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LAND SETTLEMENT PLANNING ISSUES IN IRRIGATION MANAGEMENT: A REVIEW OF EXPERIENCESIN SRI LANKA

by

Pamela Stanbury

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Digana Village via Kandy, Sri Lanka.

Telephone (08) 74274, 74331 74251, 74265. & 74268; IDD 32491;
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LAND SETTLEMENT PLANNING ISSUES IN IRRIGATION MANAGEMENT: A REVIEW OF EXPERIENCES IN SRI LANKA

Pamela Stanbury, Post-Doctoral Fellow

I. INTRODUCTION

This paper serves as a working document to identify constraints to improved irrigation management that may be attributed to agricultural land settlement planning in Sri Lanka. Its purpose is to identify a set of researchable issues on the subject, based on the available literature. The paper focuses on a particular type of irrigation system in which settlers are allocated new irrigated agricultural land in previously uncultivated or undercultivated areas. This type of irrigation system is found throughout Sri Lanka and is common elsewhere where new land is available. Literature on the Sri Lankan experience with irrigated settlements is reviewed but examples from other countries are used where relevant.

Agricultural land settlement is defined as the planned or spontaneous transfer of people into areas of agricultural potential, either rainfed or irrigated (Goering 1978). In planned settlement schemes coordination is by a central authority or agency which controls the transfer of population from one region to another, provides facilities for agriculture, including allocation of land and water resources, and provides infrastructure such as roads, schools and medical facilities,--in short, it initiates a process of regional developnent.

Settlement schemes may be conceptualized as systems which involve complex multisectoral planning activities, all of which cannot be addressed in this paper. Instead, this focuses on one management factor that affects the performance of irrigation systems, namely the management of land under settlement schemes. I attempt to define the ways in which settlement tenure policies and spatial planning of schemes affect irrigation performance.

The exercise forms part of a larger research focus which aims to answer two sets of questions relevant to the field of irrigation management:

(1) What features of land settlement planning contribute to improved irrigation management in new irrigated settlement schemes?

(2) What rehabilitation strategies can rectify irrigation problems which are the result of original land settlement planning in already established schemes?

The paper is divided into four main sections, The first, included in the introduction, reviews the characteristics of irrigated settlement schemes and discusses why settlement schemes deserve special attention within the field of irrigation management. The second section presents a brief historical overview of settlement schemes in Sri Lanka and delineates the

role of the various government departments that deal with land and water issues in settlement schemes. The third section identifies information sources on the subject in the Sri Lankan context. In the fourth section, specific relationships between irrigation management and land settlement planning that have been noted in the literature are identified. These are then used to develop a set of research issues,

Characteristics of Irrigated Settlement Schemes

Despite great variability in types of schemes, geographic location and sociocultural environments, irrigated settlement schemes share certain unique problems by virtue of the fact that the population is newly settled on planned allotments of agricultural land and provided facilities for irrigation water. Settlers are allocated agricultural land, homesteads and irrigation facilities according to specific planning strategies and usually, a series of stringent land tenure policies are implemented. Land is laid out with respect to new canal structures according to specified design criteria.

Because of the complex relationship between settlers, the land they are allocated and their access to irrigation water, careful coordination between different sectors is required for successful scheme implementation. Additionally, the first years of settlement are usually marked by a rigid set of rules imposed on settlers by the administering agencies. Coordination between different sectors demands a management structure with a strong horizontal dimension (see Bottrall **1981).** Line agencies and departments which may traditionally function independently of one mother in old irrigation systems are, in irrigated settlement schemes, required to cooperate in a single development effort.

Settlement schemes also tend to have a highly authoritarian and paternalistic vertical dimension (see for example, Scudder **1985;** Ellman et al. 1976a; or Tiffen, nd.). Tiffen (n.d., section 5) notes, "settlement schemes are those where land as well as water resources are owned or controlled by the scheme authority, and on which the farmers have the status of tenants, obliged to follow orders in respect to most important farming activities." Although this may be more true in the early stages of settlement, settlement, schemes in general may be considered extreme examples of government control.

Paternalistic attitudes in settlement schemes may have multiple reasons. Administering authorities may be unwilling to share management responsibilities for fear of losing power and position.1 New settlers may also be unwilling to take on responsibilities. Whatever the reasons, a highly paternalistic management structure has been demonstrated in Sri Lanka as well as in other settlement schemes such as Gezira in the Sudan *(see* Scudder 1985:129-130) and FELDA in Malaysia (see McAndrews **1982).**

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1. See Goodell **(1985)** for a discussion of paternalism in agricultural development projects.

In Sri Lanka, Ellman et al. (1976a:8) note the government's paternalistic attitude toward peasants in settlement schemes was demonstrated in extreme form in the early years of colonization when officials even chose marriage partners for the settlers. The SOGREAH feasibility report for Mahaweli System H (1972:102) also points out that the government's paternalistic attitude led to settlers developing a pattern of submissive behavior and restricted them from assuming community leadership positions and getting involved in planning, implementation and evaluation of programmes. It was recognized that the authoritarian structure in settlement schemes contributed greatly to wastage of irrigation water, lack of maintenance of canals and difficulties in recovering irrigation fees, The result has been a more recent emphasis in Sri Lanka on people's participation in management in rehabilitation of older schemes and in the newly established Mahaweli settlement areas.

Although it is assumed that a strong role by agencies is required in the initial phases of settlement, it is also assumed that, once settlement has taken place, greater responsibilities will be transferred to farmers.2 Given the strong administrative control in the early stages, the evolutionary process of turning over management responsibility is often difficult. Even thirty years after settlement, many schemes do not become incorporated and remain highly controlled by government agencies.

Settlement schemes may be characterized generally as having (1) a high degree of government control over planning and implementing schemes, (2) well-defined rules concerning water and land use, (3) uniform layout of fields, and (4) a long settling in period in which greater control over land and water is to be given to farmers, Given these characteristics, schemes pose unique management problems. In the arena of irrigation management, the specific settlement plans may affect settlers' ability to cooperate in water user groups, maintain canals or schedule water rotations. Other effects may be on the distribution of irrigation benefits. Such problems may have long-term consequences resulting in deterioration of irrigation systems, low crop yields and declining farm income.

Utility of *Study* for the International Irrigation Management Institute (IIMI)

Sri Lanka, as well as many other countries of Asia, Africa and South America has pursued an agricultural developnent policy of bringing new lands under cultivation to alleviate population pressure and increase agricultural production. Examples of recent or ongoing irrigated settlement *schemes* may be found in most of the countries where IIMI is currently working. While the pace of new scheme development has slowed in Asia, major programs are still planned or underway in India, Indonesia (transmigration projects to draw

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2. Scudder (1985) argues that most settlement schemes consistently pass through five stages (planning, initial infrastructure development and settler recruitment, transition, economic and social development and finally, handing over and incorporation). He notes however that the last stage is rarely reached, given the paternalistic and authoritarian management structure that initiates the settlement process.

population away from overpopulated Java), Thailand, Sri Lanka and Nepal. In addition, replanning is beginning to take place in many older schemes, particularly in Sri Lanka. Other countries of interest to IIMI where settlement schemes have been important in the past include Pakistan and Philippines. Sri Lanka perhaps has the most experience with planning and implementing new irrigated settlement schemes.

In Africa new land settlement is envisaged as a major component of the emerging irrigation strategies in many countries (see Abernathy and Berthery 1986). Many newer schemes are designed based on the model of the well known Gezira scheme in Sudan. Major schemes are in progress in the context of development of the Senegal river basin in West Africa (involving Mali, Senegal and Mauritania). Both the Land Tenure Center at the University of Wisconsin and the Institute for Development Anthropology at the State University of New York at Binghamton, among others, have been involved in assessing settlement problems in connection with irrigation projects in these areas.

