIL

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90 - 11/24

Water management
Latin America, Andes, review, literature, bibliography, GTZ

URBAN, K.

Bewässerung in den Anden - Eine kommentierte Literaturübersicht.
(Irrigation in the Andes - A commented review of literature).

Sonderpubl. der GTZ Nr. 241, 6236 Eschborn, Postf. 5180, ISBN 3-88085-421-1, 1989, 101 pp., Distribution: TZ-Verlagsgesellschaft mbH, Postf. 1164, 6101 Roßdorf, F.R.G.

The search for new strategies in the integrated development of rural development on the Latin-american continent has brought the "Irrigation in the Andes" into focus.

International evaluation of the irrigation projects in the Andes up to now seem to show that in the past the problem were very often found to be in the organizational and socio-economical. Quite often one would find that framework conditions the terraces that had been established with few technical and financial means were not being used or little used. This was the starting point to find out how irrigation concepts in the Andes had to be planned and organized to get the active cooperation of the population. Nobody started to look at the long neglected question which role the traditional organization of irrigation could play. "Remnants" of these fundamentals of the traditional agriculture of the Andes still exist today in form of collective work (mingas, faenas) that clean and maintain the canals, in form of the communities in the Andes who are responsible in cases of conflict, the "Juezes da Aguas", and also in form of traditional practices in water distribution which are still working today.

All this has led to a number of publications on this topic in the last years. It is the aim of this work to examine the literature and to introduce it to the reader in this review.

This commented bibliography is the result of five weeks search through the literature that has been done in august and September in 1988 in Peru, Bolivia and Ecuador. It is the aim of this work to examine all the available publications (including so called "grey" literature) on "Irrigation in the Andes" and to add it to the commented review after selecting it.

This report contains a review of the literature and two bibliographies. The first bibliography is commented and introduces more fully the documents that have been found relevant with the crucial issues. The second bibliography contains only a few annotations. These are publications that seemed less important or that could not be commented on for various reasons. Newly published literature was taken into consideration as well as the so called "grey" literature from public administrations and projects. Because of the many new publications much care was taken to include specifically the publications of the 1980ies.

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Water management
Review, book, surface irrigation, systems, practical condition

KAY, M.

Surface irrigation: systems and practice.

Cranfield Press, Bedford, UK, 1986, 142 pp.

This book deals with surface irrigation. This is the major type of irrigation and is likely to remain so for some considerable time. The other categories of irrigation are trickle and sprinkler and the author has already published a companion volume 'Sprinkler Irrigation: equipment and practice' (Bedford, UK).

The present book is aimed at the practical man in the field but many disciplines will find it a very useful and instructive source of information. Even for the only marginally interested reader, it provides a succinct introduction to and coverage of the principles of the subject. It does not, however, contain references to further reading. It is well illustrated by numerous photographs which, though they are not reproduced to a particularly high standard, they are supported by excellent line drawings.

There are 13 chapters starting with an overview of the book's content, followed by a discussion of hydraulics showing how water moves in different soil types and the importance of balancing flow rate and run-off during irrigation. Also described is infiltration and deep percolation of the soil so as to achieve good water distribution throughout the root zone of the crop. An easily-constructed working model is described for use in demonstrating the above points.

The three main subjects of surface irrigation are basin, border and furrow irrigation and each is discussed in a separate chapter. In each case, the effect of and interrelationships between soil type, stream size or the volumes of water required, the irrigation depth, land slope, farming practice and crops being cultivated are evaluated. For example, the shape, spacing, length and slope of furrows is described showing how the infiltration and wetting pattern will be affected by soil type with desirable for possibly disastrous effects on the crop in question. How advantage can be taken of the furrow side slope to maximize solar radiation and enhance crop growth is also described. The factors to be taken into consideration in choosing an irrigation method are discussed and include topography, soils, crops and not least, the availability of local labour and their particular skills. The faults that can develop in each type of surface irrigation are also noted.

Good land preparation is most important for efficient surface irrigation. The cutting or removal of soil from high ground to fill hollows must be done very accurately to achieve and maintain the correct, sometimes imperceptible, slope of the land. The time-honoured skills of the surveyor and operator of the planing and grading machinery are mandatory in this exercise. Although, more recently, the use of laser beams set parallel to the land surface

which are used for controlling the height of the cutting blade of the land plane, for example, now permit the most accurate levelling of the soil surface. Even so, problems can still arise in newly irrigated areas with soil settlement and recurrent land preparation may be necessary in the first few seasons.

