MAHAWELI AGRICULTURE AND RURAL DEVELOPMENT PROJECT

FINAL REPORT

by

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MARD PROJECT
PIMBURETTEWA

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Preface

This report serves two purposes. First, it is the final report of the DAI contract to implement phase two of the Mahaweli Agriculture and Rural Development (MARD) Project which began in 1992 and ended in 1995. Chapter one briefly describes the project and chapter two discusses project implementation and the achievement of the project outputs called for in the project design and the DAI contract. Annex 2 provides an accounting of all of the contract deliverables, including studies, training programs, technical reports, short-term consultancies, construction activity, and commodity procurement.

Second, the report provides an overview of the entire MARD project which began in 1988. The overview discusses not only the project ouitputs but also the project's development impact. Chapter 3 describes the project's impact, Chapter 4 discusses the factors affecting project impact, and Chapter five discusses the sustainability of project benefits and makes recommendations for next steps. It is hoped that this report will prove useful to USAID in the design and implementation of agricultural development projects in irrigated areas, the Mahaweli Authority in the management and continued development of System B and its other irrigation systems, and to donors and government agencies in other countries responsible for the development of irrigated areas.

In June 1995, the primary author spent three weeks in the project area and several days in Colombo gathering information for this report. The assistance of Bruce Spake, Jane Gleason, Y.P. deSilva, U.G.A. Abeygunawardena, T.C. Welikala, K. Sathgunasingam, W.R.B. Lalith and other MARD project staff, as well as the information and insights of Gary Alex, the USAID Agricultural Development Officer, of MEA officials, and of members of private sector agribusinesses, were invaluable in the preparation of this report.

Abbreviations and Acronyms

AID	U.S. Agency for International Development
ATGD	Agricultural Technology Generation and Dissemination (MARD project component)
DAI	Development Alternatives, Inc.
D-canal	Distributory canal
DCO	Distributory canal organization
EOP	End-of-project
ESI	Essential structural improvements
FA	Field assistant (MEA field-level extension agent)
FO	Farmer organization
FSE	Farming systems extensionist
GSL	Government of Sri Lanka
IOV	Institutional Organizer Volunteer
IPM	Integrated pest management
IRR	Internal rate of return
MARD	Mahaweli Agriculture and Rural Development Project
MASL	Mahaweli Authority of Sri Lanka
MDS	Mahaweli Downstream Support Project
MEA	Mahaweli Economic Agency
MECA	Mahaweli Engineering and Construction Agency
MED	Mahaweli Enterprise Development Project
MOA	Ministry of Agriculture
OC	Other crops (crops other than paddy)
O&M	Operation and maintenance
PCC	Project Coordinating Committee (MEA)
RARC	Regional Agricultural Research Center
ULFO	Unit-level farmer organization

Executive Summary

Executive Summary

Background

The Mahaweli Agriculture and Rural Development Project (MARD) is located in Mahaweli System B (left bank), a major irrigation scheme on the left bank of the Maduru Oya. The irrigable area, totalling 26,000 hectares, is divided into five zones. When MARD was designed in 1987 two zones were almost fully settled, two were to be settled in 1988, and one remained to be developed. When fully developed, System B was to have provided irrigated land for 25,000 farm families amounting to a population of 150,000.

Project Description

In 1987, virtually all of the settled irrigated lands were used for growing two paddy crops, one during the monsoon season (maha) and one during the dry season (yala). Although there was abundant water to support two paddy crops, the value of paddy was too low to generate a positive rate of return on the $200 million that had been invested in System B by AID, the Government of Sri Lanka and other donors. The project strategy for achieving AID's objectives, therefore, was to introduce diversified cropping on irrigated lands in System B.

MARD's stated development goal was to maximize the economic benefits obtained from the land and water resources of System B. The measure of goal achievement was an internal rate of return of at least 15 percent on AID's incremental investments in System B. The stated project purpose was to "increase total settler income through heightened resource productivity, improved terms of trade with input suppliers and produce buyers, linkages with commercial production channels, and completion of essential tertiary infrastructure." The end-of-project target was a 50 percent increase in farmer incomes.

Given the central importance of crop diversification to the achievement of its goal and purpose, the project also set specific diversification targets. The key target was the planting of 50 percent of irrigated lands during yala to crops other than paddy (OCs). A second target was that, by the end of the project, 30 percent of OCs marketed would be for export.

MARD activities were divided into five components:

Agricultural Technology Generation and Dissemination. This component provided farmers with the technical knowledge to grow crops other than paddy, especially during the yala season. MARD funded long- and short-term technical assistance and training in agronomy, horticulture, agricultural economics, and agricultural extension. The agronomic and horticultural research was carried out through the Ministry of Agriculture and the agricultural extension through the MEA.

Farmer Support Services. This component provided farmers with the services needed for the commercial production of crops other than paddy. Most of the activities were aimed at improving the private sector support system for input supply, agricultural marketing, and post harvest handling. MARD provided technical assistance, training, support for marketing trips and trial shipments, and funding for innovative marketing and processing ventures.

Strengthening Farmer Organizations. The objective of this component was to strengthen farmer organizations, first, to manage water for OC production at the turnout and farm levels; second, to take over the operation and maintenance (O&M) of the distributory irrigation canals from the MEA;[1] and third, to manage commercial activities for the benefit of their members. MARD provided technical assistance and training to MEA staff and farmers in institutional development, D-canal O&M, and business management, and financing for commercial ventures by farmer organizations.

Improving Water Management. This component was aimed primarily at increasing the efficiency of water use at the system-wide level and introducing farm-level water management practices appropriate for the production of crops other than paddy. The project provided long- and short-term technical assistance and training to MEA staff and farmers for this purpose.

Infrastructure Development. The MDS project was terminated in 1992 because of the security situation, but some infrastructure improvement was continued under MARD. The project funded the construction and rehabilitation of D-canals, drainage canals and access roads.

The total cost of project inputs was $19.5 million, divided as follows:

- technical assistance: $11.0 million
- local costs of project activities: 3.5 "
- construction: 2.5 "
- training: 1.0 "
- commodities: 1.0 "

By far the largest component was Agricultural Technology Generation and Dissemination, accounting for $9 million. Funding for the other components ranged between $2 and 3 million.

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[1] *The downstream portion of System B consists of 131 distributory canals that carry water from the main and branch canals, and about 1,200 turnouts that carry water from the distributory canals to farmers' fields. The typical turnout serves eight to ten one-hectare farms.*

Project Implementation

When the project started, neither the MOA nor the MEA had much interest in promoting crops other than paddy. The research program identified varieties and cultural practices that were suited to System B conditions, and the extension service effectively disseminated these new technologies to farmers. The ATGD component has helped introduce over 40 crops into the production systems on irrigated land during yala, and both the MOA and the MEA staffs have become knowledgeable about and committed to promoting OC production in System B. MARD also introduced commercial OC production on non-irrigated lands.

Initially, the Strengthening Farmer Organizations component suffered from lack of farmer interest. When the project started, the MEA operated and maintained the entire irrigation system so the farmers saw no reason to form D-canal organizations. And, at the farm level, farmers found they could manage the water on their fields for OC production without forming turnout groups. Consequently, MARD focussed on organizing farmers to carry out income generating commercial activities. Then, four years after the start of the project, MEA initiated a major effort to transfer D-canal O&M to farmers. MARD played a major role in this MEA effort by providing institutional development advice at the national level, training MEA institutional organizers, and training farmer organization leaders and members in institutional management, business management, and the technical aspects of D-canal O&M. By the end of the project, 103 D-canal organizations (DCOs) had been formed and had benefitted from MARD training.

The Water Management component proved to be marginal to the needs of System B during the time period covered by the project. Because System B has abundant water for growing two paddy crops, increasing the efficiency of water use does not have a high priority with farmers or the MEA. A significant concern that was addressed by the project was the provision of water for year-round irrigation. In 1993, System B became the only major irrigation scheme in Sri Lanka to have its main canal open 12 months a year. The project was also prepared to introduce improved turnout-level water management for growing OCs, but most farmers found they were able to grow OCs with little or no changes in their water management practices.

Under the Farmer Support Services component MARD completed 17 export market studies, about half of which were followed up with trial shipments. Most of these trial shipments were well received and would have led to commercial orders had Sri Lankan exporters been able to process and handle larger quantities. Exporters needed to establish effective linkages with small producers and develop harvesting, grading, processing and post harvest handling facilities in System B. MARD identified commercial nucleus farms as an effective means of performing these functions. At MARD's request, another AID-funded project, Mahaweli Enterprise Development (MED), took the lead in attracting private investors into System B. Over thirty investors

were eventually attracted, but less than ten of these proved commercially viable. MARD's role was to assist with financing for special projects on these farms and provide extension and marketing support. Six commercial farms received grants from MARD's Commercialization Fund. MARD's largest private investment initiative was to attract an investor for a refrigerated packhouse that was critical to establishing a cold chain for fruits and vegetables produced in System B.

Once these facilities were in place and operating, MARD helped exporters to conduct field trials, set up production contracts with small farmers, provide extension advice to the contract farmers, and improve their post harvest handling practices. The level of activity was highest in the 1991-1992 period when the project was most proactive in promoting production for export markets. In 1992, with MARD encouragement and support, the owner of the packhouse entered into 42 buy-back contracts with farmer organizations., covering eight crops and involving 478 farmers. After 1992, the level of activity declined as MARD took the stance of responding to targets of opportunity.

After the MDS construction activity was discontinued, the MARD Infrastructure Development component undertook the construction and rehabilitation of D-canals and drainage canals in the already settled areas of System B. Despite construction delays caused by the implementing agency's budget problems (Mahaweli Engineering and Construction Agency), MARD was able to construct 70 kilometers of D-canals, 20 kilometers of drainage canals, and 10 kilometers of access roads. This opened up 300 hectares on new irrigated lands and increased the productivity of 4,000 hectares of land that had been previously developed but was suffering from poor drainage.

Development Impact

The project had three development objectives: to establish diversified cropping, especially on irrigated land in yala; to increase OC production for export; and to create effective farmer organizations to control, operate and maintain the irrigation system.