Economic evaluations of land settlement projects have been critical because projects are expensive, complex and have limited potential for cost recovery. Problems are even more acute in schemes that involve an irrigation component. According to World Bank estimates, investment per family in irrigated settlement is four times that of rainfed (Goering 1978). One of the most comprehensive articles on settlement schemes in Sri Lanka (Economic Review 1987) considers that the unfavorable cost/benefit ratio in Sri Lanka's irrigated settlements is largely due to low efficiency of water use.3 Despite criticisms, irrigated settlement schemes continue to be promoted by national governments interested in alleviating population pressure, increasing agricultural production and allaying political instability.

Although many experiments with different settlement planning strategies have been done in Sri Lanka and elsewhere, older schemes continue to be plagued by irrigation problems stemming from the original strategies. In Sri Lanka, problems have been noted both at the agency level (for example, poor communication between land settlement and irrigation personnel and lack of joint planning between different departments) and at the farm level (for example, problems of cooperation in irrigation activities). The effects on irrigation management practices however, have never been systematically examined to determine where specific problems lie and how they may be alleviated. Thus, a systematic attempt to understand how the management of land resources under settlement schemes affects irrigation performance may assist in planning new schemes and replanning older schemes.

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3. In the contrary, according to an optimistic report on the Mahaweli area by the Mahaweli Authority of Sri Lanka, "the economic viability [of the project] has been vindicated" (see Vistas of Mahaweli 1987).

II. OVERVIEW OF SETTLEMENT PLANNING ACTIVITIES IN SRI LANKA

In Sri Lanka, irrigation development has also meant land settlement with very few exceptions, particularly in the Dry Zone area. The general history of settlement, termed "colonization" prior to independence, has been well documented. The reader is referred to Farmer (1957) for a broad and comprehensive history of settlement planning. More recent general reviews include Ellman et al.'s (1976a) annotated bibliography, a special report in the Economic Review (1987) and documents published by the Project for Advancing Settlement Expertise (PASE) under the direction of K.P. Wimaladharma. Mehinda Silva's (1986) unpublished study of the history of policies for recovery of water charges provides an excellent chronology of events in settlement planning.

Settlement in Sri Lanka has been largely based on the restoration of old tanks or the construction of new tanks primarily in the Dry Zone. The developnent of irrigated settlements has a history that goes back to the 1880s when the colonial government first rehabilitated the ancient Kalawewa resevoir and brought in new settlers. In the following years, a limited number of other schemes were developed, including Minneriya and Kirindi Oya. Serious attention to large-scale irrigated settlement activities did not begin, however until the 1930s.

During the last fifty years, settlement efforts have been concentrated in the major irrigated settlement schemes of the Dry Zone. Table 1 lists the major irrigated settlement schemes throughout Sri Lanka and these are shown on the map in Figure 1. The Dry Zone has been particularly suitable for settlement because of its sparse population and large tracts of uncultivated jungle land. Irrigated settlements have been aimed at providing new farming land to farmers from congested areas (particularly in the wet zone) and expanding extents under cultivation to increase production (particularly of paddy) on a national scale.

Major irrigated settlement schemes, defined as systems larger than 80 hectares, include approximately 580,000 hectares total covering approximately 105 different schemes (Wimaladharma 1982:8). It is estimated that 60 percent of the total irrigated area in the country is found in major irrigated settlement schemes.

Under major irrigation schemes, planning and policy implementation has until recently been carried out by various line agencies, most importantly the Land Commissioner's Department and the Irrigation Department (ID). Farmer (1957:170) described the planning procedure used in 1951. The ID sent a tracing of the area of the proposed scheme to the Surveyor General with specification of surveys required. Copies were also sent to the Land Commissioner. Having received the surveys, the Director of Irrigation prepared a blocking out plan and the Land Commissioner's department prepared the allocation of land. Under this system, the physical layout of irrigation channels was dominant and land use, spatial layout of residential areas and other infrastructure activities were secondary.

Based on lessons learned in settlement planning, attempts to improve the planning efficiency in new schemes were responsible for the establishment of

Table 1

MAJOR IRRIGATION SCHEMES BY DISTRICT

District	Year of Alienation	Name of the Scheme
1. Colombo	-	-
2. Kalutara	-	-
3. Kandy	1937	Minipe Stage I
	1958	Minipe Stage II
4. Matale	1956	Kandalama
	1958	Haththota Anicut
	1968	Minipe St.III & IV
	1969	Wewala Wewa
5. N'Eliya	1971	Mandulu Oya
6. Galle	-	-
7. Matara	-	-
8. Hambantota	1890's	Kirindi Oya
	1957	Badagiriya St.I
	1957	" St.II
	1957	Mahagalwana
	1968	Muruthawela St.I
	1972	" St.II
	1973	Badagiriya St.III
	1986	Kirindi Oya - Lunugamvehera
9. Jaffna	1939	Ganeshapuram (Iranamadu Tank)
	1952	Uruthirapuram P.8
	1953	Vaddakachchi
	1953	Vannerikulan St.I
	1954	Uruthipuram P.10
	1954	Murusummoddai
	1955	Ramanathapuram
	1962	Akkarayanan St.I
	1963	-do- St.II
	1963	Kariyalainaganaduwan
	1964	Vannerikulam St.II
	1969	Kanegambikaikulam St.I
	-	" St.II
	-	" St.III

Table 1 (Cont'd)

10. Mannar	1956	Pandivirichchan
	1956	Periyamadu
	1971	Mullikulam
11. Vavuniya	1956	Periyathambani
	1957	Chemamadu
	1957	Kalmadu
	1957	Pavakkulam
12. Batticaloa	1953	RVDB Area
	1963	Unnichchai
	1963	Vadumunai
	1965	Weligahakandiya
	1966	Kirimichchai
	1966	Madurankerny
	1966	Kithulwewa
	1966	Kattumurivikulam
13. Amparai	1956	Gal-Oya L.B. & R.B.
14. Trincomalee	1952	Allai
	1954	Kantalai
	1960	Galmetiyawa
	1966	Morawewa
	1966	Wan-Ela
	1980	Mahadivulwewa
15. Kurunegala	1947	Ridibediella
	1953	Attaragalla
	1953	Ambalakolawewa
	1955	Kimbulwana Oya
	1955	Siyambalangamuwa
	1957	Palukadawatta St.I
	1957	" St.II
	1958	Usgalasiymabalangamuwa
	1962	Hathwatuna Oya
	1965	Rajangane (L.B.)
16. Puttalam	1929	Tabbowa-Tabbowa (Ext.)
	1948	Kottukachchiya
	1949	Mahauswewa
	1949	Uriyawa
	1954	Wijayakatupotha
	1963	Pahariya
	1968	Gammirisgaswewa
	1971	Mahakubukkadawela
	1971	Mudalankuliya
	1972	Rajangane L.B. Tr.7
	1982	Inginimitiya

Table 1 (Cont'd)