Two chapters are devoted to the important subjects of operation and maintenance. The best designed and constructed schemes cannot function efficiently if these aspects of good management practice are not rigorously attended to. The author points out that the inability to carry out these tasks properly is regrettably the cause of many of the problems seen in irrigation in developing countries; in nations where efficient and productive farming is most needed.

While irrigation brings undoubted benefits, this book calls the attention of irrigation engineers and management to the very important disadvantages of water-borne diseases such as schistosomiasis and malaria. Their prevalence has been increased by irrigation, not only by providing the watercourses, which are excellent habitats for the snail and mosquito vectors, but also in the inevitable concentration of the human work force and their families into the area. Also by commonly siting worker's villages close to infected water without providing adequate and well-maintained clean water supplies and sewage disposal.

It is much to the credit of this book and its author that it covers a wide range of ideas and principles in a relatively small number of pages and in a direct manner, such that even those not immediately involved in the practice of irrigation, will feel they have gathered a large measure of knowledge of the subject. Real life practitioners will also have much to gain from it.

Abstract by J. Duncan, UK

Water management

Africa, developing countries, Transkei, Ciskei, irrigation projects, case studies, management, human factors, agricultural production, institutional constraints, socio-economy, culture, tradition, inputs, research needs

BEMBRIDGE, T.J.

Problems and lessons from irrigation projects in less developed countries of Africa.

Development Southern Africa, 3, 4, 1986, 19 pp.

This paper reviews important constraints to the development of small-holder irrigation schemes in less developed areas of Africa. It is based on two case studies from Southern Africa and experience elsewhere on the continent. Lessons from past experience and the institutional and human development considerations required for successful projects are discussed.

Regardless of the size an irrigation scheme, a survey of the literature on Third World irrigation projects, and in Africa in particular, shows that with few exceptions the economic success of irrigation projects falls far short of the expectations of planners, politicians and development agencies. Even on the few relatively successful projects there appear to be increasing social and ecological problems which will eventually have negative economic effects.

At present irrigation plays a rather insignificant role in African agriculture. Of Africa's 150 million hectares of cultivated land, only about 9 million hectares are under irrigation. Of this, approximately 75 per cent is in Egypt, the Sudan and Madagascar.

Small-holder irrigation in Africa is generally characterized by low productivity. Persistently low performance on irrigation projects poses one of the biggest problems for planners, policy makers, financing agencies, managers and participants alike. As African nations face a continuing decline in per capita food production, increasing priority is being given to irrigation development. National development plans of countries such as Kenya and Zimbabwe, as well as some of the independent South African states, such as Ciskei, Transkei and Venda, emphasize the role of small-holder irrigation development for food as well as rural development.

By its very nature, irrigation development is particularly prone to human problems. This is because the introduction of irrigation commonly necessitates a change in the way of life of those participating in irrigation projects, making it difficult for planners to predict future human behavior.

This review, faced as it was by space considerations, has been somewhat too generalized to make sweeping conclusions. However, considering available literature and the two case studies reviewed in this paper, it can be concluded that success depends on integration between technology, management, participants and the socioeconomic situation. Poorly planned projects suffer from lack

of such integration, especially in the field of management, organization and implementation. The institutional environment in which irrigation takes place has received little attention from irrigation planners. Infrastructural development and economic constraints are rarely so bad as to cause collapse of the project. The causes of the lack of success of individual irrigation projects in Africa are complex. One of the problems is the one-sided emphasis on the technical components of projects. At the basis of this is the attitude of many project planners and managers who primarily measure the success of projects according to physical development and agricultural production. Such a viewpoint neglects the fact that projects have not only a technical but also an equally significant socioeconomic character. In view of this it makes sense to regard development projects as socio-technical systems which can only be deemed to be successful when all persons and groups concerned co-operate effectively and satisfy their objectives. This co-operation will vary according to the type of project.

