MARD/MDS PROJECTS

ANNOTATED BIBLIOGRAPHY OF WORKS RELEVANT TO THE MAHAWELI AGRICULTURE AND RURAL DEVELOPMENT PROJECT

Mahaweli Agriculture and Rural Development Project
(383 - 0086)

Mahaweli Downstream Support Project
(383 - 0103)

Pimburattewa
via Polonnaruwa

Development Alternatives, Inc
Colorado State University
Oregon State University
Harza Engineering Co.

ANNOTATED BIBLIOGRAPHY OF WORKS RELEVANT TO THE MAHAWELI AGRICULTURE AND RURAL DEVELOPMENT PROJECT

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September 1989

LIST OF ACRONYMS

AO	Agricultural Officer
AI	Agricultural Instructor
ARD	Agriculture and Rural Development
ARTI	Agricultural Research and Training Institute
ASC	Agricultural Service Centre
ATG&D	Agricultural Technology Generation and Dissemination
ATO	Assistant Technical Officer
BAO	Block Agriculture Officer
BC	Branch Canal
BM	Block Manager
BO	Block Office
BOD	Blocking Out Design
BOP	Blocking Out Plans
BOQ	Bill of Quantities
BTF	Block Task Force
CAD	Computer Assisted Design
CARI	Central Agricultural Research Institute
CCA	Culturable Command Area
CCA	Cost Centre Accounting
CDO	Community Development Officer
CE	Chief Engineer
CI	Cropping Intensity
CIDA	Canadian International Development Agency
CIE	Chief Irrigation Engineer
CIIM	Colorado Institute for Irrigation Management
COP	Chief of Party
CSU	Colorado State University
D(B)	Director (System B)
DAI	Development Alternatives, Inc.
DARP	Diversified Agricultural Research Project
DC	Distributary Canal
DD	Deputy Director
DD (R)	Deputy Director (Research)
DG	Director General
DOA	Department of Agriculture
DR	Drainage
DRE	Divisional Resident Engineer
DRPD	Deputy Resident Project Director
DRPM (Ag.)	Deputy Resident Project Manager (Agriculture)
DRPM (G)	Deputy Resident Project Manager (General)
DRPM (L)	Deputy Resident Project Manager (Lands)
DRPM (WM)	Deputy Resident Project Manager (Water Management)
EA	Engineering Assistant
EA	Environmental Assessment
EEC	European Economic Community
EIED	Employment Investment and Enterprise Development
FA	Field Assistant
FC	Field Channel
FIO	Field Inspection Officer
FMU	Flow Monitoring Unit
FO	Field Officer

LIST OF ACRONYMS
(Continued)

FO	Farmer Organization
FS	Field Supervisor
FSD	Full Supply Depth
FSE	Farming Systems Extensionist
FSL	Farming System Level
FSR/E	Farming Systems Research/Extension
FSS	Farmer Support Services
GIS	Geographic Information System
GM	General Manager
GOSL	Government of Sri Lanka
HC	Horticultural Crops
ICO	Irrigation Community Organizer
ICOS	Irrigation Community Organizer Supervisor
ID	Irrigation Department
IDD	Institution Development Division
IE	Irrigation Engineer
IIMI	International Irrigation Management Institute
IRRI	International Rice Research Institute
ISM	Irrigation Systems Management
LBMC	Left Bank Main Canal
LHG	Low Humic Gley
LTTA	Long-Term Technical Assistance
MADR	Ministry of Agricultural Development and Research
MARD	Mahaweli Agricultural and Rural Development
MASL	Mahaweli Authority of Sri Lanka
MBD	Mahaweli Basin Development
MD	Managing Director
MDS	Mahaweli Downstream Support
ME&M	Monitoring, Evaluation, and Management
MEA	Mahaweli Economic Agency
MECA	Mahaweli Engineering and Construction Agency
MEU	Maintenance and Equipment Unit
MI	Maha Illuppallama
MLT	Middle Level Technician
MMD	Ministry of Mahaweli Development
MOU	Memorandum of Understanding
MPCS	Multi Purpose Cooperative Society
MRTC	Mahaweli Regional Training Centre
NCB	Non-Calcic Brown
NGO	Non-Governmental Organization
O&M	Organization and Management
O&M	Operations and Maintenance
OAL	Old Alluvial
OFC	Other Field Crops
OFD	On-Farm Development
OIC	Officer-In-Charge
OJT	On-The-Job Training
OSU	Oregon State University
PE	Project Engineer
PGIA	Post Graduate Institute of Agriculture
[illegible]	[illegible] Irrigation Community Organizer

LIST OF ACRONYMS
(Continued)

PIL	Project Implementation Letter
PMCC	Project Management Coordinating Committee
PMU	Project Monitoring Unit
PMU	Planning and Monitoring Unit
POC	Project Operation Committee
PP	Project Paper
PRC	Project Review Committee
PS	Procurement Services
RAL	Recent Alluvial
RARC	Regional Agricultural Research Centre
RARC/A	Regional Agricultural Research Centre/Aralaganwila
RBE	Reddish Brown Earth
RO	Research Officer
RPD	Resident Project Director
RPM	Resident Project Manager
RRC	Regional Research Centre
RTF	Research Task Force
RTWG	Regional Technical Working Group
SDC	Sub-Distributary Canal
SFC	Subsidiary (Secondary) Field Crops
SG	Security Guard
SK/ASK	Store Keeper/Assistant Store Keeper
SL	Sri Lanka
SLBDC	Sri Lanka Business Development Centre
SLIDA	Sri Lanka Institute Development Administration
SMO	Subject Matter Officer
SOP	Standard Operating Procedure
SOW	Scope of Work
STTA	Short-Term Technical Assistance
TA	Technical Assistant
TAC	Technical Assistance Contractor
TAC/RTF	Technical Assistance Contractor/Research Task Force
TAT	Technical Assistance Team
TGD	Technology Generation and Dissemination
TO	Training Officer
TOG	Turn Out Groups
TOG/L	Turn Out Group/Leader
TOR	Terms of Reference
UM	Unit Manager
UNDP	United Nations Development Program
US	United States
USAID	Unites States Agency for International Development
VC	Vegetable Crops
WIL	Water Issue Labourer
WM/FO	Water Management/Farmer Organization
WMS	Water Management Secretariat
WS	Work Supervisor
WUA	Water Users Associations
WUO	Water User Organizations

TABLE OF CONTENTS

			Page
Introduction			i
Chapter I	-	Agricultural Technology Generation and Dissemination	1
Chapter II	-	Water Management and Main Systems Operation and Maintenance	75
Chapter III	-	Farmer Organizations	94
Chapter IV	-	Farmer Support Services	111

LESSONS LEARNED PAPER
MAHAWELI AGRICULTURE AND RURAL DEVELOPMENT PROJECT

INTRODUCTION

The Mahaweli Agriculture and Rural Development Project (MARD) is a multi-faceted effort to improve the incomes and welfare of settler-farmers in System "B" of the Mahaweli Accelerated Development Program. Funded by USAID, the project includes the following components:

- Agricultural Technology Generation and Dissemination (ATG&D)-Research and Extension
- Water Management (WM) - Main Systems O&M
- Farmer Organizations (FO)
- Farmer Support Systems (FSS) - Marketing, Credit and Post Harvest Activities

Although the MARD Project is a pioneering effort in putting all these components into one project, all these activities have gone forward in Sri Lanka over the past 50 years and more. The literature on rural development in this country is rich and varied, while many Sri Lankans have gained extensive experience in successful and unsuccessful rural development projects of all kinds.

One of the first tasks assigned to the Technical Assistance Team (TAT) from Development Alternatives, Inc. (DAI), Colorado State University (CSU), Oregon State University (OSU) and Harza Engineering Company (HARZA) when they began the implementation of MARD was to review previous development activities and to learn from history what can and cannot work in Sri Lanka.

This effort took two principal forms during the first months of implementation.

First, team members undertook discussions with a wide range of Sri Lankans and expatriates during the preparation of the first annual workplan. They also reveiwed extensively the literature in their fields before finalizing our workplan. This plan was presented in a very elaborate and complete format, which incorporated the lessons learned from the relevant literature and from the aforementioned discussions.

Second, MARD organized in February 1989, a workshop entitled "Theory into Practice" (TIP). The TIP workshop, whose proceedings were published and distributed soon after the workshop was held, gathered public and private sector officials concerned with Mahaweli development and got their help in laying out an action plan for MARD. The discussions were centered on learning from past experiences in Sri Lanka and elsewhere in order to ensure that MARD has the best possible chances for implementation success.

Over the first year of implementation, the MARD team has had a chance to read through a vast amount of literature on development in Sri Lanka and to judge its usefulness in the light of our first season of implementation (Yala

1989). We have thus decided to produce the final part of the lessons learned paper in the form of an annotated bibliography of sources relevant to each of the four MARD components.

The chapters are not all presented identically since each component attacked the task before it in a slightly different manner. But all spent a great deal of time identifying, reading, analyzing, and commenting on the most relevant sections of the extant literature about their fields of endeavour.

MARD has learned much from those who have worked in the rural areas of Sri Lanka before us. We hope that those who come after us will learn as much from our efforts.

Chapter I
Agricultural Technology Generation and Dissemination
(Research and Extension Component)

MARD Project

This "Lessons Learned" paper places emphasis on Farming Systems Research and Extension (FSR/E) and Crop Diversification both of which are of vital concern to the Agricultural Technology Generation and Dissemination (ATG&D) component of the MARD Project. The paper reviews information that was/is available to the reviewers including books, reports, proceedings, background papers, technical notes, work plans, articles, and personal correspondence.

Many of the articles, reports, etc. on FSR/E, unfortunately, were not available to the reviewers.

These include:

1. Numerous articles, reports, etc. from CIMMYT, IRRI, IITA, ICRISAT and ICARDA on FSR/E and related topics.

2. Proceedings of the Annual FSR/E symposia which have been held for the past eight years at either Kansas State University or the University of Arkansas.

3. Publications, proceedings, working papers, background papers, etc. from the Farming Systems Support Project (FSSP), University of Florida, which was funded by USAID for several years.

4. Proceedings and reports of the many workshops, tours, conferences and meetings of the Asian Cropping Systems Working Group[1] and the Asian Cropping Systems Network (ACSN)[2], both of which are coordinated by IRRI.

   These reports include many papers, presented by various research and extension personnel of Sri Lanka, which summarize the results of the Sri Lanka Cropping Systems Programs from 1975 up to the present time. They also include, of course, papers presented by the other 9 participating Asian countries.

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[1] A few years ago the name of the Working Group was changed to Asian Farming Systems Working Group.

[2] A few years ago the name of the Network (ACSN) was changed to Asian Farming Systems Network (AFSN).

(This "lessons learned" paper includes reviews of only two of the many publications from the Asian Cropping Systems Working Group and the ACSN. These publications are:

a. Hogue, M.Z. 1984 "Cropping Systems in Asia. On-Farm Research and Management, IRRI.

b. Zanstra, H.G. et. al. 1981. "Cropping Systems Research" IRRI,

3. The following key references which are frequently cited in farming systems writings;

a. American Society of Agronomy. 1976 "Multiple cropping" ASA special Publication No. 27.

b. Byerlee, D., L. Harrington and D. Winkelmann. 1982. "Farming systems research; issue in research strategy and technology design." American Journal of Agricultural Economics. 64: 897-904.

c. Chambers, Robert, Lori Ann Thrupp and Arnold Pacey. 1989. Farmers First. Intermediate Technology, London 1989.

(Robert Chambers has previously written several to many articles including "Managing Rural Development", "The Small Farmer is a Professional" and "The Farmer First; the Farmer L6ast concept.")

d. Gilbert, E.H., D.W. Norman and F.E. Winch. 1980. "Farming Systems Research: An Appraisal." MSU Rural Development Paper No. 6, Department of Agricultural Economics, Michigan State University.

e. IRRI. 1976. "International Bibliography on Cropping Systems, 1973-74." Library and Documentation Center, IRRI. 1976.

f. Merril Sands, D. 1986. "Farming Systems Research; Clarification of Terms and Concepts." Expl. Agric. 22: 87-104.

g. Simmonds, N.W. 1985 "The State of the Art of Farming Systems Research." A Review. World Bank Technical Paper No. 43. Washington, D.C.

h. Wharton, C.R., Jr. 1969. "Subsistence Agriculture: Concepts and Scope. In "Subsistence Agriculture and Economic Development", ed. C.R. Wharton, Jr. pp. 12-20. Chicago: Aldine.

During the next six months aggressive attempts will be made to locate and procure many of these additional articles, reports, etc. on FSR/E. They will then be reviewed and the reviews will be added to this "Lessons Learned" paper.

SUSTAINABLE AGRICULTURE AND FARMING SYSTEMS

In recent years "Sustainable Agriculture" has received as much or more attention than FSR/E. In fact the two subjects are frequently jointly considered. The 1989 FSR/E Symposium, to be held at the University of Arkansas, on October 8-11, will examine the "Impacts of FSR/E on Sustainable Agriculture."

Definitions of Sustainable Agriculture and Farming Systems continue to be revised and fine tuned, as illustrated in the following two articles which are quoted from Agronomy News.

Decision Reached on Sustainable Agriculture

The concept of agricultural sustainability has received much attention recently, but the term may mean different things to different people. During a free-wheeling two-hour discussion, facilitated by Ray Weil of the University of Maryland, approximately 350 Tri-Society members hammered out a consensus on the following definition of sustainable agriculture: "A sustainable agriculture is one that, over the long term, enhances environmental quality and the resource base on which agriculture depends; provides for basic human food and fiber needs, is economically viable, and enhances the quality of life for farmers and society as a whole."

The group, representing a cross-section of opinions, agreed that the concept of "low-inputs" is not essential to sustainable agriculture, but, under some circumstances, may be an appropriate approach to meeting the four criteria listed in the definition. There was a call for a similar discussion session next year on research approaches and priorities for sustainable agriculture.

(Source: January 1989 AGRONOMY NEWS, Published by the American Society of Agronomy)

Australian Professor Defines Farming Systems

W.R. Stern, professor of agronomy at the University of Western Australia, Nedlands, Perth, offers his definition of farming systems and notes how it parallels the Tri-Society definition of sustainable agriculture printed in the January 1989 Agronomy News.

"Farming systems evolve to maximize profits while maintaining the productivity of the land. They are usually shaped by the physical environment and the availability of resources, by the prevailing economic conditions, and by the inclinations and capacities of primary producers. They are based on the productive capacity of the land, the constraints imposed by such factors as pests and diseases, the availability of suitable varieties, and the probability of occurrence of natural hazards. Farming systems also arise out of a capacity by the community to service farms and farmers and to supply the ingredients for production, for example, fertilizers and chemicals, suitable new varieties and breeds, appropriate machinery, fuel and finance, and the capacity to market efficiently. If any part of the system should fail, the farming system may break down or may change. Proof that a farming system is successful is found

in the economic viability of the farmers that adopt the system while sustaining the productivity of the land."

(Source: July 1989 AGRONOMY NEWS; Published by the American Society of Agronomy)

"The goal of sustainable agriculture is based on values of ecological soundness, environmental protection, economic rationality, equity, and humaneness toward people and animals."

(Source: Patricia Allen and Debra Van Dusen in an article on sustainable agriculture appearing in Volume One, "Global perspectives on Agroecology and Sustainable Agricultural Systems," University of California, Santa Cruz.)

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3. **Anonymous**: (1987-88) Farming Systems Research. Annual Report. Ramakrishna Mission Lokasiksha Parishad. Narendrapur - 743508, South 24 Parganas, West Bengal, India.

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Reference 1

Abdel-Rahim M.F. et'al (1985) Effectiveness of Soil Solarization in Furrow Irrigation: Egyptian Soils

Plant Diseases: 72(2) : 143 - 146.

Soil solarization of furrow-irrigated soils in Egypt effectively controlled weeds, broom rape, cork root, and root knot diseases in tomatoes. It also controlled Rotylenchus reniformi for 60 days after planting. It improved plant growth and increased yields by 25-432 percent in broad beans, onions, tomatoes, and clover in various types of soil. Rhizobium nodulation was adversely affected and plants were initially stunted, but later recovered. The beneficial effects of solarization lasted for 2 to 3 seasons. It also decreased soil salinity.

Relevance of Above Publication to MARD

Soil solarization is a relatively simple and ecologically acceptable technology that could find application in System "B", among growers of such high value crops as B'onion and strawberry. Demonstrations could be organized for the forthcoming Maha season both at the MEA Seed Farm and at Block level.

Reference 2

Anonymous: (1988) Department of Agriculture Work Plan for Subsidiary Food Crops Related to the Activities of the Diversified Agricultural Research Project. RFP No. 383-0058-003

This 67 page Department of Agriculture (DOA) and the Diversified Agricultural Research Project (DARP) Work Plan deals with project goals and objectives, agricultural policy and the farmer, project direction, farming systems research, soil and water management, extension education, seed production and certification, production economics and marketing research, training, building and construction, and procurement.

The goal of DARP is improvement of Subsidiary Food Crops (SFCs), that is, field crops other than rice. One of the goals of the MARD project is crop diversification; from rice to:

a. other Field Crops (OFCs)
b. vegetable crops
c. fruit crops; and
d. any other crop for which there is suitable local or export market demand.

DARP works under the DOA and on an island-wide basis. MARD works only in System "B" and under the Mahaweli Economic Agency (MEA) but also works with the DOA and, like MEA, depends on the DOA for development of improved crop varieties, improved agronomic practices and other agricultural research. The research results are then extended through the MEA Extension System. MEA/MARD work very closely with the Regional Agricultural Research Center, Aralaganwila (RARC/A) and benefit from these research results.

The DOA/DARP Work Plan and previous activities and accomplishments were of significant assistance to the initiation of the MARD program, especially the on-farm trials. DOA/DARP had already established selection criteria for the crop to be researched. Many of these criteria were also used by the MEA/DOA/MARD project in the selection of OFCs for on-farm trials.

The numerous DARP reports have been and continue to be of considerable use to the MARD project. The strong linkages between the two projects are of mutual benefit to both projects and to DOA and MEA. Hopefully, these linkages will expand and become even stronger.

Reference 3

Anonymous: (1987-88) Farming Systems Research. Annual Report. Ramakrishna Mission Lokasiksha Parishad. Narendrapur -743508. South 24 Parganas. West Bengal. India

The Farming Systems Research (FSR) projects at R.K. Mission, Narendrapur center have been functioning since January, 1987. The salient features from the experiences gained during the period of 1987-88 are as follows:

1. Nine villages in three sub-centres have been identified in the three coastal districts in West Bengal for conducting FSR programs sponsored by the Food Foundation. These areas suffer from low agricultural productivity due to inundation and occasional flooding during the rainy season, salinity of soil and water, poor irrigation and drainage facilities and also due to small and fragmented holdings.

2. In order to assess socio-agro economic status of these village and the farming communities, an initial benchmark survey of the identified villages was conducted.

3. Since rice is the most important crop of the area, it was considered, in consultation with the farmers, that suitable substitute genotypes in place of existing low yielding conventional rice varieties and use of threshold dose of fertilizers could be taken as initial treatments for improving rice productivity.

4. Simple on-farm trials with five H.Y. improved varieties of rice and a threshold dose of fertilizer 20:0 kg of N: P_2O_5: K 20 per hectare were conducted during the main Aman season of 1987-88. The results during the first year showed significantly promising response with three genotypes. Application of basal fertilizers significantly improved yields.

5. Simple observational trials with pulses and oilseeds in rice fallows were not found to be successful, mostly due to existing saline condition. However, the trials will be continued in the non-saline pockets next year.

6. Cultivation of vegetables in rice fallows was found to have achieved considerable success.

7. Since lack of irrigation is a major constraint for multiple cropping and deep/shallow tube wells are not suitable for the area due to salinity, trial on land shaping have been initiated.

8. Studies and observations thus far indicate that a single crop of rice or a suitable multiple cropping pattern alone may not make a sustainable farming system for the resource poor farmers.

9. Involvement of village women has been initiated through practices in kitchen gardening in the backyard of individual homesteads.

10. A systematic training program both for the participating farmers and FSR workers was found to be extremely essential.

What are same of the **"lessons learned"** from the FSR conducted by the Ramakrishna Mission that might be of help to the ATG&D component of the MARD project? Water resource management is the most vital issue in the project area at Narendrapur. Creating small irrigation facilities through land shaping have been initiated with the object of extension of multiple cropping and higher income generation. In System "B" improvement of on-farm water management cannot be overemphasized. Perhaps the most important constraint to crop diversification and the growing of OFCs is the need for on-farm water management improvement. There are many instances in the system where improvement of field channels, field drains, turn-out structures, terraces and land shaping and leveling is needed.

In order to improve the poor nutrition status in the village through involvement of village women, a program in kitchen gardening was initiated by the R.K. Mission. It was observed that village women were been on kitchen gardening during rainy season when general availability of vegetables is limited. Non-availability of good vegetable seeds was a major constraint in some areas. Seeds available from the local market were generally of poor quality and viability. Damage by stray cattle was another major problem.

The MARD project plans to place more emphasis on kitchen gardening and involvement of women. The R.K Mission results should be of assistance in designing various approaches for improving kitchen gardens and more effective involvement of women of System "B".

Reference 4

Anonymous: (1986) Farming Systems Research and Extension in Sri Lanka. Workshop Proceedings. Ministry of Agricultural Development and Research. Department of Agriculture. Division of Agricultural Economics & Projects and (USAID) Diversified Agricultural Research Project. September 1986

These proceedings include the invited papers presented at the workshop, reports of research based on the FSR/E approach, and recommendations of the five working groups. It is expected that these will generate further ideas, suggestions and propositions toward integration of FSR/E into the activities of the DOA, MARD, of Sri Lanka.

The following are excerpts from the Workshop Proceedings Executive Summary.

BACKGROUND TO THE WORKSHOP

The objectives of the Workshop on FSR/E were to provide a forum for the exchange of information on the current status and activities of FSR/E in Sri Lanka, and to generate recommendation regarding the future promotion of the FSR/E approach in the country. The workshop was organized by the DARP and funded by USAID and the Government of Sri Lanka (GOSL).

Researchers from the Regional Research Centers (RRCs) as will as agricultural administrators, economists, trainers and extension workers--people who are likely to influence the future implementation of FSR/E activities within the Department of Agriculture -- were invited to attend.

Papers were presented in three sessions covering:

1. general concepts of FSR/E and the development of a systems approach to agricultural research in Sri Lanka

2. the general approach to FSR/E at the RRCs, and

3. specific examples of the use of the approach in research undertaken at the RRCs. After the papers were presented the participants, divided into five working groups, prepared statements containing guiding principles for the future implementation of FSR/E in Sri Lanka.

CONCLUSIONS OF THE WORKSHOP

The participants reaffirmed the relevance of farming systems research and extension to agricultural development in Sri Lanka. They made the following observations and recommendation for strengthening national FSR/E activities in the future:

Definition of Farming Systems Research and Extension

The FSR/E was defined as a method of organizing several disciplines and support services to undertake a research project with the aim of increasing

resource productivity. This aim is to be achieved by employing technical innovations which are acceptable to farmers who are managing land within a target area in an ecological zone. Using this approach, agricultural development workers maintain a perspective which keeps the entire farm system in view, even if the technologies being developed are focused on only a portion of the system. In addition to its systems perspective the distinguishing features in this approach are its emphasis on interdisciplinary team work, inter-institutional coordination, farmer consultation and on-farm research as integral parts of research methodology.

Role and Organizational Complications of FSR/E

The FSR/E is seen as one of a number of tools to be used in research and extension. Its implementation does not presuppose major administrative restructuring. The continuing importance of technology development on research stations, as a basis for on-farm development, was confirmed.

Recommendations

1. High level political and administrative support is needed for the team work and field activities which are essential for effective FSR/E.

2. Continuity in support for FSR/E is needed, particularly in budgetary provisions which facilitate group work.

3. It was considered important to develop programs which make effective use of national resources, and rely less on outside support for their implementation.

4. A National Coordinating Committee nominated by the Director of Agricultural and Research Action Committees should be formed to develop FSR/E programs. These committees will be responsible for determining research priorities, developing research programs, coordinating resource allocation, monitoring and evaluating research activities, and promoting better communication regarding all aspects of FSR/E implementation.

5. Training of all participants involved in FS methods and mode of operation of FSR/E needs to be improved. The Education and Training Division of the DOA needs to have its training capability in this area strengthened.

6. A regular program of information exchange and publicity regarding the results of FSR/E activities needs to be established.

7. Policies affecting land tenure and eligibility for institutional credit need to be adjusted to encourage farmer adoption of FSR/E recommendations which may include mixed crops, resource conservation measures and the planting of crops which yield benefits only after the passage of more than one or two seasons.

The discussions and recommendations of the FSR/E Workshop, as recorded in the proceedings, have already been useful to MEA/MARD in the formulation of the Yala 1989 on-farm trials.

The Workshop Proceedings will continue to be reviewed as System "B" FSR/E programs develop and expand. Particular attention will be paid to the Working Group Recommendations. There were five Working Groups who held discussions and made recommendations relative to the following topics:

1. Concepts of FSR/E to be used in Sri Lanka.

2. Constraints to the use of FSR/E approach in Sri Lanka.

3. Considerations of farmers and market needs and opportunities in the FSR/E approach to technology development.

4. Provisions within the FSR/E approach for the acceptance and easy transfer of technology at the farm level.

5. Recommendations for future institutional arrangements and training activities associated with FSR/E.

Personnel of the MARD project need to hold additional discussions with DOA and DARP personnel to determine the degree of follow-up and implementation of workshop recommendations. For example;

1. Has an extension officer of the level AO/ADA been cooperating with the coordinator of FSR to carry out programs in farmers fields? (Item 4, page 22 of the proceedings)

2. Has a national committee been appointed to study FSR/E programs and advise DARP? (Item 6, page 22)

3. Has FSR/E training been established at the In-Service Training Institute and Agricultural Research Training Institute? (Item 1 (c), page 25).

4. Has the DOA expanded the training capacity of the Training and Education Division to include FSR/E training for village level workers and farmers? (Item 1 (e), page 26).

5. Did the DOA form a technical working group that is fully informed about FSR projects, policies, targets and plans? (Item 3 (a) at top of page 28).

6. Have regional field-level operational teams been formed? (Item 3 (a) at bottom of page 28).

7. Has a framework been developed for the integration of all appropriate agencies involved in FS development programs? (Item 1 (a), page 30).

8. Has a committee been established at the district level consisting of representatives from appropriate disciplines within the DOA? (Item 1 (c), page 30).

9. Has FSR/E been integrated into the existing research and extension system of the DOA? (Recommendations to DOA, page 35).

10. Has necessary (and adequate) training been provided to FSR/E officers of DOA? (Recommendation to DARP, page 35).

11. Have interdisciplinary teams been established? (Item 1, page 37)

12. Has the RTWG been expanded and strengthened so its structure can be used to implement the FSR/E program? (Item 2, page 37).

13. Was a DOA-FSR/E Central Committee established to facilitate the coordination of FSR/E activities? (Item 1 under Recommended changes, etc page 40).

14. Have Regional Action Committees (RACC) been set up to implement regional FSR/E activities? (Item 2, page 41).

MARD personnel should make every effort to become more familiar with past and present DOA-FSR/E activities in order to benefit from the DOA experiences and advice. Linkages between the FSR/E program of the DOA and the MEA/MARD project should be strengthened.

Reference 5

Anonymous: (1988) Plan for the Development of Regional Research Center-Aralaganwila. Department of Agriculture

This report deals mainly with the following four subjects:

1. The RARC/A, and its mandate.

2. Present status of the Research Center.

3. Agricultural research program for the next five years (1987-1992).

4. Proposed development strategy with tentative budget.

Six Annexures are appended to the report.

a. list of stores items held at present
b. current staff listing
c. manpower requirements
d. allocation of quarters
e. procurement list submitted to DARP
f. capital budget

This document has been extremely helpful to the MARD team in:

1. becoming familiar with RARC/A
2. designing a work plan to provide assistance to RARC/A
3. establishing goals which are in line with RARC, DOA and which should strengthen the RARC/A, and
4. deciding upon ways to improve Research - Extension linkages.

The MARD project should be of considerable assistance in developing future RARC work plans.

Reference 6

Balasubramaniam, V (1989) Alley Shrubs in a High Altitude Semi-Arid Environment. IITA Research Briefs 1989 - P3

Characteristics considered desirable in shrubs for use in alley cropping are the following: a fast growth habit, pest resistance, deep rooting, and an ability to produce a large biomass.

Results are outlined from a conducted in a high altitude semi-arid environment in Rawando to assess the suitability of five species of shrubs for use in alley cropping. **Sesbania sesban** gave good initial growth but did not withstand repeated pruning, **Cassia spectabilis** was the best producer of prunings. **Calliandra callothyrsus** produced the highest amount of woody stems, **Levcaena diversifolia** CV K-156 and **L. leucocephala** CV K-28 had the deepest rooting. Thus all except Sesbania were suitable as alley shrubs. Farmers preference among species will be determined by the usefulness of the by-products for fuel, fodder, green manuring, and mulching.

Relevance of Above Publication to MARD

The ATG&D program envisages the interaction of alley cropping to System "B" farmers. The above paper gives criteria for selection of species as alley shrubs.

