Summaries of Reviews of Literature Related to Irrigated Agriculture in Sri Lanka

Volume III

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Contents

Kayane, I; S. Yarnashita; S. Nakayawa and S. Nomoto. 1983. Salinization of groundwater in the dry zone of Sri Lanka. In I. Kayane and C.M. Madduma Bandara (eds.). Climate, Water and Agriculture (pp. 147-154), Zbaraki, Japan: Institute of Geoscience, University of Tsuuban.

Keywords: salinity I groundwater I electric conductivity / evaporation

Study area: small drainage basin to the north of Maha Iluppallama

Study period: **1981-1982**

Introduction

The study concentrates on the upstream part of the Aru Drainage Basin. Tests were done on **13** unconfined wells, **1** confined well and water from 5 tanks. Parameters measured were depth of well, depth of water table, water temperature, pH, RpH and electric conductivity. It was found that the electric conductivity, which is directly connected to the salinity of the water, showed differences. Time variability of the electric conductivity in the Walagambahu Tank and **4** wells around it were **also** investigated for one year.

Objective

To determine the extent of salinization of groundwater in the dry zone of Sri Lanka by determining the electric conductivity of the water.

Research Findings

Water Temperature

The water temperature of wells ranges from **26.5 °C** to **28.5 °C**, the pH from **7.0** to **7.8** with an exception in a deep well, and the RpH from **7.4** to **8.4.**

Electric *Conductivity*

* The electric conductivity of tank waters in the upstream reaches was in the lower levels of 0.1-0.2 m mholcm. while that of the Maha Kanamulla Tank in the lower reach was as high as **0.42** m mho/cm.

* In the upstream of Mawatawewa it was 0.3 m mholcm.

* An abnormally high electric conductivity of 6.0 m mholcm was found in a well located at the margin of the Walagambahu Tank. This particular well also showed tremendous variation in electric conductivity when the tests were conducted for one year.

* The variation in electric conductivity of the deep well was smaller than that in shallow wells

* The electric conductivity of tank water showed an inverse relation to the height of the water level.

* In the well that was downstream of the Waiagambahu Tank, electric conductivity showed an Inverse relationship to the height of the water level.

* The relationship reversed at the marginal well which are upstream of the tank.

Conclusion

1. The higher values of electric conductivities obtained may be caused by high rates of weathering and evaporation. According to the authors, normal groundwater in Japan has an electric conductivity less than 0.2 m if not polluted.

2. The inverse relation of the electric conductivity with tank water level indicates the enrichment effect by evaporation.

3. One but the last item in these research findings'suggests that salt is supplied from the surface layer by rain water percolating down to the water table.

4. The last research finding suggests that the rise of water table is caused mainly by the horizontal inflow of groundwater with lower hydraulic conductivity. Also it implies that evaporation is the main cause for the formation of high salinity of groundwater at the marginal zone of the Walagambahu Tank.

Recommendation

Further field study is necessary to describe the mixing mechanism of the enriched soil water with groundwater.

International Conference on Community Responses to Irrigation in South Asia. 1984. Social Science Research Council, New York. Summary Report of the Conference, Bangalore, January 4-7, 1984.

Keywords benefits water use efficiency / water management / farmer-managed irrigation systems / Asia / India / Pakistan / Nepal / Sri Lanka

Study site Nonspecific

Study period Nonspecific

Introduction

Irrigation system planning management should rest on a well-grounded knowledge of irrigation and of water users as individuals and as members of communities. This includes an understanding of their social structures, values, communication patterns, resources, their knowledge, incentives, ecology and culture. Without realistic assumptions about these factors affecting "community response," it was not possible to formulate effective programs and policies for irrigation development and improve the productivity and well-being of the rural population in South Asia.

Objectives

To reveal the experiences of researchers, project planners and implementors involved in irrigation in South Asia and to define and understand the role played by community irrigation associations in India, Pakistan, Nepal, Sri Lanka and Bangladesh.

Research Findings

Cooperation of social scientists and technical specialists is needed to advance the state of knowledge for informing government decisions on irrigation. Some engineers are becoming more concerned than the social scientists with "equity" issues; alternative technological as well as organizational arrangements for exploiting water resources should be examined. Community institutions and capacity for irrigation management should be further studied before developing models.

Merriam, J.L. 1984. The demand irrigation pilot project in Sri Lanka. In Tiffen, M. Benefits and problems with unconventional design, London: ODI: Agricultural Administration Unit.

Keyword	demand irrigation / automated system / pilot project
Study site	Mahaweli System H
Study period	Early 1980s

Introduction

The pilot project covers about 360 acres in the lower part of the D-1 Distributary Canal of System H and is served by low pressure tongue and groove, mortar-joint concrete pipe delivering water to each individual 2.5 acre farm. The outlet is a small screw valve which can deliver up to 0.5 to 0.7 cusec. The farmer can take water at any frequency, for any rate up to the abovementioned limit, and for any duration–a Limited Rate Demand Schedule. The upper 490 acres of the D-1 command are under the conventional earth ditch rotation schedule.

Objectives

To test the economics of an automated system and also to see whether farmers with an on-demand system would use less water than in a conventional system because they would be certain of water when they needed it.

Research Findings

Economic Evaluation

1. The incremental cost for the automated pipeline system compared to the conventional system is between US$345 and US$435 per hectare for a distributary channel area.

2. The necessary right-of-way is reduced to 57 percent.

3. The reduced cost of maintenance can be very appreciable, but not known.

4. Yield increases of rice have changed from 6 percent to 15 percent

5. The repayment is quite fast with the automated system.

6. The reduction in maintenance and management, greatly increased farmer satisfaction and reduction of contention are additional plus items.

7. When compared to results from rotational schedule :

   a. The land preparation was 100 percent completed at the end of the second week whereas Only 70 percent was done under the rotation schedule.

   b. crop planting was **88** percent completed at the end of the fourth week whereas only 54 percent was done under rotation.

Less-Than Expected Wafer Savings

The discharge from the re-regulating tank, serving **230** acres, was measured. Water use in the first two seasons was greater than on the surrounding area deliveries but this has to be compared. The first season involved all the land grading as well as crop planting and included water losses due to poorly installed pipelines. The water delivered amounted to 86 inches. The adjacent conventional area received 70 inches, However, of the 35 farms that did produce over **80** bushels/acre out of the **483** farms in the checked area, 27 were on the pilot project which included only **92** farms.

During the second season (dry) water supplied amounted to 106 inches, but when reduced for estimated correctable losses, this becomes about **78** inches. The average cut rate yield was **102** bushels/acre. There was no area to compare yields. However, for the preceding year the conventional areas ranged from 74 to **98** bushels/acre, averaging **84** bushelslacre.

During the third season (rainy season) the delivery was 67 inches which, again allowing for correctable losses, becomes about 56 inches. The 56 inches can be compared to deliveries in conventional areas.

Conclusion

The value of the potential water and rainfall conservation in rice is not yet accepted since it is not yet 'proven' by the pilot project as a whole. The pilot project has shown how to accomplish the saving and has done *so* on part of the area and *so* it should be used on rice lands as well as on dry-food crop areas.

Sivagurunathan. S. **1985.** Rehabilitation **of** irrigation project for improved water management. In Institute of Engineers, Sri Lanka, Transactions for **1985.**

Keywords iranamadu / irrigation rehabilitation / water management

Study period Not specified

Study area Iranamadu

Introduction

The paper discusses the design criteria and methodology adopted in the Iranamadu Rehabilitation Project. The strategy adopted in the evolution of design criteria and methodology is to obtain the views of farmer organizations on the possible remedial measures and to evaluate them by a team of Irrigation Engineers and Technical Assistants of the Irrigation Department. The project is supported by the World Bank.

Objectives

To improve water management in the rehabilitation project by ensuring the following:

* system safety
* adequate capacities to deliver available water in an efficient manner
* positive control and regulation of water deliveries in the distribution system
* measurement of flow at turnout structures and other critical locations in the distribution system
* ease of operation, maintenance and management

Recommendations

Rehabilitation of Iranamadu

Head Works. Protection for upstream slopes and remedial measures to prevent storm erosion downstream including construction of toe filter for seepage measurements and repairs to the stilling basins. The spill is also to be raised by one foot to augment the tank capacity by 7,500 ac.ft.

Project Area. The right bank to field channels should be improved and measuring devices at the turnouts should be installed. On the left bank necessary measuring devices, control and regulation structures and farm offtake should be provided.

Implementation Phase. The construction program is phased *so* that the cultivation would not be suspended. it is planned to implement the project in six years.

Project Operation

Rotational Water *Supply.* The rehabilitation is based on rotational water supply. The size of the rotational area will be 40-50 acres and the designed flow capacity in the field channel is one cusec **(28.32** lit/sec). Each rotational area is divided into three or four rotational units.
Irrigation Water Requirement. The Irrigation Water Requirement (IWR) for a canal could be expressed as

$$IWR = (ET_c + L - P_e) / \eta$$

where.

η - canal efficiency
ET_c - Crop evapotranspiration
L - Percolation losses
P_e - Effective rainfall

Effective Rainfall *(P_e)*. For lowland rice P_e could be determined by the following relationship:

$$P_e = 0.67\ (P-1) \text{ inches}$$

where **P** stands for rainfall which has a 75 percent probability of occurrence.
Pilot Area. An area has been selected under the Peasant Colony Channel under the Left Bank Scheme which commands 150 ha under the MIRP in the Iranamadu Scheme to test the methods adopted and to analyze the results.

Farmer Organizations. Farmer organizations are expected to perform their functions effectively.

World Bank. 1985. Report of review mission: Village Irrigation Rehabilitation Project, Sri Lanka.

Keywords village irrigation I rehabilitation I water management I modernization

Study sites Galle, Matara, Ratnapura, Monaragala, Anuradhapura, Kandy, Badulla, Ampara

Study period November 14-15, 1985

Introduction

This is a review of the Village Irrigation Rehabilitation Project which aimed to increase agricultural production and farmer income in existing village irrigation schemes by (i) financing the rehabilitation of village tanks and anicuts, (ii) strengthening the major government institutions involved in village irrigation, and (iii) initiating a systematic water management program.

Objectives

1. To review the program and progress in respect of rehabilitation schemes, water management and modernization schemes.

2. To submit observations and recommendations to the World Bank and the Government of Sri Lanka through the implementing agencies.

Research Findings

The mission emphasizes that the ID which is the executing agency should make an all-out effort to get the cooperation of the farmers to carry out the earthwork by contributing voluntary labor to reduce the cost of the scheme as much as possible, The mission felt that getting farmers involved in the scheme during construction would mean that O&M of the scheme would become easier.

The work related to construction, modernization, water management and O&M is progressing satisfactorily due to mutual understanding of the ID and the DAS.

The mission could not visit some districts like Killinochchi, Mullativ, Vavuniya. Mannar, Batticaloa, Amparai and Trincomalee due to security reasons. Badulla also, could not be visited for want of lime. However, meetings were held in Colombo with ID engineers and DAS officers of these districts.

Hesselberg, J. 1986. Lack of maintenance of irrigation facilities: Experiences from southern Sri Lanka. In Rice Societies: Asian problems and prospects.