On the basis of this review and experience in Africa, certain prerequisites for successful small-holder irrigation development have been defined:

- Institutional requirements
- Human development

The importance of engineering, agronomy and soils' research are not being minimized; nevertheless this paper has shown that in less developed countries institutional, social and economic aspects are generally responsible for poor performance and therefore require more research.

Retrospective studies of management and performance could be integrated into any technical or socioeconomic rehabilitation which may be required.

In the long run, there is a need for integration of evaluation research at successive stages of a project. It is vital that mechanisms be developed for proper assessment and evaluation to modify projects when necessary, as well as avoid unnecessary expenditure on projects which are doomed to failure.

Water management

Review, manual, basin, irrigation, smallholder, on-farm management, water supply, farmer participation, organization, physical requirements, canals, water distribution

SCHELTEMA, W.

Smallholder irrigation manual.

Ministry of Agric. and Fisheries-Agric. Education Departm., P.O.B. 20401, 2500 EK The Hague, The Netherlands

Irrigation at farm level means giving a crop enough water for it to grow; at scheme level it means the proper and fair distribution of available water; and above that it may mean negotiating the rights to use water from a river or other source. Irrigation covers a wide and complex range of activities, not just the application of water to a field.

"Smallholder Irrigation Manual" focuses on irrigation schemes which are operated and managed by farmers themselves. For the purposes of this book, a "smallholder" is someone who farms anything from a vegetable garden to a few hectares. The prime concern of the manual is basin irrigation, which is the simplest and most widely used method in most Third World countries.

The manual is divided into two volumes, the first concerned with extension (on-farm management, water, supply, farmer participation and organization); the second with design (physical requirements, canals, water distribution and measurement, and the waterhose level.

Abstract from SPORE

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90 - 11/28

Water management

Review, book, guiding principle, irrigated agriculture, system management, BMZ, GTZ

HUPPERT, W. and H.J. WALKER

Management von Bewässerungssystemen: Ein Orientierungsrahmen. (Management of irrigation systems: a guiding principle).

BMZ, Eschborn, Handbuchreihe Ländliche Entwicklung, ISBN 3-88085-370-3, 1988, 115 pp., sold by: TZ-Verlagsgesellschaft mbH, Postf. 1164, D 6101 Roßdorf, F.R.G.

Irrigated agriculture is a major economic factor for a number of developing countries. In face of a high population growth rate and the resulting demands for food and agricultural primary products the responsible politicians of the third world have put great hopes during decades in the efficiency of irrigated agriculture.

Aspects of irrigation system management have not been considered enough in the past. This guiding principle should help to diminish this deficit.

As this guiding principle regards the irrigation systems only with respect to its management, the specific technical aspects of irrigation will only be spoken of if they are relevant from the management point of view.

This book tries to do justice to a few management specific situation types. These types of situations are deducted with the help of situation factors they have tendentially on the management of the systems.

For each of the chosen situation types a typically ideal, management specific project conception will be developed, that can serve as a "management compass" to those involved with the information and management of their project.

What does this mean to the user of this guiding principle? With the help of the deducted situation factors, planners and decision takers should be able to find which "place" their project has in respect to the situation.

Accordingly, this guiding principle is mostly for those persons in institutions who work with the identification, planning and guiding of irrigation projects or who are responsible in the sense of strategic management advisers.

The importance of strategic management for the formation and guidance of a system is dependant on the strategic management being supported by a corresponding operative management. The frame work orientation has to be completed as soon as possible by developing working materials for the operative management. This is to be done in form of a working script.

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Water management

Review, book, Africa, Sahel, water management, techniques, Terres et vie, ENDA

CHLEQ, J.-L. and H. DUPRIEZ

Métiers de l'eau du Sahel. (Water management in the Sahel).

Ed. Terres et Vie, Belgique, en association with ENDA, Senegal and L'Harmattan, France; 1989, 127 pp., distribution by: Ed. Terres et Vie, Rue Laurent Delvaux, 13, 1400 Nivelles, Belgique

The development of "water management" is one of the ways that enables young people to find a useful employment in a village especially during the dry seasons. These activities do not need great means. They can be practiced within the village depending on the needs. They are particularly efficient because if there is water life is active in the Sahel.

This is the object of this book: rural crafts centred on water problems could take an important place in the context of the villages of the Sahel. They are a direct and indirect source of income: direct source for the craftsman, indirect source for the cultivators and breeders who profit from the water resources on their lands thanks to the advice and work of their craftsmen.