Reference 7

Breth, Steven A. (1984) Through Farmers' Eyes. Integrated Cereals Project, Department of Agriculture, Kathmandu, Nepal

This 30 page brochure is well-organized, well-written, and well-illustrated (with 25 coloured photographs).

The productivity of Nepal's small holdings has been greatly increased through a cropping systems program funded by USAID. This program had two broad objectives; to improve the technology that farmers use in their cropping systems and to help spread proven technology rapidly. Cropping systems research was carried out at six primary locations chosen to be representative of Nepal's major agro-ecological situations. The research team consisted of two Agronomists, two Social Scientists and 10 Assistant Agronomists, with a Technician at each research site to act as site coordinator. The site coordinator lived in the village and got to know the farmer's problems and aspirations. He/she and two or three aides recruited farmers as cooperators, saw that trials were properly conducted, and collected yield data and other information. Enterprising site coordinators were the backbone of the cropping systems research in Nepal. Every year 400 farmers took part in research at the six cropping systems sites. The farmers managed the trials. Commodity researchers and cropping systems researchers met informally and also at bi-annual workshops to review new findings and plan future experiments. Dissemination of new technology generated by cropping systems research took place in two stages; pre-production verification trials and production campaigns. Field days for farmers were an integral activity of the verification trials, while pilot production programs were launched at the cropping systems sites as models for the main production campaign.

The planners of the Integrated Cereals project and the Cropping Systems Program of Nepal set out to bring about significant institutional changes in the way that research is done and in which it reaches farmers. The progress that has been made is testimony to the soundness of the planners' vision and the willingness of authorities both in the government of Nepal and USAID to make a long-term commitment to the project.

There are many lessons that have been learned from the Nepal experience. As the FSR/E activities of the MARD project expand serious consideration should be given to the establishment of at least one Farming Systems Research Site within each block.

Reference 8

Chauhan Y.C. et al (1988) Effects of Soil Solarization on Pigeonpea and Chickpea. Research Bulletin No. 11. ICRISAT

Solarization is a method of heat treating soil by covering it with transparent polythene sheeting for 6 to 8 weeks during hot periods. The paper describes its effects on the growth and yield of chickpea and pigeonpea. Solarization increased the soil temperature by 6-10°C in the 0-20 cm soil profile. The primary effect of such heating was the control of soil borne pathogens (*Fusarium* spp) and plant parasitic nematodes (*Heterodera* spp: *Pratylenchus* spp; *Rotylenchus* spp). Beneficial side effects were reduction of infestation by weeds and soil dwelling insect pests, and the increased mineralization of soil nitrogen to nitrate. Solarization had adverse effects on rhizobial population and modulation, but this was compensated by the enhanced availability of nitrate. Irrigation before solarization enhances its effects, but is not a prerequisite. In general, however, the authors conclude that solarization is more appropriate for high value cash crops.

Relevance of Above publication to MARD

Same comments as for the article by Abdel-Rahim, et. al.

Reference 9

Development Alternatives Inc. (1989) Evaluation of the Cro Diversification and Irrigation Project in Jamaica. Prepared for USAID March 1989

This reference is cited in the "Lessons Learned" exercise since it deal with crop diversification and irrigation, two important components of the MAR project. The goal of the CD/I project was to promote investment in th agricultural sector in Jamaica that would improve productivity, increas employment and enhance the nation's capability to earn and save foreig exchange.

Crop diversification and export market development.

- o between 1983 and 1987, non-traditional agricultural export doubled in both volume and value.
- o Achievement of profitable, sustainable agriculture takes time- 30 years or more for countries which have substantia production and marketing advantages over Jamaica.
- o The original and principal investment promotion aims were t attract off-shore investors to the project area to undertak large-side commercial farming of winter vegetables. Th strategy has been slow to yield positive results.

Lessons Learned

1. Fostering the growth of a profitable, sustainable commercial agricultur sector take a long time. GOJ, USAID, other donors, the media, and t private sector should adjust their expectations accordingly to reflect t temporal reality of private sector development in this sector.

2. Not so much a lesson learned, but more a lesson reinforced, viz. getti the investment environment right to foster and sustain private sect development requires many policy and program elements to be in pla (access to team finance, availability of land and water resource adequate marketing infrastructure, etc.).

Reference 10

FAO.(1985) Report on Expert Consultation on FS Development. Bangkok. 23-26 July 1985

The Expert Consultation on Farming Systems Development (FSD) was held at the FAO Regional Office for Asia and the Pacific (RAPA), Bangkok, Thailand, from 23 to 26 July 1985. The objective of the Consultation was to provide an overview of the on-going activities of farming systems and prepare recommendations for the future work on FSD in the Asia and Pacific Regions. Specifically, the Consultation attempted to obtain general agreement on the concept of the systems approach to agricultural and rural development, identify problems in participating countries which could possibly be solved by using FSD approaches, identify projects or government programs in the countries where FSD activities could be initiated and determine the communication methods necessary to promote a national FSD approach.

There were 21 participants from 12 countries: Bangladesh, People's Republic of China, Fiji, India, Indonesia, Republic of Korea, Malaysia, Nepal, Pakistan, Philippines, Sri Lanka, and Thailand; two international Research Institutes - International Crops Research Institute for the Semi - Arid Tropics (ICRISAT) and International Rice Research Institute (IRRI); and the Thai-Australian Project on Land Reform Area Rural Development Support. The Consultation was also attended by FAO staff members from Headquarters in Rome, Regional Office for Asia and the Pacific (RAPA) in Bangkok, and country projects in Nepal and Thailand.

Two papers on Concept and Approach to Farming Systems Development and Data Requirements for Planning and Policy Formulation for Effective Implementation of Farming Systems Development were presented. In addition, case studies of farming systems in selected small farmer area in six countries and project ideas on FSD prepared by the participants were also presented.

RECOMMENDATIONS

The recommendations, in abbreviated form, are quoted as presented in the Report.

"It was noted that the inclusion of the FSD as a sub-program in the 1984-85 FAO Program of Work was very useful. Many developing countries have initiated or are planning to initiate FSD and expect continuous support in implementing them. The program should be strengthened and assured of its continuance."

"Since FSD involves several disciplines and different agencies, Governments should adopt a strategy regarding this new approach."

"Strengthening of rural-based multi-functional organizations such as cooperatives is recommend as integrating forces in FSD. This approach has proved successful in some countries in the region."

"The FSD programs should be undertaken where research recommendations are available."

"A better understanding of the farmer and his environment should be made through the involvement of the farmer in problem identification, on-farm activities and farm planning."

"The agencies involved in extension should be strengthened to transfer knowledge on FSD. The subject matter specialist and the extension workers should have a perspective of FSD in order to be effective in disseminating research information."

"The FSD alone will not help the upliftment of the rural economy. The support services (input supplies, output marketing, credit facilities, etc.) should be reoriented and strengthened to ensure that gains from FSD are sustained."

"It was recognized that planners and policy makers, researchers and extension workers, farmers and agri-business people have important roles in the successful implementation of FSD."

"The FSD on a pilot basis should be initiated in a area within an agro-ecological zone to improve the methodology involved and provide in-situ training for workers."

"The FSD should be offered as an option in the curriculum of agricultural colleges and universities for degree and non-degree training."

"It was pointed out that present ways of data collection and analysis do not fully reflect the information requirements of FSD. Training programs and workshops should be organized to determined the specific information and data requirements for FSD as well as methods of data collection and analysis."

"It is recognized that there are wide differences in the agro-ecological zones in the country and different farming systems evolved or have been developed from each area. National workshops to exchange experiences should be conducted among workers in these countries, particularly those who are dealing with similar farming systems."

"Each country should designate a focal point for communication and liaison with FAO and other organizations on FSD."

"Success stories on FSD should be identified and documented. FAO may arrange for the documentation and dissemination to various audiences including policy makers through its publications and other mass media."

"The members of the Consultation have identified certain project ideas on FSD. Countries concerned may consider these ideas and request FAO for assistance in developing projects proposals and in implementation, if desired."

Postgraduate Diploma Course in Farming Systems

The FAO was quick to follow up on the recommendation that "FSD should be offered as on option in the curriculum of agricultural colleges and universities for degree and non-degree training "and identified one institution in each country to offer a postgraduate diploma or degree in farming systems. The Asian Institute of Technology in Bangkok was identified by the FAO as Regional Lead Center and the Postgraduate Institute of Agriculture (PGIA) in Peradeniya was identified, by the then Ministry of Rural Industrial Development, as the local institution to provide this training. The FAO has provided financial support for the course which is of one year's duration. The program of study consists of lectures, practicals, field work, seminar and a directed study or project.

The PGIA initiated their offering of the FS PG Diploma course in 1986/87. One batch has completed the course and another batch is pursuing the course.

In early 1989 the MARD Project investigated the possibility of the PGIA assisting in the training of newly recruited Farming Systems Extensionists (FSEs) and selected Field Assistants (FAs) from System "B". This would have been an abbreviated one to two-week FSR/E offering. The PGIA was very receptive to the proposal but due to many uncertainties at the time (June/July 1989) was unable to assist in the FSE/FA training. It is hoped that the first batch of FSEs will be able to receive training from PGIA later this year (1989) or in early 1990. It is anticipated that future FSE trainees will be exposed to at least some of this FSR/E training from the PGIA staff.

Reference 11

Hargreaves, George H. (1988) Selection of Irrigated Crops for the Developing Countries. International Irrigation Center, Department of Agriculture and Irrigation Engineering, Utah State University, Logan, Utah. (Mimeo)

George H. Hargreaves is Research Professor Emeritus, International Irrigation Center, Utah State University. His 20 page paper, including 8 pertinent references and 3 tables, is adequately summarized in the following abstract and summary and conclusion which are quoted.

ABSTRACT: "The promotion of crop selection more in line with national irrigation development objectives is recommended for irrigation projects. Crop selection should take into account the desired goals and the conditions of soils, climate, and water supply."

"Monthly means of potential evapotranspiration, temperature, number of days with rain, precipitation amounts, and the standard deviations of these four values defines the climate adequately for use with crop yield models. The standard deviations of potential evapotranspiration and temperature are approximately determined by latitude. Tables providing a good definition of climate have been prepared for Africa, Latin America and selected Asia countries. These tables can be used with the various crop yield models to predict probable crop yields. A sample table for one location is provided."

"Soil conditions are largely determined from depth, texture, drainage and pH. A table of approximate rooting depth for various crops is provided." (Note: This information is extremely useful to most agricultural projects.)

"Data are presented indicating that total benefits to the economy from the irrigation of fruits and vegetables may be 10 times those from the irrigation of the same area for the production of food grains."

SUMMARY AND CONCLUSION

"In the developing countries efforts should be made to encourage the production of crops well suited to the soils and climate and to the development goals selected for priority. Specific crops and varieties have definite requirements for conditions of soils and climate."

"In arid climates where rainfall contributes little to plant growth, long term monthly means of maximum and minimum temperatures and latitude provide a good definition of the climatic potential for agricultural production. These data can be used to generate synthetic daily values for use with crop yield models. Where rainfall makes a significant contribution to crop yields, or creates drainage problems, the required data include numbers of rainy days and rainfall amounts and the standard deviations of these mean values."

"Use of the crop yield models to assist in crop selection for a limited number of crops is suggested."

"The more important soil conditions influencing crop selection include depth, texture, drainage, and pH."

"Monthly climatic data tables of the format and content presented herein are proposed for use in evaluating and comparing climates for purposes of crop selection."

"The importance of high value labour intensive crops in the crop pattern is discussed in some detail. It is clearly demonstrated that crop selection should be a dynamic process and that planning should foresee future changes in market demands and the technologies used in irrigation and agriculture. Experience in California is summarized indicating that three fourths of the dollars generated result from the growth or processing of food and fiber crops. Data sampled indicate a 2.4 times increase in yields and a five fold increase in gross farm income per hectare over a 25 year period, assuming no change in the crop pattern selected."

This paper raises several questions as follows.

1. Should MARD attempt to make use of crop yield models? Eleven crop models are being developed by IBSNAT (International Benchmark Sites Network for Agro-technology Transfer). The crops for which field modeling activities are in progress include: maize, wheat, sorghum, millet, rice, soybeans, peanuts, dry beans, potatoes, cassava and taro. Use of the crop models with either daily climatic data or synthetic values derived from monthly data provides a means for determining which crops are most suitable to the prevailing climate. However, the IBSNAT models will be available only for cereals, grain legumes and root crops. These may be of less importance in irrigated agriculture than the fruits and vegetables.

2. Should MARD be placing more emphasis on urgency of more detailed soil surveys for System "B"? Hargreaves reminds us, the more important soil conditions influencing crop selection include depth, texture, drainage, and pH.

3. Should MARD be placing more emphasis on fruit and vegetable crops? Hargreaves points out that net profits to the farmers are five times as much for fruit and vegetable crops as for grain. However, the information he uses is from a 1953 crop manual. The grains in the study included different varieties of field beans.

Hargreaves paper touches on some of the same issues as Dr. Marvin E. Jensen's short-term consultancy report of April-May 1989 on "Agro-meteorological network evaluation and recommendations for data collection and analysis, MEA/System "B"." Jensen compared Hargreaves ETO estimates for the Kaudulla site with 1963 Penman and Jensen's ETO estimates and made the followings analysis --

"The Hargreaves method, which depends mainly on mean air temperature and the difference between maximum and minimum air temperatures is not responsive to the high winds or directly responsive to solar radiation expressed as sunshine hours. Hargreaves ETo estimates for Kaudulla site greatly underestimate ETo during the windy, high radiation months."

Reference 12

Harwood, R.R. (1979) Small Farm Development. Understanding and Improving Farming Systems in the Humid Tropics. Westview Press, Boulder, Colorado

This book is intended to help agriculturalists and others better understand farming systems in the humid tropics, recognizing that the development of a greater number of the world's small farms requires a shift of emphasis in thinking, in technological research, and in communications with farmers. Its central theme is the analysis of several aspects of small farm production systems that foster efficiency in conditions of limited resources.

Dr. Harwood suggests that the purposeful blending of traditional and modern technologies may prove to be the key to starting the most disadvantaged farmers along a more rapid development path. He proposes collaborative work among scientists, extension workers and farmers to both develop and extend relevant technology to resource - limited farms, and concludes with a discussion of the critical aspects of small farm development that are either little emphasized or completely overlooked in current development programs.

The chapter headings are:

Part 1 - Small farm development

1. A new approach to analysis
2. The stages of small farm development
3. Goals of small farm development
4. Measuring the well-being of small farmers
5. Research in small farm development

Part 2 - Critical factors in small farm development

6. Physical limits to cropping intensity
7. Economic determinants of crop type and cropping intensity
8. Resource requirements of multiple cropping
9. Animals in mixed farming systems
10. Non-common farm enterprises
11. Nutrient needs of intensive cropping systems
12. Efficient use of farm resources
13. Requirements for farm mechanization
14. Stability in farming systems

Appendices

A. Sources of farming systems information
B. Farming systems terminologies
C. Botanical names of crops mentioned An Annotated Bibliography is also included.

This book is heavily influenced by Dr. Harwood's experiences in tropical Asia, but relevant examples from other parts of the humid tropics are included, and the principles described are universal in applicability. The discussion

applies most directly to those areas of the tropics having rainfall greater than 1000 millimeters (40 inches) per year.

This book has been widely read and used by many planners and implementors of cropping/farming systems programs. It should be frequently refereed to by MARD personnel who are associated with the on-farm trials and other FSR/E activities. For example, it serves as a reminder of the many factors that should be taken into consideration in designing, conducting, monitoring and harvesting on-farm trials. In his discussion of the physical limits to cropping intensity Harwood outlines the limiting factors giving detailed examples of the most important ones such as water and water availability, topography, temperature, tillage capability and soil fertility. This book is conceptual in nature and is meant to influence development thinking rather than to provide a detailed how-to do-it guide.

Reference 13

The EXECUTIVE SUMMARY of this Report Adequately Summarizes its Content and is Quoted in its Entirety

"This consultancy was primarily concerned with the transfer of technology from research to the farmer. A review was made of recent literature on research results and a superior technology package was developed for the chena lands. This technology was then evaluated in Moneragala."

"A review of agricultural production problems with subsidiary food crops in the highland rainfed areas is reported. Weeds are a serious problem and control is difficult, especially during Maha rains when farmers are not able to enter the fields. Control of weeds during the first 30 days after planting is critical to obtaining high yields. Herbicides will probably have to be used in this situation. The two-row seeder, with modifications of the seed tube, can be a highly effective piece of equipment. It allows proper management of farm land and assures optimum plant populations, utilizing the principle of crop competition to help control weeds. There is a need for machinery to shell and dry maize."

"The demonstration method of transferring technology was used in Moneragala District. Hybrid maize yields of 4.9 t/ha were obtained during the Maha season 1986/87. The Extension Division will have the responsibility of exploiting these excellent results. Arrangements are being made to increase the area and include 50 farmers in the demonstration village for the Maha season 1987. If this can be done successfully, the program should be expanded to a larger area in 1988."

"Terminates are a constraint in agricultural production in the chena area. A paper was written on their biology and control.

"The communication process for transferring technology is explained in the light of the present T and V system of agricultural extension."

"Emphasis is placed on communication, that is, the transfer of information that leads to change and improvement. Dissemination of information is the delivery of information to farmers and is an important step in technology transfer but communication to farmers is what we are interested in."

"Mass media, especially radio, is one of the most effective and least costly methods of communication with the farm population in any country. Cost-benefit ratios are reviewed and proposals made to intensify the use of radio and other mass methods. A budget for a proposed mass media program is included."

Dr. Haws' statements (1) "communication to farmers is what we are interested in" and (2) "mass media, especially radio, is one of the most effective and least costly methods of communication with the farm population" are relevant reminders to MEA/MARD personnel working with System "B" settlers.

Haws' Table 1, giving the cost of production of and net income from 21 crops, is exceedingly interesting information. The cost of production varies from Rs 3,420/- to Rs 49,926/- per hectare. The net income ranges from Rs 1,580/- (millet) to Rs 178,996/- (B. onion).

If and when System "B" research and extension personnel get more involved in maize research and production they should review the summary of maize production in Moneragala (19 points) as published by the Division of Agricultural Economics, DOA, and repeated by Haws in his report.

The procedures developed to transfer technology to the farmer are classified, by Haws, into four major areas of activity: (1) research, (2) multi-location testing, (3) pilot production, and (4) regional or national programs. The specific responsibilities and specific training activities of each of these stages is discussed in some detail, and should be reviewed by System "B" personnel involved in technology transfer.

Haws' figure (diagram) on "Applied research in farmer's fields in cooperation with national programs" indicates how research (technology generation) moves to applied research (technology verification, including multi-location testing) to pilot extension and national programs (technology dissemination). It is recommended that all agricultural professionals in System "B" review this diagram and the discussion that goes with it.

Reference 14

Hildebrand, P.E. and Federico Poey. (1985) On-Farm Agronomic Trials in Farming Systems Research and Extension. Lynne Rienner Publishers, Inc. Boulder, Colorado

In their preface, the authors examine the history of research and extension systems in the low - and middle - income countries of the world and suggest that there has been four distinct phases. The first phase was marked by the construction of a limited number of research stations and the initiation of technical training programs, often outside colleges and universities. This phase began prior to World War II and its focus was on scientific research and the exploration of new crop production opportunities.

The second phase was characterized by a focus on rapid industrial development and rapid expansion of publicly supported community development and extension education programs. A third phase was initiated in the late 1950's, with renerved emphasis on technology development and research institution building. Efforts were made to identify "packages of practice." This phase is responsible for the marked growth in food production which has taken place in the past two decades.

"Research and extension programs are now entering a fourth, client-participatory phase. The term "farming systems" was applied in the 1970's to several different activities that had common threads and similar purpose, but used different methods to pursue their goals. The common threads were:

1. A concern with small-scale, limited-resource family farmers who were reaping a disproportionately small share of the benefits of organized research, extension, and other developmental activities.

2. Recognition that a firsthand and thorough understanding of the farmers' situation is critical in increasing their productivity and helping to improve their welfare.

3. The use of scientists and technicians from more than one discipline as a means of understanding the farm as an entire system, rather than isolating components within the system."

"Farming systems research and extension (FSR/E) is an approach to technology generation, evaluation, and delivery. It is applied, farmer-oriented, agro-biological research, supported by the socio-economic science in a team effort that includes extension responsibilities. The principal product is technology. The primary clients are farmers. Since FSR/E concerns technology generation, evaluation, and delivery, there are more agro-biological than socio-economic scientists involved, and methodology emphasizes on-farm biological research as an integrated and critical portion of a sequence of activities.

"In that context, this book addresses an important problem in agricultural technology innovation, namely that of technology development methodology."

"This book faces the technology issue squarely. It recognizes that farmers use technology, not science, even though the technology is science-based. It recognizes that most agricultural workers serving the technological needs of farmers deal more with technology than with science. It faces the need for an authentic methodology of technology development, to be used by those working in innovation without the luxury of laboratory and experiment station control. Technologists need their own technology. It is not enough to make do with the traditional research methodology, even with improvisations and ad hoc adaptations."

"This book is an early step toward a methodology of technology development. It will be unfortunate, indeed, if it is the last word."

The book does three things:

1. It presents the role and philosophy of on-farm research in FSR/E activities and describes a logical sequence for technology development.

2. It presents the most-used statistical procedures in simple, easy-to-follow steps. This is a service for technicians who are often isolated and would like to or must analyze their own data.

3. It presents new ideas and methods for analyzing agronomic data obtained without the effect of usual experiment station controlled conditions.

The main chapter headings are:

1. The role of on-farm research in technology development
2. General considerations related to on-farm trials
3. Exploratory trials
4. Site-specific trials
5. Researcher-managed regional trials: agronomic evaluation
6. Researcher-managed regional trials: socioeconomic evaluation
7. Farmer-managed trials
8. Initiating and managing FSR/E programs

An index of analytical techniques and other calculations presented in the book is very useful information to the reader.

The authors have synthesized and elaborated on the work of a team of agricultural and social scientists expert in farming systems research and extension (FSR/E). Anyone interested in and working with FSR/E programs, including System "B" personnel, will find the reading of this book to be a worthwhile endeavour.

Reference 15

Hildebrand, P.E. (1986) Perspectives on Farming Systems Research and Extension. Lynne Reinner Publishers. Boulder, Colorado

The reviewers have taken advantage of excerpts from the book's preface to very briefly describe its contents. These excerpts are indicated below in quotation:

"This collection of readings is designed to provide back-ground and historical perspective on farming systems research and extension. As the collection originated, it was much longer and contained both background and required readings for the farming systems research and extension methods course offered at the University of Florida. It was also used for short courses, approximately one week in length, taught under the auspices of the USAID-funded Farming Systems Support Project at the University of Florida and several other US campuses and foreign locations. In order to reduce the volume of reading required of the participants in these courses, the readings were reduced to a minimum set."

"It is difficult to put together a book of readings in a field that is developing as fast as is farming systems. Each year new basic readings appear that should be included. However, it was thought that a book of background readings would be useful to provide a perspective of the development of the approach. The majority of the articles appeared in the 1980s, although much of the information contained in them was developed during the 1970s, when farming systems began to gain momentum."

"Selections are taken from the biological, the social, and the economic sciences, as should be expected from an activity that requires multidisciplinary participation. Articles have been abbreviated or excerpted- in some cases only one or two key paragraphs are included. Some of the papers have been written specifically for this book."

The seven main chapter headings are:

1. Introduction
2. The small-scale family farm as a system
3. Economic characterization of small family-farm systems
4. Initial characterization of farming systems: comprehending and utilizing what we see and hear
5. Designing alternative solutions and improved practices
6. Technology development and continuing characterization
7. Organization for development

Each chapter has several to many sub-headings which contain articles written by different authors. There are 26 contributing authors.

The writings in the book are excellent background information for those associated with System "B" farming systems. The reading of the book is a must for anyone who is really seriously interested in Farming Systems Research and Extension.

Reference 16

Hogue, M.Z. (1984) Cropping Systems in Asia. On-Farm Research and Management. IRRI

The excellent foreword to this bulletin is quoted below since it briefly, but adequately, describes its contents.

"This publication presents the highlights of on-farm cropping systems research and development by the member country programs in the Asian Cropping Systems Network (ACSN) coordinated by the International Rice Research Institute (IRRI). It includes detailed data-based presentations and discussion of farmers' existing cropping systems and testing of improved cropping patterns and component technologies in eight well-defined agro-ecological environments. Also briefly described are the concepts, approaches, and methodologies developed and used by the ACSN scientists. The use of site-specific on- farm research findings in target area development is discussed with specific ACSN examples."

"This monograph highlights the impact cropping systems research and development have had on the agricultural research and production on small Asian farms and illustrates how ACSN scientists have used cropping systems research and development methodologies to improve existing cropping systems.

(Note: A few years ago the name of the Asian Cropping Systems Network was change to the Asian Farming Systems Network)

The chapter Readings are:

1. Intensive multiple cropping: the food formula for hungry Asia.
2. The Asian Cropping Systems Network.
3. The setting of cropping systems research in Asia.
4. Traditional cropping systems in Asia.
5. Design and testing of improved cropping systems.
6. Cropping systems research and area development.
7. The impact of cropping systems research on the small farms.

There are 14 pages of references cited.

Appendix I presents maps showing agro-ecological zones and locations of cropping systems research sites in nine Asian countries. (Bangladesh, Burma, India, Indonesia, Malaysia, Nepal, Philippines, Sri Lanka and Thailand).

Appendix II consists of 7 very interesting and useful tables.

Table 1. Descriptions of the six rainfall regimes used in the agro-ecological classification of South and Southeast Asia.

Table 2. Descriptions of the seven soil groupings used in the agro-ecological classification of South and Southeast Asia.

Table 3. Occurrence and extent of different agro-ecological zones in individual countries of south and Southeast Asia.

Table 4. Area under major non-rice grain crops in the countries participating in the Asia Cropping Systems Network.

Table 5. Area under major root and tubes crops in the countries participating in the Asian Cropping Systems Network.

Table 6. Area under major pulses and oil seed crops in the countries participating in the Asian Cropping Systems Network.

Table 7. Area under major industrial crops in the countries participating in the Asian Cropping Systems Network.

Also included in the bulletin are (1) an excellent 7 page glossary, (2) a list of botanical names, and (3) a list of acronyms.

This exhaustive treatment of cropping systems in Asia furnishes excellent background reading for the research and extension personnel of System "B". It should be referred to frequently. The numerous references cited are useful for additional reading of general and specific topics.

Reference 17

Hudgens, R.E., M.Z. Abedin and M.H. Khan. (1988) Homestead in FSR: Strategies and Experiences from Bangladesh. (Note: This paper was presented at the Eighth Annual Farming Systems Research/Extension Symposium at the University of Arkansas, Fayetteville, Arkansas, In October 1988)

This 23 page document includes 37 literature citations and three appendices. It is highlighted in the following statements which are quotations from the summary.

"FACTORS REQUIRED FOR FSR ON HOMESTEADS"

"If the Bangladesh experiences of incorporating the homestead into the realm of FSR can serve as a model for other countries, several activities must be undertaken. These include the following:"

"Justification of the Homestead Subsystem"

"Before a serious effort can be made to improve homestead production in any country, people must recognize the importance of homestead in family nutrition and income generation. Policy-makers must also recognize the opportunity that homestead development presents for improving the welfare of landless farmers and women in society. Until the homestead production unit is given equal status with other subsystems, only isolated token efforts at homestead improvement can be expected, and FSR will remain incomplete."

"Assignment of Institutional Responsibility"

"The first question to be addressed concerns the delegation of institutional responsibility. In the case of Bangladesh, no single member institution of the NCFSRP (National Coordinated Farming Systems Research Program) was equipped to fully staff a multidisciplinary "homestead task force." For this reason, national leadership was assigned to BARC (Bangladesh Agricultural Research Council), which was given responsibility for organizing a multi-institutional working group and conducting an annual "homestead improvement workshop." The first task of the homestead working group will be to develop a diagnostic survey questionnaire to be enumerated on homesteads at all FSR sites in the country. Subsequent data analysis and planning of recommendation domains will then be carried out by the working group. Annual national workshops on homestead development provide the mechanism for the exchange of information with other government and nonprofit, voluntary organizations."

"Development of a FSR Methodology for Homestead"

"The application of FSR methodology to the homestead requires that attention first be given to formulating recommendation domains through an analysis of agro-ecological and socioeconomic factors. In the process of this national diagnostic study, specific production constraints and major subsystem interactions can be identified. Initial problem prioritization by

recommendation domain is then possible. Once such baseline data is available, individual FSR teams can obtain more detailed information through special-purpose surveys, upon which work plans specifically directed to homestead improvement can be developed."

MARD intends to assist in homestead and home garden improvement. The following should be included in the goals of the MARD project.

1. To assist in the improvement of home gardens.
2. To increase food production of homesteads.
3. To provide replacement for or supplements to purchased food supplies.
4. To generate petty cash from sale of garden surpluses at certain times during the year.
5. To encourage reciprocal exchanges of surplus fruits and vegetables.

In considering the homestead and the home garden the gender issues in decision - making need to be analyzed. In System "B", are the wives the main decision - makers on the homestead? Does female labour account for the bulk of the labor in the homestead garden? These and many other questions need to be answered before MARD launches an all-out effort for homestead improvement.

In the Hudgens et´al article the system interactions are considered and, for Bangladesh, the following two-way interactions are discussed.