Crop Diversification

For MARD, the two key indicators of crop diversification were, the area planted to OCs during yala, and the number of farmers growing OCs during yala. Between 1990 and 1994 the percent of irrigated area planted to OCs in yala increased from 3.5 percent to 4.9 percent. This small area allocated to OCs has meant that, thus far, MARD has not succeeded in achieving its development goal: maximizing economic returns to System B's land and water resources by growing crops other than paddy on irrigated lands. Another indicator is the number of farmers growing OCs in irrigated lands in yala. This indicator is important because it is a more accurate measure than area planted of the extent to which crop diversification has been accepted in System B. For all of System B, the percentage of farmers growing OCs on irrigated lands in

yala has increased from 28 percent in 1990 to 45 percent in 1994. Of the 55 percent of farmers who are not growing OCs in yala, some are on lands that are not suitable for OC production, some are in areas affected by the security situation, and others have simply chosen to accept the low incomes they earn from two paddy crops.

What has occurred in System B is that farmers have accepted OCs as a means of supplementing their incomes, but not as a substitute for paddy. Most farmers in System B are fully aware of what they could earn from OC production, and what would be required in terms of production practices, post harvest handling, and marketing. Virtually all of the System B farmers, including the 45 percent who are growing OCs, have decided continue with a two paddy production system supplemented with OC production. For these farmers, a small quantity of OC production is a low risk undertaking generating small but welcome increases in income from their one hectare of irrigated land.

Production for Export

Project efforts to increase production for export had limited quantifiable results. Most of the crops grown under buy-back contracts in 1992 were sold locally. In 1994, System B production for export totalled about $30,000, of which $24,000 was gherkins, a crop that was developed by a private exporter with minimal MARD support. In addition to the owner of the packhouse, only two exporters were attracted by MARD to System B: a firm that attempted unsuccessfully to export baby corn to Europe (but has been successful in supplying baby corn to Sri Lanka's hotels and Chinese restaurants), and a firm that was already an established exporter of Asian vegetables to the Middle East. The effort to attract private investment in commercial nucleus farms was also disappointing. It now appears that only a few of the farms currently operating will survive as business ventures unless the security situation improves dramatically and the investment climate improves as a consequence.

There is, however, a continuing exporter interest in System B. Tess Agro, Ltd., the owner of the packhouse, is exporting small quantities of mixed vegetables to Europe, is actively pursuing markets in high-income Asian countries, and is clearly committed to remaining in System B. The other two exporters attracted to System B by MARD have plans to increase production when the security situation improves. Three recent initiatives provide additional evidence that exporters are aware of System B as a source of fruits and vegetables. One is a proposal by a Sri Lankan firm to export large quantities of Asian vegetables to the Middle East (the Peace Air initiative). The second is interest shown by by a Japanese firm in growing okra for the Japanese market. The third is a proposal by large local firm to grow manioc and sweet potatoes with System B farmers organizations on a long term basis.

Strengthening Farmer Organizations

As a result of the intensive MEA training program supported by MARD, most System B farmers understand that they will one day have to assume responsibility for operating and maintaining their D-canals. A mechanism has been put in place for moving each DCO to the point where it is able to take over its D-canal. When the DCOs demonstrate a sufficient level of organization and managerial ability they enter into joint management agreements with the MEA. Thirty-six of the 103 DCOs in System B have reached this status. Once they have shown the ability to carry out all of the O&M functions on their own, the D-canals are turned over to them. Twenty-five DCOs have now fully taken over their D-canals.[2] The MEA and the DCOs jointly decide when to enter into a joint agreement and when to effect the takeover. Following over two decades of unsuccessful efforts to increase farmers' involvement in the operation and maintenance of the downstream sections of major irrigation schemes, MEA and MARD's progress in system B can be considered a major development achievment with benefits extending to all of Sri Lanka's irrigation schemes.

Quantifiable Project Benefits and Internal Rate of Return

Based on 1994 figures, the total income of System B farmers increased by 16 percent as a result of crop diversification. However, the project assumption that farmers could increase their incomes by 50 percent through crop diversification proved valid. System-wide, the diversifying farmers increased their incomes by 36 percent over growing only paddy in yala. In Ellewewa Block, where the project had the most success, the 60 percent of farmers who diversified experienced a 62 percent increase in income from their yala production in 1994.

Although MARD concentrated on crop diversification during yala, it achieved significant benefits from other activities as well. The full list of quantifiable benefits includes: 1) increased income from crop diversification on irrigated lands during yala and maha; 2) increased incomes from the production of annual and tree crops on homesteads during maha; 3) increased income from paddy and OC production resulting from irrigation infrastructure construction and rehabilitation; and 4) the value of D-canal O&M resulting from the DCO takeover of D-canals.

The total of these benefits yields an internal rate of return of 10 percent for the MARD project. Several important intangible benefits are not included in this calculation. The most important are the strengthening of the Ministry of Agriculture's

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[2] Increased to thirty-five during the last two weeks of the project. Also, during the same period farmers' organizations in five blocks have federated to form block-wide farmers' organizations.

research capabilities for crops other than paddy, the strengthening of MEA in agricultural extension and farmer organization development, and the development of a horticultural export capacity in the private sector.

Next Steps

MARD's major accomplishment in System B was to begin the transition process from a paddy-based economy to one based of diversified agricultural production. This transition has many facets which must continue after the end of the project. The most important of these are:

- farmers have developed an increased knowledge of cultural practices suitable to OC production in System B as well as an increased knowledge of OC marketing both domestic and export;

- a large number of farmers are now organized into effective DCOs and are in substantial control of the operation and maintenance of their D-canals and turnouts;

- private Colombo-based agribusinesses have developed an increased understanding of export markets for fruits and vegetables and of how to work with small producers in System B;

- the MEA extension staff in System B has become knowledgeable about OC production in association with paddy on irrigable lands as well as the production of annual and tree crops on non-irrigated homesteads;

- MEA institutional organizers in System B have become effective in forming voluntary and sustainable farmer organizations capable of operating and managing D-canals and undertaking commercial activities; and

- at the national level, the MEA is more knowledgeable about OC production and marketing; the MOA has developed an OC research program; the MEA, EIED, and EDE has gained experience on fruit and vegetable export promotion; and there is an increased GSL understanding of and commitment to OC production in irrigated area, especially for export.

The project has thus already made a major difference in System B and at the national level, but important next steps are required to take maximum advantage of what has been accomplished. If these steps are not taken, not only will many aspects of the transition come to a halt, much of the progress already achieved could be reversed.

Crop Diversification

MARD succeeded in firmly establishing OC production in System B, but did not succeed in substituting OCs for paddy as a major source of cash income during yala. The question now is: what next? How important is it that the area planted to OCs in yala increase significantly above the existing five percent? The original project assumption that a significant shift to OCs during the yala season would substantially increase the return on the System B investment as well as substantially increase farmer incomes remains valid. It would seem that, in order to 1) obtain a satisfactory rate of return on System B land and water, 2) increase farmer incomes above the poverty level, and 3) increase the productivity of irrigated land so that farmers can assume a significant share of irrigation O&M costs, MEA cannot stay satisfied with having a large number of farmers grow small quantities of OCs. The long range target has to be a substantial increase in OC production during yala.

Recommendations

- The MOA must continue to conduct adaptive research on OC production under conditions that prevail in System B. This research should be directly linked to the expressed needs of farmers as communicated through the MEA extension staff. All adaptive research should be conducted in a farming systems context. The MEA extension staff in System B, from senior management down to the field assistants, should consider OC production its top priority and be retrained accordingly.

- The Sunfrost experience with gherkins has shown that the private sector is better at providing hands-on extension advice to farmers than the public sector. The MEA needs to define its extension role vis a vis the private sector and gear itself up to perform that role effectively. Two functions of the MEA extension service should be to 1) carry out adaptive research on farmers fields to identify new technologies that could be disseminated by the private sector, and 2) act as a market-oriented catalyst and facilitator linking small producers with buyers. This will require retraining. If done properly, this redefinition of the extension function should result in a smaller but more productive MEA extension staff.

Increased Production for Export

The future remains impossible to predict. On the positive side: System B has a cold chain; farmers have had experience with buy-back contracts and producing crops to exacting standards; exporters have established market links with farmers and farmer organizations; and exporters operating in System B have gained experience in the high income Asian and European markets. On the negative side, the reasons for the lack of progress remain: the security situation in System B; poor infrastructure, especially roads and communications; seed shortages; lack of farmer experience in

production and post harvest handling; lack of grades and standards; inadequate packaging; and the lack of processing facilities to absorb the low grade products.

These problems are not easily overcome. Some are unique to System B; others are systemic at the national level. A critical mass of high value exports is required before the proper support system can be economically justified, and this requires a joint government-private sector commitment. It must also be recognized that, even in the context of a stepped up national effort to promote fruit and vegetable exports, System B suffers serious disadvantages vis a vis other regions of Sri Lanka. It does not appear advisable for the MASL to be too far out front with bold, expensive initiatives in System B. The private sector is now well aware of System B's production potential and if System B has comparative advantages in the production of fruits and vegetables for export, the private sector will identify them. The recommended stance for the MEA and donors is to respond quickly and aggressively to targets of opportunity as they arise. Examples would be the Peace Air initiative, the Japanese okra inquiry, and the proposal to source manioc and sweet potatoes.

Recommendations

- The MEA and others must be ready to support private sector initiatives in System B. The most important action for MEA to take at this time is to retrain the extension staff and utilize it to facilitate linkages between exporters and farmers. The MEA should coordinate EIED, AgEnt, and other resources in support of System B export initiatives whenever necessary.

- Looking beyond System B, the GSL should assess the country's policy framework and support system for high value fruit and vegetable exports, including roads, communications, seed import policy, cargo space, post harvest handling facilities, and proper packaging. Where private investors need to take the lead, (e.g., air cargo space and post harvest handling) the government should offer incentive systems, technical expertise and other support as appropriate.

Strengthening Farmer Organizations

Progress has been uneven across the System. The most active DCOs are in Ellewewa, Dimbulagala, Vijayabapura, and Damminna blocks (Zones 1 and 5). Twenty-two of the 24 D-canals in System B that have been completely taken over, and 21 of the 25 that are under joint MEA/DCO management are in these two zones. Similarly, most of the DCO commercial activity is in these four blocks.