This book is written from a long human experience in the Sahel of Volta: a close working together of the villagers, craftsmen and technicians. Together they were looking for solutions to the problems posed by the disappearance of water, through its use and through its exploitation. What is interesting in this experience of the Groupement des Artisans Ruraux du Yatenga (G.A.R.Y.) is the progressive evolution of a professional formation within the village structure.

Water management was born from a village need and slowly what has been developed with the means at disposal. The professional formation is part of the living experience and is integrated in the physical, economical and human environment. The point is not to transfer a ready made packet of technologies than to force the spirit of the craftsmen.

It is in the context of a global overture that one should read this book. The technical aspects, at times very precise, give a sense of being well integrated in the reflections of dealing with water and the village partners. In other words, this book was not made to be read only by the technicians but to start a fruitful discussion with the concerned village partners. If this discussion starts the technical solutions will come: those that are proposed here or others that will be suggested by them.

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Water management

Africa, Burkina Faso, Sudan savannah, rock bunds, tied ridges, field trial, soil water content, soil properties, sorghum

HULUGALLE, N.R. et al.

Effect of rock bunds and tied ridges on soil water content and soil properties in the Sudan savannah of Burkina Faso.

Tropical Agric. (Trinidad), 67, 2, 1990, pp. 149-153

Construction of ridges to which short earthen dikes are constructed at right angles at intervals of 1-2 m (ie, tied ridges) has been found to result in striking yield increases under research station conditions. This is primarily due to decreased water runoff and consequently greater soil water storage than with flat planting or open ridging.

An alternative system of water conservation which has been studied in Burkina Faso is contour bunds.

The bund system consists of a series of rock lines approximately 0.20-0.30 m high and 15-20 m apart placed along the field contours.. The rock lines are thought to reduce the velocity of runoff water, thereby increasing water infiltration and reducing topsoil loss. Unlike tied ridges, rock bunds, once constructed, require only nominal maintenance. Furthermore, as bund construction normally takes place during the dry season when labour constraints are negligible, the level of acceptance by farmers has been promising.

Although considerable information exists on the benefits of tied ridges and rock bunds on crop yield, no information is available on the relative benefits of the above two systems on soil and water conservation. The objective of the present study was to evaluate the relative efficiency of rock bunds and tied ridges, constructed by donkey traction, in terms of changes in soil water content and soil properties.

A trial was conducted during the growing seasons of 1985 and 1986 in the Sudan savannah of Burkina Faso, West Africa. Soil water content was measured by gravimetric sampling at 7-10- day intervals during the season. Soil sampled from 0-0.05 m depth at the termination of the trial was analyzed for particle size distribution, organic matter content and soil water retention. Rock bunds increased soil water content in the surface 0.30 m immediately above a rock line by an average of 32% in both 1985 and 1986. Away from the rock lines, bunds had no effect whereas tied ridges increased soil water content. At 2 m below a rock line, soil water content was increased by an average of 23 and 19% in 1985 and 1986, respectively, and midway between two rock lines by an average of 11 and 18% in 1985 and 1986, respectively. Both rock bunds and tied ridges improved water conservation in the short-term, with the latter being more efficient. Soil water retention and clay content in the surface 0.05 m were, however, greater with rock bunds and greater when tied ridges and rock bunds were combined. Sand, silt

and soil organic matter were not affected by either rock bunds or tied ridges. Sorghum grain yield was increased only by tied ridges, and was due primarily to increases in soil water content during flowering. Yield was greatest, however, when tied ridges were combined with rock bunds.

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90 - 11/31

Water management

Review, book, forestry, arid zone, semi-arid zone, IDRC, economic aspects, bibliography, irrigation, plantations

ARMITAGE, F.B.

Irrigated forestry in arid and semi-arid lands: a synthesis.

Int. Developm. Research Centre, P.O.B. 8500, Ottawa, Canada K1G3H9, ISBN 0-88936-432-X, French and English edition; 1985, Repr. 1987, 160 p.