Keywords water management / maintenance / farmer participation

Study site Kirama Oya

Study period Not specified

Introduction

It is widely accepted that maintenance of irrigation facilities is neglected in many irrigation schemes in Sri Lanka and other places in Asia. This paper gives some experiences gained from the Kirama Oya case to the question "why maintenance of minor but vital parts of irrigation systems is neglected."

Objective

To analyze the problem of neglect of maintenance of irrigation facilities in irrigation schemes and to find some solutions for it.

Research Findings/Conclusions

The researcher has identified the major reasons for the lack of maintenance and absence of water-use discipline of the Kirama Oya on the following three levels: government, local community and cultivator.

Government level. Several factors have contributed to the lack of maintenance at the government level. They are as follows:

1. The government giving more attention to the development of irrigation in the dry zone, resulting in the irrigation systems in the wet zone being neglected
2. Lack of interest of officials due to the absence of incentives
3. Frequent transfers of officials
4. Lack of communication between officers and farmers
5. Lack of transportation facilities for officers

Community level. Reasons for lack of maintenance at community level were as follows:

1. The absence of a suitable system of water management to replace the traditional authority structure

2. Disharmony created in the community by party politics in the present system resulting in management and maintenance work being neglected

3. Grazing by buffaios resulting in the abandoning of parts of rice fields

Farmer level. Factors contributing to the lack of maintenance were as follows:

1. The existence of various tenancy arrangements

2. Attitudes of farmers many of whom think that repair and upgrading of the irrigation facilities are the task of the government

3. Quitting of rice cultivation by some farmers due to many reasons resulting in the neglect of irrigation facilities in such parts

Recommendations

The paper suggests three types of solutions for the lack of maintenance. However, it suggests that research is necessary on a wide range of topics to exploit the potentials. The three types of solution are as follows:

1. Reintroduction of the traditional Vel Vidane management system

2. Government rule

3. Farmer participation

International Irrigation Management Institute (IIMI). 1986. Walawe Irrigation Project: Suitability of the project for IIMI applied research on irrigation management. Groenoble, France: SOGRFAH Consulting Engineers, 33p.

Keywords	irrigation management / Walawe Irrigation Project / water distribution
Study site	Walawe Irrigation Project
Study period	1983

Introduction

The Uda Walawe dam was constructed between 1963 and 1967 and a study was carried out in 1966 concerning the integrated development of the area to be irrigated. In 1969, the ADB granted assistance for the development of the right bank area. In 1979, when the bank prepared the project completion report, various structural and operational deficiencies were reported. The findings of the project completion report were confirmed by the project performance audit report prepared by the bank (1982). In 1983, SOGREAH consulting engineers, France, were entrusted with the preparation of the feasibility study for the rehabilitation and improvement of the right bank area.

Objective

To evaluate the potential outcomes and difficulties of the Walawe Irrigation Project for applied research in irrigation management.

Findings

Better management will be achieved through the consideration of interrelated physical, operational, agricultural, social and institutional issues.

Potential Outcomes

The potential outcomes which an be expected when choosing the Walawe Irrigation Project as a pilot area are the structural deficiencies of the project and their consequences in terms of water distribution inequity.

Structural deficiencies. Control structures on main, branch, distributary and field channels and lack of regulators in main channel.

Wafer distribution inequity. Discrepancies between head blocks and tail blocks and between the tail ends and head ends of the distribution system within blocks.

As a consequence, it will be easy to work out an accurate simulation model. The structural deficiencies being acute. their simulation and the possible improvement will be easily determined.

The model could be developed toward three(?) directions:

* Modeling and operation of the main canal to evaluate the response of the system and without with cross-regulators

* Modeling and operation of a branch canal and distributary channel to compare the prerehabilitation situation and, after construction of regulators, measuring structures and FCs

* Modeling and operation of water distribution at the field level and establishing a water delivery schedule at the main canal ,

The model will provide the following information:

* Consequence of deviation of the water demand from the expected demand

* Time of response of the system and the anticipation on time needed at the head works to modify water deliveries to deal with demand changes

Difficulties. The model should agree with the present water distribution. Two difficulties have to be faced:

1. The model should react in a global way similar to reality. This implies the representation of a certain number of sections and structures. It is necessary to limit the data to a strict minimum.

2. Due to the lack of measuring structures the present water deficiencies are not known with accuracy. These data are necessary to adjust the model once it is developed.

Operating conditions *of the* irrigation *system*. The network does not allow proper control of the water level in the canals nor the measurement of the discharge delivered to the water users nor yet the rational organization of water deliveries.

The problems identified include: a) in the **RB** main canal and branch canals the number of cross regulators is insufficient; to feed distributary channels high discharge rates should be maintained in the canal, thus leading to water wastage; b) the water level in the distributary/field channel was originally to be controlled at the check drops where grooved for checks are provided; but these are not used.

Discharge measurement. Only available method for discharge measurement is the use of gauge posts in the earth canals. These are not effective since gauge posts are located in the earth control section where water depth is subject to siltation and canal bank erosion.

Water distribution at field level. Pipe outlets to individual farmers' plots are located on distributary channels with no controls. The situation is a major obstacle to the organization of equitable water distribution and is a basic reason for inequity between head enders and tail enders.

Project performance. Distribution inequity and overall distribution efficiency.

Possible improvement of irrigation facilities. The program includes the following works:

* Modification of the present network layout to create farm turnout areas and thus **make** rotational turns possible

* Construction of measuring structures at the head of each farm turnout area and at the head of each channel

* Construction of cross-regulators to control the water level in distributary channels and branch canals at measuring structure locations, thus allowing modification of water deliveries in accordance with a fixed program

* Construction of cross-regulators in the right bank main canal

Mendis, D.L.O. 1986. Evolution and development of irrigation eco-systems and social **formations** in ancient Sri Lanka. Transactions of the Institute of Engineers.

Keywords social formation / irrigation eco-systems / ancient Sri Lanka

Study area Ancient Sri Lanka

Study period Nonspecific

Introduction

The evolution and development of different social formations in relation to irrigation eco-systems and modes of production corresponding to these stages are discussed in this paper.

Objective

To determine the stages involved in the evolution and development of irrigation systems in ancient Sri Lanka.

Research Findings

Stages involved are as follows:

1. Rain-fed Agriculture

It was the first and earliest method of crop production. It was discovered in the late stone age. The mode of production was what is described as primitive communal. There was equal distribution of the product of labor among the members of the primitive community.

2. Temporary or Seasonal River Diversion

This seasonal or temporary river diversion could have taken place in three stages as follows:

1. Flood or inundation irrigation on the banks

2. Development of contour channels on the banks to train the water for flood irrigation

3. Development of diversion channel systems on the river banks

The human settlements could have been consolidated at this stage. It is possible that pairing off and the beginning of family units rather than group living would have started at this time. Division of labor among men and the concept of private ownership of the means of production would also have started.

3. Permanent River Diversion

Establishment of permanent river diversion structures required the introduction of some form of building blocks and a method of holding them together. It is possible that brick masonry was later substituted for stone block masonry. It should also be noted that temporary or seasonal diversion structures were most oflen built on poor foundations while permanent structures were built on good natural rock foundations.

The same technology would have been used to build weirs and spillways along the contour channels. Weirs would have been used to release irrigation water to the tracts of fields, along the channel.

Further, consolidation of social formations developed under temporary or seasonal river diversion could have happened at this stage. Village-type settlements were strengthened, and fort-type settlements began at this stage. The family became the normal social unit and the beginnings of the state would have been seen with permanent settlements. Trading also would have started by this time. Due to technology development, division of labor along functional lines also started. The group or class that took control of the permanent river diversion irrigation systems would have had effective control over the means of production and hence of the society.

4. Invention of the *Horowwa* (Sluice) with *Bisokotuwa* (Access Tower)

Conveyance of water in contour channels, and discharge over weirs and spillways over a long period of time would have provided necessary and sufficient experience in hydrodynamics **for** the invention of the horowwa. This essentially led to the construction of storage reservoirs.

5. Small *Village* Tanks, Medium and Large-Scale Tanks

The observation of the discharge of water over a weir would sooner or later have given someone the idea of enclosing the weir thus creating a culvert. The tendency of water to accumulate at drainage crossings combined with this culvert in turn combined with the basic necessity to store water have given the germ for the first storage reservoir.

The social formations associated with the small village tank settlement were essentially similar to some of the most remote dry-zone jungle villages today. Even though the majority of the villagers were peasant farmers or cultivators, there was a division of labor according to skills and according to who manufactured small production for the local market.

Medium-scale reservoirs were constructed near large towns and cities in ancient times. The large-scale reservoirs were never constructed as isolated or segregated systems in ancient times. They were always interconnected to form part of a single system.

Very often, a large reservoir was built only after the channel that connected it to the rest of !he system had been constructed.

By the time large reservoirs were built, the state had come into existence. Division of labor was established, and people were identified in terms of their vocations. For example, *kulinas* were the people responsible for the O&M of large-scale irrigation systems.

Conclusions

Despite the fact that third world countries have ancient irrigation civilizations irrigation engineers and other technocrats in third world countries are finding themselves bypassed by their counterparts from the rich countries. The Kantalai Tank breach is discussed as an example.

Peoples's Bank. 1986. Tenurial arrangements and water use. Economic Review, **Vol.ii, No.ii.** People's Bank Research Department. Colombo, Sri Lanka.

Keywords water use ▮tank irrigation ▮land tenure ▮Sri Lanka

Study site Sri Lanka in general

Study period 1984-1986

Introduction

Generally, the tank, rice land, settlement area and fallow land are among basic physical features of small tank irrigation. Among them there is a symbiotic relationship. Modernization has begun to cause this relationship to disappear. With demographic expansion, supplementary village tanks without settlements are set up near the main tank. Such tanks may sometimes be owned by a single family or several families in the village.

Objectives

To study the tenurial pattern that exists in minor or village irrigation schemes and to study the different water use patterns adopted by villagers.

Study Findings

Most critical decisions related to the village tank are taken in a collective manner at the kanne meeting. The Vel Vidane is the most important person as far as the village tank is concerned, because he is the overall manager. The Vel Vidane is the link between farmers and the local Agrarian Service Centre.

People's Bank. 1986. Village irrigation and special projects. Economic Review, ii(ii), 14. People's Bank Research Department. Colombo, Sri Lanka.

Keywords: village-tank rehabilitation / IRDP / VIRP / ADZAP / agricultural productivity / cropping intensity / farm income

Study site: Nonspecific

Study period: Nonspecific

Introduction

This brief article attempts to bring forward the three special village irrigation projects that were implemented during **1981-1985, 1983-1985,** and **1981-1985.** These three projects are:

* Village Irrigation Rehabilitation Project
* Department of Agrarian Services Program
* Anuradhapura Dry-Zone Agricultural Project

In addition to these three projects, the Freedom From Hunger Campaign Board launched a separate program to rehabilitate tanks in the dry zone areas of Sri Lanka.

Objectives

To discuss the salient features of each project and to highlight the expected output **or** impact of the projects.