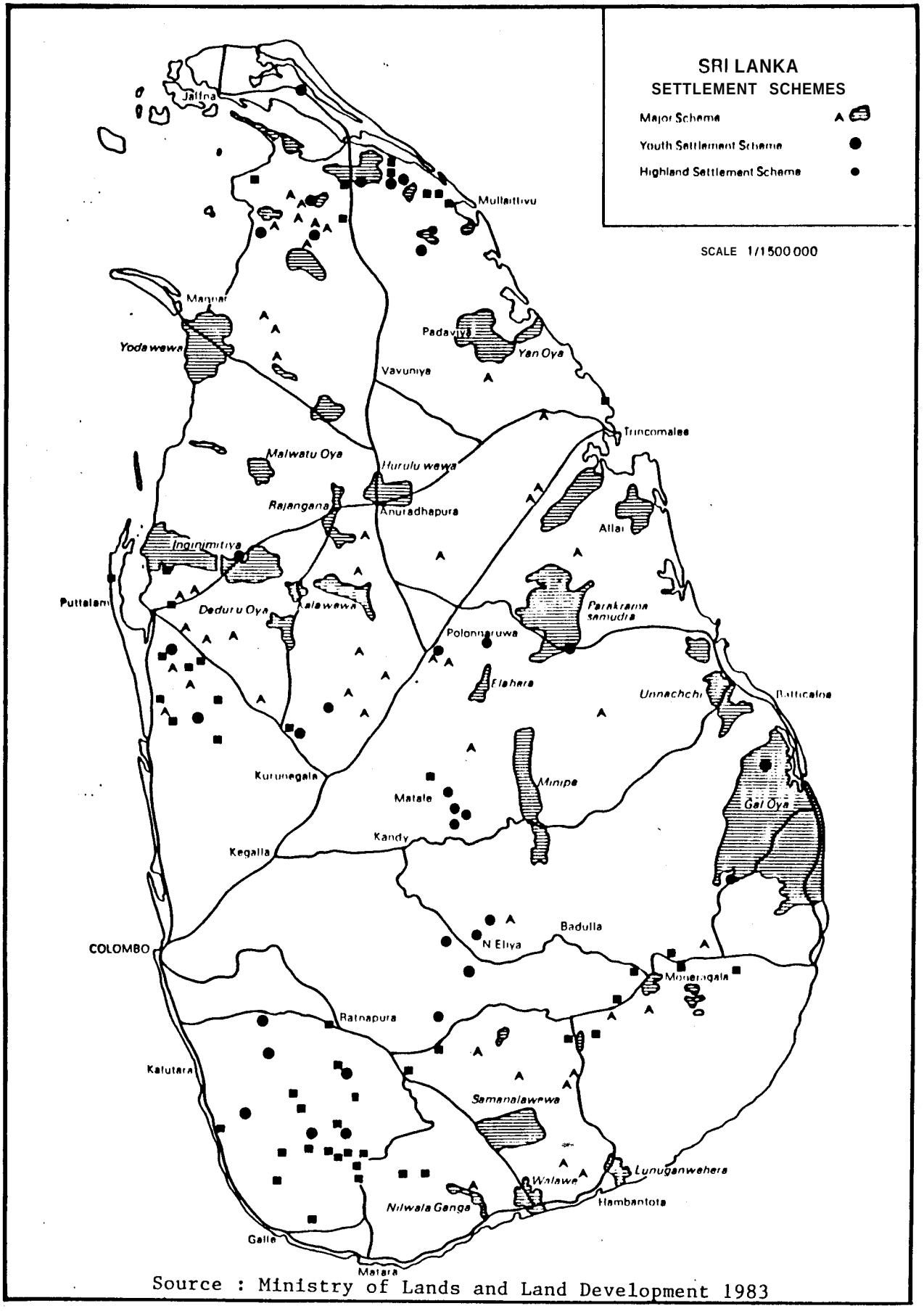
17. Anuradhapura	1925	Nachchaduwa
	1949	Dewahuwa
	1951	Kagama-Katiyawa
	1952	Huruluwewa
	1955	Mahawilachchiya
	1957	Rajangane (RB)
	1957	Padawiya
	1961	Mahakandarawa
	1974	Wahalkada
18. Polonnaruwa	1933	Minneriya
	1942	Parakramasamudra
	1949	Giritale (Old Colony)
	1956	Giritale (Ext.)
	1956	Galamuna
	1966	Kauduluwewa St.I & St.II
	1968	Pimburathewa
	1946	Elahera
19. Badulla	1950	Bathmedilla
	1955	Mapakadawewa
	1956	Sorabora
	1958	Badulu Oya
	1958	Dambarawa
	1960	Kandeganwela
	1968	Alhenwewa
	1968	Nagadeepa-Mahawewa
	1980	Dehigama
20. Moneragala	1950	Okkampitiya
	1955	Yudaganawa
	1956	Kotiyagala
	1957	Ethimale
	1958	Balaharuwa
	1961	Mahawewa
	1967	Hambegamuwa
	1967	Debarawewa
	1980	Mutukandiya
21. Ratnapura	1959	Uda Walawe (Chandrikawewa)
	1964	Kaltota L.B.
		" R.B.
22. Kegalle	-	-
23. Gampaha	-	-

Table 1 (Cont'd)

24. Mullativu	1962	Udayarkaddu
	1965	Thenniyankalam
	1967	Muruthankulam St.I
	1967	Murukandikulam St.II
	1967	Kaddaikaddinakulam
	1968	Vavunikulam
	1968	Ambalaperumalkulam
	1968	Muthuyankaddu
	1970	Tdaikaddu
	1971	Kollanvelankulam

Adapted from Planning and **Statistics Unit - Land Commissioner's Department** 1981.

Figure



Source : Ministry of Lands and Land Development 1983

independent administrative boards to plan and manage new settlement areas. Thus Gal Oya, Uda Walawe and Mahaweli irrigated settlement schemes contrast with major schemes by virtue of the fact that they are river diversion schemes that have been implemented by independent administrative boards, Enactments in parliment have given these authorities power to acquire and dispose of state land. Gal Oya, the first experiment with this administrative structure, was campleted under the Gal Oya Developnent Board and subsequently, management was turned over to the line agencies in the mid 1960s (see Gal Oya Master Plan 1982).

The Gal Oya Developnent Board was shifted to Uda Walawe and renamed the River Valleys Development Board in the 1960s. In 1982 responsibility for development was given to the Mahaweli Economic Agency of the Mahaweli Authority of Sri Lanka. These early attempts at independent administrative boards have been criticized for lack of adequate pre-project planning, insufficient soil and topographical surveys and poor cost/benefit ratio of the settlement element (see Gal Yoa Project Evaluation Committee 1970).

The most recent and largest multipurpose scheme is the Accelerated Mahaweli Project (AMP) being implemented by the Mahaweli Authority of Sri Lanka (MASL). The organizational structure to manage development of Mahaweli areas emphasizes multisectoral planning and increased participation in management by settlers themselves. The structure is designed to provide a mechanism whereby physical, economic and social planning are coordinated by a single large agency.

The large scale development of new irrigated settlement areas under MASL has brought about significant changes in irrigation management in Sri Lanka at a macro scale. It has created major interconnected systems which require scheduling river supplies for competing purposes (hydroelectric and irrigation) and between project areas. A large number of older settlement schemes have been brought into the Mahaweli system or have been augumented by it. Included are larger schemes such as Pimburettewa which was incorporated into System B; Ulhitiya and Minipe which were affected by System C; and Kalawewa, Kagama Kattiyawa, and Kandalama which were affected by System H.

Planning Reforms in Irrigated Settlement Schemes

A number of programs have been implemented in older settlement schemes to improve agricultural productivity. Increasingly, water management has become a central focus of replanning efforts. Programs include the development of the Settlement Planning and Development Board, the "Special Projects" program, "Water Management Improvement Programme," and its successor, "Integrated Management for Major Irrigation Schemes" (IMMAS). The PASE project, funded by the FAO/UNDP has taken a more holistic approach to replanning and has resulted in a new Settlement Planning and Management Division (SPMD) within the Ministry of Lands and Land Developnent.

Settlement Planning and Development Board, This board was established in 1969 with representatives of all government departments concerned with settlement schemes. The aim was to coordinate activities in different

departments. Efforts were not fully successful (see Ellman et al. 1976b) but the board has remained intact but the name changed to the Land Policy and Settlement Planning Division of the Ministry of Land and Development,

Special Projects. The first attempt at an integrated approach to replanning in irrigated settlements was the Special Projects program, implemented in 20 major settlement schemes. The program, resulting from a 1966 IBRD mission, concluded that a package program is needed in the settlement schemes to get greater return on investment. The program began at Elehera in 1967.

Under the Special Projects emphasis was placed on restructuring line agencies. Irrigation, Agriculture, Agrarian Services, Land Commissioner and Cooperatives were all to be represented on an inter-departmental committee at the project with a project office and a Resident Project manager (Silva 1986). The Special Projects program however, has been criticised for lack of participation by farmers, lack of emphasis on self-management and no planned phased-out withdrawal of project personnel (see Alwis 1982:91).