1. Crop x livestock
2. Vegetable x forestry
3. Livestock x forestry
4. Vegetable x livestock
5. Fishery x livestock
6. Fishery x vegetable
7. Homestead and resource base x forestry
8. HRB x vegetable
9. HRB x livestock

In System "B" the various interactions of sub-systems need to be identified and analyzed so that they can be appropriately considered in designing approaches to homestead improvement

What should be the FSR strategies for homestead improvement in Sri Lanka? Should a multi-institutional working group for homesteads be organized? What homestead activities are already receiving attention in System "B"? What activities are being ignored? What are the various constraints of the homesteads? What are approaches for overcoming these constraints? The Hudgens article should be of help in the assessment of the many variables associated with the homestead.

Reference 18

IRRI.(1984) Introduction to Cropping Systems. CS-01. Cropping Systems Training Series. March 1984

An Introduction to Cropping Systems is one series of modular instructional packages designed for use in rice-based cropping systems research training at the International Rice Institute. Modules in the series cover:

- site selection,
- site description,
- improved cropping systems design,
- cropping systems testing,
- pre-production evaluation,
- production program,
- component technology development and evaluation,
- environmental complexes, resource base, and present cropping systems, and
- agro-economic monitoring.

An Introduction to Cropping Systems is an overview of cropping systems. The instructional package consists of a slide set, audio tape, and an illustrated booklet.

The module is designed for individual instruction. A self test provides the trainee with a means to determine if he/she has mastered the subject matter. A glossary is included to help in the understanding of unfamiliar terms. The reference should be used for further study.

This module has been used in many countries, especially Asian continues, as well as in the various training courses at IRRI. It emphasizes the bottom up research approach; research conducted on the farm. In bottom up research, the objective is to integrate the art of the farmers with the science of the researchers. It also emphasizes the multidisciplinary approach. This module supplements the information presented by Zanstra, et.al in the widely distributed and well read IRRI bulletin on Cropping Systems Research, published in 1981 and reviewed in this "Lessons Learned Paper.

Reference 19

Jayasinghe, A. and D. W. Henderson (1989). Crop Diversification in Paddy Lands during Yala Season. A Deputy Director/Extension. Circular No. VYA/1/10/C/MISC Department of Agriculture, Peradeniya

This is a circular addressed to all Provincial Directors of Agriculture on the subject of crop diversification in paddy lands. Technical matters relevant to crop diversification are dealt with in three annexes as follows:-

Annex 1: Crop Diversification in Paddy Lands during Yala Season - by A. Jayasinghe - Agricultural Officer

Annex 2: On-Farm Water Management - Irrigated Crops - by D. W. Henderson - Consultant

Annex 3: Irrigating Other Field Crops - by D. W. Henderson - Consultant

Annex 1 deals briefly with the following topics: extension, farmer organization, credit marketing and transport, coordination with other agencies, economics of diversification, crop rooting depths, irrigation methods, water management and adoption of different cropping systems.

Annex 2 deals with water conservation, Yield and the amount of water for the season, on-farm water requirements, water flow rates etc; irrigation methods, depth of irrigation, frequency of irrigation, surface drainage and sub-surface drainage.

Annex 3 deals with farm layout for irrigation OFC, and the method of filling the basins.

Relevance of above document to MARD

The guidelines given in the Annexes in the above document, especially those relating to water management and irrigation, can be adopted/adapted in the OFT program being implemented under MARD.

Reference 20

Jayawardena, S.N. and M. Sikurajapathy.(1988) Cropping Systems for Mahaweli "H" Area. Agricultural Research Station, Maha Illuppallama. February 1988

This 25 page mimeo reviews the status of cropping pattern studies in System "H" since 1980, discusses the advantages in deciding the cultivation of crops on the basis of a cropping pattern and indicates the cropping patterns (two crop patterns, three crop patterns, intercropping, relay cropping and rice-legume patterns under rainfed conditions). Essential information on management of 11 intercrop combinations considered suitable in System "H" is presented. Yield and gross returns are estimated. Detailed information (including soil type, crop species, variety, number of days to reach maturity, planting date, harvesting date and yield) is given for seven cropping patterns.

This bulletin was very useful in initiating the on-farm trails for System "B" and will continue to be of use as the various cropping patterns are developed for the System.

Reference 21

Morris, Richard A.(1988) End of Tour Report. DARP, Department of Agriculture. (This report covers Dr. Morris activities during his 2 year long-term assignment, Septemoer 1986 - August 1988)

Morris, R.A. (1988) End of Tour Report - DARP, Department of Agriculture. (This report covers Dr. Morris' activities during his two year long-term assignment, September 1986-August 1988.)

This report is in three parts; Part I discusses the author's rationale for selecting the activities in which he participated, while Part 3 deals with matters relating to strengthening the research capability of the Department of Agriculture. Part 2 reviews research with OFCs some useful results of which are summarized below:-

1. A review of National Coordinated Yield Trials (NCYT) and other data from RARC/A revealed that cowpea and greengram are well adapted to both Maha and Yala seasons, but soyabean was better adapted to Maha than to Yala.

2. An analysis of several experiments on density and row spacing from Aralaganwila and other stations showed that the yield of green gram, black gram and cowpea was not sensitive to density and geometry except at the extremes of the ranges tested.

3. Response of cowpea and green gram to applied N, P205 and K20 is low. Response to N is low due to abundant nodulation observed in farmer's fields. In the case of P205 and K20, the levels available in the soils of System "B", though low, are adequate to meet the requirements of these crops. Soyabean responded to N application because the appropriate rhizobia are not present in System "B" soils. Hence inoculation is important in soyabean production in System "B" in addition to N fertilizer.

4. Yield reduction due to wind was observed in the chillie crops, even under irrigated conditions. Wind breaks are therefore essential for certain crops in the Yala season.

5. A fertilizer trial with maize at Aralaganwila showed no response to P and K, while that to N plateaued at 4.6 Mt/ha. N efficiency, however, was reasonable (24 kg grains/kg N applied). The 4.6 mt/ha plateau was evidence that yield was limited by a factor other than NPK.

6. Weed competition was the main contributor to low yield in sesame. Apart from weed control, sesame appears to need no other crop care. During the Yala season water is probably the key to sesame yields.

7. In legume/non-legume intercropping systems the density of the non-legume dominant crop should be kept low, if the intention is to exploit the N fixing advantage of the legume crop.

Factors other than shading can be important in intercropping, for example, a chillie-cowpea mixture exhibited mutual inhibition with Land Equivalent Ratios (LER) consistently below 1.0, and chillie yield affected more adversely.

8. Fertilizer trials particularly with P&K should be undertaken not in relation merely to crop response, but in broader terms of soil types, residual effects, and national costs. Such studies if systematized and expanded will permit soil scientists to state with greater certainty the best fertilizer practice for any given situation.

9. FSR/E is appropriate for the following:

   a. The introduction of new technology, for example, alley cropping.

   b. The identification of causes of low yields and profits and the evolution of solutions to overcome these causes.

Part 3, Further Consideration for Strengthening Research Capability, is summarized below:

1. Research on the Physical Environment

   - Genetically improved SFCs/OFCs are needed for areas above irrigation command.

   - Aspects of the physical environment must be addressed, especially those related to rainfall runoff, erosion and in infiltration.

   - More detailed rainfall data and soil classification are needed.

2. Microcomputers

Microcomputers will eventually find their way to regional research centers where they will be used for statistical and economic analysis, report writing and other functions useful to SFC/OFC research.

3. Reporting and Accountability

   - Expenditures for research must be accounted for and ultimate accountability is reckoned as impact on production, food and fibre prices, rural incomes, national nutrition, and so forth.

   - Research reports are a record of how resources have been used and how they can be examined for quantity, quality and relevance to a station's, a divisions or an officer's mandates. Reports are vehicles for transmitting information to others.

   - There seems to be little incentive to report outside the twice yearly station requirements.

- Publication and dissemination of reports will create pressure on research officers to improve research standards. Critical (anonymous) peer reviews of manuscripts will foster critical thinking and better writing skills. The DOA should provide training opportunities in writing and supportive editing services if more reporting demands are to be placed on them.

Reference 22

Morris R.A. (1989) End of Tour Report. DARP, Department of Agriculture, February - April 1989

Activities are discussed in four sections: (1) data analysis and interpretation, (2) effective rainfall for Southern Dry Zone Agriculture, (3) long-term phosphorus fertilizer management, and (4) phosphorus cycling in alley cropping systems.

1. Very interesting results were obtained from data analysis of N fertilizer responses by onions. When control yields were 18 t/na, responses were low, reaching only 2-4 t/ha. When control yields were about 10 t/ha, responses were 5 to 8 t/ha and still increasing over the N range tested. The highest response was 58 kg onion/1 kg N applied. These data suggest that N supplies in farmers' fields are quite variable and furthermore, yields are responsive to N, whether from soil or fertilizer.

2. For the effective rainfall studies, emphasis is placed on measurements of soil water changes. However, effects on crop growth and yield are also being determined.

3. Phosphorus availabilities of Sri Lanka soils are strongly influenced by post P management. For soils low in P there is significant response. For soils that have received moderate to high applications there is no response. Continued P application represents an economic loss when the crop does not respond to it, whereas if P is not applied to a crop that is P deficient, an opportunity to increase profits is lost. Determining P fertilizer recommendations is not straight forward. Computer models are being used to aid in long-term P fertilizer management decisions.

4. Large quantities of P are removed by leguminous trees used for alley cropping which are frequently "lopped" to furnish nitrogen for annual intercrops. Experiments have been designed to investigate the effect of P cycling by legume species such as Gliricidia sepium. Highly available and poorly available P fertilizer are being used in the trials.

Miscellaneous - Dr. Morris observed, at Bandarawela, several Indonesian garlic cultivars being compared to a local cultivar. Three Indonesian cultivars were superior to the local check. The international market acceptance of these cultivars should be determined before much more effort is put on cultural management research. Furthermore, lowland garlic varieties from southeast Asia (especially the Philippines) should be evaluated in System "B".

The MARD project should follow-up on the garlic studies and test Indonesian and Philippine garlic varieties in System "B".

Reference 23

Morris, Richard A. (1988) Technical Notes

1. Fertilizer Management for Crop Sequences

This report has 51 selected references, 9 useful tables and 19 well-illustrated figures. The author discusses inorganic N, inorganic P, inorganic K, organic amendments (farmyard manure, straw, compost and green manure), and integrated use of organic and inorganic amendments.

The CONCLUSIONS are quoted as presented in the report.

Nitrogen

"For either rice or other field crops grown in sequence with rice, direct immediate residual benefits, from N applied to the preceding crop, are seldom significant. Where vegetable crops have received high N rates, however, the subsequent rice crop may benefit from residual N fertilizer or from N-rich crop residues."

"Long-term N balance studies show that where inorganic N is applied, soil N may increase or decrease depending on N rate, crops in the sequence, water management, and probably soil and climatic factors. Legumes exert a less negative effect than cereals on the N balance of a rice-based sequence. If the legume is incorporated as a green manure, effects will be positive. Rice grain yield responses to 30- to 50-day-old fast-growing annual legumes incorporated as green manures before wet season rice are as high as 2 t/ha."

"Because NO3- accumulates during fallow periods, yields from low or intermediate N rates applied to cereals can be obtained by delayed inorganic N applications timed to coincide with the period of greatest N uptake. This strategy is conditional upon inorganic N reaching the active root zone, either by placement or transport by infiltrating rain or irrigation water, and assumes that soil N will be adequate to satisfy the early crop demands."

Phosphorus

"Chemical transformations increase P availability during rice cultivation. Therefore, critical soil test P levels determined by common procedures are usually lower for rice than for other crops. On soils where P is required for rice and a crop grown in sequence with rice, residual P from an application only to the latter will generally meet the requirement for rice. However, where rice yields are high, and therefore the P requirement for rice is high, this generalization may not be applicable."

Potassium

"With respect to K fertility, two factors peculiar to rice-based sequences may be important. (1) Flooding increases the K concentration in soil solution because exchangeable K^+ is displaced by accumulations of NH^{4+} and Fe^{2+}. (2) Whereas subsoil K contributes to aerobically grown crops, it probably does not to rice because its roots are concentrated in the surface 25 cm. There is little evidence of residual response by the following crop to inorganic K applied to either rice or the crop grown in sequence with rice. Residues of most crops contain a large fraction of the K accumulated by the crop, thereby contributing to the slow rate of soil K depletion. Where crops are grown in sequence with rice, those with high K requirements, such as maize, white and sweet potatoes, and tomato, will warrant preference for inorganic K applications."

Organic Amendments and Integrated Fertilizer Management

"Crop residues, FYM, compost, and GM contribute variable amounts of N, P, K, and other nutrients to rice-based sequences, but these sources alone are seldom sufficient to maintain high yields in crops in intensive sequences. This is specially true for N, a nutrient that is lost from the system by denitrification, leaching and volatilization as well as by crop removal. Empirical studies on a limited range of soils in warm climates suggest that organic amendments are most effective if incorporated before rice because anaerobic decomposition is rapid. In sub tropical and temperate climates, incorporation before upland crops in the rotation is reported most effective. The contrasting findings under the two climates appear to result from differences in the accumulation patterns of anaerobic decomposition products toxic to rice plants."

The results of these fertilizer trials should assist in designing and conducting fertilizer trials in System "B" and in the interpretation of the results. Fertilizer trials will need to continue to be conducted on the RARC as well as on the farm. Soil test analysis are vital to such trials. One of the goals of MARD is to assist RARC in setting up a Soil Testing Laboratory.

2. Factors Affecting Cropping Systems.

Morris defines cropping system as the mix of crop production enterprises used by farmers to derive benefits from a given resource base under specific environmental conditions. The reasons for cropping pattern changes can be categorized as follows:

a. **Socio-Economic Factors**

Attributes of farmer resources -

Farm size
Labour force
Cash availability and capital position
Power availability and degree of mechanization

Land fragmentation
Management ability
Storage facilities

Attributes of Community Resources

Product markets
Input markets
Roads and means of haulage (including suitable vehicles)
Information dissemination (advances in agricultural technology and agricultural prices)
Credit institutions
Commodity price distributions over the year
Storage facilities

b. **Biotic factors**

Insect-distribution over the year (pest-predator-parasite-alternate host relationships)

Weeds-distribution in relation to landscape (soil and water) factors, effect of season and of previous crop.

Nematodes-distribution in relation to landscape factors, effect of previous crop.

Disease-distribution over the year, alternate hosts, means of dissemination (airborne; soil borne, seed borne, cutting borne).

c. **Physical Factors**

Climate-rainfall, solar radiation, temperature, storms (wind, hail, and flood effects)

Land-soil fertility and soil physical characteristics which influence soil productivity, features which affect water regimes (landform, slope, texture), features that affect the adoption of modern technology (soil texture, water regime, slope).
As we characterize the factors we must be ready to recognize average conditions and the variability in those conditions.

To evaluate alternative management technologies, we must take these factors into account.

Adequate consideration of these many factors in designing, conducting, monitoring and evaluating cropping/farming systems activities is a must for System "B" research and extension personnel.

Crop Management Technology for a Cropping System

Crop management technology for a cropping pattern can be placed into 10 general groups.

1. Variety selection
2. Method of tillage
3. Method, rate, spacing of planting
4. Fertilizer management
5. Weed control
6. Insect control methods
7. Disease control methods
8. Water management (including land bedding methods)
9. Harvest methods
10. Threshing and/or cleaning method

In the MEA/DOA/MARD on-farm trials most of the above categories must be considered for all crops. It must be remembered that decisions about many categories cannot be made without considering other categories, that residual effects may be carried to a subsequent crop and that decisions on some of the management variables must be made many months in advance of implementation.

When deciding on what crop management technology research to conduct and the final recommendation to be made once the research has been completed, four questions should be kept in mind:

1. What are the costs of alternative methods?

2. What are the expected benefits from the alternative methods?

3. How is the production risk factor changed by each alternative?

4. Can the farmer cope with requirements of the technology? (Does he have the resources at his disposal? Does he have the management ability to use those resources reasonably efficiently?)

The Importance of Site Description for Research Program Development

Research programs should be well focused and as the testing phases of research are completed we must be able to describe the conditions under which our improved technologies perform satisfactorily.

The author discusses choice of crops, choice of production technology, stratification and extrapolation as they influence site selection and site description.

System "B" researchers will do well to review, time and again, papers such as this one as they select and describe farming systems sites.

5. Introduction to On-Farm Research Methods

The author discusses the components of cropping systems research as needed at a CS site. The six research phases are the same as those in an FSR/E project (see also the reference by Zanstra, Price, Litsinger and Morris).

1. Selection of extrapolation area
2. Site description
3. Design
4. Testing of crops and management technology
5. Applied research and pre-production testing
6. Production programs

The staffing, organization and the research program plan of CS sites are also discussed. The importance of the farmer and his environment is emphasized. The farmer and his field becomes an experimental unit from which research interpretations are derived.

Reference 24

Mutsaers, H.J.W., N.M. Fisher, W.O. Vogel and M.C. Palada (1986) A Field Guide for On-Farm Research. Farming Systems Program, IITA

This volume of On-Farm Research Guidelines contains practical guidelines for conducting exploratory surveys, collection and analysis of physical and socio-economic data, identification of OFR sites and design of on-farm trials. It is based on the efforts of scientists at IITA's Farming Systems Program who have cooperated, for several years with their colleagues in national agricultural institutions in West and Central Africa to develop viable on-farm research strategies and approaches that are relevant to their conditions.

The titles of the five chapters and brief summary statements are indicated below. Annex 1 is a "Review of basic economic principles" and Annex 2 discusses "Some statistical techniques". The document includes 37 selected references, 42 tables and 34 figures.

The book is and will be of help to MEA, DOA, and MARD in implementing on-farm activities.

Chapter I - On-Farm Research: Objectives and Concepts

OFR Embraces:

- o choice of the research area
- o initial collection of data through the study of existing sources and exploratory surveys
- o choice of design of innovations for testing
- o On-farm testing and evaluation, including monitoring of adoption, and
- o special studies

Chapter II - The OFR Team and the Research Area

- o OFR is a team activity that can be effective only if it is continual
- o An OFR team should be an integral part of a research institution
- o An institute that opts for an OFR program must be willing to assign a core team of scientists to the task
- o The OFR team should comprise scientists, field assistants and extension agents
- o The team, by the nature of its work, enters the territory that has traditionally been that of the extension service

- The area covered by the field team must be manageable and representative of a larger area

- The selected target area should reflect (a) the research institute's mandate, (b) the government's development priorities and (c) a single or homogeneous ecological zone

- Choose a pilot area that (a) incorporates all the micro-variability of the target area, (b) is manageable during the testing phase, and (c) is close enough to the research station so that the scientists can visit frequently to monitor the on-farm tests.

Chapter III - The Collection of Initial Information on the Research Area.

Data Collection is Done in Two Phases:

- An analysis of the existing base data, and
- An exploratory survey

For Base Data, Search:

- Meteorology records
- Soil maps, relief maps
- Publications of the national statistical bureau
- Regional project reports
- Local government offices
- University student's village studies and
- Written or verbal information from extension services, agro-service centers, etc.

Exploratory Survey:

- Is a critical phase in OFR and all the team members participate
- Provides understanding of the system, its constraints and potentials
- Combines field observations and farmer interviews

The Survey Team should Comprise:

- The core team of scientists and other disciplines
- Field assistants
- Local extension agents
- A "critical outsider" from a national or international institute. Analysis of farmer's conditions. Immediately after the survey, analyze the findings in a few roundup meetings and draft
- A typology of farms and field
- An analysis of constraints and opportunities

Chapter IV - Guidelines for the Description of the Pilot Research Area.

General Features of the Area:

- Location and size of the area, maps
- Administrative divisions
- Population, settlement pattern
- Ethnic groups, traditional hierarchy, and religions

The Physical and Biological Environment:

- Climate - potential evapotranspiration, rainfall, temperature;
- Vegetation
- Land, soil, and water

The Human Environment and the Physical Infrastructure:

- Economic environment
- Institutional environment and services
- Social environment
- Physical infrastructure

Farming Systems:

- Cropping patterns and land use
- Crop varieties
- Cropping operations and crop calendar
- Inputs and yields
- Crop disorders
- Post-harvest activities and consumption
- Livestock

Factors of Production:

- Land
- Capital, capital goods and capital formation
- Labour
- Management and information

Decision-making and Production Choices:

- Analysis of farmer's conditions
- Typology of farms and fields
- Constraints and opportunities

Chapter V - On-Farm Experimentation

Choice of Innovations:

- Addressing constraints and opportunities
- Choosing innovations for on-farm testing
- Quantification of some of the decision criteria

- Innovations for household activities other than cropping

Design of On-Farm Trials:

- Selection of treatments
- Types of on-farm trials
- Farmer involvement in on-farm trials

  1. Researcher-managed, researcher-executed
  2. Researcher-managed, farmer-executed
  3. Farmer-managed, farmer-executed

- The appropriate statistical design

Management, Monitoring, and Evaluation:

- Management of enumerators and trials
- Monitoring and evaluation
- Statistical analysis
- Economic analysis
- Farmer assessment

Reference 25

Mutsaers, H.J.W. (1989) Improving Farmers Maize Growing in Humid West Africa. IITA Research Briefs 1989 - P 2-3

On-farm testing was carried out in West Africa by the IITA to find appropriate low-input methods of improving the yields of food crops among which maize is predominant. As the most straight forward method of doing so, an improved variety of maize and a moderate fertilizer level were introduced to the farmers without however changing their usual management practices. This yield variability remained, however, indicating that other environmental factors overshadowed the benefits of the improved technology. Apart from shade, the factor most strongly harvest. Significant stand losses were caused by rodents, termites, and other pests and this was aggravated by poor field conditions and weed infestation. Stand losses can be compensated for by having high initial plant densities. Research is now being concentrated on factors causing severe stand losses in farmers' fields.

Relevance of Above Publication to MARD

This paper is an example of the effectiveness od using simple technologies for improving farming skills and yields. Similar approaches could be adopted where relevant by ATG&D of MARD.

Reference 26

Navarro L. A. (1987) End of Tour Report. September 1987. DARP Office-Peradeniya

The following points relevant to OFC emerge from the above report:

1. Sri Lanka has the potential to increase OFC production significantly even with presently available technology.

2. Primary factors influencing OFC production are: farm level for maize, soyabean, cowpea, groundnut, and grams.

4. Highest on-farm profits accrue from onion, red onion, and chillie, followed by potato and greengram.

5. Imports interfere with local production.

6. Marketing is the weakest link in the production and distribution systems for all OFC.

7. Farmers need guidance and support in their transition to market oriented production of OFC.

Relevance of Above Publication to MARD

This report highlights the importance of efficient dissemination and acceptance of technology at farm level and the need for guidance and support of farmers in their transition to market oriented production of OFC. These activities relate to the ATG&D and FSS divisions of MARD. Other issues raised in the report act as indicators for foundation of policy relating to marketing of OFC.

Reference 27

Norman, M.J.T. (1979) Annual Cropping Systems in the Tropics. University Presses of Florida

This textbook is the result of a graduate course in tropical farming systems which Dr. Norman first developed and offered at the University of Sydney, Australia, in 1971. The course was amplified, modified and refined and offered to graduate students in 1976 and again in 1977 while Dr. Norman was at the center for Tropical Agriculture, Institute of Food and Agricultural Sciences, University of Florida. The book is designed as an introduction to the subject and should be read by anyone seriously interested in farming systems. The geographical basis of the text is toward Africa and Asia.

A listing of the chapters of this textbook, of which there are 18, provides a summary of the many tropics that are discussed.

1. What is a Farming System?
2. General Hydrological Background
3. General Energetic Background
4. General Biogeochemical Background
5. General Socioeconomic Background
6. Shifting Cultivation Systems: General Aspects
7. Shifting Cultivation Systems: Biogeochemical Aspects
8. Shifting Cultivation Systems: Hydrological and Energetic Aspects
9. Semi-Intensive and Intensive Rainfed Annual Cropping Systems: General Aspects
10. Semi-Intensive and Intensive Rainfed Annual Cropping Systems: Energetic Aspects
11. Semi-Intensive and Intensive Rainfed Annual Cropping Systems: Biogeochemical Aspects
12. Semi-Intensive and Intensive Rainfed Annual Cropping Systems: Hydrological Aspects
13. Irrigated Annual Cropping Systems: General Aspects
14. Irrigated Annual Cropping Systems: Hydrological Aspects
15. Irrigated Annual Cropping Systems: Biogeochemical and Energetic Aspects
16. Mixed Systems of Annual and Perennial Crops
17. The Role Livestock in Annual Cropping Systems
18. Tropical Farming Systems Research

System "B" is in the tropics and is concerned primarily with annual crops. A reading of this book on "Annual cropping systems in the tropics" is suggested for all System "B" personnel associated with FSR/E.

Reference 28

Olsen, Farrel J. and Oval Myers, Jr. (1987) Adaptive Research Planning Team, Central Province, Zambia. Annual Reports 1985/86 and 1986/87. (Olsen and Myers are agronomist, Department of Plant and Soil Science, Southern Illinois University at Carbondale, Illinois).

The accomplishments of the Adaptative Research Planning Team (ARPT), Central Province, Zambia are detailed in the Annual Reports. The specific considerations of their farming systems/extension approach are summarized in a personnel letter written by Dr. Farrel J. Olsen in April 1989. Dr. Olsen served as the agronomist on the project during the last 2 1/2 years. The duration of the project was 5 years. A portion of Dr. Olsen's letter is quoted.

"We were stationed at the Kabwe Regional Research Station where we conducted the more complex agronomic experiments before moving to on-farm agronomic trials. We also tapped other experiment stations throughout the country for research results which might be suitable for moving to on-farm agronomic trials."

"We followed the farming systems research/extension approach in the development of appropriate technologies. Unfortunately, this process does take time and funding agencies often expect immediate results. By the time our project ended, technologies were starting to come forth on a fairly regular basis."

"We conducted on-farm agronomic trials on about 45 sites per year involving a number of different crops and experiments. The on-farm trials were kept fairly simple, generally not involving more that five or six treatments as well as the farmers' normal practice. The inputs (seed, fertilizer, chemical) were provided by the project, however, we did not compensate the farmers if they lost all or part of their crop. The participating farmers were carefully selected in cooperation with the extension workers. We were working with the traditional and small-scale farmers, most with very limited resources."

"One of the problems we faced was getting the on-farm trials planted in a timely manner. We were working in three different recommendation domains but had a trial assistant, in each of the areas, supplied through extension. I would assist the trial assistant in planting at least two sites of each type of experiment and then let him continue on while I worked in another area doing the same thing."

"We monitored the trials carefully during the growing season and kept close contact with each of the participating farmers. Rainfall data were also kept in each of the areas we worked."

"The contact farmers assisted with the land preparation, planting, weeding and harvesting. Extra care was needed at harvest time because farmers often got anxious to harvest before we could arrive to obtain yield data. It was a real challenge to keep the farmers from harvesting before we could get around to his or her farm."

"The technologies that looked promising in on-farm trials, based on agronomic and economic analysis, were extended to the on-farm test demonstration phase. Whereas, the on-farm-agronomic trials generally involved about a half dozen treatments or more replicated about two times per farm on small plots, the on-farm test demonstration phase, conducted by the extension people, usually involved one treatment compared to the farmers method put out more on a larger scale (1/4-1/2 acre in size) on a number of farms under farmer management."

"During the last few years of the Zamare Project we utilized the "Community Perspective" approach. We concentrated our trials and demonstrations within different communities (that is within walking distance of each other) which facilitated conducting the trials, interaction among participating farmers and in carrying out fields days."

"Each year we conducted field days on the trials and demonstrations. These were very successful and were a means of introducing new technologies. The field days were carried out by the extension workers in the local vernacular. As about 1/3 of our farm households were headed by women, we found it useful to conduct separate field days for women."

"Before a technology was passed on to the farmers it had to be approved by the Provincial Steering Committee. This committee was composed of a number of different entities including the Provincial Agricultural Officer, Crop Husbandry Officer, Marketing Agencies, ARPT etc. Not only did the Steering Committee evaluate the data from thee trials and demonstrations, they also made sure the necessary inputs for a new technology would be readily available to the farmers concerned before the technology was approved."

"The research-extension liason officer (one member of our team) instituted a bi-monthly newsletter that went out to all extension workers within the province. He also was responsible for assisting in their training and workshops and coordinating the field day activities and the test-demonstrations."

"Although many problems were identified through informal and formal surveys, before the project ended, farmers were directing problems to extension workers who in turn were passing them on to the ARPT."

"One of our major problems was transportation. The project involved a lot of travel and thus keeping vehicles and motorcycles operating posed a real challenge, especially when it was necessary to procure spare parts outside of the country."

"In regards to experimental designs used in on-farm agronomic trials, the randomized complete block design was used most often with 2 reps/site and usually 6 or more sites per farming system. Data was combined over sites. The RCBD was often used in a factorial arrangement."

"Anotner problem encountered in on-farm agronomic trials was selecting a suitable site. With small fields, tree stumps, shade from trees, termite mounds, soil erosion etc. careful selection of sites was necessary. At times sites were rejected for one reason or another."

There is a great deal of good information in the two annual reports and in Dr. Olsen's letter which will continue to be referred to by those conducting on-farm trials in System "B".