Conclusion

The VIRP has two main objectives: rehabilitation of deteriorated village irrigation schemes to increase agricultural production and farm income, and to ensure efficient utilization of stored water. This is a five-year project **(1981-1985)** and has a budget of **$25.9** million. Once the project reaches its full production level in **1991,** the cropping intensity will increase from **32.5** percent to **116.25** percent leading to an increase in the rice production of **37.800** tons per year and a **43** percent increase in per capita income. Under this project **12,000** tanks in **14** districts were taken for rehabilitation and another **940** tanks were also rehabilitated where the IRDP was implemented. The World Bank funded this project.

The Department of Agrarian Services modernized 500 village tanks with World Bank funding in **1983**-85. This work focused mainly on farm development and repair to head works. The main objective of this program was to introduce a systematic water management program for the non-rehabilitated working tanks by providing them with appropriate downstream facilities.

The Anuradhapura Dry-Zone Agricultural Project aims at rehabilitating 600 village tanks in the Anuradhapura District to provide irrigation facilities to about **20,000** acres of new farming land to stabilize about 65,000 acres of chena. This is a five-year project (1981-1985) with financial support from the ADB and the IFAD. The project cost is $39.6 million.

The Freedom From Hunger Campaign Board has been involved with village tank restoration since 1980.

People's Bank. 1986. Village irrigation. Economic Review ii (ii) 3-15. Colombo, Sri Lanka.

Keywords village irrigation / irrigation water management / institutional credit / drought / land tenure

Study site Nonspecific

Study period Nonspecific

Introduction

This article attempts to bring out the significance of the traditional system of village irrigatlon which is still an important source of food and employment for the rural people. But this sector has been relatively neglected.

Objectives

To highlight the effect of low-capital-intensive village irrigation development programs and to draw attention lo village irrigation systems that contribute one quarter of the total rice production under irrigated agriculture.

Conclusion

There is no accurate estimate of village tanks. The Ministry of Lands estimates that there might be about 23,000 village tanks. About 50 percent of these are working with varying efficiencies. According to the ID, there were 3.119 village tanks scattered in the dry zone (1975). According to the FAO (1980) there are 7,758 tanks. The Freedom From Hunger Campaign Board has listed 18,000 tanks (1979). Most of these tanks are situated either in Anuradhapura or in Kurunegala.

Farming under village tanks has also been mechanized. Farmers have been influenced to use high-yielding varieties and agrochemicals. But institutional credit is a serious problem for them. Farmers cultivating under village tanks are still at subsistence level for two reasons. Drought is the main cause. The second reason is the tenurial arrangements like share-cropping and leasing systems.

Due emphasis is necessary for this sector, because village tanks have proven to be suitable for their particular environment over generations Also, it will help stabilize the agricultural base which was in place as a source of livelihood for years.

Berthery, D; Sally, H and Arumugam, J. 1987. Mathematical modeling of irrigation canal systems, Part 1 - Presentation of the "MISTRALSIMUTRA" software package; Part 11 - Application of "MISTRALSIMUTRA" to the Kalankuttiya Branch Canal. Digana Village, Sri Lanka, IIMI, V. 72 p. (IIMI Working Paper No.9).

Keywords canal systems / mathematical modeling / simulation / water surface profile

Study area Kalankuttiya

Study period Nonspecific

Introduction

The paper is presented in two parts. Part I describes the software package "MISTRAL-SIMUTRA" and Part II describes the application of MISTRAL-SIMUTRA to the Kalankuttiya Branch Canal (Mahaweli System H).

MISTRAL-SIMUTRA is used for simulation of steady and unsteady flow in open channels under the impact of natural or artificial modifications. The program was developed by Societe Grenbloise d'Etudes et d'Applications Hydrauliques (SOGREAH), a French firm of consulting engineers, in the 1970s. The source programs are written in MS-FORTRAN 77.

MISTRAL accesses data and performs the calculations. It has a model coding phase and a calculation phase. In the model coding phase, the program analyzes the data pertaining to the canal topography and the hydraulic characteristics of the structures, and transforms these data into a set of coded instructions that can be easily accessed during the calculation phase. The calculation phase involves the numerical resolution of Barre de St Venant's equations by means of an implicit finite difference technique. The output consists of the water level, discharge, velocity and flow volume at each computational point.

SIMUTRA produces graphical outputs of the computational results generated by MISTRAL.

The version used by authors has a capacity equivalent to 100 computational points.

Objectives

To demonstrate the use of mathematical modeling as a research tool to investigate the interactions between design and management of main irrigation canals and thereby to identify effective and responsive strategies for canal operations.

In particular, the application of MISTRAL-SIMUTRA to the Kalankuttiya Branch Canal is intended to complement the intensive field research undertaken by IIMI on the subject of irrigation management for diversified cropping at the Kalankuttiya Subsystem since 1985.

Application of MISTRAL-SIMUTRA to the Kalankuttiya Branch Canal

Steps involved in the application of MISTRAL-SIMUTRA to the Kalankuttiya Branch Canal are:

- Data collected initially to create the model
- Data collected in view of model calibration
- Model calibration

Simulations Performed through the Model

Four kinds of scenarios are simulated with varying flows at main canals and with different conditions of distributary channels. In each case, the water surface profile corresponding to the steady-state regimes that would be established in various reaches of the Kalankuttiya Branch Canal have been computed. Complete sets of results generated by the model in terms of the flow parameters (water level, discharge and velocity) at each computational point for each of scenarios are tabulated. Analysis of the results and comparisons with field observation are also presented.

Conclusions/Recommendation

The insight gained by IIMI on the Kalankuttiya Branch Canal is promising. With limited resources, and though the model is still not completely calibrated, the application has successfully highlighted peculiarities in the design of this canal that have consequences for its operations and that are likely to contribute to its performance. Even though the model could not substitute for field work, modeling would contribute to make the field work more insightful and more efficient. It was recommended that the application to continue up to the point of performing unsteady flow simulations would ultimately lead to identifying the most effective way to operate the Kalankuttiya Branch Canal under particular sets of constraints.

Franks, T.R. and T.J. Harding. **1987.** Commissioning paddy irrigation project water management and project viability. Irrigation and Drainage Systems **3, 259-266, Martinus** Nijhoff Publishers, Dordrecht. Printed in the Netherlands.

Keywords: commissioning / water management / project viability / tank irrigation / Inginimitiya / Sri Lanka

Study site: Inginimitiya Irrigation Project

Study period: Three pre-1987 seasons (seasons 2, 3, and 4)

Introduction

This article is based on the findings of a research investigation into water management practices during the commissioning of the Inginimitiya Irrigation Project in Central Sri Lanka. Investigations centered on the water issues and areas irrigated in the right bank main canal of the scheme during commissioning. The water use observed during this period was compared with that forecast for the project at full development. From the limited data available, feasible targets for the phasingin of land during commissioning are suggested, for use by both planners and managers. The effect of adopting these targets on project viability is also discussed.

Objective

To assess project performance in relation to water use, and the rate at which that performance was approaching the forecast performance for the project at full development

Findings/Conclusions/Recommendations

1. Feasible targets for phasing-in of irrigated land during commissioning are first season - 50 percent, second season - 75 percent, third season - 90 percent and fourth season - 100 percent.

2. Equity and efficiency of the overall commissioning process depend on establishing the water management procedures of full development as quickly as possible. To achieve this, it is necessary to aim for a cropping intensity of 50 percent on the area available for cultivation in the first season.

3. Adopting these phased targets in Inginimitiya would have had an impact on project viability equivalent to a 4 percent decrease in net project benefits or a 5 percent increase in Investment costs. As the loss would be compensated by a marginal increase in the yield. the phased introduction of newly irrigated lands would have had no significant impact on project viability.

Guidelines for Managers at Commissioning

1. **Plan to irrigate 50 percent of the available land in the first season.**

2. **Institute the designed water allocation procedures as soon as possible.**

3. **After the first season of irrigation, farmers should be left to cultivate their full area.**

Perera, K.D.P. **1987.** Irrigation design for management: Irrigation in Sri Lanka. Irrigation Design for Management Asian Regional Symposium, Kandy, Sri Lanka, **16-18** February **1987, Vol. II.**

Keywords irrigation management / irrigation design / farmers' allocations

Study area Sri Lanka in general

Study period Up to 1987

Introduction

The paper discusses the history of irrigation, the present system of irrigation management, objectives for the future in irrigation management and the steps taken toward achieving the objectives.

Objectives

To achieve the optimum utilization of the land and water resources toward agricultural production by

* rehabilitation and improvement of existing irrigation schemes for water management,
* ensuring farmer participation in operation and maintenance of the schemes, and
* integrating the services and facilities provided by the various government agencies concerned with the development of agriculture.

Recommendations/Conclusions

Present System of *Irrigation* Management

The total land area under irrigation in 1987 was about 520,000 ha of which about 300,000 ha are managed by the ID, 45,000 ha by the Mahaweli Authority of Sri Lanka (MASL) and 175,000 ha by the Department of Agrarian Services (DAS). A description of the irrigation systems handled by each agency is also given.

Rehabilitation *of Irrigation* Schemes

Most of the irrigation schemes over **25** to 30 years of age have earthen canals. Over the years, the canals have eroded and silted. Some of the field channels conveying water from the distributary channels to the individual farms have suffered due to poor maintenance. Appreciable quantities of water are lost in the canals due to seepage and overflow. The government is taking action to rehabilitate these schemes.

Integrated Management of *Major Irrigation* Schemes *(INMAS)*

This program is implemented by the Irrigation Management Division of the Ministry of Lands and Land Development and it seeks to integrate the services by institutions to enhance agricultural productivity. A brief description of the mode of operation is also described in the paper.

Farmer Participation

The formation of farmer organizations (FOs) was helped by the appointment of Institutional Organizers (IOs). The farmer organizations are formed at tertiary and secondary levels. During the inception stage, field-level officers are co-opted to help these organizations. At the project level, farmer representatives join the scheme to form the project committee.

Establishment of FOs makes the cultivation meetings orderly and peaceful and the decisions taken at these meetings in respect of cultivation calendar, etc., are generally complied with. It is also observed that there is a better interaction between the officers and the farmers.

Aspects Needing Consideration at the Design Stage

Aspects such as design of an irrigation distribution system capable of proper regulation, provisions for control of water issues, incorporation of measuring devices, system capability for equitable distribution of water, minimizing seepage and other conveyance losses, etc., are listed.

Moore, Mick. 1988. Maintenance before management: A new strategy for small-scale irrigation tanks in Sri Lanka. London. ODZ. 11p. (ODZ/International Irrigation Management Institute Network Paper 88/2e).

Keywords tank irrigation / small-scale systems / irrigation maintenance

Study site Sri Lanka in general

Study period Not specified

Introduction

This paper reviews the past strategies of lank upgrading programs and highlights their weaknesses. It also suggests a new strategy for upgrading programs for small tanks.

Objectives

To draw lessons from past tank-upgrading programs and to propose a different strategy for small-scale irrigation tanks in Sri Lanka.

Research Findings

Past upgrading programs have produced meager results. The main reason was that these tank upgrading programs were based on an inadequate understanding of functions that needed to be performed to achieve improved irrigation management. These programs included physical rehabilitation and water management programs **but** they had omitted the crucial function: maintenance.

ignorance of small-scale irrigation systems also led to radically innovative water management plans for small-scale tank systems which produced few positive results.

This paper suggests a new strategy for small-scale tank upgrading programs, in which the maintenance component is included, The paper suggests that maintenance activity should be a precondition for access to government maintenance funds.