In arid and semi-arid lands, water is one of the most limiting factors for plant growth and rainfed agriculture has low and unpredictable yields. In forestry, natural vegetation and rainfed plantations have low annual increments that cannot meet the increasing needs of the local communities for fuelwood, building materials, and other products. This net deficit of forest biomass production leads to a depletion of the natural resource followed by the unavoidable desertification process, affecting human life and the environment.

Research has focused on the introduction of fast-growing tree species and on planting techniques adapted to arid and semi-arid conditions. Fast growing species of pines, eucalyptus, and others were experimented with in many countries with variable success. In an effort to avoid the depletion of the soil by such species and to widen their use, emphasis in the last decade has been on multipurpose and nitrogen-fixing trees that can provide wood, fodder, and protection and yet maintain or increase the soil fertility. Despite these efforts, the performance achieved by the trees has been limited by the low levels of available water.

To establish the potential of irrigated plantations in arid and semi-arid areas of the developing world with a special focus on Africa, a state-of-the-art review has been carried out.

The paper served as a discussion paper for a meeting of a small group of experts and representatives of countries and donor agencies.

This book is neither a manual nor is it a simple state-of-the-art volume. It is intended to serve as a source of information and as a general guide for decision-makers and managers in the field of irrigated forestry. It is also expected that the book will lead to a series of interactions between scientists and developers and between institutions at regional and international levels. The information provided on the experience in various countries and the voluminous bibliography constitutes as a starting point for such networking initiatives.

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Water management

Asia, India, semi-arid tropics, traditional systems, tank irrigation, large-scale project, water management system, small-scale water sources, ground water development

ENGELHARDT, T.

Alternatives to conventional irrigation projects - lessons from the Indian Experiment.

Quart. J. of Int. Agric., 24, 2, 1985, pp. 161-170

Traditional agricultural production in the Semi-Arid Tropics (SAT) is predominantly rain-fed and thus dependent upon the vagaries of monsoon rainfall.

Traditional farming in the unreliable high-risk environment of the SAT is notorious for its low and unstable level of productivity.

Irrigation may be capable of overcoming this constraint caused by limited water. The net income from rain-fed crops (sorghum mix) is only 16% of that from wetland crops (paddy). In addition to its effects upon production, irrigation also has a considerable impact upon employment: 1 ha of paddy requires 7.7 times as much labour input as 1 ha of rain-fed sorghum mixtures. The same area of irrigated dry crops (groundnuts) requires 4.3 times as much labour input as rainfed sorghum mix but provides a net income which, on average, is 4.5 times greater.

Modern irrigation projects however do not satisfy expectations and under changing socioeconomic conditions permanent extension of traditional irrigation systems leads to overuse of resources.

An analysis of the research results reported indicates a new concept which combines traditional irrigation (tanks) and modern technology (e.g. pumps and ground water exploration) to form a system capable of meeting the current development objectives of increased production and of ensuring equitable treatment.

An evolutionary approach to irrigation management should include the advantages of the traditional surface structures while avoiding their disadvantages. It should concentrate on small-scale resources, such as wells, because of their economic viability, social significance, income-generating and capital-forming effects and their high water-use efficiencies resulting from private ownership. On the other hand, it must prevent the wells' detrimental effect upon the ecological balance. In a composite watershed management context the advantages of surface structures are combined with the advantages of privately-owned open dug wells. Surface reservoirs are not designed to hold water for surface irrigation but solely to recharge the ground water artificially (percolation tanks). These reservoirs are small and collect runoff water from watersheds of 5 to 10 ha.

The proposed concept of percolation tanks combined with wells offers a solution to a number of deficiencies of other irrigation systems. The advantages of these small-scale systems are that they can be less expensive, are quickly constructed and require little

management of water distribution. So there is no need for a large administration with all its red-tape and costs. Percolation tanks counteract any over-drawings of the ground water and stop wasteful runoff. They also help to conserve soil but can be no more than a temporary and partial solution to the problem; they must form part of a major concept for a composite watershed development program which also uses pricing policies for electricity, pumping quotas, afforestation, alternative lifting devices, etc. By combining of century-old-experiences with open dug wells and surface reservoirs with scientific techniques of ground water prospecting and supply of energy, evolutionarily an alternative water management system can be developed. This will consist of surface reservoirs for ground water recharge, natural fractures and dykes for water transport, modern exploration techniques for their identification and traditional open dug wells as water sources.