At this time, the sustainability of the 60 or so DCOs with whom MARD has worked most closely appears promising. Many of these DCOs are now initiating their own commercial activities without MARD or MEA assistance. Several have expressed

the intention to form farmer companies at the block level. Whether the D-canal takeovers are as sustainable remains to be seen. The next three to four years will be critical. If progress to date is reversed, it is very likely that the D-canal takeover will not occur thus setting back plans to make D-canal O&M in System B financially sustainable.

The situation is even more tenuous for the 45 DCOs who have made the least progress. These organizations have been registered and received training, but they have not undertaken any commercial activities and have made little progress toward taking over the D-canals. They have little chance of becoming self-sustaining until they receive the same support provided by MARD and the MEA to the more advanced DCOs.

Recommendations

- The MEA must continue to provide technical, organizational and financial support to the DCOs in Zones 1 and 5, and increase efforts to make the DCOs in the other zones into effective and cohesive farmer groups.

- At the national level, it is critical that the GSL renew its commitment to putting D-canal management in the hands of farmers and making D-canal O&M financially self-sustaining. This requires increasing the O&M fee charged by the MEA at the same time that DCOs are being formed. It must be made clear to farmers that D-canal O&M will be more effective and will cost them less if they take it over compared to leaving it in the hands of the MEA.

CHAPTER 1

PROJECT DESCRIPTION

Background

The Mahaweli Agriculture and Rural Development (MARD) project is located in Mahaweli System B(left bank), an irrigation project located on the left bank of the Maduru Oya. The headworks for the project was financed with Canadian foreign assistance and the irrigation infrastructure, consisting of the main and branch canals, was financed by USAID. The irrigable area, totalling 26,000 hectares, is divided into five zones numbered 1 to 5. In 1987, when MARD was designed, two of the zones (zones 1 and 5) were completed and almost fully settled, two were to be settled in late 1988 (Zones 2 and 3), and one (Zone 4A) had not yet been developed for irrigation. The target number of farm families for all of System B (left bank) was 25,000, amounting to a total population of about 150,000.[1]

In 1987, AID had two objectives in System B: 1) complete the infrastructure development for Zone 4A and 2) increase the productivity of the settler families. Two development projects, the Mahaweli Downstream Support Project (MDS) and MARD, were designed to achieve these objectives. MDS was implemented through the Mahaweli Engineering and Construction Agency (MECA), and MARD through the Mahaweli Economic Agency (MEA). Within Mahaweli, the MEA is responsible for providing the full range of economic and social services required by the settler population. These services include operation of the irrigation system; infrastructure maintenance and repair; agricultural extension; social services (health, education); farmer organization development; and land use planning.

Project Goal and Purpose

MARD's development goal was to maximize the economic benefits obtained from the land and water resources of System B. In 1987, virtually all of the settled irrigable lands in System B were used for growing two paddy crops, one during the monsoon season (maha) and one during the dry season (yala). Although there was abundant water to support two paddy crops, the value of paddy was too low to generate a positive economic rate of return on $200 million that had been invested in System B by AID, the Government of Sri Lanka (GSL) and other donors. Research and experience in other Mahaweli systems had shown that by diversifying production away from paddy to other crops the net return per hectare of irrigated land could be doubled. The measure of goal achievement was an internal rate of return of at least 15 percent on AID's incremental investments (MARD and MDS) on the left bank of System B.

At the purpose level, the MARD objective was to "increase total settler income through heightened resource productivity, improved terms of trade with input suppliers and produce buyers, linkages into commercial production channels, and completion of essential tertiary infrastructure." The end-of-project target was a 50 percent increase in farmer incomes.

Given the central importance of crop diversification to the achievement of goal and purpose targets, the project also set specific diversification targets. The key target was the

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[1] The entire System B consists of the 26,000 hectares of irrigable land on the left bank of the Madura Oya, and 14,000 hectares of irrigable land on the right bank. (See the System B map presented in Annex 1.) Since, thus far, the right bank has not been developed, this report will refer to System B (left bank) simply as System B.

planting of 50 percent (originally 85 percent) of irrigated lands in the yala season to OCs. The underlying project assumption was that most of the diversified production would initially be for the domestic market, but sustained growth in settler incomes could only be achieved by expanding firmly and permanently into export markets. A major thrust of the project, therefore, and a key indicator of success at the purpose level, was the introduction of export crops into the production systems of System B farmers.

Project Components

MARD was authorized in July 1987 as a $14 million project to be implemented over eight years. The project originally had three components: Agricultural Technology Generation and Dissemination; Water Management and Farmer Organization, and Agricultural Support Services. A mid-term evaluation in early 1991 recommended that the project concentrate on farmer organization development, commercial farm development, water management and drainage improvement, and more focussed agricultural extension. This led to the design in early 1992 of MARD II, which divided water management and farmer organization development into two separate components, added specificity to all of the components, and increased project funding to $23 million. Actual expenditures totalled $19.5 million.

Agricultural Technology Generation and Dissemination (ATGD)

The objective of this component was to provide farmers with the technical knowledge to grow crops other than paddy, especially during the yala season. MARD provided long-term advisors in agronomy, horticulture, agricultural economics, agricultural extension, and plant pathology, and a large number of short-term consultants in specialized fields as needed. The extension work was carried out mainly through the MEA extension staff. MARD also provided training to MEA staff and thousands of System B farmers. By the end of the project, this component was to have:

- published production recommendations for ten crops;
- executed a continuing program of agricultural trials on farmers fields;
- tested and introduced ten diversified crops on farmers fields; and
- introduced commercial agriculture on 25 percent of System B homesteads.

Strengthening Farmer Organizations

Farmer organizations were considered essential to the success of the project. Initially, their main functions were related to irrigation and water management. Moving from paddy production to other crops would require joint management of distributory (D canal) and field canals (the turnout level) by groups of farmers with common interests.[2] MARD was to have provided 1) technical assistance in institutional development, technical aspects of irrigation O & M, and business management; 2) financial and advisory support for commercial ventures; and 3)

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[2] The downstream portion of the presently developed portion of System B consists of 131 distributory canals (D-canals) that carry water from the branch canals, and about 1,200 turnouts that carry water from the D-canals to the farmers' fields. The typical turnout serves eight to ten one-hectare farms.

training to MEA institutional organizers, farmers' organization leaders and farmers' organization members in organizational management, business management and irrigation O&M. By the end of the project, 250 turnout groups were to have achieved full control of and responsibility for water management at the field and turnout level, and 25 unit level farmer organizations (later called D-canal organizations) would be operating and maintaining their D-canals and engaged in commercial activities for the benefit of their members.

Improving Water Management

This activity was aimed at the more efficient use of water in System B. MARD provided technical assistance and training to MEA to improve main canal operation and maintenance, drainage design and on-farm water management. The focus was on reducing water use, designing a D canal operation and maintenance program to be implemented by farmer organizations, and introducing improved water management at the field level to enable farmers to grow crops other than paddy. By the end of the project, water usage for irrigation would be reduced to within 20 percent of requirement.

Farmer Support Services

The objective of this component was to provide farmers with the supporting services needed for sustained increases in the commercial production of other crops. Most of the activities were aimed at improving marketing and post harvest handling services. MARD assistance consisted of technical assistance, training, support for marketing trips, and funding for innovative and risky ventures. By the end of the project, this component was to have completed 20 market research studies, established five fully operational post harvest handling facilities, of which at least one would be for export, and established five fully operational commercial farms.

Infrastructure Development

During the early years of the project, infrastructure development work consisted almost entirely of constructing the main irrigation works for Zone 4A. About 2,000 of the targeted 4,600 hectares were developed before construction was terminated because of security problems associated with the Tamil separatist movement. Construction work then shifted to improving distributory and drainage canals in the other zones of System B. MARD provided irrigation engineers as well as funding for the construction. The output targets for MARD (i.e., excluding MDS) were: 200 kilometers of rehabilitated D-canals, 250 Kilometers of rehabilitated or new drainage canals, and 10 kilometers of new access roads.

Environmental Protection

MARD did not have a separate environmental protection component but, beginning in 1992, a number of activities were added to the other components at AID's request. The first was the preservation of wetlands that were threatened by drainage work being carried out under the Infrastructure Development component. Other activities included the introduction on integrated pest management practices (IPM), restoring the riparian forest along certain river banks, planting windbreaks, and building electric fences to control the incursion of elephants onto farmers fields. MARD provided short-term technical assistance and funded construction work much of which was carried out by farmer organizations. The specific targets for this component were to conserve or construct a 7 acre wetland in Block 503 and plant 100,000 trees.

Project Inputs

The total cost of AID-financed inputs was $19.5 million. Over an eight year period, MARD provided 36 years of long-term and 120 months of short-term expatriate technical assistance, and 21 years of long-term and 32 months of short-term Sri Lankan technical assistance. The total technical assistance budget was about $11 million. In addition, MARD provided about $3.5 million for "support activities" which included field trials, extension, marketing assistance to farmers, and the development of post harvest handling facilities, and about $2.5 million for construction of irrigation infrastructure. The balance consisted of training and commodities ($1 million each).

The project did not track expenditures by component, but based on the budget breakdown in the MARD II Project Paper adjusted for shortfalls in construction expenditures, project costs can be approximately allocated as follows:

Agricultural Technology Generation and Dissemination	$9.0 million
Strengthening Farmer Organizations	2.6 "
Water Management	2.2 "
Farmer Support Services	2.9 "
Infrastructure Development	3.0 "
Total	19.5 "

CHAPTER 2

PROJECT PERFORMANCE

Each of the five project components had specific output targets to be achieved during the life of the project. By and large, these targets were achieved. This chapter summarizes the activities under each component and discusses implementation problems. The full list of output targets and achievements is presented in Annex 2.

Agricultural Technology Generation and Dissemination

This was the largest of the project components. Its overall objective was to establish the production of crops other than paddy into the farming systems of System B. The ATGD program was divided into agronomy, horticulture, and extension.

The agronomy program upgraded the facilities at the MOA's Aralaganwila Regional Agricultural Research Center (RARC) and undertook a comprehensive OC adaptive research program. Research were conducted on a wide range of crops to test varieties, cultural practices (time of planting, spacing, weeding, etc.), fertilizer use, and disease control. The results of this work as well as knowledge already known from elsewhere were tested on farmers' fields before being incorporated into the MEA/MARD extension program.