Palanisami, K. and Flinn, J.C. 1988. Evaluating the performance of tank irrigation systems. Agricultural Systems, 28:161-177.

Keywords tank irrigation / irrigation management / performance evaluation

Study site India (not specified)

Study period Not specified

Introduction

Poor performance in irrigation schemes is observed in many Asian countries. Several constraints limit the productivity of these schemes. Some problems are poor maintenance of structures, encroachment, absence of water user associations to manage the systems and inadequate groundwater supplied to supplement the tank water. This study analyzes a range of programs implemented to improve water availability, both at tank and farm levels, in India. Improved strategies are sluice modification, canal lining, providing additional wells, sluice management and rotational water issues.

A simulation method as a tool has been used to study performance.

Objectives

To examine tank irrigation system performance using productivity increase and income equity as performance criteria under existing and improved physical and management strategies and to evaluate the financial viability of alternative improvement strategies to help guide future investment in tank improvement.

Findings

It was found that sluice modification did not improve system performance. Sluice management resulted in yield increases and marginal improvement in system performance. Canal lining, providing additional wells, and rotational management improved total rice production.

A combination of management and physical investment gave the best results and also gave the best results in terms of equity impacts.

The two management strategies, sluice management and rotational water deliveries gave the most economically sound options.

From an equity viewpoint, the option of combining management with canal lining and well development was the best choice.

Conclusion

Performance will increase where management and system improvement are used in combination. The analysis also demonstrates that equity and financial criteria may result in different strategies being chosen.

Daléus, E.O. Palm and **J.** Lundqvist. 1989. Water allocation, land tenure and yield in a ***purana*** village, Sri Lanka. Water Resources Development, vol. 5, no **1**, March.

Keywords water allocation / land tenure / village-based systems / minor irrigation

Study site Nochchikulama Village in NCP

Study period **1984** yala, **1984/85** maha, and **1985** yala

Introduction

An adequate water supply is a necessary requirement for a good rice yield. This case study of a rice tract in village irrigation system found that the duration of water coverage explained variations in rice yield for the middle and lower parts, whereas the relation between water coverage and yield was weak in the upper part of the rice tract. In general, there was a decreasing yield with increasing distance from the tank (from **4,176** to **718** kg/ha over a distance of 300 m). At the same time, there were great variations in yield within each section which could be attributed to management problems. Land fragmentation was relatively modest but the average yield for the farmer decreased when fragmentation increased.

Objectives

To analyze the allocation of water to the individual plots within a village irrigation system and to compare the spatial and temporal variation in water coverage with the variation in yield.

Findings/Conclusions/Recommendations

1. In terms of cultivation, current fragmentation must be considered fairly modest.
2. The calendar dates and the period during which water covered different parts of the Nochchikulama Rice Tract varied.
3. The individually owned and operated new fields received water earlier than the old communal fields.
4. There were no tail-end and head-end difference in water availability.
5. Shortage of water in the tail end during the critical period of the crop was due to late cultivation.
6. There was a general decrease in yields from the upper part to the lower part of the rice tract.
7. There was great variation of yields within the sections due to fragmentation and management problems.

8. Duration of water coverage during the critical period was unsatisfactory for the middle and lower parts of the rice tract.

9. For the upper part, where water coverage was considered sufficient, the relation between water coverage and yield was weak, whereas for the middle and lower parts water coverage was a significant factor behind variation in yield.

10. Farmers prefer a water depth of about 50-80 cm for about 75 days for three-months rice varieties; this is higher than the demand for water in large schemes.

11. Traditionally, because farmers in this village cultivate only rice, demand for water from the tank was fairly homogenous, and also the demand over the season followed a certain pattern. However, the new pattern of water demand is much more complex. One reason for this change is the change in tenurial pattern.

12. The introduction of non-rice crops has led to incidents of conflict over water due to different requirements in timing and amounts for the different crops.

IIMI. **1989. Irrigation** institutions in Kirindi Oya, yala **1989.** Draft paper prepared by IIMI, based on the field research.

Keywords: irrigation / institutes / farmer organizations / subcommittee / project committee / O&M / yaia / maha / Kirindi Oya

Study site: Kirindi Oya

Study period: 1989 yala

Introduction

Institutions functioning within the Kirindi Oya Project are supposed to have contributed their input for implementing the project plan to achieve the long-term and short-term objectives of the project. The biggest constraint was the coordination among line agencies. Also, rapport between farmers and officers was limited as the delivery mechanism of line agencies did not function effectively. In addilion, natural factors also negatively affected irrigation institutions during the season.

Objectives

1. To evaluate the institutional functioning in yala 1989.
2. To compare wilh two previous seasons to evaluate the progress and achievements made in the institutionalization process and to identify shortcomings.

Research Findings

1. Steps should be taken to raise the status of the present PCC subcommittee to that of the DAC subcommittee for the project, incorporating both Ellagala and the new system.
2. The Resident Engineers should take a keen interest in solving the problems related to O&M since the O&M section has limited resources.
3. OFCs cannot be introduced unless the existing problems are dealt with at the national level.
4. The decision-making process is defective.
5. There was a marked change of farmers' attitude toward the irrigation bureaucracy by the end of the season.

Mendis, D.L.O. **1989.** Development of underdevelopment in southern Sri Lanka: **Destabilisation** of ancient irrigation ecosystems by the impact of hydraulic engineering. Institute of Engineers, Sri Lanka, Transactions for 1989, **Vol.1,** pp 3149.

Keywords	irrigation ecosystems ▮ southern Sri Lanka ▮ water resources development
Study area	Southern Sri Lanka
Study period	Nonspecific

Introduction

As an introduction to the paper the author discusses the phenomenon of development of underdevelopment in third world countries. It is followed by a discussion on development of underdevelopment in southern Sri Lanka in relation to improper planning of water resources development. As examples, consequences of the construction of Uda Walawe and Lunuganvehera reservoirs are analyzed. Advantages of the Southern Area Plan and factors that denied its implementation are also discussed.

Objectives

To analyze factors which contributed to the destabilization of ancient irrigation ecosystems in southern Sri Lanka, and to identify some remedial measures.

Research Findings

The principal vehicle for the development of underdevelopment in Southern Sri Lanka is the "Map of Water Resources Development of Ceylon, 1959 which shows a collection of within-basin reservoirs in the major basins, without any consideration to trans-basin diversion.

Major Problems *Identified* with the Uda *Walawe* Project

1. The location for the Uda Walawe Reservoir was not determined on the basis of scientific **principles** of water resources planning.

2. The construction of Uda Walawe headworks was completed in record time with very low costs.

3. Downstream work has been extremely poor and fraught with problems.

4. Farmers overuse irrigation water because it is free of charge

5. Rehabilitation of the distribution system at Uda Walawe started even before construction of the channels was completed.

6. Destruction of functioning microsystems in the downstream development area by assuring the transformation of traditional subsistence farming to production for the market agricultural entrepreneur in a capitalist system.

7. Need for interdisciplinary study between engineers, social scientists, etc., was not identified.

Consequences of Lunuganvehera

1. The medium-scale reservoirs lying downstream of Lunuganvehera are supplied with excess water.

2. The promise of supplying irrigation water from the Lunuganvehera Right Bank Canal to Badagiriya has not been fulfilled.

3. Construction has taken a longer time than anticipated and has produced less irrigable land than planned.

4. Settled families are becoming an embarrassment to local authorities

5. Destruction and destabilization of the ancient irrigation systems in the area have effects on the socio-political environment in the area.

Recommendations

Remedial Measures at Walawe. To create a new macro irrigation ecosystem, major changes in the design and layout of the irrigation infrastructure are needed such as retracing the Right Bank Main Canal at a higher contour around Chandrika Wewa and bringing the layout of the distribution system closer to the ancient system of irrigation, and distribution of water.

Conclusions

Consequences of the construction of Uda Walawe and Lunuganvehera reservoirs should be a warning to other technoarats who are engaged on project formulation. The proposed Moragahakanda Reservoir and the proposed NCP canal should be reexamined in terms of rational scientific principles of water management.

Bandara K.R.N., K.K.B, Perera and V.A. Gillespie. 1990. Desilting operations of System B Left Bank Main Canal: Progress report. Pimburattewa, Sri Lanka: Development Alternatives Inc.

Keywords desilting operation I canal management I Mahaweli

Study site Mahaweli System B

Study period 1989

Introduction

The report describes the methods used to remove silt and debris from the Lefl Bank Main Canal (LBMS) in Mahaweli System B in 1989. Efficiency and cost effectiveness of the traditional mefhod and the nontraditional method are analyzed.

Objective

To study the methods used in desilting operations and analyze their cost effectiveness.

Research Findings

The desilting method used in March/April 1989 is the traditional method. In this method 10 to 24 people comprise a crew. The two people who are on the canal bed remove sill from the bed. Usually these two use, hoe-like hand tools, or their hands to pick up the sill and place it in hods. The job of the remaining people in the crew is to remove and empty the hods. They do *so* by standing on the ladder and handing the buckets up to the canal bank where the last person in the chain dumps the debris on the canal road.

It took a total of 11 working days with an average of 6 working hours per day for a load of silt that averaged 8 cm x 2.2 km to be removed.

Desilting costs were estimated to be:

* ***Rs*** 1.1 per sq.m of canal bed for the first km
* Rs 55.00 per cu.m of silt removed for the remaining 1.2 km of canal.

The non-traditional method identified was the use of mobile crane with a trailer. In the first four days of its use, the work of filling the trailer was very slow because the labor crew was still using the traditional means of getting the silt off the canal bed. Afler the shovels were used as "Experimental Productivity Enhancement Devices (EPED)" in order to remove silt from the canal the speed with which salt was removed increased significantly.

It took a total of 26 working days for removing an average silt load of 10 cm x 500 cm for the remaining 2.5 km.

Desilting costs are estimated to be:

* Rs 1.05 per sq.m of canal bed for the first km
* Rs 53.00 per cu.m of silt removed by the traditional method for about 725 m
* Rs 76.50 per cu.m of silt removed using the mobile crane and the trailer

Recommendation

With three trailers being used, it is anticipated that the cost per cubic meter removed will be significantly reduced to a level below that of the traditional method.

Dharmasena, G.T. 1990. Planning of irrigation to optimize the effect of rainfall. In Irrigation and Water Resources; Proceedings of a symposium, pp.1-17; Faculty of Agriculture, University of Peradeniya. Peradeniya, Sri Lanka.

Keywords irrigation requirements / optimization / computer models in irrigation

Study site Nagadeepa Scheme

Study period Not specified

Introduction

This paper attempts to demonstrate the use of historical data on rainfall and climate in planning irrigation to maximize the use of rainfall.

Objectives

To explore the possibility of using the computer as a data- storage system to provide statistical information on climate and to examine the possibility of planning irrigation issues before monsoonal rains.

Research Findings

A computer program was developed to calculate crop water requirements and irrigation requirements from climatic and crop data. The database includes data on potential evapotranspiration of crops, monthly rainfall and effective rainfall, and irrigation requirements. Irrigation supply was optimized using climatic data by varying the date of commencements of the cultivation.