Water management
 study, developing countries, irrigation, cost recovery, pragmatic approach, performance perspective, fees funding, efficiency, revenues, costs of collection, accountability, FAO, USAID

SVENDSEN, M.

Irrigation system recurrent cost recovery: a pragmatic approach.

In: Techn. Papers from the Expert Consultation on Irrigation Water Charges, Vol. I, 1986, FAO/USAID, FAO, Rome, 1987, pp. 106-121

The economic and fiscal viability of public irrigation systems in developing countries is currently receiving intense scrutiny from a variety of observers, policy makers, and practitioners.

The purpose of this paper is to examine the means of meeting the recurring obligations entailed in operating and maintaining public irrigation systems from the point of view that a reasonably enlightened donor agency might employ.

The paper concludes that a fundamental problem is that one understands only poorly how factors as rehabilitation, system operation, and maintenance affect system performance. Research is called for here.

In the traditional chain of assumptions connecting increased irrigation fees to improved system performance, one prominent link appears to be broken and another unreliable. The first is the linkage between fee levels and their incentive effect on farmers to produce an efficient allocation of irrigation water. Given current patterns and practices of water delivery throughout the developing world, a convincing case for such a linkage simply cannot be made.

The second link is the one relating increased funding for a government irrigation agency and improved system performance. There is reason to doubt the effectiveness of this relationship in many cases, and it is, at best, an unproven one. The implication is that while augmenting revenue flows to an irrigation organization, one must, at the same time, also analyze its functions and role with respect to their effectiveness in increasing system output and extending its lifetime.

There are two fundamental approaches to the problem of imbalance between irrigation agency revenues and the costs. These are (a) to reduce costs and (b) to raise revenues. For greatest effect, both should be undertaken together.

To accomplish the first of these, some form of farmer organization will be necessary in most cases. In the case of the second, simply increasing fees is not enough. It is necessary also to consider collection efficiencies and costs, the path that revenues take in reaching the irrigation agency, the presence or absence of supplement subsidies from the national treasury, and a number of other factors.

738

90 - 11/34

Water management
Review, irrigation, agriculture, water application

HÜBENER, R.

Verbesserte Methoden der Wasserverteilung im Bewässerungslandbau.
(Improved water application in irrigated agriculture).

Der Tropenlandwirt, 89, 1988, pp. 143-163

During the last years remarkable advances have been achieved in irrigated agriculture of arid zones regarding the development and application of key irrigation hardware - i.e. valves, sprinklers, spray nozzles, drippers etc. Today common energy-efficient implements of surface irrigation systems very often have been automated, which reduces the high labour requirements and running costs usually associated with surface irrigation. The "surge flow" concept is regarded as the most advanced method of water application in surface irrigation because it highly improves the distribution uniformity, too. In both surface and sprinkler irrigation meanwhile water is applied at maximum nonerosive stream sizes. With gravity flow systems this often helps to improve the uniformity of water distribution, whereas sprinkler irrigation systems can cover a greater area of land and therefore operate at less costs. However - all types of sprinklers require the highest operating pressures compared to other irrigation systems. Since this might impair the overall profitability, a variety of modifications was developed concerning the low pressure operation of common, proven sprinkler hardware. Most notably are the low pressure spray heads with spray plate, which help to conserve energy and water while increasing the application uniformity. Because of high application rates they reduced system capacities in the beginning, but the advent of spray booms helped to overcome these problems. Microirrigation, while being energy-efficient too, is not of that much importance to irrigated agricultural as the above mentioned irrigation systems, mainly because of cost reasons. Nevertheless, in most cases its unique method of water distribution can provide an unmatched efficiency of water use.

XII SOIL FERTILITY

739

90 - 12/32

Soil fertility
Africa, sub-Saharan, fertilizer, sustainable agriculture, food crop production, marketing, trade, policy, IFDC, ICRISAT

VLEK, P.L.G.

The role of fertilizers in sustaining agriculture in sub-Saharan Africa.

Publ. of the International Fertilizer Development Center - Africa (IFDC-Africa), B.P. 4483, Lomé, Togo; 1990, 30 pp. + annex

High rates of population growth in sub-Saharan Africa, combined with low-yielding food production systems based upon shifting cultivation, have resulted in declining per capita food production, increasing food deficits and imports, and deteriorating nutritional levels among the rural and urban poor.