Whereas MARD's agronomy program dealt mostly with the OCs traditionally grown for the local market (onions, chili, greengram, cowpeas, lady fingers, etc.) the horticulture program focused almost exclusively on non-traditional export crops (baby okra, baby corn, cantaloupe, and exotic varieties of crops such as mangos, papaya and eggplant). First, studies were undertaken to match export markets with products that could be grown in System B. Trials were then conducted to determine optimal production and post harvest handling practices, and the results were then used in an extension program conducted under the direct supervision of the horticulture advisor.

The agronomy and horticulture technology development activities included an agricultural economic component. By including farm-level economic analyses, the research was able to generate information on the labor and income implications of the new technologies being recommended. This made it possible to understand the impact of new technologies and cropping patterns on existing farming systems and helped make the recommendations more relevant to resource constraints as experienced or perceived by the farmers.

MARD's extension program followed the split between the project's agronomy and horticulture programs. The project's agronomy extension program was to have had its own staff of "farming system extensionists" (FSE), but early in the project MARD and MEA decided to incorporate their responsibilities into those of the MEA field assistants (FA). MARD's role was to provide training and advice to the MEA extension staff on integrating OC production into the production systems of System B farmers. The project produced printed extension materials and conducted numerous training sessions for the MEA extension staff and thousands of System B farmers. Several thousand farmers received training under this program.

The project's horticulture extension program dealt with export crops. The program, which

for a period of two years had its own staff of 30 extensionists, was implemented in close cooperation with the private sector exporters who would be buying the products, and usually targeted a relatively small number of farmers.

The ATGD component exceeded all of the output targets specified in the project design. (See Annex 2 for the list of reports prepared by the MARD agriculture staff.) The results of the agronomic and horticultural research program were effectively incorporated into extension packages by the project agricultural economist and extension advisors. These programs not only identified crops and cultural practices that were adapted to System B, they used farming systems approaches to define cropping patterns that optimized the use of resources available to System B farmers. At least 40 different OCs are now being grown in System B, the most important of which are big onion, chili, bananas, and groundnut in irrigated areas, and maize and yams in non-irrigated areas.

Market Development

The MARD market development program was essentially an extension of the export-oriented horticulture program. There was almost no effort put into developing domestic markets. The project found that farmers growing traditional OCs had little trouble selling their crops to local traders. Neither the farmers nor the project, however, could discover how to generate a demand in local markets for System B produce.

The market development advisor and the horticulture advisor worked as a team. After jointly identifying products to be promoted, the horticulturalist would work on developing production while the market development advisor would work on developing export demand. The marketing effort was extremely proactive. Exporters and investors were constantly invited to System B. Visits were made to export markets, often followed by trial shipments. The initial targets were Europe, the Middle East, Singapore, Hong Kong and the Maldives.

Once contacts between exporters and importers were established, the project would develop links between the exporters and System B farmers that would assure the farmer an adequate income and the exporter reliable quantity and quality. The usual mechanism was a contract between the exporter and the farmer specifying the quality required and the price to be paid, commonly referred to as a "buy-back contract". The contract could be with a farmer organization or with individual farmers. MARD or the exporter would provide the extension services to the farmers.

These arrangements required direct exporter involvement in post harvest handling, including grading, packing, and transporting. MARD's approach was to encourage the exporters to establish themselves in System B by investing in a commercial farm or other marketing facility. The AID-financed Mahaweli Enterprise Development Project (MED) took the lead in developing these commercial farms. Of the 35 agribusiness investments, mostly commercial farms, that took place in System B as a result of MED initiatives, six received significant MARD assistance through Commercialization Fund grants. Grant disbursements, totalling about $65,000, are listed in Table 1.

Early on, MARD found that System B could not produce for export markets without a cold chain. In 1991, the project entered into an agreement with Tess Agro Ltd., a Sri Lankan firm with experience in refrigeration, to build a packhouse in System B with MARD funding half of the initial

investment. The packhouse, which would offer its services to all exporters operating in System B, was completed in July 1992.

Table 1: Commercialization Fund Grants to Agribusinesses in System B				
Grantee	Date	Amount Disbursed (Rs.)	Products	Outcome
A.i. Earthmovers	3/91	225,000	white onions	Not successful
Trico Oils and Fats	3/92	688,000	animal feed mill	Completed but not yet commissioned
CIC, Ltd.	6/92	900,000	baby corn	Operational
Sunfrost	9/92	260,000	silverskin onions	Operational
Ameen (two grants)	11/92	33,000	export crops	Operational
Amumigama (NASPA)	11/92	185,000	export crops	Operational
S.P.D. Combine	5/95	426,000	banana nursery	Operational
Total		2,717,000		

Source: MARD, Commercialization Fund Summary Sheet, Feb. 25, 1995 and update of August 1995.

After opening the packhouse, the marketing advisor and horticulturalist worked to attract exporters and link them with farmers through buy-back contracts. The biggest effort was made in 1992 when Tess signed 47 buy-back contracts with farmers organizations. These contracts covered eight crops and involved about 600 farmers. Since then, the project has been able to attract two other exporters, but the level of activity has declined substantially.

This market development component received high priority attention within MARD, was always staffed by professionals with years of private sector experience in fruit and vegetable exports, always had the full support of the other project components, and invariably exceeded its output targets (marketing trips, trial shipments, post harvest handling studies, etc.). (See Annex 2 for the list of MARD marketing reports.)

Farmer Organizations

The farmer organization component had a very rough start. In the early years, the project had two farmer organization advisors, one expatriate and one Sri Lankan, and a staff of about 50 field-level Irrigation Community Organizers (ICOs). Mainly because of long delays in recruiting the ICOs, the farmer organization effort did not get seriously underway until 1990, two years after the start of the project. It soon became clear that the farmers had no real interest in forming turnout groups or D-canal organizations. They were mainly interested in growing two paddy crops for which there was abundant water with the MEA was fully responsible for maintaining the

D-canals. Between 1989 and 1992 the project made very little progress in establishing farmer organizations because 1) the farmers had no previous experience in undertaking joint activities, 2) there were no obvious immediate benefits to be gained from organizing, and 3) strengthening farmer organizations was not an MEA priority.

During this period MARD concentrated on forming Unit-Level Farmer Organizations (ULFO) to undertake commercial activities and participate in D-canal O&M. Many of these organizations became effective providers of commercial services for their members.

The environment for farmer organization development improved significantly in 1992 with the assignment of a new MEA Managing Director (MD). His top priority was to establish participatory irrigation management in all of the Mahaweli irrigation systems. MARD immediately became a key part of that effort. The project provided a consultant to set up an Institutional Development Unit (IDU) in MEA headquarters. In System B, the MEA institutional development staff consisted of an Assistant Manager for Institutional Development at the project office, Institutional Development Organizers (IDO) at the block level, and a field staff of locally-hired Institutional Organizer Volunteers (IOV) working directly with farmer organizations. The IOVs replaced MARD's ICOs.

MARD's role was threefold. First, the project carried out training programs for the IOVs in institutional development methods. Second, MARD prepared D-canal blueprints and O&M workplans and trained DCOs in their use. Third, MARD worked closely with DCOs on commercial ventures, building on earlier successes with ULFOs. MARD's support included advice in business and financial management and funding for commercial ventures such as rice marketing, input supply stores, tractor services, and rice milling. The commercialization grants to farmer organizations are summarized in Table 2. The total value of the grants disbursed was about $267,000.

As is usually the case in activities of this kind, implementation has been uneven. Some IOVs have been more effective than others, and, at the DCO level, there is a wide variation in the quality of the leadership. The MARD Farmer Organization Advisor estimates that the project was able to work effectively with about 60 the 103 DCOs in System B. All of the active DCOs, however, have benefitted from many training sessions on D-canal O&M, farmer organization roles and responsibilities, and business and financial management.

Water Management

The original project design had a substantial water management component aimed at improving the efficiency of water use from the main canal down to the farm level. In the early years, the main activity was to set up a computerized accounting system to reduce the costs of operating the main and branch canals. The model was developed and Mahaweli engineering staff were trained in its use.

At the system-wide level, the focus was on developing of a water management system that would allow year round production on irrigated lands. Since 1993, the main canal has been open 12 months a year. No other major irrigation sytem in Sri Lanka offers 12-month irrigation. At the D-canal level, the project formulated the D-canal O&M workplans to be implemented by the DCOs, prepared blueprints for each D-canal, and provided training to the DCOs. At the farm level, the project water management advisor worked with the RARC researchers on the design of

water management systems that would be suited to diversified cropping patterns. An important output was the design of an on-farm sub-surface drainage system.

Table 2: Commercialization Fund Grants to Farmer Organizations			
Farmer Organization	No.	Amount Disbursed (Rs.)	Purpose
1991			
Women's groups	5	14,500	poultry production
Poultry growers	2	44,000	" "
Fish breeders	1	19,000	ornamental fish production
Gherkin picklers	1	26,300	gerkhin production
ULFOs	3	140,000	input supply shops
1992			
ULFOs	17	745,000	input supply shops
Youth group	1	20,000	hand sprayers
1993			
DCOs	4	60,000	weighing scales
DCOs	2	75,000	input supply shops
DCOs	40	3,533,000	seed comercialization fund
DCOs	7	1,290,000	homestead development fund
1994			
DCOs	30	450,000	weighing scales
DCOs	17	415,000	input supply shops
DCOs	3	33,000	hand sprayers
TOTAL		6,865,000	

Source: MARD, Commercialization Fund Summary Sheet, August 18, 1995

Infrastructure Development

Initially, infrastructure development consisted entirely of Zone 4A development under the MDS project. With work in Zone 4A abandoned in 1992, construction activity shifted to drainage and D-canal rehabilitation work in the already settled areas of System B, mainly Zones 1 and 5. One major project objective was improving drainage and constructing tertiary irrigation infrastructure in Block 503 in Zone 5. This area had been considered an unproductive wetland. Project surveys found the land to be drainable, not only opening up 1,000 ha. of new lands, but also reducing flooding in previously irrigated upstream areas in Zone 5 and adjacent downstream areas in Zone 2. Because of construction delays caused mainly by MECA's not giving priority to the Block 503 construction project, only 300 ha. were developed by the end of the project. Another 300 ha. of upstream areas also benefitted from the improved drainage. Downstream areas of over 200 ha. will also benefit greatly, when the last five kilometers of a major drainage stream in Block 503, the Kuda Oya, is cleaned and widened.