Some of the earliest data-based field studies of irrigated settlements in Sri Lanka were carried out as part of the Special Projects program by the University of Peradeniya between 1967 and 1968 at Ellahera, Iranamadu, Padaviya, Allai, Minneriya, Gal Oya, Minipe, Hakwatuna Oya, Rajangana and Mahavilachchiya (see Jogaratnam and Schickele 1969).

INMAS. In 1982 the Water Management program was planned for 25 selected major schemes. It was an attempt to increase farmer participation and improve water management in older settlement schemes. The program drew heavily on the Minipe water management experiment which emphasized farmer participation and involvement in system management, allocation and distribution of water, and maintenance (see de Silva 1981). The Minipe experiment also provided the model of the turnout group based on hydrological boundaries which was to be promoted under the new program.

The Water Management Program evolved into the INMAS program, launched in 1984. Under the newly created Irrigation Management Division (IMD), the INMAS program is designed so that different line agencies and departments will be integrated and work together in a coordinated manner to attain common goals. In its initial stages, the program has concentrated on improving practices in water management. The key figure under the program is the Project Manager, an individual who is appointed to coordinate the services provided to the farmers and to encourage farmer participation in project activities. He is head of a project committee consisting of a representative of the irrigation department, agriculture department, department of agrarian services, agricultural development authority, land commissioner's department, representatives of the state banks and representatives of farmer organizations. A list of irrigated settlement schemes under INMAS is found in Table 2.

Settlement Planning and Management Division of MLLD. In 1983 the PASE project began as a UNDP/FAO supported project to enhance management skills of both officials and settlers within the settlement schemes. Although the

Table 2: PROJECTS UNDER INMAS *

District	Name of Project	Irrigated Extent (acres)
Kandy	Minipe Stages I-IV	12,073
Matale	Devahuwa	2,336
Hambantota	Kirindi Oya	11,013
Kilinochchi	Iranamady	20,682
Mannar	Giants Tank	24,438
Mullaituvu	Mutuaiyankaddu	6.112
	Thanimurippu	2,372
Amparai	Gal Oya	74,606
Trincomalee	Kantalai	13,762
	Morawewa & Mahadiulwewa	5,431
Kurunegala	Hawkatuna Oya	4,300
	Ridibendi Ela	4,154
	Mi Oya System	9,552
	Batalagoda	10,000
Puttulam	Tabbowa	2,089
	Inginimitiya	6,530
Anaradhapura	Rajangana	13,267
	Nachchaduwa	5,889
	Huruluwewa	8,264
	Mahavilachchiya	2,664
	Padaviya	13,800
	Vahalkada	2,060
	Mahakandarawa	6,334
Polonnaruwa	Parakrama Samudra	19,632
	Giritale	6,192
	Minneriya	16,739
	Kaudulla	10,556
Badulla	Nagadipa, Sorabora, Mapakada and Dambarawa	7,258
	Baduluoya, Batmedilla	2,500
Moneragala	Mutukandiya	2,043
	TOTAL	329,823

* Adapted from Wimaladharma 1986:37

overall management system for settlements was to be carried out under the INMAS program, institutional support was to be provided by two new divisions in the MLLD. These divisions were the Irrigation Management Division and the Settlement Planning and Management Division. PASE and its follow-up UNDP-funded project, Planning and Training in Land Settlement, have provided support to the SPMD and have initiated a process of replanning settlement schemes. It is envisaged that the SPMD will focus on management training activities and assist in replanning both irrigated and highland settlements.

An account of the first-phase accomplishments by the PASE project are written up by Wimaladharma (1986). These include training of Project Managers and settler leaders in INMAS project areas, seminars on settlement management and publication of training and management materials. Most of the activities are closely allied with activities of the IMD.

Relevant Departments Dealing with Land Settlement Planning

Apart from those agencies responsible for implementing specific programs, numerous other departments are responsible for planning and implementing settlement activities. Key sectors concerned with the allocation of land and water resources to settlers are (1) the Land Commissioner's Department in the MLLD, (2) the Land Use Planning and Policy Division of the MLLD, (3) the Land Use Division of the Irrigation Department, (4) agencies within MASL, and (5) the Presidential Land Commission.

(1) The Land Use Planning and Policy Division (LUPPD) of the MLLD was established in 1982 to collate data and reports completed by different agencies for various purposes relating to land use.

(2) The Land Use Division of the Irrigation Department was established in the 1960s and undertakes soil surveys for irrigated agriculture in major settlement schemes. With the establishment of the LUPPD, the two divisions were expected to work closely together.

(3) The Land Commissioner's Department is concerned with overall planning, settlement and management also in the major settlement schemes. It works most closely with the ID in allocation of settlement scheme lands.

(4) MASL includes a family of agencies of which the Mahaweli Economic Agency (MEA) and the Mahaweli Engineering and Construction Agency (MECA) play pivotal roles. MEA is a management corporation which in addition to other responsibilities, is responsible for all settlement activities, carried out through its "unified" management system. MECA is responsible for design and construction components of the project.

(5) The Presidential Land Commission is established to periodically review the nature and extent of land and water resources in Sri Lanka. It has recently convened to examine prevailing land laws, land registration procedures, conditions of tenure, and problems of encroachment.

III. SELECTED INFORMATION SOURCES ON LAND SETTLEMENT PLANNING AND IRRIGATION MANAGEMENT

There are numerous documents on settlement planning in Sri Lanka and numerous documents on irrigation issues (see reviews by Ellman **1976** and Wimaladharma **1985).** The task of reviewing observations about the relationship between the two is difficult however because observations are hidden in general descriptive field studies **and** planning documents. An attempt here is made to identify the most useful material rather than provide an exhaustive list of studies.

Planning documents. Studies of specific irrigated settlements have been carried out as part of pre-project feasibility studies **and** planning documents for individual schemes. Taken in sequence, planning and evaluation documents provide a history of changes in planning strategies. For example, Hartoungh's **(1968)** evaluation report **for** the FAO was highly critical of the lack of a unified management structure and strongly recommended posting a project manager in settlement schemes. He **was** not alone in making the suggestion (see for example Wanigaratne **1979)** and now the Project Manager concept has come about under the INMAS program.

Documents such as the Sogreah Settlement Planning and Development report **(1972)** for Mahaweli System H and the Rehovot Study comparing two settlement planning alternatives (Weitz et al. **1971)** both show a shift in thinking about the settlement pattern of homesteads. Both reports recommend a cluster settlement pattern as opposed to the older ribbon pattern as a **means** of fostering community participation and organization.

Poonrajah's **(1981)** overview of how settlement schemes are planned in Sri Lanka is a concise picture of the factors involved in planning new schemes. He provides support for **the** change in settlement layout to a turnout system and indicates its utility for water management purposes.

General statistical **data** on settlement planning is found in reports from the Land Commissioner's Department (for example, Statistical Planning Unit **1981)** and Mahaweli reports (for example, Ministry of Lands and Land Developnent **1983).** Information is provided on number of settlers settled, irrigated command area, pace of settlement and number of settlers **in** settlement schemes throughout Sri Lanka. Reports are also available from the National Archives and **Survey** Department.

General Reports. The most useful background reviews of settlement planning are by Ellman and his colleagues (1976a, 1976b). Details of the administrative structure **and** land laws that affected settlement schemes are summarized in brief.

A number of synthesis papers resulting from conferences sponsored by the PASE project also deal with general issues in settlement schemes. The first set of papers emerged from a USAID/MLLD sponsored seminar held in 1981 *(see* Wimaladharma **1982).** The intention **was** to reflect on past experiences in settlement planning for future development of Mahaweli areas. A number of

papers deal with irrigation management issues (see papers by Karunanayake, Alwis and Somasiri) while others deal with land issues (see papers by Gunadasa and Abeywickrema).

A second PASE seminar was held in 1985 which focused on land settlement experiences in Sri Lanka between 1978 and 1985. Sessions were held on Mahaweli settlements and major settlements by Sri Lankan experts, some of which dealt with irrigation issues, The conference papers have not been published.