Reference 29

Plusquellec, Herve.(1987) Crop Diversification in Irrigated Agriculture: Water Management Constraints. Sustainability Issues in Agricultural Development. World Bank Seventh Agricultural Sector Symposium, January 8-9, 1987

As the title indicates this paper deals with water management constraints and a review of the paper might also be included in the "lessons learned" review of the MARD Water Management component. However, since the paper discusses water management in relation to crop diversification, which is so important to System "B", it is also included in this ATG and D review. It is suggested reading for all MEA, DOA, and MARD agronomists.

The introductory and summary sections of this paper are quoted verbatim.

"Besides marketing considerations diversification from rice paddy to non-paddy crops (also called upland crops) in irrigated agriculture is constrained by several physical and institutional factors such as soils, farmer's experience, credit, extension services and irrigation facilities. This paper deals only with the physical constraints imposed by the irrigation system both at the distribution level and farm level. The issue of crop diversification will be also limited to surface irrigation which is the predominant method used for more than 90 percent of the 275 million ha currently irrigated in the world. Indeed in the vast areas of lands irrigated in Asia, surface irrigation methods are used almost exclusively for both paddy and upland crops. The scope for pressurized irrigation will remain limited to very high value crops in specific areas. Conversion to drip and sprinkler methods will progress slowly and where it will take place, diversification to non paddy crops will be irreversible. In sum, surface irrigation will remain dominant in the foreseeable future."

"This paper reviews first the different water requirements of paddy and upland crops and reviews the general technical features of the two dominant surface irrigation methods, basin and furrow irrigation used in developing countries. Then the paper discusses the issue of improving irrigation facilities to make possible the shift from paddy cultivation to other crops and/or the adoption of mixed cropping. This review is limited to the aspects relevant to crop diversification and does not pretend to fully cover the above subjects even in a condensed form."

Summary

"The precise water control needed for diversified field crops requires in general extension of the tertiary networks, improvement and modernization of the main and distribution system, and in some areas improvement of the drainage and flood conditions."

"The issue of improvement/modernization of irrigation systems to permit crop diversification has been complicated by the sharp drop in projection rice prices that occurred since 1982. The 1990 rice price projections dropped from about US $600 in 1982 to US $339 in 1984/85 and recently below US $250. Most

of the rice irrigation projects were viable in the early 80s including those for which all the infrastructure from storage or diversion works down to the on-farm water delivery works have to be built. Under the 1984/85 economic conditions, the viable investments in rice projects were those taking advantage of sunk costs in existing infrastructure."

"In the case of Thailand a fast method for screening viability of projects was developed for the Irrigation Sub-sector Review issued in April 1986. It was found that development of the tertiary system at a low cost of US $600/ha (excluding land levelling and land consolidation) is viable with only a modest paddy yield increase of 0.5 ton/ha in each season assuming a cropping intensity of 150%. To justify the investment required for an intensive tertiary system including land levelling (US $1,000/ha) a yield increase of at least 0.8 ton/ha for each season should be achieved. With the most recent price projections, a detailed analysis of each project would be needed because of the sensitivity of the rate of return at these low rice prices. Investments required to improve the tertiary system together with improvement of the distribution system may no longer be justified unless there is a substantial increase in yields (above 1 ton per ha) and/or an increase in cropping intensity by making use of the water saved through more efficient operation. The conclusion is that in a number of cases the improvement of irrigation systems at both the tertiary and distribution level may not be economically justified for increasing rice production alone, without diversification to higher value crops. The investments required for crop diversification would have to be undertaken only when there is sufficient indication that all the other preconditions for crop diversification are met: market, marketing facilities, extension services, etc. The same conclusion may be valid for other rice surplus countries."

Reference 30

Reidinger, Richard.(1987) Diversification from Rice. Sustainability Issues in Agricultural Development. World Bank Seventh Agricultural Sector Symposium. January 8-9, 1987

As indicated, the focus here is on irrigation system requirements for diversification, not agronomic. As in the case for some of the other articles, this is more a water management paper than agronomic but the two subjects cannot be separated when crop diversification is the subject. Additionally, the issues considered here are also those for farmer organizations.

The introductory and recommendation statements are excellently and briefly expressed and are quoted in their entirety. The topic discussed is of interest and concern to system personnel, whether agronomists, engineers, farmer organizers or marketing specialists.

"This paper examines the topic "diversification from rice" from the perspective of irrigated areas in the humid tropics of Asia. A major question in these areas is whether irrigation systems designed for wet season rice can support crops other than rice in the dry season. To simplify the topic, the focus here is on irrigation system requirements for diversification, not agronomics. Only selected field crops which have established markets and are already grown under irrigation on a small scale in the dry season are considered, such as soybeans, groundnut, and mung beans. In addition, diversification is viewed here as a process resulting from farmer response to changing relative crop prices and profits, not as a government policy objective. As much as possible, irrigation systems should not constrain that process. Two Bank experiences with the topic are summarized: first, in Eastern India at the micro level; and second, in Thailand at the macro or sectoral level."

Lessons Learned

1. "The water Management Pilot Project (WMPP) in Orissa, India indicates several lessons for adopting traditional rice irrigation systems for diversification. First, it is not enough to change "software" or management only, in this case by introducing Rotational Water Supply (RWS) or warabundi. Operational possibilities depend on "hardware" or infrastructure. Second, changing hardware at only one level in the system may not be enough. With WMPP, it was necessary to move from the farm level progressively upstream in the system with selected improvements. Although the total cost may not be high, the solution is complicated, and there is no single "quick-fix." It is a system problem. And third, in planning improvements, it is essential to consider operational requirements ahead of time. Hardware improvement should be as "user friendly" as possible, and farmers should commit to cooperate together and participate in operations. Planning should also assess operating costs after improvement and whether they fit within realistic Government budget constraints."

2. "The Thailand Irrigation Sub-sector Reviews (TISR's) lessons for diversification are that it is important to: (a) be realistic; and (b) plan for uncertainty. Existing irrigation systems in Thailand, and perhaps in other predominantly rice areas as well, were sited and designed for rice. We cannot expect those systems to shift out of rice without substantial time and investment, and markets may shift back in favour of rice. We need to plan for uncertainty through investments which maximize flexibility to meet changing conditions, increase main system water control, and enable better operation. In addition where diversification pays, as around Bangkok, the private sector has shown it will invest on its own. Public irrigation systems need to provide the quality of service required to support such investment, not supplant it."

Reference 31

Ruthenberg H. (1980) Farming Systems in the Tropics. Oxford: Clarendon Press

Ruthenberg's book runs into several editions since its first appearance in 1971, and is now a basic text on the subject of farming systems. It introduces a systems approach to farms and provides a framework into which various types of farming accountered in agricultural management data supporting the text is presented in a manner that provides a methodology for economic analysis of smallholder farms.

Ruthenberg identifies seven basic farming systems as follows;

1. Shifting cultivation
2. Fallows
3. Ley and dairy systems
4. Permanent upland cultivation
5. Arable irrigation farming
6. Systems with perennial crops
7. Grazing systems

Each of the above and their sub-systems, if any, are defined, their characteristics and problems described, and the development pathways employing each are examined.

The book has two supplementary chapters as follows:

1. "Methods to identify and evaluate improved Cropping Systems" by H. H. Zandstra.

2. "Farming Systems Research in the context of Agricultural Research Organization" by M. P. Collinson.

Relevance of above publication to MARD

This is a basic text book which could be referred to from time to time during the analysis and interpretation of agronomic data collected by MARD.

Reference 32

Shaner, W.W., P.F. Philip and W.R.Schmehl. (1982) Farming Systems Research and Development. Guidelines for Developing Countries. Westview Press, Boulder, Colorado

These guidelines represent a tremendous effort to bring together the many factors which need to be considered in farming systems and development programs. The preface to the guidelines very vividly traces the history of agricultural development in developing countries and how it all led to a Farming Systems approach. It also indicates how these particular authors (Shaner, Philip and Schmehl) came about writing the guidelines. Excerpts from the preface are quoted below.

"In recent years policy makers have been paying more attention to the problems of small farmers in developing countries with the idea of increasing their production and standard of living. The policy markers' objectives are twofold: (1) help those whose welfare is materially below the rest of society, and (2) to help a country increase its agricultural production. With adequate agricultural policies, these two objectives are mutually reinforcing."

"By focusing on these two objectives, leaders in developing countries work towards other national objectives. For example, increasing production on small farms may (1) improve a nation's self-sufficiency in food production, (2) supply more raw materials for industry, and (3) improve the nation's foreign exchange position. Improving small farmers' production should narrow the range of incomes among groups in the country, reduce political instability, slow rural-to-urban migration, lessen the need for food relief, and so on."

In developing countries, farmers with limited resources often do not adopt new technologies because (1) their conditions are not like those where the technologies were developed, (2) they do not have resources to purchase the required inputs, (3) the technologies do not apply to the crops grown or the livestock raised on their farms or the way they operate, or (4) they do not know about the new technologies. For whatever reason, development of new technologies sometimes leaves small farmers worse off then before. This happens when large farmers adopt new technologies and small farmers do not."

"But conditions are changing. Recently, more national and international research organizations are directing their attention to the conditions and problems of small farmers. As a result, small farmers and their environments are better understood, more research is applies to solving small farmers' problems; and the extension service works with better technologies. An approach now being applied more widely to make research relevant for small farmers is called Farming Systems Research and Development (FSR/D) or sometimes simply FSR."

"With more countries interested in FSR/D, the United States Agency for International Development (USAID) contracted with the Consortium for International Development (CID) to write a set of guidelines on FSR&D methodology. CID made Colorado State University (CSU) the lead University,

entered into agreements with other CID schools, and subcontracted part of the work to the University of Hawaii."

"The result is this set of guidelines for those in the developing countries who wish to learn about FSR/D and who might apply the procedures. This book will require updating as more is learned and better procedures become available."

"The guidelines discuss the nature of FSR/D, processes and methodologies appropriate for various conditions, and alternative means for implementation. Because most of the applied work in FSR&D has been with cropping systems, this book of guidelines emphasizes cropping systems research. By synthesizing implemented and successful approaches, these guidelines have a strongly applied orientation"

The chapter headings of this 414 page document are:

1. Executive summary
2. Introduction
3. Conceptual framework
4. Target and research area selection
5. Problem identification and development of a research base
6. Planning on-farm research
7. On-farm research and analysis
8. Extension of results
9. Deciding on an FSR/D approach
10. Implementation
11. Training

References are cited at the end of each chapter. There are from 1 to 26 appendices for each chapter with a total of 61 appendices. Reference are also cited in the appendices. The appendices present detailed examples of producers described in the text, covering a variety of countries with different cropping and livestock systems, environmental conditions, and research and development capabilities.

These guidelines contain a wealth of information and should be most helpful to System "B" research and extension personnel. Frequent reference to the guidelines is encouraged.

Reference 33

Shaner W.W., P.F. Philip, and W.R.Schmehl. (1982) Readings in Farming Systems Research and Development. Westview Press, Boulder, Colorado

The well-written preface to this book gives an excellent review of the reasons for writing the books and the general nature of the book. Much of the preface is quoted in the following three paragraphs.

"In October 1978, the United State Agency for international Development contracted with the consortium for International Development (CID) to prepare a set of guidelines on farming systems research and development (FSR/D). In carrying out the contract, CID gave Colorado State University (CSU) lead responsibility and subcontracted portions of the work to the guidelines --

Farming Systems Research and Development: Guidelines for Developing Countries -- was written primarily for research and development institutions in the developing countries. Another product of that contract is this book of readings on FSR/D."

"In researching the materials for our book of guidelines, we found that some scientists had conducted considerable research in FSR/D -- primarily in cropping systems -- and a few development groups had been successful in implementing the approach. However, much of this work was scattered throughout the world and published results had not been widely distributed. Consequently, one of our project team's first tasks was to contact institutions and individuals who were working in FSR/D or related areas. This initial reconnaissance culminated in a workshop in FSR/D held at CSU August 1-4, 1979. Some of the world's leading practitioners in FSR/D participated in this workshop."

"These papers are but a sample of the contributors' writing on FSR/D. Nevertheless, they convey themes that run through many of their other writings."

A listing of the selected readings and authors is as follows:

1. Farming System Development in a Resource-Limiting Environment
   Richard R. Harwood.

2. A General Overview of Farming Systems Research
   D. W. Norman and Elon Gilbert.

3. Aiming Agricultural Research at the Needs of Farmers
   Donald Winkelmann and Edgardo Moscardi

4. An Ecological Systems Conceptual Framework for Agricultural Research and Development
   Robert D. Hart

5. One Farm System in Honduras: A Case Study in Farm Systems Research
   Robert D. Hart

6. A Cropping Systems Research Methodology for Agricultural Development Projects
   Hubert G. Zandstra

7. Motivating Small Farmers to Accept Change
   Peter E. Hildebrand

8. Indonesian Cropping Systems Program
   Jerry L. McIntosh

9. Farming Systems Research at ICRISAT
   B. A. Krantz

10. Farming Systems Concepts Arising from the TAC Review and from Personal Experience
    Donald L. Plucknett

This collection offers a comprehensive view of the commonalities and diversities of the farming systems research and development (FSR/D) approaches being applied around the world. The book is a must for anyone interested in gaining a concise, yet broad view of this new and growing field of research and its importance to small-scale farming in developing countries. Frequent referral to the "Readings in FSR/D" is recommended to System "B" personnel.

Reference 34

Shaner W.W., P.F. Philip, and W.R.Schmehl. (1982) Readings in Farming Systems Research and Development. Westview Press, Boulder, Colorado

System "H" was the first area developed under Mahaweli. Land settlements were initiated in 1975. By the end of 1984 approximately 39,855 hectares of irrigable land (with 14,572 hectare of existing paddy lands) was developed. 24,000 farm families are now settled in System "H".

A cropping system research project was initiated in 1980 from the Maha Iluppallama Research Station to design and test alternate cropping patterns with the aim of increasing land productivity and farmer well being. Cropping patterns tested from 1980 through 1986 included:

- Rice - rice (in LHG soils)
- Rice - OFC (in RBG soils)
- Rice - catch crop - OFC (in RBE soils)
- Rice - legume (under rainfed conditions)

The OFCs were chilli, soybean, cowpea, greengram, blackgram B'onion, red onion, bush-sitao, groundnut, and some vegetable crops such as radish, beans, and mustard.

The studies showed that most of the crops tested could grow successfully to get attractive returns. Having demonstrated from field trials that OFC can give higher returns in RBE soils, the extent under OFC in Yala season has expanded rapidly. Rice-chilli and rice-onion are popular patterns in the area.

Experiences from the Mahaweli System "H" Cropping System Research and comments from those who conducted the research have assisted MEA/DOA/MARD personnel in selecting the crops for the on-farm trials for Yala 1989 plantings.

Reference 35

Vignarajah, N. (1988) Farming Systems Research. Background Paper. January 7, 1988

This background paper was prepared to initiate discussion among research managers/administrators, and concerned researchers and extensionists, in the Sri Lanka Department of Agriculture. The paper explains the concepts, objectives and implications of FSR.

According to the author, FSR explicitly implies:

1. A multi-disciplinary and inter-disciplinary approach.

2. A holistic orientation where interactions between components are studied and understood so that technologies recommended for adoption become stable and sustainable.

3. Farmer participation and interaction. Scope for direct dialogue between researcher and the researched, the farmer.

4. Strong linkages with extension at all stages.

5. A problem solving approach.

6. That it does not replace on-station disciplinary or commodity research.

7. Feedback from farmers to on-station researchers through farming systems researchers and extensionists; thus, a "bottom up" rather than a "top-down" approach.

8. The existence of sub-systems (for example, cropping systems, livestock systems).

9. Not only understanding why some technologies are accepted by farmers but also why several new technologies are rejected by farmers.

The author presents his analysis of "FSR in Sri Lanka - the state of the art" and lists seven key deficiencies in the Sri Lankan programs in cropping systems as well as in any FSR programs.

Eleven recommendations are made relative to careful selection of FSR sites, manning of the FSR sites, coordination of the sites, establishment of linkages with other departments and institutions, the coordination of all FSR/E activities, giving special attention to the resource poor farmers, proper monitoring and conducting timely workshops and the "incorporation of farming systems" into training programs.

Twenty two literature citations are presented.

Reference 36

Warnakulasuriya, H.U. (1988) Production and Marketing of SFC Aralaganwila and Girandurukotte Regions. Production and Marketing Research Report No. 6 - DARP, Peradeniya.

This preliminary study is one of a series undertaken by the D/AEP of the Department of Agriculture on the SFC sector at regional and sub-regional levels in Sri Lanka. The objectives of the study were to:

1. Identify the potentials and constraints with respect to production and marketing of SFC in Mahaweli Systems "B" and "C".

2. Recommend policies and programs which will better exploit the potentials and minimize the constraints identified.

In addition to a general agro-ecological description of the region and the institutional arrangements therein for administration, extension, training, enterprise development, irrigation and credit, and marketing the report covers the following main topics:

1. Current status and trends in SFC production.

2. The physical production environment for SFC.

3. Constraints on and potential for production; specifically of maize, sorghum, finger millet, cowpea, green-gram, blackgram, soya, groundnut, sesame, chillie, B'onion, and roots and tubers.

The main conclusions and recommendation are as follows:-

1. Soils and climatic conditions in System "B" and "C" are not constraints to production of SFC.

2. Potential extents of lands suitable for SFC are estimated to be 15 percent of the home garden area, 5 percent of the irrigable highland area, and a considerable but undetermined extent of the moderately to well drained lowland area.

3. Research at Aralaganwila and Girandurukotte indicates that maize, cowpea, soya, and onion perform well in the region. On-farm trials should be conducted to maximize the returns from these crops to farmers.

4. Institutional support for agriculture in the region is presently weighted heavily in favour of paddy production. This situation should be rectified with a view promoting diversification to SFC in paddy lands.

5. Attempts to increase production of SFC in the region should be complemented by parallel development of marketing opportunities for the produce outside the region.

6. There should be better coordination of agricultural extension services and marketing.

7. Information about soils in the region is inadequate. Soil studies should be undertaken with a view to defining production boundaries and specifying fertilizer recommendations for the various SFC more precisely.

Relevance of Above Publication to MARD

This report confirms the suitability of System "B" for various OFC and identifies maize, cowpea, soya, and onion as crops that should be given priority. However, their maximum exploitation requires more information than is presently available on the soils and fertilizer use in relation to system "B". This is an area of study that MARD could support through strengthening facilities at RARC/A.

Reference 37

Zandstra, H.G., E.C. Price, J.A. Litsinger and R.A. Morris. (1981) Cropping Systems Research. IRRI

The Asian Cropping Systems Working Group (now called the Asian Farming Systems Working Group) brings together scientists from national agricultural research institutes. Since 1975 and up to the time this methodology bulletin was published the group met nine times to formulate a framework for CSR and develop the needed specific research methods.

The Group Represents the Following Countries and Institutions:

Bangladesh	Bangladesh Rice Research Institute
Burma	Agricultural Research Institute
India	Indian Council for Agricultural Research
Indonesia	Central Research Institute for Agriculture
Nepal	His Majesty's Department of Agriculture
Malaysia	Malaysian Agricultural Research and Development Institute
Philippines	University of the Philippines
South Korea	Office of Rural Development
Sri Lanka	Department of Agriculture
Thailand	His Majesty's Department of Agriculture
International Rice Research Institute	

Chapter 1 - Development of a Cropping Systems Methodology

Annual production from a given area of land can be increased by improving the yield of a crop, or by growing on extra crop during the year. Cropping systems research seeks the technology that will increase production by both methods.

Chapter 2 - Cropping Systems and Cropping Systems Research

- The crop production activities of a farmer provide its cropping system.
- A cropping pattern comprises all the components required for the production of a set of crops on one plot during a year.
- The productive base of a CS is plant growth, which is influenced by management and environment.

Chapter 3 - Cropping Systems Research Sites

- A CSR site is the area in which a research team designs and tests cropping systems.
- The sites must be selected to ensure the applicability of results obtained on them to other areas with the same environment.

- The first activity of a CSR team is to describe the existing CS in a selected area.

- Site description must also include an extensive analysis of water availability.

- The availability and present use of resources such as land, labor, cash, traction power, and infrastructural support services are important determinants of CS performance.

- Site description provides the research team with an idea of the input levels commonly used by farmers and the yields they obtain from there inputs.

- For site description, particular attention should be paid to the history of farmer's technology.

Chapter 4 - Design

The design phase of CSR has two distinct but closely related activities: the design of improved cropping patterns to be tested and the formulation of the overall research program to be conducted at the site for any 1 year.

The research program at the site includes:

- cropping pattern testing
- evaluation of farmers cropping patterns
- component technology research
- special problems - oriented surveys

Chapter 5 - Testing

- Cropping patterns are tested in farmer's fields to verify the assumptions made in the CSR process, particularly those at the design stage.

- Superimposed trials are used to evaluate the performance of the component technology assigned to the experimental cropping pattern against that of alternative formulations.

Chapter 6 - Pre-Production Testing and Pilot Production Program

The pre-production phase of CSR includes multi-location testing and the organization, implementation, and evaluation of a pilot production program.

This bulletin lists 52 references and a "Further Reading" section provides additional selected references to general background articles for each of the activities in CSR. There are 6 appendices covering fertilizer rates determination, experimental design for determining yield losses, yield-loss studies for weed control recommendations, varietal testing, cropping pattern monitoring and costs and returns analysis of cropping patterns.

This bulletin has been widely read and used by many countries in the development of their farming system programs. It should not be overlooked by those who are developing farming systems programs for System "B".

Chapter II
Water Management
and
Main Systems Operation and Maintenance

EXECUTIVE SUMMARY

Fifteen documents relating to Irrigation Operations and Maintenance are reviewed. The majority of these dealt with the Water Management aspect of Operation and Maintenance (O&M) rather than issues of "how and when" things are done.

These fifteen documents provide a good representation of what has been written for the last 15 years about Asian Irrigated Subsistence Agriculture, for example:

1. There are head-end and tail-end problems;
2. There are many problems associated with rotational irrigation;
3. Fees are not collected and rules and regulations are not enforced;
4. Farmers over irrigate or misuse water because they don't have the necessary knowledge;
5. Farmers over irrigate because the amount of water they receive is based on the land area rather than on the amount they require; and
6. Government Irrigation Officials have inadequate resources to do their mandated jobs.

Some of the documents present either interesting concepts or results that deserve to be emphasized. A precis of these are presented.

Work in Egypt indicates that farmers do not waste water when they have to work to get it to their fields. There the traditional system is that in the delivery channels the water surface is about 75 cm below the surface of the farmer's field. Where the farmers have traditionally had to lift water to their fields, there is no indication in the paper that raising the water level results in the farmers using more or too much water. This may be because the farmers had learned the value to water. It is indicated that the primary benefit of raising the water level is reduced labour cost.

The IBRD paper lists what appears to be realistic resource requirements for an irrigated area of 2,360 ha. This level of manpower and equipment if it were under the control of a System "B" Block Irrigation Engineer would go a long way toward increasing the reliability and responsiveness of System "B".

Two papers, one by G. Davids and the other by the Flow Monitoring Unit, System "B", indicate that while efforts are being made to calibrate measuring

structures and to record and use the measurement data, the data is suspect because of errors in structure design and construction. Although Davids only evaluated field channels, personal observation has shown that the same problems pertain to measuring structures in Branch and Distributary canals.

The Flow Monitoring Unit noted that the highest actual, according to their measurements, deliveries tend to be associated with D-canals having small service areas. This has been noted elsewhere in Asia, and the association deserves further investigation.

Davids further makes a strong case for letting farmers take full responsibility for O&M up to and including the D-canals because of the large Government manpower resources needed to monitor all turnouts. This is further emphasized in the CH2M Hill report on System "B" Operations, Maintenance, and Training Guidelines.

Martin and Yoder's report, which is based on their Ph.D. dissertation study, on two small (the equivalent of 2 to 4 System "B" turnout areas) irrigation systems, suggest that rights to specified quantities of quantities of water results in better O&M. This is also dealt with by Peiris and other authors who indicate that water must have value, and the rules and regulations pertaining to its use must be both clear and firmly, evenly enforced either by the Government or by the farmers.

Throughout, the studies indicate that ROTATIONAL IRRIGATION is very difficult to implement and that continuous irrigation (except under conditions of severe shortage under agreed upon distribution rules) is easier to implement. A major reason for this is that under present conditions, it is practically impossible to prevent farmers from modifying the physical system to get more water for themselves.

In general, the documents reconfirm that water goes from high places to low places so that it is better for farmers to plant upland crops in the higher areas of their holdings (if they have any) and paddy in low-lying areas.

An excellent suggestion in one document, is that SPECIAL WATER COURTS be established to adjucate water disputes. The Water Tribunal in Valencia, Spain is the oldest, continuously operating one known. It is recommended that a study tour to Valencia be authorized and organized for the appropriate GOSL legal experts.

In conclusion, special note must be taken of Merriam's experiment with Pipeline Irrigation. This approach is innovative, and, as Mr. M. Panapitiya suggests, it is worthy of consideration in System "B". Conceptually, its application would be to by-pass Head-ender Field-Channel inlets along a D-Canal to supply water to the Tail-enders. Tail-enders, for example the last third of a D-Canal, could bury a pipe line from the D-Canal inlet to the location in the D-Canal where the first of their Field-Channels are located. A valve at the pipe outlet would control water to the tail enders, and the gate setting at the D-Canal inlet would control total flow to both Tail and Head enders. If others consider this approach to have merit, investigations into its application could begin in 1990.

CH2M Hill International, Operation, Maintenance, and Training Plan for System B: Water Management Guidelines for System B of the Mahaweli Irrigation Scheme, Colombo, Sri Lanka, June 1988

This study of water management practices in System "H" was conducted to develop water management guidelines for System B.

Recommendations pertinent to System O&M are extracted.

1. MEA must transfer to project farmers a greater proportion of water management workload responsibility with a corresponding level of authority.

2. System B's operational theme should be reliability with flexibility.

3. Distribution canals should be operated and maintained by farmer organizations.

4. Water allocations to farmer groups should provide farmers with equal production opportunities not equal shares of water.

5. The Distributary system should be designed with a greater awareness of operability and manageability, not simply hydraulic capacity.

General Conclusions

1. The root causes of water management successes and failures usually relate to the management organization and seldom to the physical system.

2. Lasting improvements in water management almost always involve organization of project farmers for an increased role in water management decision-making.

Davids, Grant G. (CH2M Hill/MEA), Field Canal Measurement Structures Inventory Report for Construction Blocks 501 and 502, Maduru Oya System "B" Irrigation Project, April 1986.

In System "B" the current proposal is for MEA to recognize each turnout area (comprised of 8 to 20 one-ha farms) as the basic element for water requirements and operations. Using predicative techniques modified by field observation, MEA will estimate the water requirements of each turnout and prepare corresponding distributary, branch, and main canal operation schedules to deliver the required amount. The ability to measure water at each offtake in the canal system is obviously critical to implementing such a plan.

During the Maha 1985-86 operation period an inventory was carried out in Damminna Block to assess the quality of irrigation structures with respect to water measurement capability. The survey concentrated on field canal off takes because they were more numerous and the quality of their measurement was more suspect.

This reports presents the field canal structure inventory data and results, and assessment of the proposed canal operations plan, cost estimates for suggested remedial construction activities, and suggestions for improving design and construction procedures.

Assessment

Because of full and partial submergence only 33 percent of the structures can be used as measurement devices without special efforts to correct for submerged conditions.

In the submerged category, 41 percent of the structures cannot be used for flow measurement.

To prevent submergence the hump must be at least 15 cm (6 inches) above the downstream bed level for an unsubmerged flow to occur.

The principal field conditions which tend to cause submergence of the hump are:

1. hump constructed at elevation lower than specified.

2. silt accumulation in the field canal, and

3. weed growth in field canal.

Conclusions and Recommendations

1. At present 67 percent of the field canal offtake structures in Construction Blocks 501 and 502 cannot be used for flow measurement of adequate accuracy.

2. The intended field canal delivery plan and the canal plan cannot be implemented satisfactorily with the present water measurement capability at the field canal level.

3. The major causes of field canal humps operating submerged and partially submerged is that the hump crest elevation is too low with respect to the downstream field canal water level. This condition results from siltation and excessive weed growth in field canals downstream of the hump and/or faulty construction.

4. The following measures are recommended to correct submerged structures in Blocks 501 and 502:

   a. a general program of improved field canal maintenance, accompanied by

   b. a selective programme of remedial construction.

5. A conservatively high estimate of cost to complete remedial construction is Rs 250,000/.

6. Conditions similar to those identified in Blocks 501 and 502 are to be expected in forward areas of System "B", unless design and construction quality is improved.

7. Recommended design improvements are:

   a. increased elevation of crest of hump to about 30 cm above designed field canal bed level, and

   b. improved effectiveness of the stilling basin.

8. General construction work supervision should be intensified to achieve a closer conformance with design and improved quality of construction.

Egyptian Water Use and Management Project, Improving Egypt's Irrigation System in the Old Canals - Finding of the Egyptian Water Use and Management Project-Final Report, 1984

The water supply for any given area is monitored by observing water surface levels in delivery canals. The water is typically delivered 50 cm to 75 cm below the ground surface of the fields so irrigators must lift the water onto the fields (this is the traditional method).