Environmental Protection

MARD's environmental protection activities were carried out under the ATGD, farmer organization, and infrastructure development components. One important intervention was the protection of wetlands in Zones 1 and 5. A wetland was constructed in Block 503 when the tertiary irrigation system was developed, and a second wetland was constructed in Zone 1. The project target of one percent of the constructed area was achieved, but because all of Block 503 was not constructed, all the land to be set aside for wetlands was not developed. Wetland construction and protection has now been fully integrated into MASL's construction program for System B.

A second major intervention was the introduction of integrated pest management practices. MARD provided a plant pathologist for two years to introduce improved pest management practices. Numerous trials were conducted that resulted in extension recommendations to reduce the use of many pesticides and fungicides. The project trained hundreds of farmers, private sector input suppliers, most of the MEA extension staff, and thousands of students. System B farmers are now much better informed of the health and environmental dangers of inappropriate pesticide use. MARD's IPM staff worked jointly with the wetland protection staff to set up a system for monitoring water quality in the irrigated areas of System B.

The project, working through farmer organizations, also started a riparian reforestation program to reforest drainage stream banks (to reduce soil erosion and improve biodiversity in the agricultural landscape); a windbreak program designed to protect certain horticultural crops and reduce wind erosion; and an electric fencing and fence protection program to reduce elephant-farmer conflicts. These programs were mostly of a pilot nature, but did successfully demonstrate environmental protection techniques that were well received by farmers.

Conclusion

Project activities experienced short delays from time to time, but these were not out of the ordinary for an area as remote as System B. MEA found it difficult to transfer highly qualified staff to System B and keep them there for more than a year. MARD also at times found it difficult to recruit staff. In addition, project activities were delayed by the security situation. However, despite these problems, most of the project's output targets were met and often exceeded.

Even more important, when conditions changed making certain project activities inappropriate, project management was quick to make design adjustments. The most important of these design changes were:

- The joint MEA/MARD decision to abandon the idea of MARD's FSEs working in parallel with MEA FAs, and merging the two extension staffs into one.

- The recognition that the project would not achieve large increases in area planted to OCs and the decision to focus of the number of farmers producing OCs.

- The decision in 1991 to shift the focus of diversification activities from low value field crops to high value fruits and vegetables and the related decision to pursue export markets aggressively with bold and ambitious production and marketing interventions.

- Adding horticulture and agricultural economic expertise to the technical assistance team to strengthen the ATGD component.

- The evolution of the farmer organization concept from turnout groups responsible primarily for field-level water management, to ULFOs undertaking commercial activities, to the final concept of DCOs operating and maintaining their D-canals and carrying out income generating commercial ventures for the benefit of their members.

CHAPTER 3

PROJECT IMPACT

Development Impact

The basic measures of project success are: 1) increased farmer incomes; 2) increased production of crops other than paddy; 3) increased production for export; and 4) progress in establishing farmer organizations.

Impact on Farmer Incomes

The project surveys tracking project impact show the following increases in farmer income in the last full year of the project (yala 1994 and maha 1994/95) as a result of diversification into OCs:

	$ thous.	% change
• increased income on irrigated lands in yala:	427	17.6
• increased income on irrigated lands in maha:	144	6.2
• increased income on homestead lands in maha:[3]	400	100.0
• total increased income:	1011	16.0

Not counting homestead production, the increase would be about 11.5 percent.

Across the System, results varied widely. Farmers in some irrigation blocks produced almost no OCs and experienced no measurable increases in income. In Ellewewa Block, where the project had the most success, the 60 percent of farmers who diversified experienced a 62 percent increase in income from their yala production in 1994. Table 1 shows the variations between blocks. (See Annex 3, Table1 for details on income increases by block and by season.) The average income increase during yala for diversifying farmers is 39.2 percent, with three blocks experiencing increases of over 50 percent. Even within individual blocks there are large differences in the income growth of diversifying farmers. Because of poor farming practices, many farmers were unable to increase their incomes by diversifying away from paddy, whereas other more skilled or motivated farmers were able to triple their incomes. It is important to remember, therefore, that the income increases achieved by MARD are probably just the beginning of a long process of changing farming practices in System B.

The project also had an impact on incomes as a result of infrastructure development. The development of Block 503 permitted the resettling of 300 households, and improved drainage in Zones 1 and 5 increased the productivity of about 4,000 hectares by 25 percent. The increased production resulting from these two activities is at least $300,000 per year and could be as high as $450,000 per year.

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[3] The homesteads are on unirrigated land and therefore grow only OCs. The 100 percent figure used here assumes that OC production on the homesteads is double what it would have been without MARD's adaptive research and extension activities.

Table 3: Income Increases Due to Crop Diversification in Yala Season - 1994				
Block	No. of Farmers	% of farmers diversifying	% incr. in incomes of diversifying farmers	Value of incr. income (Rs. thous.)
Ellewewa	2,121	60.5	62.0	6,745
Dimbulagala	2,441	55.7	25.8	2,985
Vijayabapura	1,885	42.2	60.4	4,065
Damminna	1,416	61.7	15.1	1,105
Sevenapura	2,289	35.6	36.8	2,535
Senapura	1,737	44.4	34.7	2,275
Singhapura	1,284	20.5	33.1	655
Aselapura	1,258	24.8	69.7	1,855
Totals	14,431	44.9	39.2	22,220

Source: Lalith and Gleason, Report on the Yala 1994 Crop Diversification and Cultivation Census in Mahaweli System B, MARD, December 1994.

Impact on Crop Diversification

The key question to ask with respect to the MARD project is whether it succeeded in introducing diversified cropping to System B. Project data show conclusively that farmers who diversify can multiply their incomes. If production of OCs has become firmly established, then farmer incomes have been permanently increased and will likely continue to grow.

OC production during the yala season

One indicator of diversification is the area planted to other crops during the yala season. The larger the area planted to other crops, the larger the value added generated by the land and water resources of System B. Project records show that the percent of irrigated lands planted to OCs during yala has only increased from 3.5 percent in 1990 (360 hectares) to 4.9 percent in 1994 (700 hectares). The largest increase was in Ellewewa Block which went from 4.3 percent in 1990 to 9.6 percent in 1994.

Although the percent of area planted to OCs during yala has remained fairly stable, the value of OC production in yala more than doubled between 1990 and 1994. This is in sharp contrast to the value of paddy production which has shown no increase. Table 2 shows the value of yala production from 1990 to 1994. Because there are such wide fluctuations in production and prices, growth rates vary greatly from year to year, but the value of OCs as a percent of total value of production is steadily rising.

OC production on homesteads

The first years of the project concentrated on OC production on irrigable lands to the exclusion of the non-irrigated homesteads. Beginning in 1992, the project's extension program gave increased emphasis to the homesteads. As a result, farmers began to view their

homestead lands as a means of increasing their cash incomes. During maha 1994/95, more than 1,500 hectares were devoted to annual crop production, mostly maize, yams, bananas, chilli and cowpeas. The project also succeeded in increasing tree crop production. A census of homestead tree in 1993/94 found almost 300,000 trees of 80 different species. The majority of these were fruit trees, mostly coconut, mango and jak, which in time will become important sources of income and food. The MEA Nursery, with MARD funding, provided a significant portion of homestead trees after 1991.

Table 4: Production of Major Crops in Yala, 1990 - 1994
(Rs. million)

	1990	1991	1992	1993	1994
Paddy	115.1	130.8	186.6	150.0	115.2
Big onion	1.9	3.7	4.3	3.6	7.4
Chili	5.2	6.4	11.1	1.4	4.1
Banana	n.a.	n.a.	n.a.	0.1	3.5
Groundnut	0.4	neg.	0.1	0.5	2.6
Butternut	0.3	n.a.	0.2	0.3	0.9
Brinjal	n.a.	n.a.	0.6	0.7	1.0
Greengram	0.8	0.5	0.9	1.1	1.2
Cowpea	0.7	0.7	0.7	0.8	0.9
Red onion	0.8	0.9	0.2	1.4	0.4
Cantaloupe	n.a.	n.a.	2.3	0.7	0.9
Long bean	n.a.	n.a.	0.3	0.4	0.7
Gherkin	0.8	0.8	1.0	0.7	0.7
Total value of OCs	10.8	13.1	21.6	11.9	24.6
Total value	126.0	143.9	208.2	161.9	139.8
OCs as % of total	8.6	9.0	10.4	7.3	17.6

Sources: MARD yala crop diversification and cultivation census reports, 1990 to 1994.

Number of farmers growing OCs

Another indicator of diversification is the percentage of farmers growing OCs in yala. This figure is important because it is a more accurate measure than area planted of whether diversified cropping has been established in System B. Project records show that, for all of System B, the percentage of farmers growing other crops during yala has increased steadily from 28 percent in 1990 to 45 percent in 1994. In Ellewewa block, the percentage of farmers growing OCs increased from 35 percent in 1990 to 60 percent in 1994. Table 1 shows the large variation between blocks in numbers of farmers diversifying. At the unit level the differences are even greater. In one unit (Aluthoya in Damminna Block) 95 percent of farmers have diversified; in two over 80 percent have diversified; and in seven units between 70 and 80 percent have diversified. The two blocks with the lowest percentage of farmers diversifying (Singhapura and Aselapura) are the most recently settled and are in areas with the most severe security problems.

System wide, OC production is now firmly established. It is highly likely that as farmers gain experience with OCs and as the security situation improves, the large majority of System B farmers will choose to grow OCs. This can be attributed almost entirely to MARD's agricultural research and extension program. It has been frequently noted that many of the farmers in System B were not farmers before resettling and are finding it difficult enough to grow two paddy crops, much less grow several crops on one irrigated field. Furthermore, for most OCs, the returns to labor are relatively low except for the best farmers. In 1994, most of the OCs provided an average return to labor of about Rs.60 per day, about the same as for paddy. (See Annex 3 Table 2.) However, although the average return to labor was relatively low, the range between the best and worst farmers was quite high. By adopting a farming systems approach and working closely with the best farmers, MARD was able to demonstrate that, with good cultural practices, farmers could greatly increase the returns to land and labor by shifting from paddy to other crops.