Field studies of major irrigation schemes. Some of the earliest data-based field studies of irrigated settlements in Sri Lanka were carried out as part of a program for major scheme rehabilitation. Nine schemes were selected for initial baseline studies, the first being Ellahera. Studies were carried out by the University of Peradeniya between 1967 and 1968 (Jogaratnam and Schickele 1969) and resulted in the first of the schemes selected as "Special Projects."

Another early baseline socioeconomic survey is Fonseka's (1966) agricultural geography of Kagama (new) colony. At the time of the author's study, the scheme was to receive water from the new Nalanda Oya resevoir and many changes in agricultural production were anticipated, Very little information is supplied in the report on land settlement and irrigation management however.

The Agrarian Research and Training Institute (ARTI) has produced the most comprehensive problem-oriented studies of major schemes. ARTI's first occasional paper on the Thannimurrippu scheme in Vavuniya District examines the problem of turnover of irrigation responsibilities to settlers [4] (Ellman and Ratnaweera 1973). The study is consistent with other observations about problems of paternalism of many new settlement schemes and discusses one innovative strategy for facilitating the turnover of irrigation management responsibilities to farmers.

ARTI has also sponsored a number of studies at Minipe. Wanigaratne's study (1979), based on secondary material, outlines a number of irrigation management problems that may be attributed to lack of integrated planning by line agencies. He also pays attention to the problem of encroachment and its effect on the physical irrigation system.

Minipe has been a source of a number of other studies because of the early water management experiments carried out under Godfrey de Silva (see 1981). The most recent and comprehensive is Peiris's study (1987) which reviews this important experiment that has influenced the present INMAS program, The author shows how factors such as the policy of advanced alienation and deviation in the number of agricultural units from design have

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4. This settlement scheme is classified as a village expansion scheme according to Ellman and Ratnaweera (1973) and is not included in general lists of major settlement schemes. However, Thannimurrippu is included in schemes under the INMAS program, as shown on Table 2.

have contributed to poor irrigation management practices in the scheme. His picture of water management experiments is a rather gloomy one and he concludes that farmer participation has been promoted in areas where it may not be applicable.

Kimbulwana Oya irrigated settlement scheme near Kurunegala has also received more attention than most schemes because of its unusual management strucure. Weeramunda's (198'7) report on water management at Kimbulwana is also evidence of a highly paternalistic administration in a settlement scheme. Weeramunda argues that the paternalistic system has been successful in implementing a water management program, at least in the short run. Gunadasa's (1987) report deemphasizes the paternalistic element and focuses on how involving farmers in planning contributed to a successful rehabilitation program.

Ranatunge, Farrington and Abeysekera's (1981) study of five major irrigation schemes coming under the Tank Irrigation Modernization Project is a benchmark descriptive survey. It proposes a number of ways of improving the efficiency of these schemes by focusing primarily on irrigation management.

One of the most recent new settlement schemes is the Inginimitiya major irrigation and settlement project in Puttulam district. The Land Commissioner's department (1982) also carried out a baseline survey of the pre-project conditions to determine the suitability of settlement.

Field Studies of River Basin Schemes. Numerous commissioned baseline studies have been carried out for the larger river basin projects but because they are pre-project studies they'provide less useful information on settlement planning effects, Later evaluation studies include Abeyratne's (1982) study of second-generation settlers in Gal Oya. It presents a critical picture of planning for the future population growth of the area, given the design for the system and size of allotments, Widanapathirana's (n.d.) study of spatial differences in resource use also deals with similar issues of inequitabilities in water distribution due to spatial planning.

In Mahaweli areas, Tilakasiri (1985, 1986) studied settler adaptation to irrigation water use in System H. His 1985 paper does not address the land settlement component but does present useful basic information on the older settlement schemes such as Kagama and Kandalawa which became embedded in the Mahaweli system. His 1986 study deals more closely with the relationship between land and water in Mahaweli system H. He focuses on tenurial arrangements and water scarcity, which he notes is a most prominent feature of new settlement areas. This short paper is in fact, one of the very few that deals directly with land and water problems.

Siriwardena's (n.d.) study of socioeconomic differences in Mahaweli System H presents a picture of the rapidly emerging wealth differences and individualism. He attributes many of the problems to settlement plans which emphasized the family farm and family based production system. He argues that this has led to lack of village cohesiveness required for water sharing and forming water user organizations.

Scudder and Wimiladharma (1979-1985) have examined the effects of settlement planning in Mahaweli areas, based on annual visits to selected settlers in the scheme areas over a period of six years, Their conclusions emphasize the difficulties of generating economic growth given the small farm size and the lack of attention to off-farm income possibilities in the project areas.

The general picture that emerges from a variety of settlement documents is one of vast experience in planning and much experimentation with new strategies. The significant trends in planning include (1) greater attention to the sociocultural environment as opposed to irrigation design only; (2) attempts to encourage greater participation by settlers themselves; (3) emphasis on an integrated management structure which crosscuts line agency responsibilities, and (4) primary emphasis on improving irrigation management in new schemes and those under rehabilitation.

Despite the trends, no studies to my knowledge take a comprehensive look at how irrigation management practices have been influenced by policies for allocating land in the schemes. The following section reviews the material that is available on the subject.

IV. FUNCTIONAL RELATIONSHIPS BETWEEN LAND SETTLEMENT POLICIES AND IRRIGATION MANAGEMENT

This section draws on relevant literature to identify both what is known about the relationship between land settlement and irrigation management and what gaps in understanding remain. It focuses specifically on two key aspects of land settlement planning, namely settlement tenure policies and spatial planning of schemes. The section concludes with a review of issues for further consideration.

Settlement Tenure

The current system of land tenure in irrigated settlement schemes is governed by two principal enactments, the Crown Lands (Encroachment) Ordinance of 1840 and the Land Development Ordinance of 1935. As a result of the Crown Lands Ordinance, all land not under permanent cultivation was declared the property of the state which could then declare the right to settle new people on land and develop the land according to its need.

In 1935, the implementation of the Land Developnent Ordinance (LDO) resulted in a new system of settlement tenure which has remained in the settlements to the present. Under the LDO, land may only be allotted to carefully selected cultivators and may not be alienated or sold without permission. Furthermore, land can pass to only one heir and residence on the allotment is required. Settlers are granted land on a provisional basis and their grants may be cancelled if violations such as non-development of land, non-residence or non-adherence to water management rules are found.

Under the LDO, no provisions were made for settlers to become land owners at any stage. Under the Paddy Lands Act of 1958, tenants on land were given increased security of tenure and the cultivation committee was established as an organized body of farmers. Under the recent Swarna Bhoomi program, settlers are being given the opportunity to convert their original land permits to grants (giving them tenure close to that of a free hold title) if they have fully developed their land. Although there is much discussion about the program, the degree to which settlers have actually been given grants is unclear. One example is Dewahuwa where even after 30 years of settlement, research by IIMI staff indicates that no settlers have received grants.

The rigid state sponsored tenure system is designed to protect the small farmer and prevent large landholders from gaining access to large tracts of land. It is also designed to avoid drop-out and ensure that settlers participate in the development of the settlement area. While there are clear reasons €or implementing rigid tenure policies, Gunadasa (1982:66) argues that irrigation management problems in the major colonization schemes are "very closely connected with the rigid tenurial basis of the right to hold land under the settlements."

The imposed state-sponsored system of tenure contrasts with traditional tenure arrangements in purana villages. When state lands were alienated, non-state lands were treated as **purana** lands and were integrated into the

settlements only for irrigation purposes. The existing system of land tenure remained (Abeywickrema **1982).** Farmer (1957:128) notes that the new tenure system for settlers was based on the idea, "that an independent, individualistic peasant proprietor, owning a compact block of land, was the ideal - an ideal far removed from economic cooperation and web of reciprocal obligations involved in traditional tenure and typified by the bethma system."