Interventions

Two delivery channels were elevated and provided with pumps to supply the required head and flow rate for efficient irrigation and to eliminate the need for each farmer to lift water. In both cases, the increased head supplied at the field turnout resulted in significant reductions in the irrigation time and farmers were pleased with not having to lift water. In fact, economic analyses showed that the primary benefit was lower labour costs due to reduced irrigation time.

Flow Monitoring Unit, System "B", Mahaweli Economic Agency, Water Management Evaluation for Damminna, Yala 1986, Revised April, 1987), April 1987

Presents a summary and evaluation of water distribution in Damminna of System "B" during Yala 1986 season.

The evaluation noted that the highest actual deliveries tend to be associated with D-canals having small service areas. These areas should receive high priority in future attempts to improve water management.

Too little water was delivered to D6/502, the largest D-Canal in the . The under delivery may be explained by substantial reuse of irrigation return flows and suspected lower than average percolation rates. D6 encompasses a low-lying area with relatively fine textured soils.

Conclusions

1. In Damminna in Yala 1986, 986 ha of land were cultivated. The principal crop was paddy, accounting for more than 99 percent of the total cultivated area. Chillies and cowpeas were grown on very limited areas.

2. Rainfall occurred during 6 of the 18 weeks of the season, but totalled only 42 mm, an insignificant amount compared to water requirements. Thus, rainfall, was not included in the water balance.

3. The average depth of water delivered over the entire season was 2.34 meters or 21 percent more than the computed requirement of 1.93 meters.

4. Actual canal deliveries to individual D-canals very widely, ranging from a high of 7.11 meters for D4A/501 to a low of 0.98 meters for D6/502. There are not obvious explanations for this variation.

5. Within the levels of confidence placed in the evaluation appraisal, four D-canals were delivered an adequate amount of water; 10 were delivered too much; and one was delivered too little.

6. Unfortunately, crop yields were not measured according to D-Canal command areas so water use and yields cannot be correlated.

Hunting Technical Services Limited, Irrigation Systems Trials Unit "H", 404, 2nd Monitoring (Final) Report, Sri Lanka, November 1980

The Consultants' full-time presence on the Irrigation Systems Trails Unit, System "H", 404, ceased at the end of November 1980. This report is the third in the series covering the development of the trials since their inception in April 1979. This Second Monitoring Report attempts to draw more definitive conclusions from the first year's data and observations, and of necessity repeats part of the content of the First Monitoring Report.

Of primary importance to this Lessons Learned Paper is the section on Rotational Irrigation.

Rotational issues are necessary to ensure that an individual farmer receives a manageable stream size on his farm and as a possible means of eliminating the tail-end problem. Continuous irrigation of upland crops is impractical and undesirable while a large stream size (at least seven l/x) is necessary to ensure that water reaches the far end of a farm. For flooded rice smaller flows are acceptable since water is not advancing across a dry field but raising a surface water table. Rotational issues are implemented at three levels:

1. at the individual farm;

2. at the farm channel;

3. at the distributary channel.

Rotations at the Individual Farm

Standard practice is for pairs of farms on an individual farm channel to irrigate simultaneously. In a 14 farm turnout, each pair would irrigate for 24 hours in a 7-day cycle. Formalization of such a concept, so that it is rigidly enforced is impractical for the following reasons:

1. On the conventional system, water requirements vary enormously between farms on RBEs and farms on LHGs. Some farms will receive considerable irrigation through run-off from the farm above. A uniform supply period is impossible to achieve.

2. Many farm turnouts have odd numbers of farms. Farms are likely to be irrigating for a few hours within any twenty-four. Such precision is difficult to attain.

3. Poor construction means that most structures are not capable of efficiently diverting a field channel flow to only two farms at one time.

Implementation of farm rotation is best left to the farmers themselves. The establishment of turnout groups in close contact with their field officer should ensure that distribution is reasonably equitable.

Rotations of the Farm Channel

For irrigating wetland rice, rotations of the farm channel have the following disadvantages:

1. Larger stream sizes provide a much greater potential for waste.

2. Large turnout areas with a high proportion of RBEs may require flows of such magnitude that the standard D-channel turnout would not be capable of passing the required flow.

3. In a rotational system it is important for the farmer to know when he will receive his water - preferably on certain days in the week. A rotation cycle can be thrown out of phase by failure of the irrigation supply upstream or the temporary suspension of supplies due to rainfall.

4. Wetland rice grown on RBEs tends to dry out very quickly (within 2 or 3 days) and before the next irrigation is due. Similarly a rotational issue is not adequate for providing a quick rise in the water table during land preparation.

5. Farm rotation need to be more organized to receive an adequate supply with the consequent problems mentioned in "Rotations to Individual Farm".

6. A higher degree of organization is required to implement the frequent opening and closing of turnout gates.

For the surface irrigation of upland crops rotation of farm channels is usually necessary to provide large stream sizes and to prevent water-logging of some areas.

Rotation of Distributary Channels

D-channel rotation has all the disadvantages already listed. In addition, the following disadvantages occur:

1. Extra costs for larger channels.

2. The time taken for water to reach the end of a long D-Channel may increase rather than reduce the tail-end problem.

3. It is socially desirable to keep water flowing continuously in D-canals.

International Bank for Rural Reconstruction and Development, Sri Lanka: Appraisal of the Tank Irrigation Modernization Project, November 1976

There are some 130 major tank irrigation schemes in Sri Lanka, serving a total cultivated area of about 400,000 acres. The tanks were originally constructed to provide supplemental irrigation during the Maha Season.

Five project areas (tank schemes), three in Anuradhapura District, one in Vavuniya, and one in Mannar District, are selected. All were built in the mid-1950's (like Pimburattewa). Currently they are operated for only daylight irrigation for each farm on a 7-day rotation.

There is a need to construct and rehabilitate drains.

The paper estimates resource requirements to operate and maintain 6,000 acres:

Engineer	1
Technical Assistant	2
Maintenance Supervisor	4
Maintenance Labourer	40
Driver	5
5-Ton Truck	1
Agricultural Tractor	1
Dump Truck	2
4-Wheel Drive Car	1
Motorcycle	4
Pedestrian Roller	1

International Science and Technology Institute, Inc., Final Evaluation of Sri Lanka - Water Management (Project No. 383-1057), Washington, D.C.: 1986

This is evaluation of the Gal Oya Water Management Project

System Operation

Rotation vs Continuous Flow

The original project design and subsequent operation was on a rotation basis at the Branch canal level as was customary with majority of irrigation projects in the country. However, the rehabilitation design adopted the criterion of continuous flow in the entire system providing for rotation only among the farmers along a field canal. This change in operation pattern was made to effect economy by using existing canals with minimal change in cross-section and to ease and simplify operation. This is highly desirable and preferred by the farmers, since continuous flow in the system inspires their confidence in availability of water and hence the reliability of the system.

Some Operational Issues

It is quite clear that the hydraulic operation of the system has improved considerably since rehabilitation. But the rehabilitation is not complete and considerable areas in the lower reaches have yet to come under full operation. Due to the apparent abundance of water available and better hydraulic efficiency, combined with good rainfall patterns in the past two years, there is a feeling of surplus water in the head reaches. This may have led to some wasteful water use practices. However, with the completion of the entire system, water use has to be more efficient throughout, if the benefits of the rehabilitation are to be enjoyed more equitably in all sections of the command area.

An example of the problem of direct outlets, discussed above, is the distributary canal LB 23, serving approximately 160 acres has about 52 direct outlets serving approximately 90 acres. One lot of five acres (three acres official allotment and two acres of encroachment) has seven direct outlets. Most of the lots served by the direct outlets are also situated conveniently at the head of the 5.5 km long distributary. The three field canals serving 20 lots are at the tail end of the canal. In theory, the farmers on the field canals should complete the earthwork on their field canals themselves with free labour, maintain the field canals and practice rotation among themselves. This is patently inequitable considering the fact that majority of farmers in the upper reaches get water from direct pipe outlets, have no field canals to build or maintain and are absolutely assured of water at any time from the continuously flowing distributary canal. It is no wonder therefore that this rather long D-canal is poorly maintained and currently the farmers on the field canals at the tail end are being satisfied by pushing discharges far in excess of the design discharge through the distributary canal. This, of course, is one of the bad examples of operation problems, but is certainly not alone. There are a considerable number of canals with similar problems. If the system were to operate properly such built-in inequities have to be corrected.

Martin, E. D. and R. Yoder, Institutions for Irrigation Management in Farmer-Managed Systems: Examples from the ills of Nepal, IIMI Research Paper No. 5, 1987

Studied two irrigation systems totalling 64 ha (Argali: 47 ha and Chherlung: 17 ha) managed by farmers.

Very poor soil for irrigated farming with 4 to 7 liters/sec/ha application rates required during the monsoon season.

Major Finding Based on the Study of these Two Small Areas

The principal of water allocation has important implications for the efficiency of water use and the expansion of the irrigated area. Allocation of water in proportion to area irrigated provides no incentive for efficient water use nor a mechanism for expanding the area irrigated.

On the other hand, allocation by purchased shares in Chherlung provides both the individual incentives for efficient water management and a mechanism for expanding irrigated area. As the system improved, the amount of water delivered and consequently the amount of water per share increased considerably. Shareholders can decide whether to keep their shares and reduce their management input or to sell part of the additional water. Because the individual can sell part of his water, he is aware of the opportunity cost of his use of water and there is a financial incentive to manage his water efficiently. In addition, if an individual sells part of his allocation, the amount of labour that he must contribute to maintaining the system is reduced.

Merriam, John L., Demand Irrigation Schedule Concrete Pipeline Pilot Project: Mahaweli Development Board, Area - Second Interim Report Yala 1982, San Louis Obispo CA, 1982

Four basic questions are posed for the Pilot Project to answer:

1. relative and absolute costs of supplying the limited rate demand irrigation schedule;

2. will the farmer waste water when they have control;

3. is it possible to save water and rainfall; and

4. will crop yields be increased by having water available as the crop needs it?

This report at the end of the second season, results while optimistic, cannot be considered conclusive since the first season was drought season and crop yields were affected, and this second season only the Pilot Project area grew paddy so there was not direct comparison of yield or water use with other areas.

Water Use

The farm water delivery of 200 cm is excessive for the needs of a Yala crop. This depth was applied by farmers during their second season of use during which training was given, but without regulations or coercion, only encouragement to not waste water. They were advised to keep their paddy fields flooded but have no runoff. This program of minimal pressure on the farmer was intentional to see if Government or group regulation and interference could be negligible.

Under the anticipated program of Demand Irrigation Schedule (DIS) the water deliveries should be about half or less of this season's use. It may be that the next steps of surveillance and reprimand, even fining, may be needed. This would involve labour and administration probably equivalent to that needed for canal operation on the rotation schedule which can be partially eliminated with the automated DIS system.

Another probably more practical alternative to bring water use down to a minimum would be to have a hired group irrigator. Under this program the farmers on a Field Pipeline would employ an irrigator, possibly one of their group, and he would be fully responsible for control and proper application of the water -- when, how much, and how long. Control of the irrigator should remain with the farmers so they should hire and pay him. However, since he should also be somewhat responsible to the Government and would replace a Government employee, perhaps half of his salary should be furnished by the Government.

Initial Water Table Raising

With the continuously flooded paddy program used with DIS, the canal seepage and land preparation excess water raises the water table for the maintenance of the flooded condition so the water is not wasted. The study of water table levels below the canals but above the fields shows that the water table rose from the dry season depth of three meters to about one meter in the first two weeks of the season. This will occur under the conventional as well as DIS program.

Time of Use

Flow meters are installed on five of the Field Pipe Lines. Observations were made twice a day, at about 0900 and 1500. From these readings, it is very obvious that the anticipated day time use is happening. The day time rates are about three times the night rates. One may conclude that farmers are shutting off their valves much of the time, though night time flow is practical.

Merry, D.J., P.S. Rao, and E. Martin, Irrigation Management Research in Sri Lanka: A review of Selected Literature, IIMI Occasional Paper, International Irrigation Management Institute, Sri Lanka, June, 1988

The review focuses on a few topics relevant to the Irrigation System Management (ISM) Project, and more broadly, to improving performance of major

irrigation systems in Sri Lanka: and it attempts to identify the major works on the chosen topics.

This paper reports on:

1. system operations and performance,
2. organization and management of irrigation systems,
3. rehabilitation and modernization of irrigation systems.
4. resource generation and mobilization.

Irrigation System Management

In System "H":

1. farmers tried to follow the new water schedules when they developed confidence in the system;

2. practical difficulties in actual operation, as the cultivation calendar is not followed by the farmers;

3. farmer education by itself will not reduce over-consumption of water. In the absence of a system of water charges based on volume of water, a farmer has no incentive to reduce his consumption of water. It is necessary to deal decisively with the minority of farmers who break the law by taking legal action against them;

4. weirs installed for the measurement of flow in turnouts were unusable. The elevations of most of the turnouts were too low to permit weirs to operate normally;

5. out of 83 allotments receiving water, only 40 received it through authorized project outlets;

6. boards for controlling water flow at the outlets were not available;

7. concrete in the farm outlet head control structures were of very poor quality. Many of the structures were crumbling, cracking, or both;

8. many of the original farm outlets were placed at too low an elevation to permit irrigation of the land;

9. rotation of water distribution, where practiced at all, was done in a haphazard manner with little supervision. Farmers at some of the turnouts tried to use a continuous flow system. The turnouts at the upper positions of ditches removed too much water from the ditch when continuously open, especially when enlarged by farmers.

10. of the 83 allotments receiving water from one distributary, 33 were operated by renters;

11. maintenance of structures, as well as ditches and access roads, was poor; and

12. it was reported that the continuous flow system was working more smoothly in other systems than in System "H" because the farm outlets were designed for continuous flow [that is, three inch diameter pipe rather than six inch diameter pipe].

In Kaudulla Irrigation System

1. need to develop more effective institutions for system management, including at community level;

2. the need to generate resources for maintenance of the system since the national economy cannot do this (figures are given to show that if current O&M fees are collected, they would be three times the present funds given by the Government for maintenance);

3. evaluation of system performance, especially with limited resources is very difficult; and

4. the main deficiency of the system is its inefficient use of rainfall.

General Lessons Learned

The important findings of the studies reviewed above have a number of common elements. These include:

1. monitoring and evaluation of irrigation system performance is difficult and very expensive in terms of resources;

2. Maha season water deliveries are generally high and rainfall is not effectively used. Productively per unit of water is low. Water saved in Maha can be used in Yala when water is really scarce;

3. generally water deliveries are not timely, not predictable, and not reliable. Water distribution is inequitable at the main system level as well as at the farm level. The important causal factors for this state of affairs are related both to the complexity of the system and physical constraints, and the constraints related to resources, institutions, and behavior of operators and water users;

4. main canals are long and do not have adequate controls and cross regulators. In cases where the canals are single-banked and pass through intermediate minor tanks, water conveyance along the system takes more time than in the case of double banked canals;

5. there are instances where farmers have generally been cooperative and tried to follow the designed operation schedules once they developed confidence in the system. However, there are practical difficulties in implementing operational plans at the farm level. Cultivation calendars are not followed as agreed to; leading to wastage of water. Farmers have no incentives to save water. Sanctions to deal with violators of discipline are not enforced and are therefore not effective. Many unauthorized outlets from distributaries and the presence of many encroachers and lease-holders makes it difficult to get organized or disciplined behavior from farmers;

6. irrigation water requirements are higher than design values in the early stages of commissioning of a project;

7. rotation water distribution introduced in systems designed for continuous distribution can lead to inadequacies in system capacities;

8. water measurement devices are not liked by farmers and are frequently damaged; and

9. inadequate funds for maintenance and lack of motivation for system operating personnel are quite pervasive and lead to poor system performance.

Organization and Management

General Lessons Learned

1. farmers will respond to opportunities to take greater responsibility for system O&M in cooperation with Government officials;

2. the use of specially trained catalysts, deployed in communities with a mandate to spend a couple of years working with farmers is an effective method for organizing responsible and useful farmers organizations;

3. the presence of such legitimate and effective farmers organizations leads to improved cooperation among farmers, and improved cooperation and communication between farmers and agency officials. This in turn makes the agencies jobs easier and increases the incentives of officials to be responsive. These improvements in turn can lead to improved system performance on a sustained basis;

4. the development of farmers' groups and changes in irrigation management agencies are mutually supportive; in the long run, both must occur and changes in one have a strong impact on the other.

Resource Generation and Finance

General Lessons Learned

1. almost all major irrigation systems in Sri Lanka have suffered from poor maintenance due to lack of sufficient financing. The Government cannot afford to pay full O&M costs and achieve other social welfare goals;

2. problems associated with O&M fee collection include:

   -- farmers do not understand the purpose of the fee,

   -- specification registers are not up-to-date; not all beneficiaries are charged the fee,

   -- farmers are charged for incorrect areas,

   -- some farmers get water, if at all, only in Maha. They should not have to pay the same rate as those who get water for two seasons;

3. the following contribute to farmers' resistance to paying:

   -- propaganda against recovery by political groups,

   -- lack of confidence in officers,

   -- failure to take action against defaulters;

4. it is suggested that special water courts be set up as normal judicial process is too slow.

Peiris, G. ., Irrigation and Water Management in a Peasant Settlement Scheme of Sri Lanka: A study of the Water Management of Minipe. A report submitted to the Agrarian Research and Training Institute of Sri Lanka, Peradeniya, January 1986

Study done in Yala Season 1985. The purpose of the project was to enable the settlers of the scheme to assume a dominant role in the affairs of water management. This failed.

Water Management and the Farmers

1. Farmers say they do not clean canals before the operation season because it is easier to do so after water is released.

2. Farmers took a long time for land preparation and planting, in many areas this stretched over many weeks. Where farmers had no certainty whatever that water supplied at the commencement of the season would continue to last, their response was one of completing field preparation and sowing in the shortest possible time.

3. The guiding principle of water regulation has been the availability of water rather than the need to induce the farmers to adopt conservational methods of water use.

4. The regulation of total volumes of water to the D-canals more systematically and more equally needs two preconditions.

   a. Maintaining daily records of water discharge to D-canals. The recc ds must be analyzed and used for the purpose of determining the req rements within the D system, and

   b. Optimizing the relationship between the volume and timing of discharge into D-canals.

Water Management Synthesis Project, Evaluation Review of the Water Management Project No. 383-0057, WMS Report 10, Logan, Utah, USA, July, 1982

1. System control points should be minimized.

2. The current system operation should be studied carefully before major changes are made.

3. Any proposed alterations in deliveries should be carefully considered before being implemented, because such alterations may effect return flow users in ways which result in counter productive situations.

4. Since much of the system has become accustomed to a large scale rotational cycle these portions of the system must be maintained under that operation mode. Discharges should be approximately the same in the distributaries and channels after rehabilitation as they were before. Changes in the broad water delivery patterns should be made very slowly-perhaps over a period of 5 to 10 years.

5. A major reason for downstream control in the system is to keep water in the major branches continuously, which should reduce maintenance and probably improve deliveries for domestic purposes to the tail-end distributaries.

6. Another potential benefit of controlling deliveries at the distributary inlets in that this should make the water flows to farms come in a crisper or sharper manner. In other words, instead of taking days to reach reasonable equilibrium, the shorter flow path from the head of distributaries to the ends (as opposed to the flow distance throughout an entire submain system) will result in what might be called crisper operation. The delivery cycle could be decreased and perhaps better production could be obtained with very little additional water inputs.

Water Management Synthesis Project, System of the Mahaweli Development Project, Sri Lanka 1982 Diagnostic Analysis, WMS Report 16, Fort Collins, CO, USA, December 1983

1. The channels had steep slopes in several places. This resulted in deterioration of channel conditions due to erosion and sedimentation of the channel bottom. This deterioration was also due to the lack or malfunctioning of control and regulating structures. The downstream cushions of the turnout structures functioned as measuring devices, which were later silted and submerged.

2. Overall maintenance of the system was inadequate. No proper procedures were adopted to identify the maintenance work, prioritize the repairs, and allocate funds. This unfavorable aspect of the scheme affected normal functioning, and resulted in excessive seepage and reduction in the flow of water.

3. The farmers in the project area were accustomed to traditional lowland paddy cultivation with standing water in the field. They did not have the skills required to manage water for upland crops. Basin-to-basin flow in upland crops resulted in significant deep-percolation losses from the upstream basins.

4. Only some of the farmers were provided with 15-cm diameter concrete circular pipe turnouts with planking arrangements. As a result, the rest of them took sods from the canal bank to and raise the water surface, thus damaging the bank.

5. Water-logging appeared in well-drained areas due to excessive application of water, channel seepage, and inadequate drainage facilities.

6. The cropping patterns adopted did not conform to the soil conditions. For example, paddy cultivation occurred in the well drained upper slopes with high infiltration and upland crop cultivation occurred in poorly-drained areas with a high water table.

7. The water supply was inequitable and undependable. The actual supply was less than required in all turnouts, except one. The farmers did not follow a rotation within a turnout area. In some turnouts, all of the farmer irrigated simultaneously. Farmers toward the upstream end irrigated whenever they could divert water.

8. The irrigation channel systems did not have facilities for equitable distribution. There were no farmer organizations within the turnout areas for the purpose of organizing irrigation distribution and maintenance of canals.

Water Management Synthesis Project, The Rajangana Irrigation Scheme, Sri Lanka: 1982 Diagnostic Analysis, WMS Report 19, Fort Collins, CO, USA, December 1983

The Rajangana canal system is very old and deteriorated. This is similar to the old Irrigation Department systems that have been incorporated within System "B".

1. The banks of the channels were vertical and irregular. Considerable damage to the channels was done by cattle and humans, who were using the channel as a source for bathing.

2. The bed gradients of D- and F-channels have deviated from the design gradient.

3. The farmers were unaware of the exact dates of the rotational issue, and there was no uniformity in their response regarding the days set a part for rotation. This reveals that significant information relating to water issues was not properly communicated to the farmers, which in turn indicated that management had no close dialogue with the farmers.

4. Institutional arrangements among the farmers were conspicuously absent.

5. The amount of seepage and percolation was high in the upper parts of the slope and relatively low in the lower parts of the slope. It was not possible to maintain standing water in the upper slopes under a rotational system. Cultivation of lowland paddy in the upper slopes must be discouraged. It may be worth studying how much of the deep percolation loss in the upper areas is reused in the lower area and what effects this has on the fertility of the soils of the lower areas.

Water Management Synthesis Project II, Diagnostic Analysis of the Minneriya Scheme, Sri Lanka Yala Discipline Reports 1986, WMS II, Fort Collins, CO: November 1987

Main System Engineering

While the rotation schedule was followed somewhat, it was not totally implementated. The gates of some D-canals were left partially open so that they flowed continuously, albeit at somewhat lower flows. The D-canals near the tail experienced large fluctuations in supply, partially due to the rotation but possibly partly in response to the low average supply during each rotation.

Chapter III
Farmer Organizations

1. Introduction

The chapter consists of four sections: (a) introduction, (b) main characteristics of the participatory style of irrigation water management, (c) summary of lessons learned for MARD, and (d) summaries of papers and reports on Sri Lanka's experiments on Water-User Organizations (WUOs).

In recent irrigation systems development exercises, the importance of the participation of farmer beneficiaries in system management has been emphasized. This style of irrigation management has particularly been introduced at the tertiary and quaternary levels, although the agency, which is responsible for the entire system, keeps some control over such farmer organizations. The degree of separation of powers and duties between the agency and farmer organizations is the main area of debate in recent times over the participatory management of irrigation systems in Sri Lanka.

2. Main Characteristics of The Participatory Style Irrigation of Water Management

During the last two decades, agency-managed, large-scale irrigation systems have experimented sharing water management responsibilities with the beneficiaries of the system, that is, farmers. Orienting farmers to take over management responsibilities has often been attempted through catalyst agents. Examples of such interventions are the Gal Oya Left Bank Water-User Organization Programme, the Minipe Farmer Organization Programme, the Kimbulwana Farmers' Committees Programme, and Farmer Organizations Programme of the Irrigation Management Division of the Irrigation Department. Some of the main characteristics of these programs are:

a. Agency officials are expected to accomplish more than their usual duties as they bring the farmer-beneficiaries into the management of irrigation systems.

b. Strong emphasis placed on farmers' understanding of potential benefits of improved irrigation water management.

c. Initial implementation as a "pilot program" with a view to learning lessons to replicate elsewhere.

d. The functioning irrigation regulatory and conveyance structures is judged from the view point of efficient and equitable distribution of water; hence more emphasis on farmers' assessment.

Lessons Learned: A Summary

a. Multiple, competitive institutions to cater to farmers' needs sometimes confuse farmers. Introduction of new delivery mechanisms often ignore the existing delivery systems. Such interventions frustrate agency officials. On many occasions, these officials became the "enemies" of the project.

b. Planners pay little attention to land distribution and land alienation among settlers. Hidden tenancies and other illegal transactions often escape the attention of the credit and input specialists' attention. As a result, planning in these spheres has become difficult.

c. Project officials, whose routine duties typically remain within the technical grooves of an irrigation system, can be mobilized effectively for activities of wider concern with little training and incentives. However collaboration between officials and farmers often remain superficial.

d. Pilot areas' performance in participatory irrigation water management programs are distinctly superior to other areas' performance. This can be attributed to the greater efforts that are applied to pilot areas in the form of publicity, advice, and instruction.

e. Farmer leaders or representatives, who operate at the Distributary (D-) canal and Field (F-) channel level, sometimes are not allowed to share the decision-making authority with agency officials. On such occasions, they are at best intermediary and supplicant.

f. Too much concentration on rehabilitation or irrigation water management has in some instances, alienated farmers from farmer organizations, as such emphasis often neglects agricultural, extension, and marketing activities.

g. Planning has suffered from the non-availability of precise information on settlers and the socio-economic infrastructure. In this regard, the knowledge on existing institutional structures for farmer organizations is imperative.

h. Farmers' sense of ownership of the F-channel facilities is an important pre-requisite to participatory management in major schemes. Most of them do not have it because their members did not contribute money or labour during project construction. Government officers should try to develop a sense of ownership among farmers over the completed irrigation structures. They should have provided the necessary environments that are conducive for the development of attitudes for ownership of the F-channel at least.

i. The WUOs are not legalized. In many major irrigation schemes the WUOs are organized, but are not legalized yet. Many, if not most, do not have constitutions and by-laws to follow and the absence of which

prohibited them from generating funds for the Operation and Maintenance (O&M) of the sub-systems that they are supposed to be responsible of.

j. The absence of a continuing program for farmer organizations after the projects are over is a serious problem in many irrigation cum settlement schemes. Technical and economic assistance for farmer organizations are usually available during the project. After project completion, the associations are left on their own to survive and are often forgotten until a new project arrives.

k. It is necessary to get the help of both farmers and officials to evolve an efficient WUO system. Thus the emphasis on farmers' participation in irrigation water management should not undermine attention paid to officials' role in evolving an efficient water management system. In fact, if officials boycott WUOs, it would become difficult to introduce a participatory style of management at the tertiary level.

l. Farmer training programs are needed not only at the beginning of WUOs but also periodically as follow up programs. Such follow up training brings farmers into close contact with agency officials. Farmer representatives will thus be called upon to disseminate new knowledge and extension among farmers. Training can be multi-faceted -- training in water management can for example, include training on crop diversification and savings.

Recommendations

System "B" of MEA is one the major irrigation cum settlement schemes in Sri Lanka. Irrigation facilities were constructed by the government without farmer's participation. If only technical and economic aspects of rural and agricultural development programs are introduced, no matter how innovative and important they might be, they are not alone sufficient for achieving sustainable development. They need to be supplemented with the establishment of suitable farmers' organizations encompassing those engaged in productive farming. Thus in the MARD Project, the establishment of sustainable WUOs is one of its major objectives.

To develop farmers' attitude for participation in the management of System "B" the following are recommended.

1. A well organized training program to educate farmers about the importance of WUO's participation in improving farmer's income should be organized.

2. All TOGs must be strengthened because they are not properly organized.

3. A D-canal WUO should be formed only after TOGs in a particular D-canal are strengthened.

4. All deserving WUOs should be legalized as soon as possible.

5. The management and responsibility of operating and maintaining the D-canals must be handed over to legalized and deserving WUOs.

6. Priority in technical and economic assistance should be given to those WUOs with management responsibilities.

7. The Project Office must have at least one person who will be responsible for the farmer organization program during and after the project.

8. The MEA Office in Colombo must likewise have one person whose sole responsibility is to coordinate the farmer organization program during and after the project.

Detailed Summaries

SHYAMALA ABEYRATNE, State Intervention in Irrigation Development: The Village Irrigation Development Programme (VIRP), in IMMI, Participatory Management in Sri Lanka's Irrigation Schemes, IIMI, Digana, Sri Lanka, 1986

The two main objectives of VIRP are: physical rehabilitation of deteriorated minor irrigation schemes to increase agricultural production and farm incomes, and the introduction of a systematic water management program to ensure efficient utilization of stored water once rehabilitation is completed.

The VIRP is a 5-year project and has earmarked for rehabilitation 1,200 village irrigation schemes with financial assistance from the World Bank. The Irrigation Department is responsible for the civil work component of the project and the Department of Agrarian Services for planning and implementing a water management program.

The rehabilitation process was divided into four stages, namely:

the preliminary investigation stage,
the design stage,
the construction stage, and
the handing over stage.