Impact on Production for Export Markets

When MARD started in 1988, it explored all possible export markets and analyzed the production potential of System B. These studies found that there were large export markets for products that could be produced in large quantities in System B. The decision to pursue these markets aggressively was made in 1991. At this time, the decision was also made to concentrate on the high income markets for high value crops. This meant focussing on Europe, Singapore and Hong Kong, and giving lower priority to the Middle East market for Asian vegetables.

These efforts, however, have not yet resulted in increased exports. The farmgate value of small farmer production for export in 1994 totalled about $30,000, of which $24,000 was accounted for by gherkin exports which would have occurred without MARD. About 200 farmers produced gherkins, and another 50 or so farmers produced okra and chili. The packhouse throughput in 1993 and 1994 is summarized in Table 5.

Table 5: Tess Packhouse Throughput (metric tons)

Product	1993	1994
Baby corn	32.8	2.0
Okra	11.7	19.0
Gherkin	1.5	15.7
Sweet corn	1.5	0.0
Cantaloupe	43.9	39.7
Other	1.5	0.4
Total	92.9	76.8

Although exports have not increased, efforts to introduce System B products to export markets did produce satisfactory results. Marketing trips to Singapore, Maldives, Kuwait, Korea and Hong Kong did not succeed in opening new markets; but trips and trial shipments to Europe and the Middle East (Dubai) were well received and resulted in orders for commercial shipments.

Small quantities of okra, baby corn and Asian vegetables were subsequently shipped to Europe and Dubai. Sri Lankan exporters have thus far not been able to build on these early successes, mainly because of production and post harvest handling constraints.

The project's ambitious and determined efforts to alleviate these constraints, had mixed results. Tess Agro, Ltd. has invested in a packhouse that includes the only hydrocooling facility in Sri Lanka. Combined with Tess's refrigerated trucks, this packhouse provides a cold chain that will meet System B's needs for many years to come.[4] MARD also worked closely with TESS to establish links with System B farmers. The project's horticulture staff identified crops that grew well in System B and provided an extension staff to work with the farmers who had buy-back contracts with Tess. In yala 1992, Tess entered into 42 buy-back contracts with farmer organizations, covering eight crops (mostly okra, butternut squash and cantaloupe) and involving 478 farmers. In the end, most of this production was sold locally and contracting activity gradually declined. By 1994 Tess was contracting with only about 40 farmers to grow okra, melon and small quantities of mixed Asian vegetables. These farmers were, however, becoming experts in production of such crops.

In addition to Tess, only three exporters were attracted to System B. Sunfrost has been contracting with individual farmers to grow gherkins since 1989. The company has its own extension staff and a commercial farm which it uses as a collection and brining center. At its peak, in yala 1993, Sunfrost contracted with 445 farmers to grow gherkins. In yala 1994, the number of farmers dropped to 179. Sunfrost is also experimenting with okra and other crops for export. In maha 1992/93, MARD attracted CIC, a Colombo-based agro-chemical firm, to grow baby corn for the European market. After two seasons the company discontinued export production because it was unable to compete with exporters from Thailand, but has continued produce fresh, brined and pickled baby corn for the tourist hotels and chain restaurants. The third exporter is CBS, an established exporter of Asian vegetables to the Middle East. During three seasons beginning in maha 1993/94 CBS contracted with four farmer organizations (about 100 farmers) to grow chilli, okra and cantaloupe. CBS is not operating in System B since April 1995 because of the security situation. The declining trend in buy-back contracting is summarized in Table 6. It will be noted that in yala 1994, excluding gherkins, about seven hectares of OCs were planted under buy-back contracts, out of a total OC area of 695 hectares.

With the major exception of the packhouse, efforts by MARD and MED to attract agribusiness investment to the region have also not been successful. Of the 21 commercial farms currently operating, only one is fully operational as a farm (growing bananas for the domestic and Middle East markets), and one, Sunfrost, is functioning as a collection, processing and experimentation center. Only two of the 21, Sunfrost and CIC, have contracted with outgrowers. Many of the remaining farms are not expected to survive as business ventures.

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[4] It should be noted that, although the packhouse, which is designed for a maximum daily throughput of 50 tons depending on the product, was to have been utilized by any exporter operating in System B, thus far only Tess has made significant use of it. The main reason seems to be the high price that Tess must charge to break even. Increased packhouse throughput would cause this price to drop sharply.

Table 6: Buy-back Contracts in System B, 1992 to 1995				
Season and Product	Company	No. of Contracts	No. of Farmers	Area (ha.)
1992 yala				
Butternut squash	Tess	11	132	16.1
Bittergourd	Tess	1	6	.6
Okra	Tess	4	67	7.4
Snakegourd	Tess	5	10	1.6
Cantaloupe	Tess	4	151	15.3
Yellow onion	Tess	10	67	2.2
Cabbage	Tess	5	26	2.6
Brinjal	Tess	2	19	1.9
Gherkin	Sunfrost	207	207	51.0
1992/93 maha				
Chili	Tess	6	231	24.6
Yellow onion	Tess	1	108	8.6
Okra	Tess	2	58	5.8
Baby corn	CIC	1	37	5.6
Gherkin	Sunfrost	193	193	42.0
1993 yala				
Cantaloupe	CIC	3	163	8.3
Baby corn	CIC	3	85	14.7
Gherkin	Sunfrost	445	445	80.0
1993/94 maha				
Cantaloupe	Tess	1	10	1.0
Okra	Tess	1	10	1.0
Okra	CBS	1	20	2.0
Chili/okra	CBS	2	58	5.8
Chili	CBS	1	25	2.5
Gherkin	Sunfrost	69	69	6.9
1994 yala				
Okra	CBS	2	32	3.5
Cantaloupe	CBS	1	5	0.5
Cantaloupe	Tess	1	10	1.0
Melon/chili	Tess	2	21	2.1
Gherkin	Sunfrost	179	179	18.0
1994/95 maha				
Okra	Tess	1	20	2.0
Melon/chili	Tess	2	21	2.1
Cantaloupe	Tess	1	10	1.0
Okra	CBS	1	6	0.6
Cantaloupe	CBS	1	5	0.5
Gherkin	Sunfrost	85	85	19.5

Source: MARD project impact monitoring records.

In conclusion, MARD has not yet established production for export in System B. However, there is a reasonably solid base on which to build. Tess Agro Ltd., has been exporting small quantities of mixed vegetables to Europe continuously since 1992, and is clearly committed to staying in System B; Sunfrost is firmly established in System B with gherkins and will probably expand into other crops; and CIC and CBS have expressed plans to return to System B once the security situation improves. More importantly, the packhouse is continuing to function and hundreds of farmers are familiar with growing export quality products under buy-back contracts.

Two recent private sector initiatives provide additional evidence that System B is at least on the exporters' radar screen. One is a proposal by a Sri Lankan firm to export relatively large quantities (at least ten tons per week) of low value OCs from System B to the Middle East (the Peace Air initiative). The second, is a Japanese firm looking for a source of okra for the Japanese market.

The Impact on Farmer Organizations

Since 1992, the MEA has looked to MARD for assistance in creating effective farmer organizations for the purpose of taking over the operation and maintenance of the distributory and field canals and associated drainage canals. This has been a highly successful undertaking. When the project started there were no functioning farmer organizations in System B. The farmers of System B are now organized into 103 D-canal organizations. The activities of these 103 organizations are summarized in Table 7. Most of those that are not active are located in areas affected by the security situation.

For the MEA, the main focus of the farmer organization work has been the D-canal takeover. As a result of an intensive training program supported by MARD, the large majority of System B farmers understand that they will one day have to assume responsibility for operating and maintaining their D-canals. A mechanism has been put in place for moving each DCO to the point where it is able to take over its D-canal. Most D-canals are still being operated and maintained entirely by the MEA but, even in these cases, the DCOs participate in MEA training sessions on how to organize for effective D-canal O&M. An important intermediate step is to have the DCOs perform D-canal rehabilitation work (Essential Structural Improvements - ESI) under contract. Thirty six DCOs have performed this work. When the DCOs demonstrate a sufficient level of organization and managerial capacity they enter into joint operation agreements with the MEA. Twenty-six DCOs are presently in this status and are expected to take over their canals this year. Once they have shown the ability to carry out all of the O&M activities on their own, the D-canals are turned over to them. Thirty-three DCOs have now graduated from joint operation status and have fully taken over their D-canals.

Not only are the farmers more capable of operating and maintaining their canals, the MEA now has a much better understanding of the takeover process and of its remaining responsibilities after the takeover has been completed. MEA and DCOs jointly decide when to enter into a joint agreement and when to effect the takeover. Problems and obstacles are also jointly resolved.

MARD has also been very successful in getting farmer organizations involved in commercial activities. Of the active DCOs, about 70 have received direct MARD assistance for

commercial activities. Fifty four DCOs are involved in commercial activities, including paddy marketing, renting tractor and sprayer services, supplying agricultural inputs, coconut cultivation, and consumer goods retailing. Several have entered into buy-back contracts to produce OCs for exporters. Many of these DCOs have demonstrated the ability to manage themselves as financially sustainable businesses.

Table 7: Farmer Organization Activities in System B

					D-canal Takeover status*		
	No. of DCOs	Rec'd. MARD Assist.	Com-mercial Activity	ESI Work	MEA	Joint mgmt	DCO mgmt.
Ellewewa	14	10	7	11	4	4	6
Dimbulagala	14	10	11	13	0	7	7
Vijayabapura	13	11	12	12	2	6	5
Damminna	10	9	8	10	0	5	5
Sevanapitya	17	13	8	0	14	1	2
Senapura	10	9	5	0	7	3	0
Singhepura	15	4	0	0	15	0	0
Aselapura	10	4	3	0	10	0	0
Totals	103	70	54	36	52	26	25

* Including Bakamuna (System G), 37 DCOs have assumed joint management and 33 have assumed full management.