This concept was tested by doing an operational study for a medium-size reservoir (Nagadeepa Scheme) and in the Inginimitiya Scheme. However, it was not possible to show any results by trying it out only in one season.

Conclusion

It was found that if the storage water is limited, it is difficult to plan the date of commencement of cultivation even based on statistical analysis of ciimatic data. However, the computers can be utilized to prepare relevant information on historical weather information for implementation in multipurpose projects.

Elkaduwa, W. K. B. 1990. Water management practices in lowland rice of Mahaweli System C Project. In proceedings of a symposium on Irrigation and Water Resources. E.R.N. Gunawardena (ed.). 24-25 August. Kandy, Sri Lanka.

Keywords: irrigation management / irrigation methods / Mahaweli Project / major irrigation schemes / Sri Lanka

Study site: Blocks **301** and **302** in Mahaweli System C

Study period: **1985** yala and **1985/86** maha

Introduction

Water use by lowland rice in Mahaweli System C was studied during **1985** yala and **1985/86** maha in blocks **301** and **302** representing the conventional system and an improved system, respectively. In the conventional system, inadequacy of topographic detail for designing together with construction deficiencies, caused flow-regulating and measuring difficulties. Severe problems prevented cultivation in **16** percent of the area. The total irrigation duty was **3,362** mm in yala and **3,565** mm in maha with a total rainfall of **323 mm** in yala and **1,762** mm in maha. In Block **302,** despite the satisfactory irrigation facilities, the actual duty exceeded that of Block **301** by **10** percent. In Block **301,** the design was to rotate water issues irrigating only two farms simultaneously. In actual practice, disorderly actual issues and structural defects caused a demand for more water. The field canal flow varied to **39** percent below the designed rate of **28.32** Us. In Block **302,** water issues sometimes exceeded double the designed rate of **2** l/s/ha continually. Although the water requirement declined toward the end of the season, the issues were almost constant at **31** mm/day in Block **301** and **27** mm/day in Block **302.** Measured water requirement varied from **32** to **13** mm/day down the **3-5** percent slope. The average water use for land preparation was **548** mm in yala and 895 mm in maha. Disorganized water issues, deep impounding for soaking, delays in repairing damage bunds, etc., were responsible for high wastage of water. In Block **302,** better availability of water shortened the duration of land preparation by **13** days and consequently reduced the total water use.

Objective

To study the water use by lowland rice in Mahaweli System C.

Findings/Conclusions/Recommendations

* The improved system had not increased the irrigation efficiency as compared with the conventional system which also had the problem of irrigation difficulties and excessive water use. To remedy those, it is necessary to consider topographical details for designing,

* Although the conventional system was designed for rotational issues, management practices at the field level were highly disorganized and highly wasteful. A farm-level rotational system with the help of farmers is needed.

* Completion of maintenance work before mid-September for maha and before mid-March for yala to commence water issues will minimize the irrigation water use. An organized system of water issues should be practiced for the land preparation period to minimize the water use and to reduce the duration.

* Channels must be cleaned and desilted before the water issues commence and the farmer must be present in his field during the water issues to prevent surface runoff due to overirrigation.

* The flow in channels must be regulated effectively during rainy periods to minimize irrigation duty.

* Toward the end of the season water supplies must be gradually decreased to meet the declining demand for staggered cultivation of different age varieties.

TEAMS. **1990.** Final report submitted to IIMI in connection with institutional building process of five major irrigation schemes in Sri Lanka, **1990.**

Keywords	farmer participation / organization / institutional building / Sri Lanka / Ridibendi Ela
Study sites	Parakrama Samudraya, Giritale, Minneriya, Kaudulla, and Ridibendi Ela
Study period	1988/90

Introduction

To understand the actual functioning of FOs in Parakrama Samudraya, Giritale. Minneriya, Kaudulla and Ridibendi Ela, it is important to review their evolution. An attempt is made to visualize these developments in terms of the period (a) prior to INMAS, and (b) prior to ISMP, *so* that the impact of institution building under ISMP could be understood objectively.

Objectives

1. To make an independent and objective assessment of what has been done *so* far in Parakrama Samudraya. Giritale, Minneriya, and Kaudulla in terms of institution building related to FOs.

2. To evaluate the institutional strength of FOs in Ridibendi Ela in terms of actual performance and to identify any lessons that could be learnt from this scheme which might be applicable to the schemes in Polonnaruwa or elsewhere.

3. To investigate whether there are ways in which the institution building process could be made more effective while testing other possible innovations which can Improve the process.

Research Findings

In trying to develop FOs it is fundamental to define who should be admitted as members of such organizatlons. The improvement of the functional environment is needed, i.e., the ID should revise its own strategies and project a different approach in institution building. At the same time, the IMD should continue to play the catalytic role in a learning process approach and endeavor to consolidate its accomplishments to develop a sector-wide communication process. Efforts should be made to increase the efficiency of FOs in undertaking rehabilitation and maintenance works. The IOs are change agents and they need **db** be educated and trained after defining their role clearly. Emphasis should be given to organizing training programs for the benefit of the principal office-bearers and the committees of the DCOs.

Jinadasa, W.P. 1990. Rehabilitation experiences in Anuradhapura District. IIMI-ID Seminar. 10 December, 15p.

Keywords Anuradhapura / tank irrigation I irrigation rehabilitation

Study area Anuradhapura District

Study period The late 1970 and the 1980s

Introduction

This paper discusses the construction and maintenance problems encountered in the Anuradhapura District during the implementation of the following projects:

* Tank Irrigation Modernization Project (TIMP)
* Anuradhapura Dly-Zone Agricultural Project (ADZAP)
* Village Irrigation Rehabilitation Project (VIRP)
* Major Irrigation Rehabilitation Project (MIRP)

Objective

To analyze the rehabilitation experiences in the Anuradhapura District under the foliowing projects: TIMP, ADZAP, VIRP and MIRP.

Research Findings for TIMP

Problems Encountered during Implementation

1. Delay in the arrival of machinely and equipment causing delay in the construction program by almost one and a half years

2. Some of the machinery, such as small dumpers, vibrating rollers, etc., being inefficient during operation

3. Most of the spares required for the machines being unavailable with the local agents

4. Delay in getting spares resulting in separate construction units for every 6,000 acres, again resulting in some buildings constructed for such units never being used

5. The limited knowledge held by the construction staff on design concepts resulting in mistakes at the initial stages

6. Construction staff having to face difficult situations in trying to accommodate farmers' requests since farmers were not consulted at the design stage

Problems during Operation

1. Preparation of strict operation schedules by the water management consultant resulted in additional staff requirements.

2. Much damage was caused to structures such as turnouts because farmers felt the new structures obstructed the water flow.

3. Under the TIMP concept, the land preparation should start with available soil moisture and plowing. But farmers were very reluctant to go for dry plowing without the tank having a sufficient storage for the ongoing cultivation.

Similar experiences are listed for the other three projects.

Recommendations

1. Now that FOs are established, it is better to have a close dialogue with them before finalizing designs for rehabilitation.

2. Carry out surveys and detail designs, and plan construction works adequately to avoid delays in implementation.

3. Allow sufficiently long construction periods for rehabilitation works in view of the limited closed seasons available.

4. Include illicitly cultivated lands in the designs as far as possible. This will prevent illicit tapping of water and damages to structures.

5. Involve farmers in the rehabilitation activities as far as possible.

6. Have simple measuring devices in place of the standard weir arrangement.

7. Educate farmers as far as possible on the necessity of certain structures and their usefulness.

Lenton, R. 1990. Development and implementation of innovation in irrigation. Paper presented at the conference on Appropriate Development for Survival, the Contribution of Technology. London: 9-10 October, The Institute of Civil and Mechanical Engineers, pp. 3-15.

Keywords irrigation innovation / implementation / technology transfer

Study area Sri Lanka and Indonesia

Study period Nonspecific

Introduction

This paper analyzes the process of implementation of technological and managerial innovation in irrigation in developing countries. It is described in three parts. The first part describes aspects of irrigation and its management. A case study each on operational planning and practices in irrigation in Indonesia and on project management structures in Sri Lanka is analyzed in the paper. The first case study describes the development and testing of a set of low-cost operational changes in the management of irrigation systems in Indonesia designed to use the country's existing infrastructure more efficiently. The second case study describes the development and initial implementation of a recommended organizational change in an irrigation scheme in southern Sri Lanka. Part III presents the generic lessons learned from case studies and from IIMI's experience elsewhere.

Objectives

To shed new light on how technological and managerial innovation in irrigation is implemented in developed countries and to help define the characteristics of effective technology development and transfer.

Conclusions

1. Successful implementation of an innovation requires a process of development, adoption and implementation of technology that is both interactive and long term which, in turn, requires partnerships between researchers and practitioners. Such partnerships provide a mechanism for jointly addressing implementation problems.

2. Technology cannot be effectively "transferred without strong policy commitment at the highest government levels.

3. There is a need for strong and effective national systems of technology development and implementation that involve partnerships among the research and development community.

Lowe, T.C. and K.R. Rushton. 1990. Water losses from canals and rice fields. Irrigation and Water Resources, Proceedings of a Symposium Sponsored by ODA, UK. 24-25 August 1990, Sri Lanka.

Keywords water loss / rice cultivation / numerical models

Study site Not specified

Study period Not specified

Introduction

Significant losses of water occur from canals and rice fields. Existing field evidence is reviewed and the use of numerical models for understanding the causes of the losses is discussed. The paper also describes preliminary field studies of a site near Kandy, Sri Lanka. Practical difficulties in carrying out field studies are highlighted but it is shown that these studies can lead to a greater understanding of the movement of water in these fields. The paper concludes with a discussion on the reuse of water.

Objective

To understand the process involved in water losses in canals and rice fields.

Research Findings

important findings from the numerical studies are as follows:

* the hydraulic conductivity of the underlying strata is of critical importance in estimating losses from channels
* The size of the channel has only a small effect on the magnitude of channel losses
* The presence of less-permeable zones, such as clay lenses, beneath the canal has a significant effect on the channel losses
* The losses are also affected by the groundwater heads in the underlying aquifer

Efficiency of Lining

Due to imperfections in the concrete or due to the presence of cracks and broken slopes canal lining has only a small effect in reducing losses.

The Flow of Water through Terraced Rice Fields

Losses from rice fields are likely to remain a serious problem, especially if the soil is reasonably permeable. The preliminary study performed at Suriyaagoda has provided much useful information about the situation in a wet-zone terrace system in Sri Lanka. The work has also served to illustrate a number of ways in which field studies of terrace systems should be conducted to understand their behavior. Losses can be reduced by maintaining a shallower water level in the fields but this is only possible with continuous flow systems or where water is supplied from wells. Although it is important to minimize these losses, it will remain a difficult task to develop practical means of achieving significant reductions in these losses. Consequently, it is likely that in most irrigation schemes the losses will be greater than 50 percent. This prompts the question as to whether water can be reused. The reuse of water has been achieved in certain localities by withdrawing water from drainage channels or open wells. Where reuse has been practiced, greater flexibility can be achieved than when relying solely on surface irrigation water.

In examining the possibility of the reuse of water, the movement of water in the aquifer system must be studied. Due to the presence of clay lenses in most aquifer systems, the downward movement of water is likely to be slow. Consequently, water should be withdrawn from the upper zones of the aquifers rather than from deep tube wells. The timing of the reuse of water is also important. The practice adopted in agro-well schemes of growing a rain-fed or surface-irrigated crop during the maha season and then using well water for the yala season is to be commended.