Some of the major problems that surfaced at each of these stages are: the preliminary investigation team overlooked certain important considerations; the local community was not consulted nor involved in the design process; the contractors imported their labour from outside, hence involvement of the beneficiaries was minimal. Furthermore, there was a great delay in construction and the quality of work was poor.

The implementation of the water management component of many village irrigation systems was successful. But there are some drawbacks: the

APTs are responsible for organizational activity but were not properly trained for such work: the lack of FRs on the APT who would provide local feedback; the constitution of the APT, granted its "official flavour" is that it has no ID representative and; the Tank Supervisor, who was also responsible in consolidating farmer organizations and assisting the group leaders was overloaded with other functions because he was also responsible for supervising the laying out of internal F-channels and drainage systems, in assisting farmers in constructing and replacing prefabricated farm gates, establishing rain gauges and time schedule boards and, in installing water measuring devices.

Abeyratne specifically mentioned some of the things that made farmer participation in O&M of village tanks today more difficult. These things are: village today does not enjoy the primacy it had in the past because, the landholdings under the village tank are extremely fragmented and do not meet subsistence requirements; some community of water-users was not co-terminus with those represented in the Tank Committee; the critical question on who owns the water source and; the question on what will happen to the fate of irrigation water management if anything happens to existing institutional arrangements.

She likewise said that the ability and willingness of the community to take on responsibility depends on at least four factors: (a) high level of community participation from the inception right through the different phases of project development; (b) the existence of local organizational capacity capable of decision-making in relation to system management, (c) resource mobilization for irrigation-related tasks; (d) economics and social incentives for participation that would include agricultural prices to encourage farmers to contribute towards the system; and (e) a clear-cut property rights in land, water, and the irrigation works that bind the community together and provide a reason to get together for group decision-making and other irrigation related tasks.

W.A.T. ABEYSEKERA, Mobilizing Farmer Participation in Irrigation Rehabilitation and Management Programmes through Tank Committees: The Case of Tank Irrigation Modernization Projects, in IMMI, 1986

This study covers five large irrigation schemes in the North Central Dry Zone. The primary objective of the projects under the study, was to increase agricultural productivity in these five schemes through intensification of land use and increased crop yields by adopting better water management and agricultural practices. The strategy to achieve this objective was twofold: (a) improving irrigation water management and (b) improving crop management. This strategy was heavily biased towards improving management at the farm level. The major lessons learned are (a) it is necessary to organize farmers to participate in the project from the initial stages; (b) it is necessary to learn from farmer circumstances; (c) unless exogenous problems are remedied, it is unlikely that any efforts made at the tertiary level would generate adequate results; and (d) physical improvements alone cannot guarantee project

success and they should be combined with socio-economic improvements for the project beneficiaries.

NANDA ABEYWICKRAMA, Government Policy on Participatory Management, in IMMI, Participatory Management in Sri Lanka's Irrigation Schemes, IMMI, Digana Village, Sri Lanka, 1986.

Government intervention in irrigation development in Sri Lanka was initiated by the British Rulers in 1856 through Irrigation Ordinance No. 9. This ordinance requires the proprietors at a meeting to determine the cultivation calendar and details of the seasonal operations at the beginning of each season. The principal objective of the ordinance was to enhance farmer participation in the O&M of the irrigation systems, improve water management practices and increase rice production. This ordinance also obligated the proprietors to pay irrigation rates.

The ordinance worked well only in village irrigation schemes but it failed in irrigation systems where major irrigation works are maintained by the Government.

Abeywickrama cites some of the reasons why the ordinance failed in major schemes, as follows:

a. Farmer-beneficiaries were not consulted in the designs not were they involved in the construction of irrigation facilities.

b. Allowing individual outlets on a massive and complex distribution system.

c. Large number of small farmers are involved in each system. Primordial, and organic relationships are absent.

d. The remoteness of the reservoir and main system from the beneficiaries leads to a diminished percentage of involvement.

e. Social welfare policy of the Government leads to accept responsibility for O&M.

f. The heterogenous nature of the beneficiaries makes coordination and cooperation difficult.

g. The kanna meeting mechanism proved inadequate to develop farmer's participatory attitudes in systems.

h. The O&M settlement irrigation bureaucracy was insensitive to the need for participatory management.

i. The returns from the new irrigated farming were not a great improvement over the traditional rice-based peasant farming.

j. Government policy was to step in to undertake restoration or major rehabilitation works when farmers failed to contribute their share in maintenance.

k. The belief that the D-canals can be better operated and maintained by professional officers.

l. The main and secondary systems seldom function at optimum level.

m. In village systems, beneficiaries pay an irrigation service fee or contribute labour for repair and maintenance.

Abeywickrama concluded that participatory management in village schemes is no doubt feasible. In the medium scale systems, participatory management has already been demonstrated in Kimbulvana. But nobody has done it yet in major systems. His suggestion was for the government to have a long-term policy prospective on participatory management.

Agrarian Research and Training Institute (ARTI) Proceedings of a Workshop on Water Management in Sri Lanka, 1986

The group discussions of the above workshop provides a good summary of performance and problems of farmer organizations in Sri Lanka.

a. Tertiary Level of Irrigation System

Problems are mainly of three kinds: (1) many turnouts are not of uniform size and often unmanageable by farmers, (2) the length and complexities of the channels make it difficult for farmers to maintain them effectively, and (3) the work of the field level officials such as Jala Palakas is not satisfactory.

Proposals for Improvements

1. Attempts should be made in new irrigation system construction or in rehabilitation to form fairly uniform turnouts, for example, on the basis of one cusec for about 30/40 acres.

2. The irrigation agency should take the responsibility for maintenance where the F-channel is more than half a mile in length or when the irrigation area is more than 100 acres.

3. The Jala-Palakas should be selected by farmers by consensus and should be remunerated by the irrigation agency.

4. Institute a revolving fund (land tax, fines for water management offenses, and contributions from farmers) for maintenance of the system.

5. The need for vertical integration of farmer organizations and clear lines of communication at the various levels.

At the secondary level it is proposed that farmer organizations should be formed as a federation not only at the F-channel level, but also at the distributary and main channel levels and at the project level. Furthermore, farmers should be involved in the decision-making process.

At the system level, farmer organizations should follow hydrological boundaries with a F-channel farmer organization at the bottom and project/tank committee at the complex. Farmers should be aware of the allocation for maintenance and should participate in decision-making regarding allocation of funds. The possibility of farmers contributing towards maintenance was suggested, with farmer organizations to collect maintenance fees in future.

J. ALWIS, Irrigation Legislation and Participatory Management, in IMMI, Participatory Management in Sri Lanka's Irrigation Schemes, IIMI, Digana Village, Sri Lanka, 1986.

According to Mr. Alwis several laws have been introduced to enhance farmer participation in irrigation management since 1856. The Irrigation Ordinance No. 9 of 1856, according to him, envisaged farmer participation at public meetings of proprietors summoned by the Government Agent (GA). This was followed by Irrigation Ordinance No. 16 of 1906, which provided for the setting up of a District Advisory Committee to advice the GA on drawing up rules regarding cultivation practices. Powers were given to the whole body of proprietors through Section No. 1 of the Irrigation Ordinance No. 45 of 1917. Some of the powers vested to this body are: the power to make rules on matters pertaining to the management aspects specific to each scheme which included the enforcement of certain customs, irrigation headman, mobilizing farmer contribution, and system management; the power to decide on the irrigation rates, and to validate any irregularity, correct any informality, decide on matters referred to the proprietors by the Governor and decide on bethma cultivation; and the power to appoint a committee to frame rules on their behalf.

Paddy Land Act of 1958 amended the Irrigation Ordinance which gave the GA a more or less independent authority. This Act brought a significant change in the composition of cultivation meeting and introduced a far-reaching tenancy reforms in the paddy sector. The tenurial arrangements of most lands in the government-initiated major irrigation systems are governed by the Land Development Ordinance. An Irrigation Ordinance was introduced in 1968 to bring it in line with the Paddy Land Act. In this connection, the Irrigation Headman was removed and the Committee appointed by the proprietors was abrogated and both were replaced by the Cultivation Committee.

The problem of enhancing farmer participation in irrigation management became more serious with the creation of new specialized agencies such as the Agrarian Service Department in 1958 and many others thereafter, where even the diagnosis of field level problems affecting farmers was marred by individual professional biases and divided loyalties.

Mr. Alwis also said that proper maintenance of the irrigation facilities was one of the objectives that motivated the colonial Government to issue Irrigation Ordinance No. 9 of 1856. Thus, the willingness of farmers to pay irrigation rates was made an important consideration. In this regard, an Irrigation Ordinance that relates to the irrigation of both construction and maintenance was introduced in 1935. The scheme provided for the imposition of an irrigation rate, and for deciding on responsibilities between the Government and beneficiaries for maintenance, labour contribution, variation of rates, and conditions applicable to irrigation rates. It also provided for an emption in rates in instances where beneficiaries agreed to undertake maintenance work on their own. Subsequent amendments to the Irrigation Ordinance showed that the choice of the farmers to contribute by irrigation rate has been restricted by imposing the will of the bureaucracy. This resulted to low collection rates.

A major revision of this policy was introduced in 1984. The scheme attaches more importance to promote and mobilize farmer participation for maintenance than to the recovery of money. Hence farmer organizations are requested to identify maintenance items and to set priorities to prepare a maintenance program for implementation in each year under the implementation of the ID. The present experiences on the new policy will have to be monitored to determine the best course of action, he finally said.

JEFFREY D. BREWER, Changing an Irrigation Bureaucracy: The Sri Lanka Irrigation Department, paper presented at World Rural Sociology Congress, Bolonga on June 24, 1988

The paper focuses its attention on the process by which the Sri Lanka Irrigation Department is being changed to accommodate farmer involvement in system O&M. The author discussed both attitudinal changes in irrigation officers and organizational and procedural changes in the Irrigation Department. Those changes, though generated by forces within the country, did not come from the farmers nor from the Department, but by the direction from foreign ideas, particularly those supported by the World Bank and USAID.

The paper likewise took note that the Sri Lanka data implies that both organizational and attitudinal changes are needed, and suggest that organizational change are likely to precede, rather than follow attitudinal change.

PIYASENA GANEWATTE, Farmer Training Programme in Sri Lanka in IMMI, Participatory Management in Sri Lanka's Irrigation Schemes, IIMI, Digana, Sri Lanka, 1986.

Ganewatte's paper deals with the government's training programs for farmers for the last decade and a half. His discussion dealt with the Training and Visit system in the Kurunegala District; the farmer training

in the Mahaweli Project area; and the training of farmers and farmer representatives in the Gal Oya Farmer Organization Programme.

According to him, Sri Lanka had tried several schemes to train farmer and farmer-leaders in water management, agricultural production, plant pests and disease control, farm credit management, and marketing and community development. After a careful analysis of the different schemes used to educate farmers in the irrigated areas, his recommendation was to adopt the experiences gained in the Gal Oya Farmer Organization Programme. The training programme in Gal Oya uses the TOGs; the D-Canal WUOs; and the Federations of Farmers' Organization as the main channel in educating the farmer-beneficiaries of the project. He also stressed the importance of giving more attention on water management in the conduct of agricultural extension and farmer training.

DAVID GROENFELDT, Distinguishing Utility and Futility in Farmers' Organizations For Irrigation Management: Lessons From Sri Lanka, IIMI, Digana Village, Sri Lanka

The author examines the development of agency-sponsored farmer organizations in two irrigation systems in Sri Lanka where field research has been conducted over a two-year period. The irrigation management functions of the farmers are viewed in terms of the management environment including: (a) the irrigation agency's functions; (b) policies and support services for farmers' organizations; and (c) government policies of land tenure and irrigation cost recovery. In his research framework, he considered two alternative scenarios for increasing the level of farmer participation in the two study systems. The first scenario modeled on examples from the Philippines and Indonesia, would require changes in: (a); (b); and (c). He argued that this scenario is not feasible in Sri Lanka for political reasons. The second scenario, however, calls for incremental changes in the irrigation agency's function, moderate changes in policies and support services for farmers' organizations and no change in government policies of land tenure and irrigation cost recovery. He said that the second scenario is feasible, and could result in significant, albeit modest, improvements in irrigation management.

His argument in favour for the second scenario are: (a) neither the policy environment which underlies the Philippine success (stringent budget cut and life or death cost recovery), not the socio-political tradition of autonomous village-based irrigation associations -- obtains in the Sri Lankan context; (b) expecting farmers to form organizations in order to carry out the functions already provided by the government is futile; (c) the logic behind irrigation service fees, is that the government in providing service for which, under donor pressure, the government is asking farmers to pay; and (d) expecting policies that will place greater authority in farmers' hands is, given past experiences, unrealistic.

The less dramatic, but more promising course of action leading to increased farmer management participation calls for a joint problem

solving by agency staff and farmer representatives. Hence, before trying to form organizations, emphasis needs be given to creating management functions which both agency staff and farmers view as reasonable and useful, he said.

DOUGLAS J. MERREY and SENERATH BULANKULAME: Responsibility in Irrigation System Management: Some Policy Suggestions For Sri Lanka, IIMI Management Brief, September 1987.

Merrey and Bulankulame both believed that farmer participation in irrigation system management in Sri Lanka has already been accepted as concept by most professionals and policy-makers concerned with improving system performance. But questions remain about the organization form farmer participation should take, the degree of responsibility fakers should be asked to shoulder, the relationships to be developed between the farmers and the government, and the specific task to be assigned to the farmers and government agencies to change their respective roles in irrigation management.

They said that a clear policy commitment is required to develop and implement effective participatory method, and that a special legal framework will be required to facilitate the process.

The first suggestion is to revise the classification of the irrigation systems into: (a) Village Tank and Small Anicut; (b) Small Medium System; (c) Large Medium System; and (d) Major/Multipurpose Systems. Appropriate policies are recommended for each of these as follows:

a. Village Tank and Small Medium System: These two systems be placed under the responsibility of one agency. The government would provide financial and technical assistance as needed and requested by farmers. Complete turnover of ownership and management responsibility to legally constituted users organization.

b. Large Medium System: A joint farmer-government management, with farmers having responsibility (including ownership) for branch and distributary canals and field channels through the legalized associations of water users.

c. Major/Multipurpose Systems: The government will retain primary responsibility for management at the main reservoir and inter-basin transfer levels and a joint farmer-government responsibility for large components, such as main canal and sub-systems similar to that suggested for the large medium systems.

The authors suggested strategies for achieving policy objectives and said that three common elements are essential for all the strategies:

a. a clear policy statement and strong political and administrative support from government and strong support from the farmers;

b. a legal framework supporting the policy objective; and

c an approach to develop appropriate strategies for implementing the policy, which would include learning from other countries.

JAYANTHA JAYEWARDANE, The Training of Mahaweli Turnout Group Leaders in IMMI, Participatory Management in Sri Lanka's Irrigation Schemes, IMMI Digana Village, Sri Lanka,1986

This paper is an evaluation of a Turnout Group Training Program that was carried out in the Mahaweli System "H" from 1979 to 1983. The main aim of the training program was to organize farmer groups and to train them in the various aspects of agriculture and water management, especially their managerial and organizational skills. Such group activity and training, it was envisaged, would make farmer groups strong and less dependent on the Mahaweli Authority and the Government. Another aim was to correct the belief that the government and its functionaries have to do everything for the settler. The training program that started in 1979, focussed on representatives of turnout groups (FKs) who were expected in turn to disseminate this training and information to the other farmers in their groups. Training was held fortnightly at the Community Development Centers which were located in various parts of System "H". The subsequent evaluation of the training program showed, according to the author, that turnout group training has had a positive effect on the farmers in enabling them to organize themselves to make maximum use of the land, water, and other resources available to them. Some increase in their productivity was noticed and crop diversification was also introduced as a part of the training to which farmers responded well. A rapid reduction of the irrigation problems that beset most of the farmers in the initial stages of the project, especially in the receipt and equitable distribution of water was also evident as a result of the regular farmer training program.

T.H. KARUNATILAKE, Farmer Participation in Water Management in the Mahaweli Projects in IMMI, Participatory Management in Sri Lanka's Irrigation Schemes, (IIMI),1986

This paper deals with the early experiments of settler participation in irrigation water management in the Mahaweli System "H". The program aimed at getting settler-farmers' commitment and assistance in the O&M of the irrigation system. The strategy adopted was to guide them in the efficient use of irrigation water and to get them to self-manage the secondary and tertiary irrigation systems.

The program began in 1979 and followed the following guidelines which have since remained more or less unchanged in farmer participatory programs of the Mahaweli Projects. The physical basis for the groupings is the irrigation turnout (TOG) and this forms the social basis for the community as the members of the group will also be the farmers who

cultivate land under the turnout. The group has to have a broad perspective and cover not only irrigation water management but also other aspects of agriculture such as soil management, cropping and land preparation. The author argues that the turnout-based water management organizations have yielded gains such as the reduction of the excessive use of irrigation water and increase in the yield per acre of paddy cultivation. The author further argues that the TOG is instrumental in bringing about a considerable transformation in agricultural practices.

The author makes a case against the federation of TOGs at a higher point on the irrigation network at the initial stages of their formation. Such large organizations with other objectives could fail to meet fundamental objectives of the small groups and thus could diminish their effectiveness.

JAYANTHA PERERA, The Gal Oya Farmer Organization Programme: A Learning Process in IIMI, Participatory Management in Sri Lanka's Irrigation Schemes, IMMI, Digana Village, Sri Lanka, 1986

The Gal Oya Farmer Organization Programme started in 1979 as a component of the Gal Oya Left Bank Rehabilitation Project. The main objective of the program was to get the farmer beneficiaries into irrigation water management. For this purpose, a group of catalysts, Institutional Organizers, were deployed to live with farmers and to motivate them to organism into their own field channel organizations. The program continued for five years and during this period a complex four tier farmer organization network evolved in the area. The program clearly showed the need to introduce some form of organizational set-up, preferably with the commencement of settlement. Another lesson is the need to federate farmer organizations at different levels to articulate farmers problems and demands all the way up to the highest level. This facilitates farmer-officer relationships and promotes farmers' self perception as the share-holders of the Project. Such organizations should be loosely structured multi-purpose organizations. They should preferably be established on hydrological lines, that is, the members must jointly share and control a single water source such as a field channel.

The program was badly affected by the frequent departure of trained Institutional Organizers. This necessitated the recruitment of several batches of Institutional Organizers. As a result, the progression of the formation of farmer organizations was retarded and its replicability was challenged.

N.G.R. DE SILVA, Involvement of Farmers in Water Management - Alternative Approach at Minipe, Sri Lanka, in United Nations' Food and Agricultural Organizations (FAO), Participatory Experiences in Irrigation Water Management, Rome, 1985

The Minipe Irrigation Scheme comprises an area of 6,000 ha of paddy land. It was begun in 1939 and was finally completed in 1969. Before the

water management project began in 1978, the level of water management in the irrigation scheme was extremely poor. Under the water management project a cadre of change agents was enlisted by the Department of Irrigation with the support of an NGO, the National Heritage Programme. The main objective of the program was to mobilize local human resources to improve agricultural productivity based on socio-cultural practices of the past. A team of highly motivated group of youths was appointed as catalysts who in turn was supported by the buddhist priests and school teachers who had great influence upon the rural people in the area. Informal group representatives were elected from among the farmers to represent areas of between 2 and 4 ha in the Pilot area. These leaders were trained to participate in water management and were incorporated into the project coordinating committees where both farmer representatives and government officers were expected to work with each other.

The functioning of these committees although satisfactory, encountered several difficulties. First, the poor attendance of government officials at the committee meetings. Second the lack of finances to speed up water management programs. Third the lack of sufficient number of resource personnel to take the participatory role in water management to the grass-roots level. Despite all these weaknesses, farmers became accustomed to the new decision making processes through their representatives. Furthermore, the extension workers found that their work became much easier due to the regular ready-made forum of the water management committees of which they themselves are members. The coordination of activities within each sub-project area is done by the farmer-chairman of the committee, not by a government officer, and this motivated the farmers to work towards the safeguarding, continuation, and improvement of the system.

NORMAN UPHOFF, Participatory Evaluation of Farmer Organizations' Capacity for Development Tasks in Agricutural Administration and Extension 30 (1988) 43 - 64 pp.

This paper presents a methodology initiated with irrigation user-groups in Sri Lanka to evaluate their performance. The author has identified two inter-related problems that confront any evaluation of the organizational capacity of farmer organizations. The first is that an organization's capacity is very difficult to assess, as it represents potential rather than just performance. Indirect measures are needed for estimating this important variable in agricultural administration. Secondly, most approaches to evaluation are themselves "top-down" and thus inconsistent with the capacity they are supposed to assess. The author argues that ideally a system of evaluation that itself supports the value and process of "participation" in development activities would meet this difficult task. The methodology developed in this paper recognizes five activity areas: (a) water management, (b) maintenance of structures, (c) agricultural practices, (d) organizational capacity, and (e) organizational linkages.

NORMAN UPHOFF, An Overview of Concept and Strategies for Farmer Participation in Water Management in ARTI, 1986

The author discusses the farmer participation approach to water management as a "learning process approach." He presents several aspects and assumptions of the approach. The first is the assumption that local people have something valuable to contribute to the process, be it their labour, ideas, experience, and ingenuity. The second is the value attached to the right of people to make decisions affecting their lives and even to make mistakes. The third is that local people should have more responsible involvement in development efforts because they can improve them according to the criteria of efficiency and effectiveness set from outside. Based on these grounds the author makes a comparison between "participatory" and "paternalistic" approaches and reiterates the danger of emphasizing the take-it-for-granted attitude of officials and policy implementors that those with education and authority have full knowledge to make decisions for other people.

On the other hand, the author argues that it is equally naive to assume that farmers know everything which makes them the most suitable people for decision-making in their own environment. The author gives a comprehensive description of different dimensions of "participation": participation in (a) decision-making; (b) implementation; (c) benefits; and (d) evaluation. Finally the author gives some guidelines for effective participation: (1) respect for rural people; (2) willingness to let people make their own decisions; (3) acceptance that the local organization is really the members', not the government's; (4) acceptance of the fact that there will be some "mistakes"; and (5) willingness to be flexible and to live with a certain "variability." The author concludes that a participatory approach to irrigation water management, or to any aspect of development, is not an automatic solution. Various approaches will work better under different circumstances, so there is no single approach that can be called "participatory."

D.R. WIJETHUNGA, <u>The Wew-Sabha and Peoples Participation in Small Irrigation Systems</u>, In IMMI 1986

The National Freedom from Hunger Campaign Board of the Ministry of Agricultural Research and Development has carried out several experiments with regard to farmer organizations in rural development particularly, in irrigation water management in small village irrigation systems. The paper is a short appraisal of some of these experiments in the dry zone. The main feature of the program is the approach to restore village irrigation systems in partnership with farmer beneficiaries. All activity is geared, it is explained, to restore to the village an ecologically balanced environment.

Farmer organizations were organized around already existing Rural Development Societies in each village. But the Board later found such a strategy would not bring the necessary socio-economic improvements to the poorest segments of the community. Therefore an innovative association

called Wew Sabha (tank committee) was established with the people who took part in the reservoir restoration activities. The members were expected to restore their reservoir with their own hands, repair and maintain the irrigation system, regulate and control issue of water from the reservoir, plan and regulate cultivation, and to organize inputs and marketing facilities. The paper reports some mixed results of this experimentation. The main obstacles came from the vested interests in the village community. The author concludes saying that to ensure the sustained involvement of farmers in Wew Sabha activities several factors should be there which are often beyond the capacity of the farmers. The first is to ensure that each Wew Sabha generates sufficient funds to pay for repair and maintenance of the reservoir and its irrigation systems. The second is to provide them with technical knowledge, so that they could do O&M effectively and economically. The first can be achieved mainly by contributing some capital from their harvests to the Reservoir Maintenance Fund and the second by organizing farmer training programs and on-the-job training.

KAPILA P. WIMALADHARMA, Participatory Management in Irrigation Projects, the Unfinished Experiment in Sri Lanka, in IMMI, Participatory Management in Sri Lanka's Irrigation Schemes, IIMI, Digana, Sri Lanka, 1986.

According to the author, participation of the local community is today taken as a defining feature of community development. However, confusion remains as to whether all community members or only the select target groups need to participate.

In Sri Lanka, during the last decade and a half, several different experiments were launched in which the central focus was on the involvement of the water-users in irrigation management. Kurunegala district is one area that carries representative types of these various experiments, and further, where the activities in most experiments have been documented.

His comparative overview of the different experiments are briefly discussed hereunder:

a. The nature of the experiment were not meant to be scientific.

b. The scope for most of the government sponsored projects, water management was the major, if not the sole, specific goal, whereas, the NGOs saw it only as part of a comprehensive development.

These two extreme positions in regard to irrigation management have important implications for the question of beneficiary participation according to the author. Hence he opined that a research should be undertaken to study whether a functionally-specialized and interest group-specific organization better be able to procure fulsome participation than a multipurpose organization comprising of diffuse membership.

Finally, the author said, "organizing farmers in Sri Lanka is an unfinished experiment. A multitude of farmer organizations exist. Some complain that institutions have not been allowed to continue to grow for 5 to 6 years, and that instead, we have had a series of experiments. We are the great experimenters: experimenting at village level with different farmer institutions, at the district level, and even at the national level but in not applying the lessons drawn from the earlier experiences.

Chapter IV
Farmer Support Services

AGRARIAN RESEARCH AND TRAINING INSTITUTE. Price Data and Market Intelligence in Food Marketing, Proceedings of a Seminar, 26-27 September 1983, Colombo.

A collection of papers presented at the seminar: appropriate papers are summarized below. The foreword notes the importance of integrating the small farmer into the market system and indicates this can be done through making available information on market conditions and prices, preparing periodic forecasts, and recording flow patterns (it is assumed this means channels of distribution) on agricultural commodities.

The introductory remarks by the Director of the ARTI, note that there are at least 28 different institutions in Sri Lanka collecting agricultural price data, and that there is little if any coordination among them. The Market Research Unit at ARTI was set up to serve the National Food Policy Committee.

Marketing is defined in the traditional sense as being all those activities involved in getting goods and services from the producers to the consumers, and thus includes transport and storage. It is noted that "we are now in what is known as a free market economy where the private, cooperative and state sectors play an equal role," (an unusual definition, to say the least), and that the Sri Lankan domestic agricultural sector is entirely in the hands of the small producers. These farmers are characterised as producing for household subsistence, with decisions being household based, risk minimizers, having small and unstable marketable surpluses, low bargaining power, suffering from a capital deficit and having only seasonally available cash. Given the above, farmers are not attractive clients for the trading community, but if they were assured of market outlets, they could be induced to increase production beyond immediate household needs, thus increasing incomes, and presumably integrating them into the trading system. While it is pointed out that there are several shortcomings in the marketing system, one of the major ones is the lack of market information at all levels of market decision making, with many small farmers knowing little about the prices prevailing for their products. Public price information systems lack the requirements of timeliness, accuracy, and comprehensiveness, and key marketing organizations lack information on marketable surpluses, thus limiting their ability to forecast and to modify marketing policies as needed.

"Price Data and Market Information for Decision Making" Nanayakkara, Upali, Director of Marketing, Agricultural Development Authority.

The ADA collects and analyses price and output data for rice, potatoes, red onions, and chillies for the weekly Cost of Living Committee meeting and for internal decision making. They are also attempting to

collect and analyse data on coarse grains and pulses, but with less success, since it is subsistence cropping, and is both sporadic and widely dispersed. According to ADA experience farmers are highly responsive to floor prices higher than market equilibrium levels and to production subsidies, which is hardly surprising. The author notes that price data and market information collection in Sri Lanka are seldom related to system improvement but are rather for the purpose of "administrative objectives", and that "studies have generally been subjectively based towards facilitating raw roles that administrative price support agencies and/or food procurement and distribution agencies are required to play." He rather pointedly notes that data gathering and analysis is for officially motivated cost of living management efforts within limited urban/industrial commercial sectors. This may explain both the large number of data collection agencies and the fact that there is little if any agreement between their respective sets of data: to some degree, the data reflect the purpose for which they were gathered. There also follows a discussion of floor prices and the tendency of a floor price system to encourage inefficiency by justifying high cost producers.

"The People's Bank" Siriwardena, S.S.A.L.

This paper discussed the results of a survey in System "H" of the Mahaweli, and is especially important for what it reveals about the informal credit system which operates in the agricultural sector. The survey indicated that most market transactions in the Mahaweli are carried out through the informal credit system, with 64 percent of the transactions effected by traders in 1982 on a credit basis. The crop mortgage is also important, and in one block it was found that over 75 percent of total production had been purchased by traders in advance of harvest in return for covering cultivation expenses and personal consumption needs up to the harvest period. That the farmer receives a total lower return is amply illustrated by the fact that the average advance purchase price for rice was found to be Rs 38-44/- per kilo when the average market price was Rs 60/-. The author points out that in the Mahaweli a degree of intensive farming has to be carried out to achieve economic levels of production, and this intensive farming requires a heavier initial capital outlay, and increased costs of production, putting the small farmer under great pressure. The author points out that the continued growth of the middleman or private trader sector is an indication that they are providing services not otherwise available to the small farmer, but that peasant farmers locked in to the informal credit system will not benefit from market information because they are not independent to use such information. The author states that the Marketing Organization of the MASL found it difficult to break through the private trader system and win farmers over to their marketing program, and also notes that Yala season is now the most important, since that is when the higher cost and higher profit cash crops tend to be grown. It was found in System "H" that during Yala some of the lands were leased to outsiders for cash crop cultivation.