Cost Benefit Analysis

The MARD project rationale was that crop diversification was necessary to increase farmer incomes and maximize economic returns on the land and water resources in Sysatem B. The economic analysis in the project paper indicated that, if the project achieved its diversification target of 50 percent during the yala season, the internal rate of return (IRR) would be in the 15 to 20 percent range. Actual project experience showed that 1) fifty percent diversification in yala was neither appropriate nor achievable in System B; 2) a much lower level of diversification would have been sufficient to achieve an IRR of 15 to 20 percent;[5] and 3) the project as designed generated significant quantifiable benefits not fully taken into account in the project paper. Despite not having achieved its main success indicator, MARD proved to be a major development success.

The cost benefit analysis presented in Annex 4 shows a ten percent rate of return based only on quantifiable benefits. These benefits are:

- increased incomes from crop diversification on irrigated lands during yala;

5 See Annex 3, Table 2 for data on net returns per hectare for the major OCs in System B.

- increased incomes from crop diversification on irrigated lands during maha;

- increased incomes from the production on annual crops and tree crops on non-irrigated homestead lands during maha;

- increased incomes from increased production resulting from infrastructure development in Zones 1 and 5 (mostly paddy production); and

- the value of improved D-canal O&M resulting from the DCO takeovers.

The benefit stream yielding the ten percent IRR is based on two key assumptions. First, it is assumed that MARD has successfully initiated a crop diversification process that is likely to continue after the project has ended. Farmers now know that OCs are more profitable than paddy and have learned appropriate cultural practices. Similarly, traders now routinely purchase OCs in System for sale in other areas. OC production can now be expected to grow on its own as farmers become more sensitive to market opportunities. Second, it is assumed that the benefits to farmers and the GSL of D-canal takeover by DCOs are large enough and sufficiently recognized for the process started by MEA and MARD to continue. The projected benefits do **not** depend on any significant growth in exports. Although there are reasons for optimism, it has not yet been established that System B will successfully enter export markets as a result of MARD's efforts. Based on experience to date, it can be expected that most of the OC production from ten percent of the yala area and 2.5 percent of the maha area will be for domestic markets.

As discussed in Annex 4, the quantifiable benefits on which the IRR calculation is based reflects the impact of certain intangible benefits, notably the MEA's increased agricultural extension capacity, the improved research support the MEA receives from the MOA, improved seed and seedling supplies, improved marketing channels, and the success of the farmer organization effort. There are also a number of intangible benefits not reflected in the IRR calculation, of which three should be highlighted:

- MARD's crop diversification efforts have had an impact far beyond System B and even beyond the other Mahaweli systems. As a result of MARD activities, the MOA now has an active high priority OC research program, and the Mahaweli is actively introducing OC cultural practices in its other systems.

- MARD not only assisted the MEA in developing DCOs in System B, it provided critical technical assistance in the national effort to transfer D-canal O&M from the government to the farmers. Many of the guiding documents used in all of the Mahaweli systems were prepared by MARD consultants, and the MARD farmer organization advisors served on the MEA's national-level committee overseeing the transfer process. In this way lessons learned in System B were applied to other areas.

- For the last five years, MARD has played the leading role in developing a horticultural export industry in Sri Lanka. It pushed the process farther and more rapidly than any other development project or government agency. Although the short-term results have been disappointing, the project has significantly shortened the learning curve and both System B and Sri Lanka are now better positioned to move into export markets on a large scale when the conditions are opportune.

- For the past three years, MARD has taken the lead in making MEA staff and farmers and

thousands of school children aware of the importance of Integrated Pest Management, protection of elephants, reforesting denuded drainage streams, and preserving wetlands. All of these programs are popular in the Mahaweli and will now continue on their own, except for the IPM program which has already secured outside assistance from the FAO, CARE, and the private sector.

These four benefits, which are non-quantifiable at this time and were not used in the IRR calculation, could prove to be MARD's most significant impact over the long term.

CHAPTER 4

FACTORS EXPLAINING PROJECT IMPACT: LESSONS LEARNED

The MARD project represents a unique effort to increase small farmer incomes through crop diversification in irrigated areas. The project had a clear end-of-project target -- increase farmer incomes by 50 percent mainly by shifting production in the yala season from low-income paddy to high-income other crops -- and a well defined strategy: 1) generate and disseminate new agricultural technologies; 2) introduce appropriate irrigation design and water management practices suitable for growing other crops; and 3) improve marketing channels and develop new markets.

This strategy was aggressively implemented. The project did not achieve its quantitative targets, but did push the change process as far as it could during the relatively short project time frame. In the process, many valuable lessons were learned that are applicable not only to other Mahaweli systems, but to many ambitious agriculture development projects in irrigated areas.

Introducing Crop Diversification on Paddy Lands

A basic project assumption was that the increased incomes obtainable from the production of other crops would induce farmers to shift away from paddy. When the project started, the production system was based firmly on two paddy crops. The production and marketing systems were both firmly established, although incomes were low. Growing other crops meant learning new cultural practices, reallocating labor time, and depending on new markets that were both less certain and less well understood.

The project proceeded systematically to introduce new crops. Adaptive research was carried out on research stations and on farmers fields. Once appropriate varieties and cultural practices were identified, the crops were disseminated to farmers through the extension system. The project had intended to introduce improved water management practices at the turnout and farm levels but these proved not to be necessary at the levels of production achieved by the farmers. Finally, the project worked on developing markets for the new crops.

The end result was that a large percentage of farmers chose to grow other crops, but not at the levels anticipated on the project design. The project objective was to have System B farmers move away from paddy to other crops as the major source of income during the yala season. What has occurred is that farmers have accepted OCs as a means of supplementing the income they earn from paddy production but not as a major source of income that substitutes for paddy. The best OC farmers produce as much as they can with family labor; and most chose to produce much less. For these farmers, producing small quantities of OCs for local markets is a low risk proposition generating small but welcome increases in income from their one hectare of irrigated land.

The key factor explaining the small area planted to other crops is that, unlike in System H where there is not enough water for farmers to grow two paddy crops, farmers in System B have a choice regarding whether or not to grow other crops. The choice is between earning increased incomes by shifting from a relatively simple farm enterprise to a more complicated one, or continuing with the existing enterprise and accepting existing incomes. Given that choice most chose stay with what they knew best. This factor alone explains why System B farmers are

planting five percent of their irrigated area in yala to OCs instead of 50 percent as called for in the project design.

However, although the farmers did not abandon one farming system for another, they did integrate OCs into their production systems. There is no way to know how fast and how far the transition to OCs will go, but there is no question that it has started. In some localities (units) over 70 percent of farmers grow crops other than paddy on over 10 percent of the irrigated area during yala. (See Lalith and Gleason, Report on the Yala 1994 Crop Diversification & Cultivation Census in Mahaweli System B, MARD, 1994.) In other localities, virtually no farmers have chosen to grow other crops. Most localities are in between, clustered around the average (45 percent of farmers growing OCs on five percent of the area). These variations between localities provide insights into the main factors affecting crop diversification in System B.[6] These are summarized below.

- The strongest determinant of crop diversification was the experience of the farmers. The most experienced farmers were able and willing to adopt new and more demanding cultural practices whereas more recently settled farmers, many of whom had never farmed before, were fully engaged in learning how to grow paddy and manage a farm that is producing only one easily marketed crop. Good extension programs that were effective in improving farmer skills were also a factor. When MEA transferred extension staff from high OC production areas to low production areas, OC production in the latter areas increased measurably. (See MARD 1995 Annual Workplan, January 1995.)

- Farmers must perceive a crop to have a secure market before they will grow it in significant quantities. Although at least 40 OCs are grown in System B, 12 OCs account for the bulk of the production. (See Table 4.) Almost all of the OCs produced in System B have well established and relatively stable domestic markets, and most have a relatively long shelf life if properly stored. These crops are now firmly established in System B. Production of perishables for new markets, however, has not been established. Farmers will not grow these crops unless they have contracts with firms that have a proven track record, for example, gherkin production for Sunfrost. The returns to land and labor for the major OCs are presented in Annex 3, Table 2. It will be noted that these crops, including gherkins, all have well established markets and, excluding yala 1993 which was adversely affected by heavy rains, all of the crops showed relatively stable returns.

- Labor requirement was an important determinant of crop diversification. The crops that required the least labor per hectare were the ones that were most readily adopted by farmers. The most obvious example is bananas, which require relatively little labor once the trees are planted. From almost no production in 1992, bananas have become the second largest OC in System B and will probably be the largest by 1996. Greengram, cowpeas and groundnut are also popular with farmers because they have relatively low labor requirements relative to most vegetables.

More generally, labor requirement is the main factor explaining why the percent of area

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[6] Gleason, Lalith and Perera, Investigation of Factors Associated with Crop Diversification in Irrigable Lands in System B, MARD (1993) presents the findings of a MARD survey assessing the importance of the following factors with respect to crop diversification: length of residence in System B, educational level of farmers, years of farming experience, membership in farmer organizations, extension, marketing, and land suitability.

planted to OCs is so low. Even the most progressive System B farmers have grown only what they were able to cultivate with their own family labor. The combination of uncertain demand in OC markets and low profit margins, has made most farmers unwilling to take the financial risk of hiring laborers for OC production.

Introducing Export Agriculture to System B

MARD put a tremendous effort into developing export agriculture in System B. Project interventions were aimed at all levels of the production and marketing chain, from the producer to the final markets. In many respects this turned out to be the most unique and useful learning experience offered by the project.

MARD staff recognized from the outset that this would be a very difficult and risky undertaking. Sri Lanka had only one significant success in the high value market -- gherkins; and System B had virtually no experience in producing OCs of any kind, much less high quality products for discriminating markets. Other Asian countries, notably Thailand, had a long head start on Sri Lanka. Within Sri Lanka, other regions closer to Colombo with more developed infrastructure and in some cases better growing conditions, seemed to be in a better position to supply these markets than System B.