Settlement planning under the Mahaweli Authority has included an attempt to reintroduce some traditional tenure practices, most notably the bethma tenure system. Under the bethma system, during periods of water scarcity farmers divide plots in smaller areas to conserve water (see Tilakasiri **1986:21).** Some successes have been noted in applying this system to settlement areas.

Despite the formal and rigid policies established for the settlement schemes under the state sponsored system of tenure, it is no secret that conditions in the field are quite different. Wickremaseka **(1982)** indicates that at Minipe, thirty years after settlement, subletting, sharecropping and extensive fragmentation are common and are exacerbated by the high value placed on irrigated land. In new Mahaweli areas, these practices are quickly emerging also (see Tilakasiri **1986).** According to Ekanayaka and Groenfeldt (1987), the high proportion of non-owner cultivators at the Dewahuwa irrigated settlement scheme stands out as the single most important fact of Dewahuwa's agrarian context. Because leasing, fragmentation and mortgaging are illegal practices however, they are difficult to document by field investigation.

Although leasing, fragmentation and mortgaging are not unique to settlement schemes, they pose particular problems because non-owner cultivators are not legally recognized in settlement schemes and thus cannot demand rights to water, credit or help from officials. These aspects of land settlement tenure, both in policy and practice, may affect settlers' ability to cooperate in irrigation organizations, settlers' relations with agency personnel, and may alter physical canal structures and water distribution.

(1) Effects on Water Conflict and Cooperation. It has been argued repeatedly that violation of strict tenure rules is responsible for poor participation rates in general management decisions by farmers (see for example Pieris **1987;** Gunadasa **1982;** Abeyratne **1982).** When settlers engage in unofficial tenurial arrangements, permit-holders often surrender their right to land to unofficial farmers. Because such operators are not legally permitted to cultivate the land, they have no status for participation in local water user organizations or in general management decisions. The mechanisms by which informal participation by operators take place outside the formal meetings is unclear however.

Hidden tenure arrangements may influence the effectiveness of local leadership in water management activities. At Dewahuwa irrigated settlement scheme, Ekanayaka and Groenfeldt **(1987)** note that farmer representatives have limited effectiveness due to the high proportion of cultivators who have temporary relations with landowners through lease, mortgage or ande

agreement.

Despite the well known effects of hidden tenancy on farmer organization, new policies have not been introduced and policies continue to be implemented as if the situation did not exist. For example, under the INMAS program, replanning efforts are focused on farmer organizations. Stipulations include that farmer organizations must include (1) only bona fide cultivators and (2) should represent all cultivators (see IMD/MLLD booklet # 2). Yet it seems clear that the two components do not match.

(2) Effects on canal maintenance activities. Canal maintenance at the tertiary level is an activity that requires collective action on the part of the settlers but cases where illegal tenants fail to carry out obligations are numerous. Tilakasiri (1985:47) has shown that in Mahaweli System H area, settlers are required to collectively clean canals but sharecroppers and lease-holders tend to neglect their duties since they have short term investment in the land. Abeyratne (1982:2) has also shown that illegal land transactions at Gal Oya have had adverse effects on irrigation maintenance. Similar problems are noted at Dewahuwa (Ekanayaka and Groenfeldt 1987). While the problem has been well documented and lessons have been learned, possible solutions to improving maintenance activities have not been identified.

(3) Effects on water distribution. The reintroduction of bethma practices in Mahaweli areas has permitted farmers to continue to cultivate irrigated crops in periods of water scarcity. This has been a novel approach in settlement schemes to improve water distribution. Little is known about the success of bethma practices and about the possible application of such practices in new schemes OF those under rehabilitation in other parts of Sri Lanka.

Abeyratne's (1982) study at Gal Oya is perhaps the only one which discusses the relationship between water distribution and illegal tenure practices. She suggests that illegal fragmentation of holdings may affect the degree to which each individual operator has access to irrigation water since canal offtakes are designed so that each farm plot has an outlet to a farm of uniform size. She also suggests (ibid, p. 94) that when fragmentation occurs, it results in more irrigation offtakes and use of more irrigation water to cultivate the same extent of land. Furthermore, since the practice is illegal, parcel operators have no legal forum for dealing with water problems.

Finally, Abeyratne (1982:45) also suggests that fragmentation occurs more frequently in areas where water is more abundant, noteably in the head end of the canal system because farms can be more easily fragmented while remaining economically viable. In areas of water scarcity, subdivision of original plots should be less likely. The claims about the effects on water distribution are scanty however and are presented as suggestions rather than assertions. Much scope remains for looking into the effects of settlement tenure on water distribution.

Violations of rigid tenure policies in settlement schemes are clearly a

well known and understood problem. The effects on irrigation management practices are also quite well documented in general, though some systematic clarification would be useful. Policies remain intact however, and no innovative means of alleviating the problems have been tried except perhaps at Kimbulwana Oya where even illegal encroachers were granted new irrigation outlets on payment of a fee (Weeramunda **1987).** Potential solutions, rather than problems are the gap in understanding settlement tenure issues. In particular, little is known about if and how agency staff handle irrigation problems due to tenancy.

Settlement Layout and Design

The spatial layout of settlement schemes involves complex regional planning to catalyze a process of regional development. Many of the earlier settlement schemes have been criticized for too much emphasis on irrigation layout and design and limited emphasis on other factors such as social grouping of settlers or distance between fields and homesteads. More recently, settlement planning in Mahaweli areas has attempted to plan the layout of schemes in a more integrated manner. This section looks specifically at the effects of the layout of agricultural and homestead allotments on irrigation management activities.

Spatial Planning of Homestead Allotments and Farmer Participation in Irrigation Activities

In the earlier settlements, settlers were allocated homestead allotments which were relatively close to their fields and were spread along the canal system in a ribbon pattern. Planners recognized that the spatial layout made access to fields easier but did not enhance a sense of community in the settlements. As a result, more recent settlements are planned according to a cluster pattern, as opposed to the old ribbon design (see Ponrajah 1981). Clustered settlements are designed to foster community participation and encourage a sense of shared responsibility particularly in the use of irrigation resources.

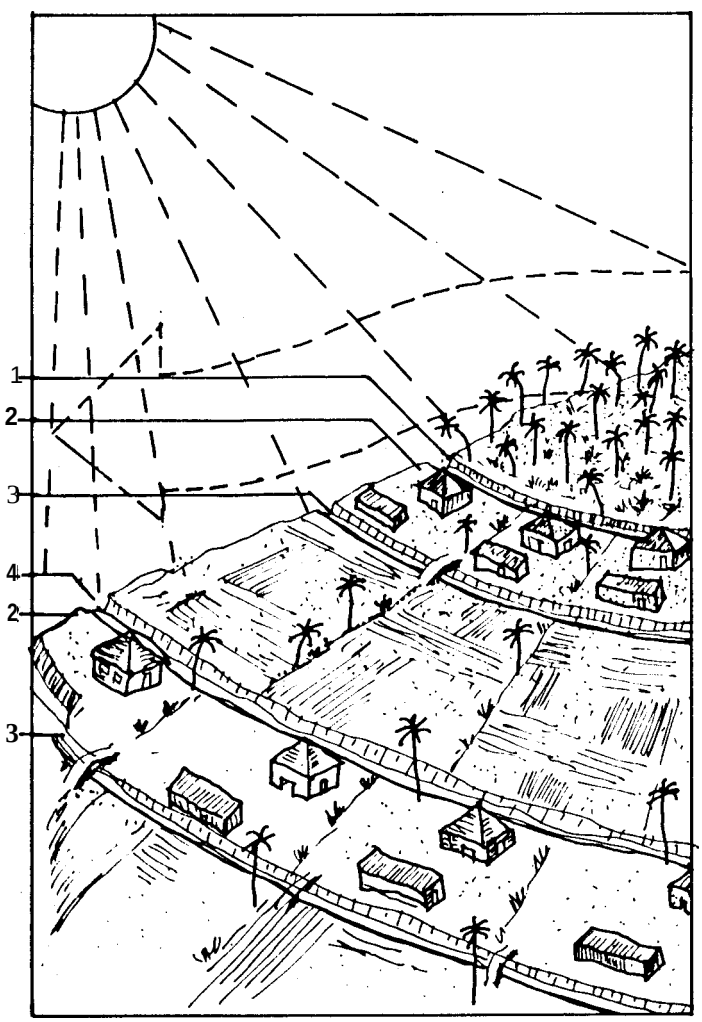
One of the best arguments in support of cluster settlements is found in the Rehovot study of settlement planning alternatives at Uda Walawe (Weitz et al. **1971).** The study group noted that the earlier layout of villages was dictated almost exclusively by the topography of the terrain and the position of the irrigation canals. They noted that as a result, individual holdings are widely dispersed within village boundaries so as to be closer to their field allotments. This ribbon pattern of settlement caused problems of social and organizational integration. By conducting a detailed cost/benefit analysis, the study team concluded that the clustered settlement pattern is preferable to the ribbon design. A comparison of the two types of settlement patterns is found in Figure 2.