Recommendations

The methodology required for the reuse of water lost from irrigation schemes is in the early stages of development. Detailed studies need to be carried out into the existing strategies, and the potentialities of this approach in other areas of Sri Lanka need to be explored.

Mendis. D.L.O. 1990. Layout of channel systems in irrigation projects in Sri Lanka. In Gunawardena E.R.N (ed.), Irrigation and Water Resources: Proceedings of a Symposium. Faculty of Agriculture, University of Peradeniya. Peradeniya, Sri Lanka.

Keywords open channels / water distribution / reservoirs / irrigation systems

Study site Sri Lanka in general

Study period Nonspecific

Introduction

River diversion schemes and storage reservoirs were two types of irrigation systems in ancient times. Modern developments in these schemes with associated water management problems are highlighted. The absence of preventive maintenance of these schemes led to the introduction of the so-called "irrigation rehabilitation projects." The need for the redesign of channel systems for crop diversification is also discussed.

Objective

To analyze the weaknesses of the layout of channel systems in irrigation projects.

Findings

Four types of weaknesses identified were as follows :

1. ***Wafer*** Management

In theory, each farmer is independent of all farmers and dependent only on the irrigation system. But in practice, all farmers are necessarily interdependent. This arises from the fact that there is a need for rotation of water issues in the field channels and distributary channels made implicit in the design of these channels.

2. Rehabilitation

There have been a number of so-called irrigation rehabilitation projects necessitated by the absence of preventive maintenance on these schemes. Project appraisal reports describe the work done under the rehabilitation projects as being based on a "pragmatic approach." which means the irrigation systems have been repaired and restored but not redesigned.

The need for redesign of some channel systems arises on account of a new awareness of the nature of the agricultural soils, and of the need to diversify crops to suit the soils and to increase farmer incomes. Water distribution for irrigation has to be designed anew using new technologies.

3 Structural *Improvements*

An earlier attempt by the Irrigation Department to introduce structural improvements at Wahalkada Weva included the lining of distributary and field channels, and the installation of cross regulators in main channels and of measuring devices in main and distributary channels. However, improvements in system efficiency and farmer acceptance were said to be marginal. Farmers did not go in for crop diversification to the extent anticipated. Field channels could not carry the extra load required for land preparation and *so* on.

4. Lift Irrigation

Another new program tried out was lift irrigation in a few projects like the Nagadeepa Maha Weva. Most of these projects failed because the pumps could not be maintained, so the new designs of channel systems could not really be put to the test to the extent desired. It was a pity that lift irrigation was introduced at all, because the natural topography of the dry zone is such that there are areas where well-drained soils are available under gravity command, and these locations could have been used to try out the new irrigation distribution systems.

Conclusion

From time to time, farmers themselves bring home to technologists that some of the innovations copied from foreign manuals are meaningless in the local extent. Technologists must face these issues honestly, and come to honest conclusions, without deceiving themselves further on account of misplaced loyalties to their peers and predecessors. Their only loyalty should be to the people **who** have enough burdens to bear without those imposed on them by learned professionals.

Nayakakorala, H. B. 1990. A preliminary study on alternative water management in field channels during land preparation for lowland paddy. In proceedings of a symposium on Irrigation and Water Resources. E.R.N. Gunawardena (ed.). 24-25 August, Kandy, Sri Lanka.

Keywords irrigation management irrigation methods on different soil types I lowland rice I Mahaweli Project / major irrigation schemes I Sri Lanka

Study site Mahaweli System H

Study period Not specifies

Introduction

Lowland rice is cultivated both on Reddish Brown Earth (RBE) and Low Humic Gley (LHG) soils in many irrigation schemes. These two soils occupy the same catena and are irrigated by the same distributary channel network. However, the water requirement for land preparation of the two soils varies greatly and leads to many irrigation management problems. The feasibility of an alternative water management method in the field channel to overcome some of these problems was evaluated in a preliminary study. In this method, water was first issued to farms with RBE soils. The farms with LHG soils were watered only after the farms with RBE soils were soaked. The farmers on the LHG soils were encouraged to use runoff and seepage from RBE soils. The results revealed that the new method of water issue uses less water and reduces competition for water between RBE and LHG soils. All the farmers in RBE soils were satisfied with the new methods compared to 64 percent of the farmers in LHG soils.

Objective

To explore the possibilities of overcoming the water management problems during land preparation period by changing the water management practices at FC level.

Findings/Conclusions/Recommendations

* The issue of water first to RBE soils and then to collect runoff and seepage in LHG soils is possible to a certain extent as a water-saving measure. Farmers having RBE soils in their allotments benefit directly from this method. However, not all the farmers on LHG soils benefit by this practice since some may not receive adequate runoff and seepage into their allotments.

* There is potential for reducing water use during land preparation for rice and alleviating some of the water-shortage problems by introducing new water management practices at the FC level.

Padmarajah, S. and Mapa R.B. 1990. Changes in soil physical properties along a Reddish Brown Earth Soil catena: A challenge for irrigation planning. In proceedings of a symposium on Irrigation and Water Resources. E.R.N. Gunawardena (ed.). 24-25 August, Kandy, Sri Lanka.

Keywords	irrigation management / soil physical properties / major irrigation schemes / Sri Lanka
Study site	Catchment C of the Agricultural Research Station, Maha Illuppallama
Study period	Not specified

Introduction

One of the most important factors in irrigation planning is estimating the irrigation rate and frequency for given soil and agronomic conditions. Soil physical properties play a very critical role in these estimates which form the basis of many costly operations that are required in irrigation project development. Reddish Brown Earths (Alfisols) are a major soil group appearing in the command area of major irrigation schemes. These soils occur in undulating terrain in the catenary landscape and are further classified as well drained (WD), imperfectly drained (ID) and poorly drained (PD).

A study was conducted to characterize the soil physical properties along the Reddish Brown Earth soil catena for the use of irrigation planning and management. The results indicated that WD showed a steady infiltration rate of 1.9 cm/h which is optimum for surface irrigation methods. Steady infiltration rate declined along the catena where ID and PD showed rates of 0.6 and 0.3 cmlh, respectively, making them marginally suitable for surface irrigation methods due to excessive surface losses and poor soil aeration during irrigation. The available water capacity was 74.3, 67.4 and 54.6 mmlm for WD. ID and PD, respectively.

Objective

To characterize the soil physical properties such as steady infiltration rate and water retention characteristics along an RBE soil catena to provide the basic information needed for better irrigation management.

Findings

- LHG is marginally suitable for cultivation of OFCs under surface irrigation due to its low infiltration rate which will necessitate alteration in water application rates and frequencies to avoid runoff losses and crop damage due to poor soil aeration with temporary ponding under surface irrigation.

- Apply shallow depths more frequently.

* The steady infiltration rate of the well-drained class is optimum for surface irrigation methods and OFCs could be cultivated without much effort in fields which were originally designed for rice cultivation.

* LHG requires more frequent irrigation compared to WD. The problem, however, is not felt at present due to excess irrigation at WD area and subsequent flow of overland and seepage water toward LHG which result in waterlogging rather than in water shortage.

* WD is unsuitable for rice cultivation due to higher deep percolation losses

Recommendations

* Apply irrigation in shallow depths more frequently in LHG soils.

* The water requirement in rice in WD soil has to be reassessed considering deep percolation losses, and water issues should be altered accordingly.

* Select only a WD area for the cultivation of OFCs and provide small frequent water issues

Perera, D.G.A. 1990. Bisokotuvas in architecture and irrigation works of Sri Lanka. **ICTAD Journal:(2):** 43-52.

Keywords bisokotuva / irrigation architecture / hydraulic structure

Study area Sri Lanka in general

Study period Nonspecific

Introduction

Bisokotuva is the square enclosure which can be observed on the dome of a dagoba. Implications of four kinds of bisokotuvas in ancient Sinhalese architecture and functions of bisokotuvas in ancient irrigation works are analyzed in the paper.

Objective

To analyze the implications and functions of bisokotuvas in architecture and irrigation works of Sri Lanka.

Research Findings

Bisokotuvas in *Irrigation* Works

1. The bisokotuva protected the long sluice running under the earthwork dam from damage due to the surge of water under high pressure.

2. A bisokotuva was always designed and placed in relation to the underground sluice, in the same way as the surge chamber in a modern hydroelectric reservoir, like the penstocks leading to the turbines in the power house.

3. The bisokotuva, the sides of which always rose above the high water mark, was there to absorb any charges and countercharges from either directions.

4. The mouth of the outlet culvert was always placed below the water level in the channel leading to the fields to prevent water cascading at the sluice exit, a condition which could cause damage to both the dam and the channel bunds.

5. A bisokotuva enables lowering of the water level by balancing the inflow and outflow *so* that the same volume of water that entered it at high pressure was made to leave it at a lower pressure.

6. A bisokotuva enabled equalization of pressure on the two sides of a valve when it became necessary to open it or close it.

Wickramaratna, H. A. 1990. Management of irrigation schemes to get maximum benefits from available water. In proceedings of a symposium on Irrigation and Water Resources. E.R.N. Gunawardena (ed.). 24-25 August, Kandy, Sri Lanka.

Keywords: irrigation management / irrigation methods / farming practices / groundwater / major irrigation schemes / Sri Lanka

Study sits: Sri Lanka in general

Study period: 1990

Introduction

A common problem in irrigation schemes is the insufficiency of water to cultivate the full anticipated extent under the project. It could be due to the cultivation of rice in soils which are ideally suited for other field crops and the lack of coordination among the officers of different disciplines and the farmers. By proper understanding of irrigation methods, groundwater behavior, agricultural requirements and farming practices, available water can be used in a more profitable manner.

As the price of rice in the world market has not changed during the last 15 years, growing rice in areas of high water consumption is not economical. Cultivation of high-value field crops should be considered in all such areas. Some of the suggestions to achieve the main objective are facilities to provide irrigation water round the year, provision of an effective drainage systems during the period of high rainfall, staggering of cultivation to get the benefits of buildup of the water tables and to make use of available rainfall. Flexible operation schedules, working in close coordination with the farmers and making sensible adjustments during crisis situations are vital for efficient management.

Objectives

To analyze the problem of insufficient water in the irrigation schemes and to assess how to achieve full benefits from the irrigation projects.

Findings/Conclusions/Recommendations

* There are differences between planning stage assumptions and actual behavior,
* Conveyance losses from the irrigation channels and infiltration and percolation losses from the farms in certain areas during a particular period may vary considerably from the planning stage assumptions.
* By monitoring flows, groundwater, and salinity levels suitable crops and cultivation programs can be prepared for such areas.

* Crops should be cultivated according to the type of soil, land slope and availability of water in the system.

* Irrigation schedules should be prepared to suit the cultivation programs allowing for staggering of cultivation to get benefits from return flows.

* Water issue schedules should be flexible and day-lo-day adjustment will be necessary.

* Cultivation of subsidiary crops round the year should **be** considered.

* It is necessary to get farmers' involvement in the management of the project and in the decision-making process.