Traditionally, shifting cultivation and complex cropping patterns have permitted low-yielding and relatively stable food production systems. Expanding populations, however, have pushed agriculture onto more marginal lands, and the fallow periods have shortened. Ordinarily, lands under shifting cultivation require between 7 and 15 years to restore soil fertility. But leaving land out of production for such periods is a luxury that few farmers in sub-Saharan Africa can afford in the face of rapidly expanding population. The Food and Agriculture Organization estimates that 70% of the deforestation observed in Africa is directly caused by migratory farmers, who in their quest for food have no incentive whatsoever to ponder the long-term environmental consequences of their behaviour.

Increasingly, infertile soil is the key constraint to greater crop production and food self-sufficiency in sub-Saharan Africa. Whether sustained food self-sufficiency can be realized without a decrease in population growth rates is uncertain.

Numerous forecasts predict that, if widespread starvation is to be averted, soil fertility management approaches based on anything other than increased chemical fertilizer use would lead to massive increases in food imports. The International Food Policy Research Institute (IFPRI) has estimated that, unless recent per capita production trends are radically changed, sub-Saharan Africa will face net deficits in major food crop production of close to 50 million tons by the year 2000, which means that the region would be producing only 75% of its total food requirements.

With continuous cropping increasing, new systems of soil management are required. Various long-term cereal trials in West Africa illustrate the rapid decline in soil productivity and the importance of the use of intermediate or variable inputs such as manure, lime, or mineral fertilizer for improving and maintaining crop yields. The importance of returning crop residues,

777

90 - 14/23

Potential crops

Survey, book, dissertation, Africa, Kenya, Senegal, arid regions, case studies, wild plants, human nutrition

BECKER, B.

Wildpflanzen in der Ernährung der Bevölkerung afrikanischer Trockengebiete: Drei Fallstudien aus Kenia und Senegal. (Wild plants for human nutrition in arid regions of Africa: three case studies from Kenya and Senegal).

Gött. Beiträge zur Land- u. Forstwirtschaft in den Tropen und Subtropen, H.G., 1984, 341 pp.; sold by: Institut f. Pflanzenbau und Tierhygiene i. d. Tropen und Subtropen, Grisebachstr. 6, 3400 Göttingen, F.R.G.

The Sahelian zone which stretches across Africa south of the Sahara is a region beyond the areas of crop production. However, the indigenous vegetation can be used directly as food for men. In three case studies - two in Northern Kenya, one in Senegal - wild plants used in human nutrition was investigated.

The Turkana in Northern Kenya make use of approximately 80 edible autochthonous plants, their neighbours, the Samburu, about 170. In the Ferlo in Northern Senegal some 20 wild species are consumed. A literature survey revealed a total of nearly 800 food plants in the arid and semi-arid belt from Senegal to Kenya. For the most important edible species the use, means of preparation, the ecological potential and cultivation methods are described.

Although wild plants theoretically can supply only about 10% of the population's energy needs, their contribution to the vitamin and mineral supply is considerable, particularly of the vitamins A, B₂ and C. Seasonal wild vegetables fill the gap of lowest staple food supply at the beginning of the wet season. Theoretically the Sahelian vegetation can produce 4-18 kg wild fruits/ha, equivalent to 1-5 kg per person per day.

Recommendations are made for the integration of food plant species in afforestation measures, the use of wild plant food in famine relief programmes, and the integration of the traditional knowledge about such foods in adult literacy and school curricula.

Author's summary, amended

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This is the third edition called "Abstracts on Sustainable Agriculture". In view of the good experience made with the "Abstracts on Intercropping", GTZ intends to continue making the documentation available. Intercropping remains an important aspect of the abstracts but will now be treated as an integral component of sustainable agriculture.

These abstracts are more comprehensive than the usual type of annotated bibliography but they cannot substitute the original publication. For details it is advisable to refer to the original.

The abstracts are divided into different sections, e. g. integrated systems, agroecology, homegardens, soil fertility, water management etc. The subject index, based on key-words, the geographical indices as well as the index of authors help the reader to find abstracts on specific aspects of sustainable agriculture easily.



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