In Mahaweli System H also, SOGREAH (1972) also recommended **a** cluster settlement approach based on the idea that it will improve social integration and reduce conflicts between settlers. The recommended settlement pattern emphasized the homogeneous community (by caste and community of origin). Each hamlet was to be of 100-125 families. Four to five hamlets were to be

Figure 2

LOCATION OF FARMYARD AND FIELDS

CLIMATICAL ENVIRONMENTAL ENGINEERING AND IRRIGATION CONSIDERATIONS



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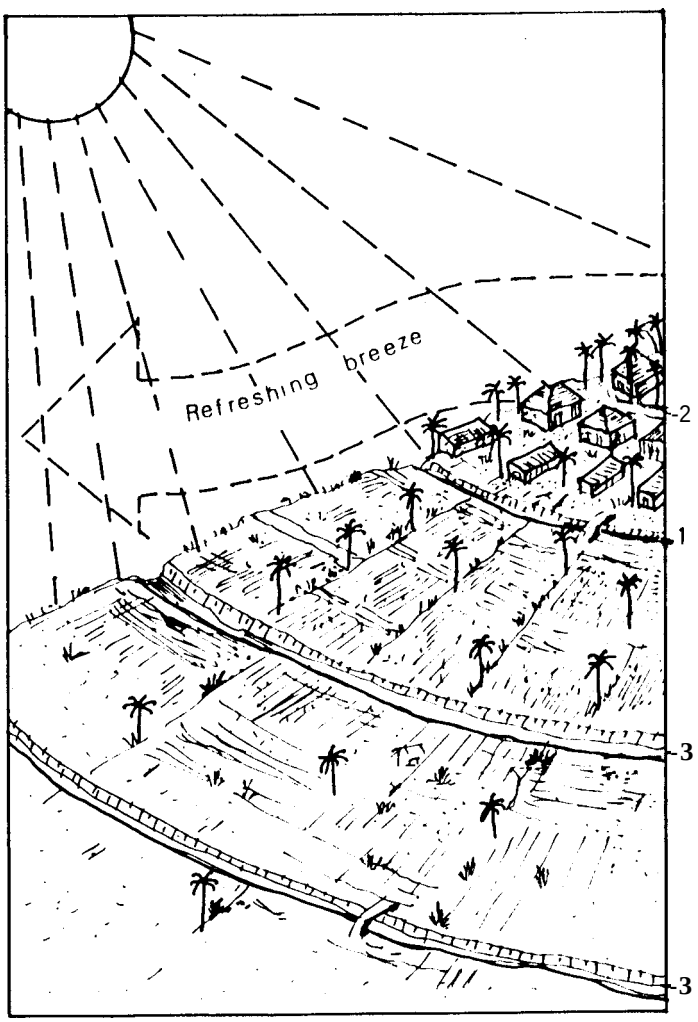

GATHERED

Legend

1. Main Water Canal
2. Road
3. Distribution Water Canal
4. Drainage Canal

Source: Weitz et al. 1971

clustered around a service center. Despite the emphasis on improving community integration, no recommendations were given about settling farmers together who are also farming in the same turnout area.

The benefits of clustered settlements are described primarily in feasibility reports, not in post-project evaluations. As a result, it is difficult to determine whether the clustered settlement approach has been implemented consistently and whether it has helped diminish conflicts and increased participation in irrigation activities. Furthermore, the relationship of the clustered hamlet to the turnout group or hydrological unit has not been reported. However, according to preliminary investigations by IIMI staff, allotments at Uda Walawe continue to be highly dispersed, particularly in the tail end areas despite plans for clustered settlements. In the new Kirindi Oya settlement areas on the other hand, the homestead allotments are so highly aggregated that distance to paddy fields may be greater than the recommended .5 mile.

Encroachment

Encroachment onto reserve areas and additional use of irrigation water by this group is reported for nearly all settlement schemes. For example Abeysekera **(1986)** notes that in Mahavilachchiya irrigated settlement scheme in Anaradhapura District, there were 900 authorized allotments of 5 acre units and about **250** illegal encroachments. Encroachments tended to be on canal and road widenings. In Gal Oya, PRC Engineering Consultants (1985:II-12) cites the example of the Uhana/Mandur Branch Canal which was designed to serve **7,925** ha but served **13,300** h4 in **1985,** of which **1,175** ha was encroached land.

The severity of encroachment problems in settlement schemes stimulated the Sri Lankan government to conduct a block by block survey in **1978** to truely determine the extent of the problem. This survey formed the basis for the Encroachments Regularization Programme which granted legal tenancy to encroachers already having developed land. The extent to be regularized per encroacher is **2** acres highland and 1 acre paddy (Ministry of Lands and Land Development 1983:33). Regularized encroachers are also required to reside two years on the land, Although it may be clearly recognized that. regularization of encroached areas is the only means of dealing with the problem, the effect of this program on the capacity of the irrigation system are unknown.

(1) Effects of encroachers on water cooperation and conflict. There is some support to the idea that encroachers contribute to water disputes and conflicts. Pieris (1987:51) notes that encroachers at Minipe Colonization Scheme increase the number of people involved in decision-making and create difficulties of orchestrating water supplies due to the sheer numbers. Finally, they are not officially recognized so that they cannot formally participate in management. In an article in The Economic Review (1987:10) the author notes, "water disputes increased as a result of the misuse of irrigation water for encroached land and it created social disharmony." Regularization of encroachers does give them legal rights to participate in management activities.

(2) Effects of encroachers on water distribution. Levine and Burkhoff (1983:6) have suggested that water duty estimates may be biased because of encroachers tapping water from unauthorized parts of the irrigation system. The result may be that tail end farmers receive water shortages. Abeyratne (1982:41) supports this suggestion by noting that in Gal Oya Scheme, encroachers tend to be attracted to areas where water is more abundant, thereby affecting downstream water flows,

Gunadasa (1982:65) has also shown the effects of encroachment on water distribution at Hakwatuna Oya and Kimbulwana irrigated settlement schemes. "Illegal tapping of water deprives the legitimate settlers of the opportunity of using it in required amounts and at the correct time... Additional extents cultivated in excess of the extent designed to provide water has become an important cause for the incidence of water scarcities throughout a settlement system." In Mahaweli areas also, Tilakasiri notes (1985:47) that, "Making alterations in the existing canals or making new ones to supply water to these lands is found in all turnout areas in general. With the use of more land than is planned for cultivation, the demand for water is increased,"

Ranatunge, Farrington and Abeysekera (1981), in their benchmark survey of five major irrigated settlement schemes coming under the Tank Irrigation Modernization Project (TIMP), show that there were serious problems of delivering water to the tail end. They suggest that the poor condition of water distribution is largely due to encroachers taking water at the head.