Wickramaratna, N. 1990. Need for adoption of new design concepts and technologies in major irrigation schemes. In proceedings of a symposium on Irrigation and Water Resources. E.R.N. Gunawardena (ed.). 24-26 August, Kandy, Sri Lanka.

Keywords: irrigation management / irrigation technology / crop diversification / Mahaweli Project / major irrigation schemes / Sri Lanka

Study site: Sri Lanka in general

Study period: Nonspecific

Introduction

At present, rice cultivation is not highly remunerative to the small farmer. On the other hand, cash crops can be very attractive in income terms as well as in labor absorption potential both on-farm and off-farm. Finally, these crops consume less water per unit of land cultivated relative to rice. Therefore, it is important to provide some flexibility so that farmers can respond to changing market signals and national policy directives from time to time rather than being tied down to rice alone. Thus, there is a need to modernize existing irrigation systems to increase their flexibility and reliability. Otherwise, farmers would not be motivated to grow non-rice crops which are a high-risk venture where cash and labor inputs can be three or four times that of rice crops. Moreover, the concepts adopted in irrigation system designs have not been appreciably improved during the last twenty years. Hence, development scenarios for future irrigation projects are proposed.

Objective

To propose new design concepts and technologies for diversified cropping in major irrigation schemes.

Findings/Conclusions/Recommendations

Development scenarios for future projects for cultivation of non- rice crops.

* Development of lands in future irrigation projects should be limited to the areas with well-drained soils in the first stage.

* The rest of the areas with heavy soils can be distributed to farmers after a few years to cultivate either rice or for pasture.

* To satisfy the needs of the farmer, the ideal mode of water delivery is an "on-demand" system. The canal system, therefore, should be designed to function as an automated irrigation system. Water levels in the main and branch canals should be controlled by hydraulically operated gates.

Secondary canals should be designed to maintain a constant level, and field channels should be replaced by low pressure pipe systems with meters to measure the flow. Monitoring of water flow should also be applied to the water pumped to farms from the secondary canals (or from shallow dug wells) in the farm or a constant discharge module should be fixed at each turnout and farmers should be well organized at turnout level for the distribution of water within the turnout.

* Precise land leveling should be done to increase the efficiency of surface application methods or drip/sprinkler irrigation methods should be used.

* Rice should not be cultivated even in the maha season and each area should be allocated for one type of crop.

Upgrading of existing projects would be the same as for new projects, but implementation of actual physical improvements would be much more difficult.

Amarasekara, N. 1991. Environmental consequences of the Menik Ganga Diversion. Article published in the Island, 26 June 1991.

Keywords: environmental impacts / Menik Ganga / river diversion / water transfer

Study area: Southern part of Sri Lanka

Study period: Nonspecific

Introduction

In an attempt to obtain sufficient water for the Lunuganvehera Reservoir which was constructed under the Kirindi Oya Irrigation and Settlement Project, it is considered to divert the Menik Ganga water into this reservoir. The wisdom of this proposal is questioned by the author. Guidelines for environmental evaluation of long-distance water transfer projects and environmental and social implications of long-distance water-transfer projects are discussed in the paper based on experiences gained from other countries.

Objective

Assessment of environmental consequences of the Menik Ganga Diversion.

Research Findings

Environmental issues associated with large-scale water transfer projects are: micro-climatic changes, changes in water velocity and discharge, sedimentation and erosion, evapotranspiration, changes in water table and groundwater recharge rates, resettlement of human populations and pressure on land use. For the Menik Ganga, which flows through the heart of the Yala sanctuary, the desirability of agricultural development is subject to question.

Recommendations/Conclusions

The following recommendations are given in relation to conducting the Environmental Impact Assessment (EIA) of the Menik Ganga Diversion:

1. Water transfer problems should be analyzed in connection with the river-basin development process.

2. As specified in the amended National Environmental Act of 1988, it is a requirement to do an EIA for this diversion project even though it may be costly and time-consuming.

3. The EIA should be carried out in the exporting area, the importing area and the link path between the two areas.

4. A main component of an EIA should be based on the environmental analysis of physical, biological and socioeconomic systems.

5. Alternatives to the proposed project should be recommended.

6. The EIA has to be opened to public comment and hearings before any development decision is taken.

Guidelines used in evaluation of large-scale water transfer projects in developed countries are given below :

1. Explaining why water transfers had been selected as a development strategy over other options and predicting the impacts of the water transfers.

2. Identifying the merits and demerits of water transfers as opposed to other options available for water management.

3. Indicating the institutional factors which favor water transfers and those which discourage them.

4. Indicating the kinds of tradeoffs that have to be made when transfers are selected as a water and environment management strategy.

Amarasekara N. 1991. Environmental impact assessment of the Kirindi Oya Irrigation and Settlement Project (KOISP), Sri Lanka. ESCAP Environment News, 9 (2):12-4.

Keywords: Kirindi Oya / environmental impact / irrigation development

Study area: The Kirindi Oya Irrigation and Settlement Project

Study period: Nonspecific

Introduction

The author says no environmental impact assessment was done prior to the implementation of KOISP and feasible alternative sites for the construction of the Lunuganvehera reservoir were not adequately considered.

Objective

Recognition of major environmental physical issues from the Kirindi Oya irrigation and Settlement Project.

Research Findings

Expected *Positive Impacts*

1. improvement of irrigation facilities to 11,300 acres of existing rice fields.

2. Settlement of about **8,325** farm families in the area and the establishment of **28** hamlets and **5** village centers.

3. Provision of pipe-borne drinking water to the hamlets.

Negative *Impacts*

Negligence and lack of knowledge of the upland catchments caused the following problems for the lowland population:

1. Destruction and destabilization of the ancient irrigation ecosystems in the area

2. Effects of converting secondary forest area to irrigated cultivation and the introduction of a new settlement

3. Waterborne diseases

4. Fisheries development around the Hambantota and Tangalle areas being very low due to poor water quality in KOISP

5. Organic and inorganic pollution *of* surface water and groundwater by excessive use ofagrochemicals resulting in ecological imbalances

6 Delay in land development and drainage construction causing salinity problems in the command area

7. Non-protection **of** the wildlife and forest reserves in the project area

8. The reservoir constructed not being filled to the expected level in the past years **of** operation, resulting in the proposal to divert the Menik Ganga

9. Adverse impact of the Menik Ganga Diversion on the major national park **it** flows through.

Eleperuma, T. **1991.** Performance **of** irrigated agriculture in Sri Lanka. Institute of Engineers, Sri Lanka, March **1991.**

Keywords irrigated agriculture / management / insurance

Study site Nonspecific

Study period Nonspecific

Introduction

This paper attempts to highlight the shortcomings in the economical management of large irrigation schemes and to search for a remedy.

Objective

To identify a mechanism which could be used in the management of large irrigation schemes *so* that the risk factor of an investment by farmers can be reduced and they could take part in operational planning.

Research Findings/Conclusions

According to the author a well-established commercial insurance scheme covering irrigation as a specific risk has advantages over the present system defined by the "Agricultural Insurance Law No. 27 of 1973."

1. Farmers would have a financially responsible representative

2. Insurers will absorb the irrigation risk which otherwise would be a burden on the farmers.

3. Farmers' financial interests with respect to irrigation water availability would be well represented at operational decision-making levels through participation of the insurer.

4. The ratio of premium to coverage would be a good indicator that can be used to judge the level of irrigation management, the variation of irrigation management that exists within an irrigation scheme, the variation of irrigation management that exists between different irrigation schemes, and the financially infeasible areas for improvement or abandonment.

5. Involvement of several insurers with similar policies would provide the advantages of free competition to the insured.

6. Removal of risk of irrigation water shortages would increase farmer confidence and thereby increased inputs by the farmer would increase the net agricultural output.

7. The net total of insurance cover of a particular irrigation system would indicate the net worthiness of irrigation in that system which could be used in justifying diversions from the Mahaweli River.

8. The net totals of insurance covers of different irrigation systems could be used to determine the overall diversion pattern of the Mahaweli System that gives the optimum economic return.

9. Bureaucracy involved in operational planning and management of irrigation schemes would be kept under constant surveillance by the insurers for better performance on their part.

10. There would be fewer problems for the state in managing irrigation schemes due to an Increase in the efficiency of management.

11. The evolution of economically affluent farmer communities will reduce social problems.

IIMI. 1991. Improving management **of** irrigation systems maintenance: Proceedings of a national workshop held in Colombo **on** 8 October **1991.**

Keywords maintenance / irrigation management / performance indicators

Study site Nonspecific

Study period Nonspecific

Introduction

Maintenance of irrigation systems is an important issue for irrigation managers as well as for researchers. Many studies have been carried out to study this problem in the recent past. The International Irrigation Management Institute (IIMI) organized a workshop to review some studies done on this important topic.

The main issues discussed at the workshop were:

1. Strategies for reducing operational costs and general charges for maintenance

2. Improving the present procedure of O&M estimation and allocation *for* and implementation of routine maintenance

3. indicators for evaluating the performance of O&M

4. Organizational setup to carry out the O&M activities at project, range and national levels

5. Policy changes needed for effective implementation of the O&M budget

Findings

1. There is considerable scope for reducing operational costs and general maintenance charges.

2. There is no connection between O&M estimation and allocation. Estimates are not used as a basis for execution and they are always far in excess of the allocation.

3. Conveyance efficiency, area irrigated and equity are the indicators to evaluate O&M performance.

4. O&M will work best under a single responsible person.

5. There needs to be a change in O&M allocation policy at treasury level. It should be needs-based rather than based solely on what was allocated in the previous year.

6. It is necessary to use new advanced technology such as precise land leveling and drip/sprinkler irrigation methods at the on-farm level.

Conclusion

It was found that if the storage water is limited, it is difficult to plan the date of commencement of cultivation based even on statistics on climatic data. However, computers can be utilized to prepare relevant information on historical weather information for implementation in multipurpose projects.

IIMI (SLFO). **1991.** Study on management and cost of operation and maintenance of irrigation systems under the Irrigation Department. Colombo, Sri Lanka.

Keywords: government-managed irrigation systems /operating costs / maintenance costs / irrigation systems / Sri Lanka

Study sites: Giritale, Ridi Bendi Ela, Gal Oya Left Bank, Inginimitiya, Mahakanadarawa

Study period: 1989-1990

Introduction

This study looks at the present status of operation and maintenance, and gives a detailed analysis of present levels of O&M funds spent, procedures, institutions, etc. It was also recognized that in this process very interesting findings would emerge which would give a broader perspective of the subject which, in turn, can help policymakers adopt acceptable solutions.

Objectives

1. To define a level of O&M which can be considered as adequate.

2. To cany out applied research on O&M useful to the Irrigation Systems Management Project, the Irrigation Department, the Irrigation Management Division and other organizations using the guidelines.

Research Findings

Operation and maintenance funds allocated for Giritale, Ridi Bendi Ela, Gal Oya Lefl Bank, Inginimitiya and Mahakanadarawa do not meet the actual requirements. Also, the available financial resources do not yield optimum benefits due to poor management of O&M in the areas of programming and exeouting, allocation and supervision of work, accounting and documentation, attention given by management, farmer participation, etc. Even with the presently available financial resources, there is ample scope for improving the O&M performance by better management.