"Oils and Fats Corporation" Amerasinghe, M.J.S.

This company has a stated volume of 5,000 tons per month, and agricultural raw materials account for some 85 percent of production costs. Maize accounts for 25 percent of the weight of the poultry feed they produce and is a major concern, since it is available only from January through April, thus requiring substantial inventory and storage costs. Since most maize cultivation is of chena type, it is in small holdings and thus Oils and Fats uses a collector/supplier system to avoid having to deal with individual farmers.

At the time of the paper, soybeans were priced at Rs 6,000 /-per ton, and the author stated that at that price it was uneconomic to purchase, as the extracted oil (which must be removed to incorporate soybean meal in feed) could not be marketed in sufficient quantities and at high enough prices to justify production.

Rice bran is used extensively, and has the advantage of year round availability. Over time the company has induced millers to upgrade the quality of the bran offered by paying a premium for better quality. The result has been that they have been able to completely replace wheat brans.

Of special interest was that the company stated it had no information on prices or cultivation from external sources.

"Department for Marketing Development" Jayasekera, L.T.

This paper calls for the planned production of vegetables, and an increased emphasis on consumer demand. They provide data to the Cost of Living Committee, and collect price data at Pettah, Wellawatte, Kirulapone, and Thibirigasyaya.

"The Central Bank" Athuraliya, N.A. de S.

The bank collects data from more than 100 centers, using teachers with economics and statistics training. They collect retail prices on 300 items, and producer prices (including input prices such as seed and fertilizer) for paddy, coconut, and rubber. Retail prices are collected twice weekly, producer prices twice monthly. Of special interest is that they produce frequency distribution charts and identify seasonal variation of prices. Emphasis was made that while a great deal of data is collected little effort is made at analysis, and that the lag between data collection and publication often destroys its usefulness to the private sector.

"Department of Census and Statistics" Weeratunge, D.S.L.

Collects weekly retail prices each Wednesday, including prices for 101 food items in each district of the country. Has been collecting Farm Gate prices since 1966. Major problem: time lag of one to two years between collection of data and publication.

"Mahaweli Authority of Sri Lanka" Amerasekera, G.L.W.

The marketing division of the Mahaweli was established to provide a market driven mechanism to the farmer. The division sends out marketing staff to the wholesale and retail markets to gather data for comparative price analyses, upon which they make crop recommendations for the coming season. According to the author the MASL also plays the role of intermediary, collecting agent, and broker, and negotiates with state, cooperative and private sector organizations on both price and quantity issues. They also arrange all logistical matters for the collection of produce, and attempt to make farmers become more commercially oriented. In at least one case, they have introduced a scheme in conjunction with the private banking system to give farmers credit in exchange for what amounts to the establishment of a cess system to insure the loan is repaid. It is stated that the repayment rate for cultivation loans has risen to about 80 percent and for Hatton Bank is virtually 100 percent.

"The Private Sector" Ariyathunga, R.A.

The author is with a private spice brokering firm and in his paper reiterates some of that company's experiences in the market. He notes that if one stays with high quality, price fluctuations are more moderate than is the case for second quality product, and that occasionally there is concerted action by competitive buyers to jointly act to lower prices. This is done by having only one firm bid on a lot of spices, distributing the lot later to other members of the group. A list of "to be expected" trade malpractices follows including the standard placement of the highest quality spice on the top of the container. The author notes that little or no information is provided by the government on the status of the world market.

"Agrarian Research and Training Institute" Vithanage, Dr. Nelson S.

This paper discusses the role of the marketing research unit at ARTI and notes that ARTI is the source of the Food Commodities Bulletin, which reports wholesale and retail prices for 30 food commodities. Movements and stocks through the Colombo terminal market are also covered by ARTI, and there is a weekly presentation of a feature which discusses current problems in agricultural marketing.

The seminar concluded with a Recommendations and Suggestions for Further Follow-up Action, which was remarkably inconclusive with some of the participants happy with the status quo, while others advocated the establishment of a central statistical agency.

ASIAN DEVELOPMENT BANK AND GOVERNMENT OF SRI LANKA. Subsidiary Crops Production and Processing Project, Minster Agriculture Limited, Thames, England and Agroskills Limited, Colombo, Sri Lanka, in association with Tropical Development and Research Institute Limited, London, Jan 1987

This report notes that the GOSL has, through the Accelerated Manawelli Program, virtually achieved self-sufficiency in rice, while simultaneously rehabilitating traditional crops. This has led to the neglect of the subsidiary crops sector, which includes minor export crops, fruits and vegetables, and other field crops. With the advent of the National Agriculture, Food and Nutrition Strategy however, and the provision of funding through the ADB, the possibility exists to formulate projects for potential funding. This report addresses that possibility and examines several potentials.

The report notes that under the Agrarian Service Act of 1979, land which is currently or at any time has been used for paddy production, should only be cultivated with paddy during paddy season. While the Act is rarely enforced it has the potential of creating legal problems.

That said, the report goes on to state that paddy is not the most economic crop for well drained lands and there is a need to develop alternative crops, particularly in the Yala season. This statement occurs within the context of examining constraints with regard to farming and cropping systems, and is pointed to as the major problem with irrigated rice in the dry zone. For rainfed systems in the dry zone the report states there is a need to introduce cropping patterns that will stabilize chena cultivation and increase farm profitability under rainfed conditions. As to homestead systems in settlement projects it notes that these are under utilized due to farmer interest in paddy. The indicated solution is a restructuring of these units to increase production using results from regional research stations such as Maha Illuppalama.

An examination of the economics of subsidiary crop production indicates that, for rainfed cereals and legumes, black and green gram are the most profitable, while soy bean is not very attractive and rice produces a low margin.

For irrigated cereals and legumes black and green gram are again the most attractive followed by groundnuts, while for other irrigated crops up country vegetable growing is the most attractive. Green chillies in the low and mid country are noted to be profitable but requiring such labour as to return Rs 79/- per man day.

For fruit trees and minor export crops, all appear profitable. Special mention is made of the economic viability of citrus for the domestic market, especially if storage is introduced.

In terms of inputs it is noted that in seed production, due to high government control, there is a problem with the lack of issue of new varieties, lack of production and an inability to distribute seeds, which it is hoped will be alleviated through government commitment to

privatisation of the seed industry. For private nurseries it is pointed that the issuance of permits for purchase are subject to favoritism, training is not available, quality planting material is not available, prices have not been revised to compensate for increased costs, and nurserymen suffer from an average delay in payment time of five months. This has resulted in the inability of nurserymen to resort to institutional borrowing to purchase shade houses, irrigation equipment and develop wells.

The report identifies the following crops for export, fresh or processed, or for local processor use: pineapple, passion fruit, soursop, mango, vegetables such as gherkins for semi-processing and cashews, and notes that increased production can be brought about on nucleus estates, through small holders in the Mahaweli above command, through medium scale production on 2-8 hectare farms, and from small scale production on mixed homestead and home garden areas.

Other field crops with potential include: of immediate potential onions, chillies, chick peas, sesame, ginger, black gram and cassava, of potential dependent on pricing policies, maize and soya, and of potential but dependent on technology, garlic and turmeric. Production increases for all these crops can be expected from small and medium scale farms in the dry and intermediate zones, and from irrigated well drained soils, the latter due to (1) greater return on water usage (2) ability to produce out of season. Further development of the SFC sector is likely to come from new uses for existing crops (cotton for cloth production, cassava for starch) and new crops such as macadamias and pharmaceuticals. Current constraints to the introduction of new crops are lack of access to land and overly restrictive quarantine regulations.

The report makes particular note of the existence and potential use of 64,000 acres in Mahaweli Systems "B" and "C" for irrigated tree fruit and nut production in the above command areas, using groundwater and pumped irrigation systems.

There follows a discussion of the Post Harvest Handling and Processing Sector, the salient points being that:

1. existing fruit and vegetable exporters operate at 50 percent capacity or below;

2. there are 11 fruit processors, and the technology level is some thirty years behind, but probably adequate for the markets served;

3. there are four soybean processors, using about 35 percent of their capacity due to lack of supply;

4. oilseed processing centers on sesame in the Jaffna area and castor oil, which is exported raw;

5. the animal feed industry has 8 plants, with adequate technology and capacity;

6. for fresh fruits and vegetables post harvest handling technology is not applied at any stage between producer and consumer for the local market except for washing and trimming at the retail level. The use of storage is unknown;

7. exporters of pineapples, green chillies yams and some vegetables have begun to use reefers for Mid-East shipments. This has created a need for pre cooling to remove field heat;

8. insufficient attention has been placed on introducing varieties required by the export market;

9. soybean processing for human consumption is covered in some detail and it is noted that:

   a. the thriposha program needs to double its intake of soybean and maize. Thriposha is a babyfood distributed free to over 58,000 children through Ministry of Health and Care, and

   b. Ceylon Oils and Fats used only three percent of their capacity of soybean oil manufacture due to lack of raw material in 1985,

10. soybean and maize for animal feed: the capacity of the feed mills is 22,500 tons per month but only 1/3 is being utilized due to lack of raw material and in spite of an increasing demand for animal feed; and

11. in fruit, vegetable, and nut processing the report points to opportunities in fruit concentrate manufacture, processing of soursop into single strength juice either frozen or aseptically packaged (this would require organized plantings), production of lime juice for culinary markets, and the introduction of the technology for the preservation of vegetables in brine for export to Japan.

Marketing of subsidiary crops is a function of six Government organizations, all involved unprofitably, as well as the private sector, which by definition requires profit for survival. Besides the six government organizations directly involved there are another six with indirect involvement, and this creates overlaps and deficiencies, particularly in the provision of marketing information.

Marketing functions performed are basic and consist mostly of bulking and distribution, with little storage and virtually no drying, cleaning and grading. While the system is efficient, quality standards are low and losses high. Poor quality is largely the result of lack of producer knowledge and sufficient incentive. There is an effective discussion of the marketing system under "marketing chains" which states "there is no evidence that they (intermediaries) charge excessively for the service they provide. Reduction in the number and influence of intermediaries will come with the integration of supply... which will remedy them two serious failings of Sri Lanka 's agricultural economy, sustained commercial volume and acceptable quality... quality control should begin

where the produce is grown and has to be maintained by the marketing system.

Marketing credit is required for trade finance for buyers and for fixed and working capital to purchase post harvest facilities, cleaning, storing, packaging equipment, etc. Marketing facilities in both polas and Colombo and Kandy markets are inadequate.

The major problem in analysing the domestic market sector is lack of data, according to the report, but there is evidence of a growing demand for subsidiary crops. It is likely that demand for fresh unprocessed products will grow in line with population and income growth. There are shortages of green gram and cowpeas but periodic gluts of potatoes, onions, beans, tomatoes, cabbages gourds, limes and mangoes. (Note that some of these can be stored long periods.) There is an unsatisfied demand as evidenced by imports for dried legumes, onions, chillies, garlic, turmeric, and blackgram.

Exports of fresh fruits and vegetables is 36 percent Middle East (primarily Saudi Arabia), 37 percent ESCAP (primarily Japan) and 27 percent Europe. Exporters are concerned that they are unable to develop consistent sources of supply and thus have not developed the markets to the extent that they could. (An opportunity for MARD?)

Exports of processed vegetables are non existent although the report notes that gherkins and chillies in brine are though to have good possibilities. Exports of processed fruits have been declining since the 1960s, when significant passion fruit exports occurred. (Must investigate - passion fruit concentrate is in growing demand)

<u>Exports of Other Field Crops</u>:

sesame: problem is mix of black and white grains

blackgram: export markets in Japan and Singapore for bean sprout production, but Sri Lanka suffers from poor quality image (immature seeds, non-germinating/sprouting)

castor: should be in increasing demand for paints, lacquer, lubricant, disinfectant, pharmaceutical use.

ginger: exports growing to Middle East

<u>Opportunities</u>:

Minor Export Crops - not applicable to System "B"

Fresh fruits and vegetables: 1. concentrate on Middle East Market (I agree), Europe second (stiffer competition, freight problems) and bananas, citrus and vegetables for ESCAP market

Processed Products: In short-term concentrate on semi-processed gherkins and chillies and passion fruit, pineapple and soursop concentrate. (Disagree on pineapple).

Problems: The report notes "there should be a critical review of the export freight business, in particular of the intermediation of the Central freight Bureau, and of air freight capacity."

Credit: Short-term crop loans used to dominate (76 percent of ag loans in 1976), but now long term loans account for 64 percent, indicating institutional credit being extended to fewer farmers, and small farmers turning to informal credit sources. Of farmers sampled fully 52 percent were unable to meet bank requirements, mostly due to lack of collateral and previous defaults. Survey revealed private money lenders charged 30-84 percent interest, but farmers considered this acceptable because it was quick and easy (low opportunity cost?) Credit for high value crops tended to come from institutional sources.

Trade credit - buyers finance internally. Major wholesalers indicate bank credit procedures cumbersome and frustrating.

It was suggested that involving the semi-formal sectors such as cooperative credit societies, thrift societies and producer societies, as responsible bodies for providing and recovering credit could be useful-(gherkin producers society)

Policy Constraints:

1. lack of clear government signals
2. lack of government financial support to the ag private sector
3. physical infrastructure, particularly access roads and communications
4. post harvest technology
5. Production and utilization of soy and maize is in confusion due to lack of clear signals by government. These two crops accounted for 63 million in foreign exchange
6. list of agro industries eligible for tax holidays needs to be expanded

Private sector fiscal and policy improvements needed are:

1. ease of acquisition of land for agriculture
2. easing of outdated procedures for approval of private sector activities
3. fiscal incentives
4. infrastructure development

Based on its study and the National Agriculture Food and Nutrition Survey the report recommend that for fruits and vegetables - encourage extension of growing season absorb gluts through storage and processing, improve varietal selections, and provide seed and planting material through the private sector. This is probably a 5,000 ton incremental market incremental to the current 5,000 tons for other field crops:

develop rainfed farming systems and integrate crops and livestock, improv storage and road access, and improve market information flows for impor substitution concentrate on chillies green gram onions and turmeric fo other field crops: maize for human consumption and animal feed and vic versa for soy, produce cassava for starch.

3. **RONCO CONSULTING CORPORATION. A Study of Food Processing and Produc Development Technology, Washington, D.C. July, 1986**

This study ties in with the one above in that it uses as its base th National Agriculture Food and Nutrition Strategy.

Major points are:

1. Development of "appropriate technology" processing facilities at th village level may be acceptable for the domestic market, but wil seriously impede access to the international market. For this, har currency machinery and technology of the state of the art level wil be required.

2. Food technology, processing and product development is fragmente between too many institutions and tends to occur in isolation fro the private sector.

3. For fresh produce for export there was no modern sorting, grading c packing. No cold storage or chilling rooms available, and no airpo facilities for air shipments. Port facilities are excellent on th other hand and are provided by the private sector, with facilitie for refrigerated and CAS containers. Shipping companies have bee unable to generate high use of facilities due to lack of sufficien and consistent supply of raw materials.

4. For rice and legumes packaging was limited to bulk.

5. For oilseeds, it was reported that Sri Lankan production is high cos due to low productivity, with imported soy oil cheaper than domesti beans. Large quantities of sesame and coconut oils are produced a cottage industry.

6. For fruit and vegetable processing, technology varied from state o the art to hand operations, but packaging was limited to cans, olde type glass, and inexpensive plastic.

The limited packaging technology available in Sri Lanka was felt t be a constraining factor on all food processing (this is doubtful, excep in the case of aseptic).

It is pointed out that traditional product flows will continue t exist and that much can be done improving or better adapting traditiona packaging to lower handling costs and decreasing waste, etc.

The heart of this report is in the statement that "there is no close communication in the production/marketing link and thus producers see no point in growing large volumes of a crop because there is no visible market: entrepreneurs are reluctant to risk investment in processing because of the lack of uniform and consistent supply necessary to develop a strong market. To provide adequate supplies of raw material for industrial processing, crops must be grown specifically for that purpose. It is not satisfactory to consider surpluses from the fresh commodity market as the source of supply for processing."

The study recommends the formation of a National Postharvest Technology and Food Processing Center.

4. **RESEARCH AND CONSULTANCY SERVICES (PRIVATE) LIMITED. Subsidiary Crops Marketing Study Technical Report, Colombo. December 1982**

This should not be considered a report but is rather a proposal for a study. Of interest was their brief discussion of marketing factors which affect the nature of arrangements available for transfer from commodity surplus area which include:

1. the highly seasonal nature of production which concentrates the bulk of marketing activity into a few short weeks, and which means that marketing mechanisms lie idle for the bulk of the year (so what? this doesn't mean the people are idle, nor I suspect are the mechanisms idle - they have shifted to other non-SFC crops),

2. relative perishability affects the crops differently, with more pricing volatility for potatoes, manioc and sweet potatoes than for grains, oilseeds and pulses,

3. multiplicity of small surplus producers requires a lengthy and broad marketing channel for accumulation in bulk at transport points, and

4. development of roads in rice areas has meant relatively easier access for rice than for SFC's which tend to be grown under chena conditions and which thus suffer from access problems.

5. **AGROSKILLS LIMITED. Subsidiary Food Crops Marketing Study - Main Report, Colombo, Sri Lanka. October, 1983**

Marketing is not the main constraint to the development of this sector: while there are areas of marketing for these crops that can be improved they do not relate to the performance of marketing functions by traders or to the behavior of market channels, but rather to infrastructure development and policy support.

Availability of land is not expected to be a constraint.

Domestic demand for SFC's is expected to rise by 1.5 to 3.8 percent per year.

Castor seed has high export demand but is constrained like most SFC's by inadequacy of the production base.

Returns per unit of land range from high for potatoes and onions to low for coarse grains. However, the choice of crops by producers is heavily influenced by input requirements and their familiarity with the crop.

More than 80 percent of SFC production enters market channels-little is retained for home consumption, and the bulk is sold immediately on harvest. Better storage facilities at producer level or production area level would facilitate spreading sales over longer period.

For cassava, blackgram, soybean and chillies, the local traders and collectors pay higher prices than outsiders: the opposite is true for other SFC's.

Commitment of crops to pre-harvest buyers did not necessarily mean lower prices for the farmer for chillies, cassava, potatoes, and onions, but did for maize, ground nut, greengram and finger millet. (this was a one time study, so it could mean that chillie buyers for instance just guessed wrong that year, and suffered losses-a reflection of their risk in providing crop advances)

The market structure for SFC's is efficient and producers receive a high share of the final wholesale price - in many cases 80 percent.

A theoretical study suggested that pricing was efficient and that the difference in prices between two points did not exceed transport costs, and that seasonal price differences were not greater than storage costs: it was also found that the length of the storage periods necessary to benefit from price variations was so long as to make storage for speculative purposes unprofitable.

Premature harvesting of SFC's is a serious constraint to subsequent storage and the maintenance of quality standards. Praedial larceny or the fear of it is one of the chief causes of premature harvesting.

Lack of attention to post harvest activities causes serious losses through spoilage and pest attack, and greater attention is needed to packaging, particularly for onions, potatoes and chillies.

There are recorded instances where the timing of imports has been such that it can be shown that they effectively depressed prices to the farmer.

Constraints to the production of SFCs were summarized as being:

1. high bank lending rate limited the traders scope and flexibility,
2. lack of producer credit, or lack of access to credit,
3. limited availability of irrigated land for SFC cultivation,
4. quantity and quality deficiencies,
5. prices of some SFCs uncompetitive due to high unit costs of production: needed are high yielding varieties of superior quality,
6. increasing costs of agro-chemicals and fertilizers,
7. migration of unskilled labour increasing cost and decreasing availability of hired labour, and
8. limited progress in integrating crop and livestock farming.

On the basis of potential export and domestic demand, nutritional benefits, national profit, input cost, farmer preference and production feasibility it was recommended that the following crops receive priority attention: maize, greengram, soybean, cowpeas, onions and chillies. Lower priority should be given to blackgram, potato, sesame, groundnuts and castor.

Development of the SFCs will depend on:

1. emphasis on production of pulses for the domestic market, principally as import substitutes,
2. development of value added processes for crops such as soybeans for domestic market,
3. development of legumes and starch crops for domestic livestock sector,
4. emphasis on production and marketing of chillies and onions as high value crops generating high incomes, and
5. development of export markets for few commodities on a long term basis.

The export marketing of sesame, blackgram (for bean sprout production) and castor beans appear to merit support.

In terms of marketing channels for SFCs it was found that farmers are not without a choice of buyers; and that the more readily marketable the crop the less likely the farmer was to be committed to fixed buyers. Among primary buyers of SFC the local trade predominates. State sector organizations compete with local traders for maize, groundnut and cowpea,

while outside trade agencies compete for onions, chillies, sesame and pulses.

Producers who based their selling prices on their own outside inquiries were found to obtain better prices than those who accepted the locally prevalent price for maize, cassava, onions, soybeans and cowpeas. The evidence of this study indicates that contrary to the popularly held view that the market structure for agricultural produce exploits the farmer and that marketing intermediaries make exorbitant profits at the expense of farmer and consumer such is not the case.

6. **FAO. Agricultural and Food Marketing Situations in the Mahaweli Area, Sri Lanka, Deonampo, Narciso, FAO, July 1986**

The title of this study is a misnomer: the study concentrates on estimating the demand for SFCs to 1991 on a national basis, and estimating supplies to 1991. There is a description of the various marketing systems in use for each of the crops. This report notes that requirements for soybeans and maize are higher than supplies due to increasing requirements of livestock feed manufacturing, and also notes increasing demand for green gram, cowpeas and vegetables. Sesame, groundnuts and onions are expected to be in an oversupply situation, and will require exports to alleviate price decreases. There follows the usual diatribe of market bashing, assailing the middleman, and extolling the virtues of government intervention in the market. It is recommended that farmers be organized into groups, to acquire and utilize storage and transport facilities, and to undertake responsibility for their own marketing.

Government must intervene to plan production by identifying markets then allocating demand and resources by region. This is a far cry from private enterprise.

7. **AGROSKILLS, LIMITED. Food Marketing Study in the Left Bank of Mahaweli System "B", Colombo, Sri Lanka. March, 1987**

INTRODUCTION

This study was commissioned by USAID as an input to the Mahaweli Agriculture and Rural Development Project, and is based on detailed interviews with 120 farmers and 47 traders all in System "B".

The study admits its own limitations in that since SFCs constituted less than one percent of the agricultural production of System "B" at the time of the study "the description of market channels, and of market participants, the identification of produce flows and of the market structure, and assessments of food storage and food processing requirements would have to be made in terms of the only commodity which used these channels, rice .... nor was it possible to identify the credit requirements or financing sources of producers and traders in SFC....

EXECUTIVE SUMMARY

The study is oriented to planning the development of storage, processing and marketing activities which, though initially oriented to rice, would benefit all grain commodities in the future, and to assess the potential for diversification under changing conditions, and to plan for future processing and marketing of projected crops. The land use patterns indicate a much lower level of well drained soils in System "B" than in other systems, and thus prospects for the development of SFCs are less. The development of the system has resulted in the presence of fewer animals, who formerly used the land as their traditional grazing area.

Prospects for Diversification:

Substantial prospects exist in the use of poorly drained soils for non-rice crops and for elevated patches in paddy tracts for SFCs.

Poorly drained soils might be used for the growing of grasses during both Maha and Yala as feed for small dairy herds in cut and carry operations, which would require a small dairy project.

Irrigated maize offers another prospect in that 1.5 percent of the farmers could be engaged in production of eggs for consumption within System "B" alone, assuming flocks of 100 birds.

Strong marketing possibilities are exotic vegetables for surrounding markets and onions for storage and subsequent sale.

Storage:

Additional central storage will be needed to handle projected increase in rice, and traders will need storage for their activities. Since existing townships are scheduled for relocation no new investment in storage has taken place.

On farm storage is restricted to farmers houses, forcing immediate disposition of surpluses, but only 15 percent of the farmers expressed interest in improving on farm storage.

Processing:

Food processing in System "B" is restricted to rice milling. The study points out that since national milling capacity exceeds demand, what should be done is to encourage the relocation of existing mills from surplus capacity areas. Financial incentives may be necessary to accomplish this.

The area now covered by System "B" constituted part of the maize bowl of Sri Lanka at one time, and small quantities of maize and sesame continue to be produced, with the only processing being limited to sun drying and winnowing. Quantities are so small at present that they do not justify investment in mechanical cleaning or processing equipment.

Vegetables are marketed through the town trader at the pola and are subject only to trimming and washing of the most rudimentary type.

Market Structure:

The majority of the rice crop is bulked by the regional wholesalers, but SFCs, intended generally for local sale, are bulked by local trader groups.

The Colombo market absorbs 17 percent of the paddy, 28 percent of cowpea and 40 percent of greengram produced and is the major price determinant.

Trader Financing:

Trade financing is generally from internal funds, both for fixed and operating lines. Larger traders indicated a need for financing for storage and transport facilities.

Constraints:

1. isolated location, dependence on rice
2. storage

MARKETING IN SYSTEM "H"

System "H" was reviewed as a model of what could evolve in System "B", especially since System "B" is a monocrop area, and has not had the time to develop that "H" has had.

"Development of marketing did not take place in the manner intended by the MASL, nor did the facilitating functions develop .. in the manner originally intended.

"Marketing functions in System "H" have seen several phases of intervention, participation and monitoring by the official system ... during the 10 years of its existence, in spite of substantial capital expenditure on infrastructure development, a coordinated and preempted development of marketing infrastructure has not been seen to have taken place within the system. The already developed peripheral towns outside the area expanded their activities taking advantage of production in the system, while entrepreneur development in the system seems to have taken the form of intermediary functions.

Socio-Economic Conditions of System "H"

A typical community has not developed, and there is a complex mix of settlers with varied behavior patterns, and the pattern of water allocation has meant that farmers who heretofore cooperated with each other now must compete for limited resources.

There is less land available for SFC, but this has resulted in higher prices: despite this farmers still prefer to cultivate paddy in both Maha and Yala.

Paddy cultivation in System "H" will barely produce income enough to meet a families needs: SFCs and other crops are needed to raise income levels, and in System "H" this has resulted in an increase of SFC cultivation from a level of 3320 acres in 1980 to 9800 acres in 1984. System "H", however, has a history of long standing settlers, easy market access with good transport, and an efficient marketing system.

Chillies have been the main cash crop and the CWE has been the major buyer, which has a stabilizing influence on prices.

Soybean has had marketing problems, adverse weather conditions and a shortage of seeds, but is purchased by Oils and Fats Corp, Paddy Marketing Board and the private sector. Farmers don't cultivate cowpea due to low prices, partially caused by substitutability by masoor dhal. Vegetables grown in both maha and yala seasons have had expanded markets opened up. Storage is not a constraint in System "H", and a feature of the system is that storage here serves as assembly facilities to channel production to end users. Since the system is in close proximity to a well developed network of urban centers which are also processing and marketing complexes, it has advantages that System "B" does not have.

Contrary to MASL intentions, which were to site rice mills in close proximity to production, mills have actually located where there are other advantages: proximity to major roads, access to markets, availability of labour, water and electricity. Many have located outside the system.

Immediately after harvest, 50-60 percent of the paddy crop is generally marketed, the remainder being retained for home consumption. Virtually all of the SFCs are marketed immediately.

The marketing system which has developed over time is the same one as has historically been there - it just gotten bigger and more well defined.

Successful processing and marketing of milk products using mini-dairy complexes has been demonstrated here.

Market information is the main problem farmers face. For SFCs price setters are the State sector agencies more than the private sector. Marketing production coordination by the MASL is weak and fragmented and the fact that large buyers can import exacerbates the problem, since they do not communicate their needs far enough in advance.

The Kalawewa Export Promotion Village, while it has lead to higher incomes for a small group of farmers, has also promoted resentment from those outside the scheme.

Constraints:

1. hidden tenancy,
2. informal credit arrangements on farm storage,
3. lack of established private traders based in the system, and
4. absence of convenient market locations within the system other than polas.

LAND USE IN THE LEFT BANK

36,000 ha irrigable
25,000 ha suitable only for paddy

6,500 ha "other irrigable" (not suited for gravity irrigation)
600 ha MASL livestock development

3,000 ha available for medium to large scale entrepreneurs

POTENTIAL FOR DIVERSIFICATION

"... It is necessary in the first instance to acknowledge the impossibility of wooing the Sri Lanka farmer completely away from the cultivation of rice particularly when he has been allotted a hectare of ill drained land highly suitable for the growing of this crop..."

"Considering that some of the major constraints to crop diversification in the left bank of System "B" are not amenable to amelioration and that others may be only moderated with time, a strategy for diversification may only be devised within the framework of these constraints and would need to be developed over a period of several years."

The principal elements of the strategy would be:

1. a crop/stock combination involving growing fodder on ill drained soils under irrigation,

2. introduction of selected oil seed crops under irrigation in Yala,

3. growing market oriented crops such as exotic vegetables under irrigation in paddy during Yala,

4. maximizing cultivation on homestead gardens in Maha and in paddy lots during Yala of grain legumes and condiment crops with appropriate storage, and

5. growing long term high value rice using 4 month water issue during Maha.