Irrigation problems associated with illegal encroachment have been substantially documented. Less however, is understood about the effects of the regularization program, either positive or negative. In other words, do regularized encroachers participate such activities as irrigation maintenance or decision making more than illegal encroachers? Are conflicts reduced? Does it improve the reliability of water duty estimates by irrigation staff?

Layout of Field Allotments and Water Distribution

A variety of problems in coordinating the layout of field allotments with respect to irrigation facilities have been identified in the literature. Many of the older schemes were designed for continuous flow under paddy cultivation. They had few control structures or measuring devises and allotments had direct access to water at the primary or secondary level. With greater emphasis on water management in recent years, the turnout system was introduced in 1979 in Mahaweli areas to permit rotational water distribution. Rehabilitation of older schemes such as Uda Walawe has involved the construction of field channels parallel to the distributary canal and blocking all but one offtake in order to introduce a rotational system.

Problems of correspondence between the turnout group and hydrological units have been noted by Ekanayake and Groenfeldt (1987). At Dewahuwa, they noted that "the boundaries of turnout groups are defined as spatial subsections of the total system which may include part or all of one or more field channels, as well as direct-issue turnouts from the distributary , or

even the main canal." (ibid 1987:29). While the lack of correspondence between the turnout group and the hydrological unit have been observed, the consequences have not been addressed.

Defects in construction of field channels and outlets due to disregard of topography have also been noted to influence water distribution (see Tilakasiri 1986). Poor surveying and lack of communication between land and water agency personnel has made it difficult for some settlers to get access to irrigation water.

The relationship between spatial planning of agricultural plots and access to irrigation water is one of the more poorly researched and understood aspects of settlement planning. Defects have been documented from past experiences but this central aspect of land/water resources has been largely untapped.

Size of Field Allotments and Irrigation Management

The size of individual holdings to be allocated to settlers has diminished over the last fifty years of settlement. In some of the earlier schemes such as Minneriya and Dewahuwa, allotments were of 5 acres paddy lands and 2 acres of homestead. In the Mahaweli areas settled more recently, allotments consist of 2.5 acres paddy land and .5 acre homestead. The size of allotments has been much debated and the most recent size agreed upon is the result of attempts to settle more families and an ideology about the individual self-sufficient family farm.

The appropriate size of allotments has been a subject of much debate, In System C, the Israeli Interest Section has proposed an alternative distribution pattern, given (1) the current domination of *paddy* cultivation, (2) the high water usage and (3) the lack of irrigation water. They have recently proposed experimenting with communal commercial land by giving .4 ha. paddy land, .4 ha upland and .4 in communal commercial land to each settler. The alternative land plan would require no changes in the main and branch canals and minimal changes in the distributary system (Porat 1986).

Although there are many arguments for one or another size allotment, reasons have little to do with irrigation activities **per se**. Rather, they are based on economic productivity and possibilities for moving beyond a subsistence level of production (see for example, Scudder and Wimaladharma 1985). The relationship between irrigation management practices and the size of allotment is however, not discussed in the various reports on settlement schemes.

Expansion of existing settlement areas and irrigation management

Many of the irrigated settlement schemes in Sri Lanka have experienced a process of growth whereby older small tanks have been incorporated into larger systems. In the Mahaweli areas this has been most pronounced but even ,inareas such as Kirindi Oya, segments of the scheme have been settled in the 1950s, others in the 1970s and others at the present time, At *each* stage, the allocation of irrigation water shifts and new demands are placed on the

system. In periods of water scarcity, settlers in older areas may receive preferential treatment before settlers in new areas are allocated water. The regional settlement and irrigation issues have received little or no attention in the literature which tends to focus on segments of schemes or schemes as a whole.

Issues for Consideration

The literature reviewed points to a number of documented cases where land settlement policies have affected water distribution, canal maintenance and degree of farmer cooperation or conflict in managing a common resource. Policies have been modified due to experiences with settlement planning and new strategies in vogue at different times. Yet, gaps remain, particularly in understanding the effectiveness of the most recent policies and in developing possible solutions to recurrent irrigation problems due to settlement planning (such as poor maintenance due to hidden tenancy, disputes due to encroachment, etc.). Topics that are currently not well understood are reviewed in the following and form the basis for a field research project. It is anticipated that a clearer understanding of these will be useful to irrigation management specialists.

(1) Joint management of land and water by agency staff. Overlying each of the specific topics for consideration is the question of how agency staff manage joint issues which crosscut line agency responsibilities, particularly those of the Irrigation Department and the Land Commissioner's Department. How do they jointly solve problems that may arise? How is information passed between various officials? No literature is available on the means by which those concerned with land settlement.and those concerned with irrigation interact to solve problems.

(2) Unauthorized tenancy and irrigation activities. A great deal of research has documented the high frequency of unauthorized tenancy practices and suggestions have been made about its negative impact on irrigation activities. How does project management handle individual problems as they arise? What possible solutions have been devised? What possible solutions could be devised?

(2) Effectiveness of regularization of encroachment in enhancing irrigation management. It has been quite well demonstrated that illegal encroachers may have adverse effects on the distribution of irrigation water in a given system. The magnitude of the encroachment problem has led to regularization policies in older schemes. How effective have these policies been in diminishing problems vis-a-vis water? In new schemes, what policy shifts have been implemented to recognize encroachers at the time of project implementation?

(3) The effectiveness of the turnout group system in new settlements and the effectiveness of turnout rehabilitation strategies in older schemes?, Attempts have been made to improve the layout of field allotments with respect to canal outlets under the turnout system. A systematic look at the relationship of settlers' field allotments to canal outlets both in older and new schemes may highlight management problems and help identify more

effective rehabilitation strategies in older settlement schemes.

Turnout groups are a relatively new feature of settlement schemes whereby a group of farmers corresponds to a hydrological unit. However, it has been shown that in some cases, problems of correspondance between the two remain. Field research may document the extent to which this is common and may then investigate the effects on management activities.

(5) Expansion of existing settlement areas. No studies have been undertaken to document the effects of augmenting water supply and increasing irrigable acreage in schemes. What are the implications for different segments of the population? How do agency staff responsible for different areas communicate and jointly solve problems?

(6) Size of Field Allotments. In most settlement schemes in Sri Lanka, landholding size varies depending on when land was allotted. Often, different segments of schemes will have different landholding patterns. Litle is known about how these differences affect water distribution within a scheme or the effect of different size holdings on farmers' ability to manage their. shares of irrigation water.

V. CONCLUSIONS

This working document has approached irrigated settlement schemes as complex systems which pose special irrigation management problems. It has reviewed the unique features of settlement schemes and presented a brief summary of settlement history and administration in Sri Lanka. Finally, it has looked at what is known about the effects of settlement on irrigation management and identified gaps where further research may assist in understanding irrigation management problems.

The research that has been done in settlement schemes has documented many planning problems and shifts in policies, It has been shown in this paper that some of the effects of settlement on irrigation management are well known. In Sri Lanka relatively few new areas are open to settlement but the past experience here offers many lessons and shows numerous innovative strategies. Furthermore, Sri Lanka continues to face irrigation management problems which may be attributed to settlement planning in its older schemes. Thus, replanning is becoming a significant focus of activity.

In reviewing settlement planning issues in irrigation management, this review has drawn attention to the historical dimension of irrigation management problems. Irrigated settlement schemes are dynamic systems which are often highly controlled in the initial stages and pass through various phases. The initial settlement plans may be felt for many years and may affect replanning strategies. It has been shown for example that turning over management responsibilities to farmers may be rendered difficult because of policies implemented at the inception of schemes.

Finally, this review has shown how broad the experience in the implementation of new settlement schemes has been in Sri Lanka. Numerous experiments have been undertaken to correct deficiencies in past schemes. In

the area of land policies and irrigation management, experiments have been made in such areas as developing the turnout group as a hydrological unit, in regularizing encroachers and reintroducing a system of bethma tenure. Sri Lanka thus offers the opportunity to understand how land settlement policies may assist in improving irrigation management in new schemes, both in Sri Lanka and elsewhere, and in older schemes under rehabilitation.

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