Agricultural Cooperative Development International. 1992. Draft project proposal: Farmer organizationlbusiness development activity. Colombo, Sri Lanka.

Keywords: farmer associations / management planning / irrigation management / Sri Lanka

Study site: ISMP sites

Study period: Nonspecific

Introduction

In farmer organization development among low-income small farmers, pmgress is slow and frequently years are needed to build sustainable farmer organizations. If sustainability of farmer organizations is to be ensured, income streams are needed and permanent administrative and financial structures must be in place with knowledgeable leadership, willing and able to lead those organizations.

Objectives

To sustain **FO** development and O&M of the irrgation infrastructure within selected irrigation systems, to promote agri-business and other income-generating business activities and to provide start-up grants or loans.

Projected Outputs

1. A survey of a select number of Di[illegible]ibutary Channel Farmer Organizations and System Levf Farmer Organizations resulting in one End of Project Status (EOPS) Report.

2. Legal study of **FO** registration and current incorporation status and recommendations on needed changes.

3. At least 100 FO leaders trained in responsibilities in organizational leadership.

4. Ten to fourteen staff hired, trained and working on a full-time basis assisting FOs.

6. At least four feasibility studies completed for FOs wishing to undertake value-added agro-processing.

Amarasekara, N. **1992.** Environmental consequences **of** major irrigation development **in Sri** Lanka: A preliminary assessment. Water International **1992,** 17 **(2): 88-97.**

Keywords | irrigation development / environmental impacts / preliminary assessment

Study area | Sri Lanka in general

Study period | Nonspecific

Introduction

This paper presents preliminary findings from several individual environmental studies conducted in major irrigation systems namely Nilwala Ganga, Kirindi Oya, Uda Waiawe, Gal Oya, Minipe. Hakwatuna Oya, Mahaweli, Parakrama Samudra, Mahakanadarawa and Padawiya.

Objective

Preliminary assessment of environmental impacts of major irrigation development.

Research Findings

Environmental issues identified are: salinity and waterlogging, sedimentation and catchment degradation, pollution of surface water and groundwater, water-borne diseases, disruption of wildlife habitats and socioeconomic disruption and settlement.

Salinity and Waterlogging

Land degradation due to salinity and waterlogging is primarily associated with major irrigation schemes and irrigated lands in the dry zone (reference is given). Excessive drainage in the Nilwala Ganga Project has created high acidity in the upper reaches of the service areas. A comparison study made in the valley bottom lands of 'Purana' villages under minor irrigation system with those in the newly irrigated 'H' System in the Mahaweli Project indicates the gradual emergence of problems of salinity. Engineering structures built to contain saline intrusion have not been effective.

Sedimentation and *Catchment* Degradation

Sedimentation of tanks and irrigation works directly results from soil erosion in catchment areas. Studies contending that the life span of new Mahaweli reservoirs will not be affected seriously during the first 50 years have not considered the continuing changes in the upper watershed land use and catchment characteristics (reference is given). An increasing trend in their runoff/rainfall ratio was revealed from one study. In theory it indicates increased sediment transport from upstream and eventual increase in reservoir siltation. A recent study of the Polgolla Reservoir indicated that 44 percent of its capacity had silted within less than 12 yrs.

Surface Water and Groundwater Pollution

Fertilizer pollution has become a potential hazard in surface water and groundwater. Intensive agricultural practices have already caused nitrate pollution of groundwater and surface water. Groundwater pollution due to fluorides is also mentioned. The cause and source are not given. The most serious threats to groundwater come from nitrate and bacterial contamination. Nitrate pollution come!; from extensive use of agrochemicals and from sewage effluent from pit latrines in the settlement areas. Sewage effluent also causes bacterial contamination of groundwater.

Waterborne Diseases

Environmental changes associated with the development of irrigated agriculture and human settlements are also sources of waterborne diseases. The most serious waterborne diseases in major irrigation are malaria, filariasis, dengue and Japanese B-encephalitis. The Kirindi Oya is one irrigation and settlement project where waterborne diseases were not taken into account.

Disruption of the Wildlife Habitat

The natural wildlife habitats which exist in undeveloped areas will vanish with the conversion of large areas of undeveloped land to agricultural uses. Again the Kirindi Oya Irrigation and Settlement Project is discussed.

Pollution of Lagoons and Estuaries

A study conducted by the National Aquatic Research Agency revealed that the Bundala Lagoon has lost all the capacity for prawn and fish culture due to water pollution from the Kirindi. Oya Project.

Socioeconomic Disruption and Resettlement

The negative effects of poorly planned resettlement can result in the need for extremely costly management intervention. The Kirindi Oya Irrigation and Settlement Project is discussed.

Marikar, F., J. Wilkin-Wells, S. Smolnik and R.K. Sampath. 1992. Irrigation system performance and its impact on crop productivity in Sri Lanka. Water Resources Development, vol.8, No.4, December.

Keywords: irrigation system performance / crop productivity / tank irrigation / North Central Province / Sri Lanka

Study site: Parakrama Samudra Scheme and Giritale Scheme in the North Central Province

Study period: 1986 yala

Introduction

This article analyzes the performance of two irrigation systems in Sri Lanka, using performance measures adapted from Theil's mean square forecast error concept. The performance is measured in terms of defined objectives that are decomposed into three components measuring adequacy, equity or dependability of water deliveries, and management capability. The relationship between the level of performance, as estimated by the above measures, and crop productivity is determined using regression analyses. The study demonstrates that inputs and instiutional variables such as fertilizer, labor, and power concentration have a positive impact on yields while poor irrigation management performance has a negative impact.

Objective

To estimate the level of managerial performance of two irrigation systems in Sri Lanka and study the relationship between the level of performance of the systems and crop productivity.

Findings/Conclusions/Recommendations

1. Adequacy, equity and dependability. and management capability have some impact on crop yields.
2. The concentration of power in the distributaly-level community also appears to have an impact on crop yields. Obviously, the concentration of power in a few hands enables those wielding the power to generate a beneficial influence on crop production by appropriation of water.
3. Better water management has some positive impact on crop yields

Upasena, J. and Abeygunawardena, P. 1993. Economic value of irrigation water in Dewahuwa Irrigation Scheme. Tropical Agricultural Research, vol.4.

Keywords | water prices / economic value / groundwater / nonmarket valuation / willingness to pay / Dewahuwa / Sri Lanka

Study site | Dewahuwa

Study period | April 1993

Introduction

In Sri Lanka, irrigation water has been unpriced *so* far. Lack of participation of water users in system management and inadequate funds for operation and maintenance (O&M) of irrigation schemes have led to the deterioration of schemes over time. Cost of annual O&M activities has been estimated through many studies. However, the O&M fee collection collapsed due to many reasons, This study analyzes a new approach to estimate the economic value of irrigation water using nonmarket valuation techniques. Productivity change (PC), land value (LV) and willingness to pay (WTP) methods have been used to estimate the value of water and the results are indicative except in the land-value method. The productivity change method has given the value of water as Rs 750 per acre per rotation in critical periods of growth. Farmers' WTP for water is Rs 2,405 per acre per season' when they have to receive water from a private water source (agro-well). They would like to pay Rs 560 per acre per year for the water received from the existing irrigation scheme. This amount is fairly high compared with the figure of Rs 370 per acre per year which is the current estimated cost of O&M of the irrigation schemes.

Objective

To estimate the economic value of irrigation water using nonmarket valuation techniques.

Findings

Productivity change with the availability of water is Rs 750 per acre per rotation in the critical period of growth; this must be modified with more reliable data of crop productivity in different water regimes.

The land-value method shows that value of water to be Rs 4,616 per acre per year. Farmers' willingness to pay on contract agreement is Rs 4,810 per acre per year for private water sources such as agro-wells. Their willingness to pay for water received from the irrigation scheme is Rs **560** in cash and Rs 594 in kind per acre per year. These figures are higher than the estimated cost of O&M, i.e , Rs 370 per acre per year (1990 prices).

Conclusion

More comprehensive exercises to **determine the farmers' willingness to pay for water under different situations will provide better results in valuing irrigation water.**

Galappatti, R. Morphological consequences of Mahaweli development unknown.

Keywords environmental effects / irrigation program / river-basin development

Study site Mahaweli

Study period Nonspecific

Introduction

The environmental changes caused by the Mahaweli Development Project are of major concern. Prediction of environmental changes requires that the major physical and biological processes involved are understood and quantified. The fundamental process involved is the movement of water and sediments and the consequent changes in river morphology and water levels. Very little attention has been paid to acquiring the essential data, know-how and methodology for predicting the morphological behavior of the Mahaweli.

Objective

To identify the short- and long-term consequences of the changes in river morphology and water levels associated with the Mahaweli Development Project and to propose rectification for consequences.

Research Findings

The morphological behavior of any stretch of the Mahaweli downstream of the Kotmale Oya confluence is influenced by a multiplicity of often conflicting demands.

Some of the findings are listed below:

1. Stretch from Kotmale Oya Confluence to Polgolla

This stretch of river has a sandy bed with propagating sand banks. There are several water-supply intakes and also a flourishing sand mining industry which is largely unregulated. The short-term effects of these activities have been beneficial from the point of view of flood control and the intake of water for the Kandy Water Supply Scheme. If, however, the long-term trend is toward aggravation. the water intakes could become silted. Some flow problems may occur. If the trend is toward degradation, the water levels could be lowered, again making the pumping stations ineffective. Any further development of water extraction must take these factors into account. Degradation may also affect the stability of some bridge abutments and the pier.

2. Stretch from *Victoria* to Minipe

Of the three reservoirs Victoria, Randenigala and Rantambe. the only one that could be affected by large siltation would be Victoria. The Victoria Reservoir is too large for us to expect that sedimentation will occur only in the dead storage. In fact, the bulk of the sediment will be deposited higher up causing a reduction in active storage. Although this is not expected to be excessive, the process of sedimentation should be carefully monitored.

3. Stretch Downstream of Minipe

The river downstream of Minipe will experience a drastic reduction in the sediment-carrying capacity originating from a reduction in the overall discharge and from the increased regulation of the discharge. The sediment supply which was significant a few years ago will dwindle to nothing. Thus degradation of the river bed will result. The decreased carrying capacity will slow down this process.

The long term consequence will be a lowering of both the bed level and the water level. Groundwater levels in the vicinity will also be depressed. Some river-crossings will also be endangered. The longer-term supply of sediment from the Amban Ganga will also be reduced by the exploitation of that catchment.

4. Tidal Reaches

The problems that could arise in the estuaries and just upstream will be mainly due *to* salt water intrusion caused by lowered bed levels coupled with smaller water discharges.

Recommendations

1. Greater effort should be exerted in collecting sediment transport data and in setting up the infrastructure necessary for continuous monitoring of sediment transport, river-bed levels and river flows at carefully selected sites.

2. A one-dimensional numerical unsteady flow model of the Mahaweli System has to be set up. Much more field data about the river geometry, etc., have to be collected before such a model can be set up. Once the flow model is established it can be used for simulations of morphological behavior.

Conclusion

There has been a great deal of discussion about the environmental impact of the Mahaweli Project. **If** we are to look into the future, the first step should be to acquire and install the technology required to make meaningful and quantitative prediction of the physical changes that are likely to take place. All other environmental impact assessments need this information as a starting point.