Preliminary calculations indicate that one acre of grass will support three cows under a cut and carry operation, and yield an annual return of Rs 6,700, as compared to Rs 10,000 from a hectare of rice. This is based

on three hundred days lactation and three litres of milk per day per cow. Even basic herd improvement should be able to improve yields quickly.

Under a maize poultry combination, poultry farmers would grow 1.5 acres of maize under irrigation in Yala for home mixing of feed. Maize would be 30-40 percent of the ration, the remainder of the bulk rice polish and broken rice. Using again very preliminary figures the report estimates a net return to the farmer in excess of Rs 10,000 per year.

Irrigated sesame is recommended, but it is noted that more research is needed, and that specialization in either white or black sesame is preferable to Sri Lanka's current "brown". Trials of irrigated sesame have obtained good yields.

For exotic vegetables the report recommends cabbage, carrot, radish, beet and knol-khol, and potato.

The report also discusses the possibility of raising maize for other uses - primarily for other poultry farmers, and mentions that while green gram and cowpea are already grown in the area, the provision of adequate storage would assist farmers in obtaining higher prices.

For condiments, the report emphasizes chillies and onions, again with the storage option to capture off season prices.

STORAGE FACILITIES

Limited attention has been paid to the availability of on-farm, intermediate and central storage, especially in relation to likely production levels. The farmer survey found the average family has a maximum of 60 bushels in storage, the principal form of storage being jute/poly bags. Only 20 percent of the rice farmers maintain separate storage areas, and this is usually in conjunction with living quarters. System "B" farmers retain less per crop than those of other systems because they produce rice in both seasons. Improvement of on farm storage will enhance incomes through loss and waste reduction, quality improvement and an ability to offer paddy for sale at other than peak market times.

The SFC storage is negligible, and utilizes improvised containers, woven rattan boxes, tin drums, jute bags, etc. The diversification of agriculture in System "B" will require major changes in all levels of storage, and could require:

1. increased paddy storage, since paddy production will increasingly be limited to Maha,

2. retention of all maize production for on farm feed production,

3. production of sesame and cowpeas will require different storage characteristics, and

4. introduction of exotics will require storage and handling techniques totally different from familiar crops.

Post harvest operations are the most neglected part of the process in System "B", and even the most sophisticated farmers, knowledgeable about crop diseases and pests and even the toxicity of various agro-chemicals show no interest in pests affecting stored products, and in preventive measures.

Intermediate storage for paddy and SFCs in System "B" are in reality collection and transit facilities, and have not really been designed for storage per se. Storage consists of stores constructed by MPCS prior to System "B" development, stores constructed by the MASL, limited private sector collectors storage and private miller storage. The presence of a major market at Polonnaruwa may inhibit development of storage in System "B". Under a diversified cultivation scheme, present and planned storage will create problems. Quality deterioration due to purchase of high moisture paddy is common, while bird proofing, rodent proofing and the use of dunnage to control moisture seepage are non-existent. No attempt has been made to plan the central storage needs of the system, and while there are significant facilities at Polonnaruwa, they will be unable to accommodate the surplus paddy and SFCs produced in System "B".

POST HARVEST TECHNOLOGY

With expanding production and growing quality awareness, post harvest technology will become more important: gone are the days when product shortages meant produce of any quality could be rapidly disposed of at profitable prices. Moisture and impurities are the two factors which cause buyers to downgrade price: moisture can be controlled through proper sun drying while cleaning equipment is needed to take care of impurities. 84 percent of the farmers interviewed expressed interest in mechanical cleaning. A quality inspection and surveying service needs to be established to certify grades.

PROCESSING FACILITIES

Paddy processing is the sole major agro industry in the area, and while the MASL plans may include the development of rice mills in System "B" it is more likely that development will follow the pattern of System "H" and that mills will not be located in proximity to the crop, but rather to take advantage of roads, power and market access. There are 27 huller mills in the area, all designed for processing the farmers needs for home consumption, but only 825 tons per month capacity in the commercial type mills.

The SFC processing is extremely limited and generally consists of sun drying and manual winnowing. Impurities are high, but manual cleaning is not encouraged due to the small quantities. Possibilities exist for splitting cowpea into dhal at the cottage level, and for the production of feed using broken rice, maize and rice hulls. This would require the production of sufficient amounts of maize to sustain a milling industry.

The technology is simple, and maize milling could be done in conjunction with medium scale rice mills, the only additional equipment required being a hammer mill.

Shelling of cowpea and greengram, currently undertaken almost exclusively in Colombo could be undertaken in conjunction with rice milling as well, as it utilizes similar machinery, and could be set up for approximately Rs 200,000/-.

Sesame can be cleaned through the adaptation of existing paddy/rice separators, and for a small additional investment export packaging could be undertaken at the primary processor level.

The potential also exists for a viable vegetable processing industry. This would primarily entail separation according to size shape and color, the major determinants of price, and limited packaging.

MARKET CHANNELS

The regional MPCS accounted for 81 percent of the rice transactions, but for cowpeas, greengram and vegetables the town trader was of greater importance, accounting for 45-65 percent of the transactions, followed by the local collector. Vegetables, cowpeas and greengram tend to be purchased farm gate, but rice is usually delivered to a central point. Chillie, banana and manioc are also transported to market by the producers.

Farmers share of the retail price is high.

MARKET STRUCTURE

Paddy, chillies, and onions are grown for market needs while greengram and cowpeas and vegetables are grown for the farmers own needs, according to the farmer survey. The bulk of the crops are sold at harvest, and at prices suggested by the buyer.

Primary markets are the principal method through which the farmer purchases both consumer needs and ag inputs, and serve as the collecting point for some types of produce, notably cowpea and greengram.

Bazaars have grown up along the main roads, and are the location for the town traders. The bazaars at Aralaganwila are restricted by the fact that they are outside the area designated by the MASL and are thus "illegal," a factor inhibiting their investment in permanent, improved facilities.

Polas are primarily consumer markets and do not function as collecting points. There are more exotic vegetables brought in from outside the area than local vegetables.

Wholesale distributors are located outside System "B" at Kaduruwela for rice, greengram, and cowpea. Incoming produce is sources primarily

from Colombo, secondarily from Kandy, Dambulla, and Polonnaruwa. Colombo accounts for 17 percent of the paddy, 28 percent of the cowpea and 40 percent of the greengram produced in the project area.

27 percent of the traders thought that cowpeas and greengram had the first priority as crops that had good market potential and 90 percent thought that greengram and cowpeas had second priority after rice.

Financing requirements expressed by the traders were for operating capital, with the exception of the regional wholesaler who needed funds for transport vehicles. Traders were largely financing their requirements from their own funds, with only very limited recourse to bank financing.

While there is a desire to promote group activities, there is no mechanism to promote it, and the competitive element has preempted the group spirit that formerly existed. As the farmers develop a patron client relation with the MASL there is likely to be increasing dependence.

FINANCE AND CREDIT

Cost per hectare of paddy cultivation is estimated to be in excess of 8,000 Rs excluding labour, a figure well beyond the reach of most farmers. Production credit for rice in use currently does not take into account all real costs nor the consumption component, and thus farmers are forced to rely on the "informal" credit system. Of 120 farmers interviewed only 10 had access to credit, and of those more than half obtained it from friends and relatives. Of this same group, 87 percent indicated a desire for bank assistance to facilitate group storage, marketing, or transport facilities.

MARKET DEVELOPMENT PROGRAM

"However well intentioned and however necessary at the present time, the program of direct intervention lacks both cohesion and comprehensiveness. Nor does it appear sustainable in the long term for an organization like the MEA with its multifarious development commitments ..... must rely on building up a strong chain of market participants to perform intermediary functions. The MEA has an opportunity of preventing skewed growth ... which provides settlers opportunities to participate in the trading in their production."

Basically this section of the report calls for the MEA to act as a catalyst for the private sector and then to step aside.

ANALYSIS OF CONSTRAINTS

1. Remote location, with zones 1 and 5 particularly isolated.

2. Dependency on rice.

3. Inadequacy of present resources to complete 4a and 4b.

4. Absence of private sector activities:

   a. unavailability of private storage facilities.
   b. absence of direct communications facilities, and
   c. inadequacy of transportation facilities.

SUMMARY OF RECOMMENDATIONS

1. Grass-milk integration to produce 12,000 liters of milk per day, and to process 4,000 liters per day. Construction of small dairy plant with homogenizer/pasteurizer, cream separator, yoghurt plant, and butter and ice cream unit.

2. Maize-poultry integration for the local market, raising both eggs and broilers.

3. High value rice production, raising samba rice for premium market, and requiring four-month water issue.

4. On-farm storage construction, reexamination of intermediate term storage requirements and encouragement of private sector.

5. Establishment of a bonded storage system to provide for urgent financial requirements of farmers.

6. Specially designed and constructed storage for SFCs, onions.

7. Post harvest systems improvement.

8. Grain drying.

9. Infrastructure improvement.

10. Establish bonded warehouses for rice.

8. **WEERAWARDENEA, I.K. AND I. COLONAGE. Short History of Credit for Peasant Agriculture - Evaluation Studies No. 2, Ministry of Agriculture and Lands, 1974**

This study traces the development of rural credit disbursed by the Government in the early stages of rural credit in Sri Lanka from 1940's up to 1970. The Department of Agrarian Services was solely in charge of the tasks of credit disbursement, marketing, and issue of fertilizer during this period. This report includes the Governments' policy towards these matters and a report on the subjects.

This article will help MARD to understand the experiences gained during the early period of rural credit. The lesson is that Government Departments have failed in handling direct rural credit, it must be best left to the professionals.

9. **MALHOTRA, V.P. Report on Sri Lanka's Rural Credit Project -Volumes I and II (Rural Credit Consultant), Central Bank of Sri Lanka, 1987**

The first volume covers institutional aspects and goes on to describe the roles of the Rural Credit Advisory Board set up under monetary law. It analyses the relationship between the Central Bank and other Credit institutions and argues on the logic behind the decision to set up specialized institutions to handle Small Farmer Credit. It explains the various factors responsible for defaulters and suggests the need to identify the causes in order to draw up a policy to keep the defaults to the barest minimum.

The second volume consisting of six chapters covers guidelines to the Rural Credit Department on matters like refinancing and organizing rural banking institutions. Inspection of Commercial Banks and cooperatives dealing with rural credit of providing suitable monitoring and reporting systems for rural credit of Projects implemented by rural credit institutions.

Certain changes in the rural credit structure was made during the last few years when credit came under the control and supervision of the Central Bank. Understanding the Central Bank policies and the logic behind such changes will help MARD in recommending the formation of new credit programs for crops like grapes or strawberry.

10. **NARASINGHAM, Governor, Reserve Bank of India. Banks and Agricultural Credit - The Indian Experience, (Occasional Paper), 1985**

This report traces the Indian experience in granting rural credit which dates back from the All India Rural Credit Survey in the 1940's. He describes how India has emphasized rural Credit for the development of new technology in the Agricultural and Industrial Sector and how it has moved away from security-based lending to production oriented credit. It also refers to the importance of monitoring the progress to avoid pitfalls in quantitative expansion at the cost of quantitative deterioration. It shows the need to employ trained staff in handling rural credit and the need to introduce and subsidize interest rates on Agricultural Credit.

He finally concludes by stating that the field of agricultural credit provides vast scope for experimentation and innovations.

India is one country that has done much in rural credit programs. This experience will in no small way help MARD in its new credit recommendations.

11. **GUNASEKERA, R.G.G.O. (Former Commissioner of Co-operative Development.) Institutional Credit to the Peasant Sector through Cooperatives, 1974**

Ceylon studies seminar describes the important features of the credit scheme, its fundamental defects, the farmers attitudes towards credit, and

some suggestions for change. The success achieved by cooperatives in rural credit.

Being interested in developing farmer participation the role of cooperatives in credit, will provide useful information to the MARD Specialists.

12. **ASIAN AND PACIFIC REGIONAL AGRICULTURAL CREDIT ASSOCIATION (APRACA). Agricultural Credit Policies and Programs in Sri Lanka, 1984**

The Government first provided loan funds for small-scale food production through its departments. Due to the growing rate of defaulters it made Peoples' Bank in 1967 and Bank of Ceylon in 1973 its agency to participate in funding and financing rural credit. Recently one private owned Bank and two foreign banks have also joined in the financing of rural sector small farming. Loan defaulting has been a constant problem in rural sector agricultural credit and the state Banks are trying to work out a solution to this dilemma, so that funding could be made available without being a burden on the financial resources of there banks.

While this report provides an overall review of credit it shows the role of the newer banks like the Hatton National Bank and the Rural Development Bank in the disbursement of rural credit. The strategies of these banks and their high recovery rate experiments will no doubt provide a lesson to MARD thinking.

13. **ASIAN AND PACIFIC REGIONAL AGRICULTURAL CREDIT ASSOCIATION (APRACA). Strategy for Recovery of Agricultural Loans - With Special Reference to Small Farmer Development, 1985**

Section one of this paper reviews the agricultural cedit situation since 1967. It examines the role played by the Government, the Central Bank, and the two public banks in Agricultural Credit in bringing about development in the Agricultural Sector. Sections two and three examines the methodology adopted by the two public banks to appraise short-term cultivation loans and briefly discuss medium- and long-term loans. Section four on recovery performance examines the causes for low recovery rates. The final section describes the measures adopted by the Central Bank to improve the rural credit situation of the country such as by creating a Rural Credit Advisory Board.

The reasons for defaulting and the steps adopted by the Government banks and the Central Bank, the limitations and conditions for granting further loans to defaulters will be useful to MARD when planning for future loan schemes.

14. **AGRARIAN RESEARCH AND TRAINING INSTITUTE. Small Farmer Credit - A Case Study of Edanduwana of Tolangamuwa in the Kegalle District. 1978**

This is a survey conducted by the ARTI to ascertain the amount of credit granted to small farmers. Both at institutional and non-institutional credit. The survey included the policy on agricultural credit and the impact on production. It notes that the institutions which are expected to play an important role in the provision of credit has developed a certain apprehension due to the fact that the rate of default has continued to increase. It is concluded that in spite of the belief that more credit has to be provided to the small farm sector to step up production, a significantly positive correlation between the two variables cannot be observed from the available statistics. It argues the need for a clear credit system to be organized, for the right type of policy measured should be identified and implemented.

It is necessary to identify groups on the basis of their operational characteristics, by more generalizing their important characteristics get lost.

The problems of agricultural credit finally are different from area to area depending on their socio-economic environment. Therefore, in order to find out reasons, one should conduct a series of more studies on the basis of identifiable areas.

While there is enough information on institutional credit there is very little information on non-institutional credit. This case study will help MARD to understand this aspect.

15. **GANEWATTE, P. Socio-Economic Factors in Rural Indebtedness - ARTI I - A Case Study in Kagama Kattiyawa Special Project (North Central Province), 1979**

This survey describes the former attitudes to various types of credit and its priorities for repayment and the information collected should not be ignored in forming new Credit Schemes to meet the type of situation. This study also provides useful data on large settlement schemes.

Facts about credit programs implemented in irrigated settlement schemes will be useful in planning for Mahaweli credit programs.

16. **FERNANDO, NIMAL. The Rescheduling of Cultivation Loans - Central Bank Staff Studies, 1988**

The rescheduling scheme was introduced by the Central Bank in 1986. A major objective of this scheme was to rehabilitate the non-wilful defaulters of cultivation loans extended under the comprehensive Rural Credit Scheme. The study showed that a significant proportion of the target groups non-wilful defaulters did not participate in the schemes due

to poverty or lack of adequate publicity. The bank branches too did not play an active role in implementing this scheme.

This study provides reasons as to why the defaulting farmer did not respond to the rescheduling scheme. The facts will teach MARD in proposing rescheduling of old loans.

17. **GUNAWARDHANA, L. Credit Cooperatives in Sri Lanka - Year Book of Agriculture Cooperation 1986 edited by I.E. Bayley and E. Pornell, Oxford.**

The paper provides a brief history of the movement and discusses its present structure. The activities of the Credit Cooperatives ambrace deposits, loans, banking facilities, as well as social, cultural, and welfare work. The main problem of credit cooperatives is their small membership. The final section of the paper discusses future plans and makes some suggestions regarding education funds, supply activities, channelling Government loans, and linkages with other cooperatives.

When recommending new scheme cooperatives Thrift and Credit Societies provides the answer to small-scale capital formation at village level. This report will be a lesson to MARD in mobilizing local capital for development through farmer elected cooperatives.

18. **SRI LANKA ASSOCIATION OF ECONOMICS. The Political Economy of Small Farmer Loan Delinquency - (In Savings - Development No. 4 - 1987)**

The theme of the paper is the important interaction between the political factors, that induce Government to adopt Small Farmer Credit Programs, and the nature and design on such programs. Several of the defects which are embodied in the conditions of lending of such programs arise out of political expediency. The economic features of loan programs are often modified to fulfil political objectives. Further, in the implementation of these credit programs political pressures and continuous political intervention often violate the enforcement of lending and repayment conditions. He argues that political interaction is a fundamental reason for high default rates in Small Farmer Credit Programs.

This report will help MARD to understand some of the political thinking behind the credit programs and reasons for their failure.

19. **FERNANDO, NIMAL. The Interest Rate Structure and Factors Affecting Interest Rate Determination in the Informal Rural Credit Market in Sri Lanka - (Savings and Development No. 3), 1987**

Despite Government policies on credit, the informal sector continues to be in dominant source of rural credit in Sri Lanka. Contrary to the popular belief, if the interest rate structure of the informal credit market is not exorbitantly high or exploitive, a large share of interest free loans extended by friends and relatives for a variety of purposes

clearly demonstrates the importance of kinship, friendship, and numerou other social relationships in the informal credit market in Sri Lanka. major condition is that comparatively high rates prevail not due monopoly situations but due to other reasons.

There is very little information available about the informal credi market. MARD will profit by the report as it is one of the few document that has studied this aspect.

20. **RANAWEERA, N.F.C. Delivery System for Small Farmers - Has it bee appropriate? (Seminar Paper Commonwealth Secretariat. 1987).**

The service provided to farmers differ considerably betwee countries. This applies to agricultural research, agricultural extensio agricultural credit, agricultural marketing, and infrastructural a institutional development, irrigation development, and organization farmer groups.

An integrated package approach towards farmer support service a explained in this paper will give MARD an insight into the working of su projects elsewhere.

21. **CHAN-KIL-CHUNG. Agricultural Marketing Development Plan for the Mahawel Area, FAO, Rome), 1986**

This report consists of five chapters. Chapter I presents a brie introduction of the Mahaweli Project. Chapter II describes the existi marketing system in the area which consists of Government organizations rice marketing systems, subsidiary food crops and vegetable marketin systems, rural periodical markets (Pola s), and farmer organizations Chapter III discusses problems in the present marketing systems from t perspective of marketing development. Chapter IV presents mid-te agricultural marketing development plan which includes propose strategies for alienation of paddy/rice marketing chemical reorganization of marketing chemicals. Formation of farmer organization, development of pola s, development of storage facilities and reinforcement of distribution systems. The final Chapter V discus input marketing system in the Mahaweli area.

MARD being directly involved in the marketing aspect of Mahawel produce, this book will provide some very useful information for MARD plan for marketing.

22. **KING, G.R. AND R.W. SCHERMERHORN. Agricultural Marketing Development i Sri Lanka - Strategy for Domestic and Export Marketing of Subsidiary Fiel Crops and Vegetables. Washington Ronco Consulting Corporation, 1986**

The report begins with a discussion on the role of marketing i agricultural development. It describes the current situation in regard t

the role of agriculture in Sri Lanka's economy, the national strategy for the future development, and the direction of the agricultural industry. The current situation for subsidiary field crops and vegetables. It identifies major constraints in the marketing of subsidiary field crops and vegetables and suggests strategies designed to address these constraints.

MARD's special area falls in the development of subsidiary crops and this paper on this aspect will be useful.

23. **ABEYSINGHE, ARIYA. Agriculture and Agricultural Marketing in the Mahaweli Economic Zone. (Sri Lanka Journal of Development Administration Vol. 3) 1986**

This article deals statistically with production of paddy and other agricultural crops such as chillies, cereals, and pulses in the various systems of Mahaweli in the context of national requirements.

This report which gives details of crop specialization in the Mahaweli system and the facilities available to market such produce will be useful to the MARD farmer support services program.

24. **AGROSKILLS LTD. Mahaweli Enterprise Development Strategy - Information on System for Strategy, 1985**

Chapter I provides introduction to the strategy and the information system. Chapter II presents commenting on historical data and information outputs. Other chapters deal with management data and techniques of storage and access.

This report gives much information in planning.

25. **INDUSTRIAL SERVICES CO. LTD. Agro Industry Development in Mahaweli System (Unido Haife Israel), 1986**

This report discusses the main issues of potential agro industrial development opportunities existing in Mahaweli System "H". An Agro industrial development plan is proposed on crop diversification and producing of crops of varieties suitable for industrial processing. Seven agro-industrial projects - chillies, spices, soyabean, milk, fuits and vegetables, peanut and sesame, and animal feed are presented in an integrated program, each covering the approach for the development. Recommendations are presented for priority implementation location of projects, manpower, training, research, and development requirements, entrepreneurship estimate of investment requirements, and technical assistance.

MARD's work programs and the approach in the development of agro-industries through commercial farmers.

26. **FAO. Proceedings of Seminar in Agricultural Marketing - Held a Giradurukotte, System 'C' in June 1986, Rome**

This volume is a compilation of lectures and exercises prepared f participants of the course. The papers cover such subjects on marketi like drying, storage, and processing of fruits, vegetables, and subsidia food crops, standardization of farm products for marketing, improveme of rice post-harvest production, problems associated with fruit processi industry, collection, interpretation and dissemination of mark information, production programming for marketing, credit delivery syste and role of farmers organizations.

Experiences of the Mahaweli Authority in marketing Mahaweli produc as described in this report will help MARD to handle this aspect wi greater care.

27. **MANORAJAN, N. Fiscal Policies for Agriculture and Supporting Agro Industry - Economic Review Vol. 13, 1989**

The paper deals specifically with non traditional agriculture a with industries for the processing of these crops. In the area of fisc policy, special attention is paid to income tax concessions, subsidies a operation of import duty, export duty, and the turnover tax.

MARD being interested in assisting in the processing of agricultur produce. This report which explains the fiscal policies subsidi concessions will be useful.

28. **BURNELL, JAMES AND JAMES ROSS. A Study of Food Processing and Produc Development Technology, Sri Lanka. Washington; Ranco Consultin Corporation, 1986**

This study intends to access the status of technology being used fo food processing and product development and post-harvest managemen handling of perishable coarse grains, grain legumes, and oil seed. I identifies and prioritize problems both in the economic and technica spheres. It discusses issues in both public and private secto involvement. It provides suggestions for the development of overa strategy for the Government to strengthen institutional capacity of foo technology and increase private sector participation in this sector.

This article is of special importance to MARD as its role of activit involves not only productivity, but utilizing correct technology for pos harvest handling of crops.

28. **WICKRAMARATNE, M.L.J. Role of Corporate Activities for Newly Emerging Agro-Industries - Economic Review Vol. 13, 1982**

This paper draws attention to certain factors to be considered before establishing agro-processing industries in the Mahaweli area. He argues that to ensure a return, the private sector should be given an economical viable blocks of land. He lists examples to prove his point.

Subsidiary Food crops Marketing Study:

Volume I	-	Main report
Volume II	-	
Volume III	-	

This report written by a former Executive Director discusses the commercial farmer concept in the Mahaweli program. It will provide useful information regarding MARDs approach towards the private sector.

30. **FAO - Food Marketing Policy and Systems in Sri Lanka. (In Food Marketing in Asian Countries Reports of 9 Countries), Rome, 1986**

The subjects covered include marketing of rice, fruits, vegetables, livestock and diary produce, and fish. Intervention by the state and public organizations and suggestions for improvements of the food marketing systems in Sri Lanka.

Food marketing being a special area MARD has to concentrate. This paper will provide the necessary background information on such activities.

31. **NANAYAKKARA, DR. UPALI. Present Organization of Marketing Extension Services in Sri Lanka, 1986**

This paper is divided into four sections. The first part describes the present organization of marketing extension service in the domestic agricultural sector. This section emphasizes on special programs with marketing assistance such as the Mahaweli Development Program, export villages, producer guidance, and contract growing schemes. The second part discusses proposals and strategies on improved linkages among credit sources, establishment of farm groups, and extension services. Parts 3 and 4 deals with training programs and training methods.

A very comprehensive report on marketing written by a very experienced marketing specialist will help MARD to understand the problems and constraints and the future of marketing in Sri Lanka.

32. **SOYZA, WIJESIRI. The Role of Rural Institutions in the Supply of Inputs to Farmers with Special Reference to Agrarian Service Centers - (SLIDA) 1982**

The author examines the evolution of institutional framework to increased food production through assistance to farmers. The objectives and functions of cultivation committee, agriculture productive committees and Agrarian Service Centers. Then it presents a detailed description of the preparation of the Annual Agricultural Implementation Program and the input supplied by the Agrarian Service Centers.

Input supply through farmer organizations will help MARD to avoid the mistakes of earlier farmer organizations.

33. **Agricultural Marketing Strategy and Pricing Policy - World View Symposium, Washington, 1987. Ed. Eiz. D**

The marketing of agricultural products can be considered as a tool of development policy and can be used as an instrument for regulating and executing the development process in many developing countries. However marketing constraints are becoming increasingly problematic.

Complex political institutions, economic and operational issues concerning agricultural marketing have made it difficult to develop a general framework for understanding the performance of the marketing system in individual countries. This book contains material on marketing institutions pricing policy, experience in planning and managing markets, and participating farmers in marketing decisions.

Pricing policy and marketing are connected topics and the farmers should be made aware of its relationship. This information will help MARDs training program to upgrade the farmers knowledge on this subject.

34. **ARACHCHI, SENAKA. Non-Farm Employment on the Rural Sector of Sri Lanka-Trends and Prospects. Sri Lanka Association of Economics, 1984**

This report deals with general non-farm employment in the rural sector. The first part provides a brief over view of the labour force, followed y a review of rural occupational profile, problems and prospects of non-farm activities, Government policy and programs, and promoting the development of rural non-farm occupations. The final section deals with required policy responses and promotional measurers in this connection.

Increasing income and employment through non-farm activities will give MARD a knowledge of earlier experience of non-farm activities in rural areas.

35. **MARGA INSTITUTION.** Role of Women in Post-Harvest Food Conservation and Processing - A case study from Sri Lanka, 1980

The objection of the study: (a) to ascertain the extent of participating of women in post-harvest food conservation and processing operations, (b) to determine the extent of women's participation in the traditional areas of home food preparation and cooking, (c) to obtain information on various techniques tools and implements, types of energy, and labour used, and (d) to ascertain how much basic knowledge is acquired by women through education and media.

The role of women in post-harvest activities is a part of the farmer support service. There MARD is expected to concentrate upon in System "B". This report gives details of both traditional and modern approaches to this subject.

36. **PANDITHARATNA, N.G.P. Director General, MASL. Mahaweli Settlers and the Problems of Rural Credit - Third Aniversary Lecture of the Rural Staff Training College, Central Bank - by (Occasional Paper), 1986**

In the context of the type of development envisaged in the Mahaweli Areas, institutional credit facilities must be geared towards helping to generate commercially oriented farming community. However, it is not possible to do away with subsistence agriculture at the initial stages of the project. Apart from the short-term cultivation loans which predominates this area, the medium-term loans to purchase tractors and sprayers, should also be made available to settler families. The Mahaweli officials should play a major role in the disbursement of recovery of credit. The author discusses the problems connected with credit such as non-pay of loans, low volume of finance for consumption and investment, and remedies that has to be taken to solve some of the problems.

This article specifically talks of issues involved with credit of Mahaweli settlers. It not only speaks of short-term production loans but also with medium- and long-erm loans. Written by a former Director General, this report will help MARD in a number of ways to develop a long-term development program to assist small farmers.

36. **LITTLE, ARTHUR L. INC. Developing Sri Lanka's Private Sector and its Investment opportunities. Vol. 3 Opportunities in Agro-based Industries, Cambridge (Massechuchess), 1986**

The major focus of this private sector assessment study is to identify key sub sectors with promise and then goes on to elaborate their potential. The agro-industrial areas covered in this study are fruits, vegetables, coconut products, dairy, fisheries. Details on production, processing, marketing, and opportunities available for private sector development.

The development of private sector development in System "B" by encouraging commercial farmers to participate in investment programs aimed at developing agro-industries is a responsibility entrusted to MARD. This article focus mainly on this subject.

37. **NANAYAKKARA, DR. UPALI. Post-Harvest Losses and Small Farmer Storage Problems in Sri Lanka. (Report of the Workshop on Post-Harvest Losses and Small Farmer Storage - New Delhi Vol. 2), 1987**

The paper deals with problems connected with perishables and food items. The central factors identified are of a technical and on economic nature. It is argued that the existing system of perishable produce marketed by the private sector is both efficient and economic. The paper shows the need to develop the demand side as against the present supplied in order to give a better deal to the producers and consumers.

Unless the farmers are well trained in post-harvest activities they will not be able to avoid waste. The development of storage facilities with a view to encourage the farmers to hold on to the produce until the price is good is another approach towards higher income. MARD is specially interested in both. The lessons from this paper will therefore be useful.