However, the potential pay-off was seen as justifying the effort and risks. There were clearly large overseas markets for crops that could grow in System B. Post harvest handling facilities, including a cold chain, could be installed as necessary; and links between farmers and exporters and between exporters and importers could be established. Marketing trips were made to Europe and Asia in 1991 and 1992; the packhouse was completed in 1992; and MARD assisted the packhouse owner in negotiating buy-back contracts with hundreds of farmers. At the same time, MARD with MED support made a determined effort to attract investments in commercial farms which would enter into buy-back contracts with outgrowers, serve as collection and grading centers, and utilize the packhouse facilities.

The lessons learned were as follows:

For MARD, the easiest part of the task turned out to be getting farmers to grow export quality products under contract. At the start of the project System B farmers had no experience other than growing paddy as a cash crop and small quantities of other crops for home consumption. Beginning in 1989, Sunfrost began contracting with individual farmers to grow gherkins. In 1992, Tess entered into buy-back contracts with farmer organizations to purchase a wide range of Asian vegetables. Farmers proved willing and able to enter into these relationships. The key proved to be effective extension support. Farmers had to learn about contracting, then had to learn how to produce, harvest, grade, package and store export quality products. In the case of Sunfrost, the exporter provided the necessary extension staff. In the case of Tess, MARD provided not only the extension staff and farmer organization support, but also technical expertise in buy-back contracting and post-harvest handling.

MARD also proved effective in introducing System B products into markets where they could compete. The project's horticulture and export marketing staff had extensive private sector experience in fruit and vegetable exports. Many of the project's trial shipments generated orders for larger quantities. What the project discovered is that importers are constantly looking for dependable sources of competitively priced quality products. The key was knowing how the international marketing system functioned and how to establish initial contacts. Project staff

were more experienced in the high income European and Asian markets than in the low income Middle Eastern markets, so most of the progress was in the former.

The project's most intractable problem was the inability to attract exporters and investors into System B. To go from trial shipments to commercial shipments requires the full range of support services, from seed and other input supplies, to harvesting, collection, grading, cooling, processing, packing and transporting. The project found that these services could only be provided through private sector investment and long-term commitment. Sunfrost assigned a strong manager to System B, hired a staff of extension agents, and invested in a commercial farm that serves as a collection point, brining center, and site for adaptive research. MARD succeeded in attracting private investment in a cold chain which was absolutely critical to the increased production of fresh produce for export. Other efforts to attract investors, however, proved largely fruitless. The most frequently cited reason was the security situation, but there were other factors, notably System B's remoteness and lack of infrastructure, especially roads and telecommunications. These were all problems beyond MARD's control.

There was also the broader problem that the fruit and vegetable export sector was not seen by Sri Lankan investors as highly lucrative. Gherkins continue to be Sri Lanka's only significant vegetable export. Several Sri Lankan businesses also export small quantities of fresh fruits and vegetables to the Asian market in the Middle East. For the fruit and vegetable export sector to attract major private investment, it will be necessary for the government to provide whatever incentives are necessary to create a highly developed and efficient support system comparable to what is in place in other successful exporting countries such as Thailand, Kenya and certain Central American countries. Without a national commitment of this type, it will be very difficult for project like MARD to achieve significant successes no matter how sound the strategy and how determined the effort.

Strengthening Farmer Organizations for D-canal O&M

With MARD's assistance, the MEA has achieved exceptional success in establishing effective farmer organizations in System B. The key was to provide farmers with reasons to organize. One of these reasons was the need to take over D-canal O&M from the MEA. The MEA developed a program, spearheaded by the Managing Director himself, for informing farmers of the need for and benefits of farmers taking over the D-canals. The MEA also established committees to meet regularly with DCO leaders to discuss farmers' needs. The MEA has developed an admirable record of being responsive to farmer requests expressed in these meetings. MARD also provided a third reason -- the income derived from DCO commercial activities.

MARD support for FO commercial activities had begun earlier in the project with the ULFOs, and was expanded with the newly formed DCOs. First, the project provided tractors to the most effective organizations. Later, the project helped finance DCO input supply shops and revolving seed commercialization funds. In 1991 and 1992, the project also worked closely with the farmer organizations in negotiating buy-back contracts with exporters. And, in 1994, the project was instrumental in getting many DCOs involved in collecting and selling paddy to the Paddy Marketing Board. MARD also worked with MEA in arranging for DCOs to do "essential structural improvement" (ESI) work on D-canals under contract. As the level of commercial activity of many DCOs increased, MARD provided business and financial management support by assigning enterprise managers to selected DCOs and conducting audits that helped introduce improved financial management practices.

MARD discovered early on that there were very few reasons for farmers to organize. The irrigation system could easily support two paddy crops, paddy was easily marketed by individual farmers, farmers had developed the view that the government will always maintain the entire irrigation system from the main canal to the farm at no cost to the farmer, and OCs could be grown in most areas without farmer organizations managing the water. Project experience also showed no one activity was enough to motivate farmers to form strong organizations. Attempts to form ULFOs around commercial activities in 1990 and 1991 had only limited success. Similarly, contracting with MEA to carry out ESI work generated income for farmer groups but did not provide a basis for cohesive, cooperative effort. Finally, farmers who had no prior experience working together proved to be ill prepared and poorly motivated to assume D-canal O&M responsibility. By combining all of these activities, the most active organizations had strong incentives to meet regularly and work cooperatively to solve common problems and undertake activities of mutual benefit.

The main factors explaining MEA and MARD's success in strengthening farmer organizations were:

- MEA committed itself to transferring D-canal O&M responsibility to DCOs in a collaborative manner. Farmers now understand why D-canal takeover is necessary and are taking over the D-canals voluntarily after they develop the managerial and technical capability.

- Farmer organizations in System B gained valuable experience in working together by carrying out commercial ventures and providing commercial services for their members. MARD training in business and financial management was a critical part of this process. The activities of these organizations are financially sustainable and many of the organizations have the expertise to manage them in a financially sustainable way.

- Farmer organizations are most sustainable when there is an economic base to support their activities. In Zones 1 and 5, the level of economic activity makes it possible for farmer organizations to provide valuable services to their members and be financially viable. In Zones 3 and 4, farmers do not form organizations because the level of economic activity is too low for the organization to generate immediate benefits or break even financially.

CHAPTER 5

SUSTAINABILITY OF PROJECT BENEFITS: RECOMMENDED NEXT STEPS

MARD's major accomplishment in System B was to begin the transition process from a paddy-based economy to one based of diversified agricultural production. This transition has many facets which must continue after the end of the project. The most important accomplishments thus far are:

- farmer incomes have increased by 16 percent as a result of increased OC production;
- farmers have developed an increased knowledge of cultural practices suitable to OC production in System B as well as an increased knowledge of OC marketing both domestic and export;
- a large number of farmers are now organized into effective DCOs and are in substantial control of the operation and maintenance of their D-canals and turnouts;
- private Colombo-based agribusinesses have developed an increased understanding of export markets for fruits and vegetables and of how to work with small producers in System B;
- the MEA extension staff in System B has become knowledgeable about OC production in association with paddy on irrigable lands as well as the production of annual and tree crops on unirrigated homesteads; and
- MEA institutional organizers in System B have become effective in forming voluntary and sustainable farmer organizations capable of operating and managing D-canals and for undertaking commercial activities; and
- at the national level, the MEA is more knowledgeable about OC production and marketing; the MOA has developed an OC research program; the MEA, EIED, and EDB has gained experience on fruit and vegetable export promotion; and there is an increased GSL understanding of and commitment to OC production in irrigated area, especially for export.

The project has thus already made a major difference in System B and at the national level, but important next steps are required to take maximum advantage of what has been accomplished. If these steps are not taken, not only will many aspects of the transition come to a halt, much of the progress already achieved could be reversed.

Crop Diversification

MARD succeeded in firmly establishing OC production in System B, but did not succeed in substituting OCs for paddy as the major cash crop during the yala season. The question now is: what next? How important is it that the area planted to OCs in yala increase significantly above the existing five percent? The original project rationale that the value added from two paddy crops does not provide an adequate economic return on the System B land and water

resources is still valid. And the original project assumption that a significant shift to OCs during the yala season would substantially increase the return on the System B investment as well as substantially increase farmer incomes also remains valid. It would seem that, in order to 1) obtain a satisfactory rate of return on System B land and water, 2) increase farmer incomes above the poverty level, and 3) increase the productivity of irrigated land so that farmers can assume a significant share of irrigation O&M costs, MASL cannot stay satisfied with having a large number of farmers grow small quantities of OCs. The long range target has to be a substantial increase in OC production during yala.

Recommendations

- The MOA must continue to conduct adaptive research on OC production under conditions that prevail in System B. This research should be directly linked to the expressed needs of farmers as communicated through the extension staff. All adaptive research should be conducted in a farming systems context. The MASL/DOA research coordination committee must begin meeting soon after the MARD Project ends so as to ensure coordination.

- The MEA extension staff in System B, from senior management down to the field assistants, should consider OC production its top priority and be retrained accordingly. Consideration should be given to targetting the farmer organization as the locus for the revitalized extension effort. Farmer organization officers have said they would be glad to help push the production of OCs, but need to seen as central to MEA's extension effort and not on the margin.

- The Sunfrost experience has shown that the private sector is better at providing hands-on extension advice to farmers than the public sector. The MEA needs to define its extension role vis a vis the private sector and gear itself up to perform that role effectively. Two functions of the MEA extension service should be to 1) carry out adaptive research on farmers fields to identify new technologies that could be disseminated by the private sector, and 2) act as a market-oriented catalyst and facilitator linking small producers with buyers. This will require retraining. If done properly, this redefinition of the extension function should result in a smaller but more productive MEA extension staff.

- The MEA should continue to implement the many valuable innovations introduced by the project with respect to irrigation system design and operation, from the main canal down to the field canals and lowland drainage canals, including the 12-month irrigation system.

Increased Production for Export

The future remains impossible to predict. On the positive side: System B has a cold chain; farmers have had experience with buy-back contracts and producing crops to exacting standards; exporters have established market links with farmers and farmer organizations; and exporters operating in System B have gained experience in the high income Asian and European markets. On the negative side, the reasons for the lack of progress remain: the security situation in System B; poor infrastructure, especially roads and communications; seed shortages; lack of farmer experience in production and post harvest handling; lack of grades and standards; poor packaging; and the lack of processing facilities to absorb the low grade products.

These problems are not easily overcome. Some are unique to System B; others are systemic at the national level. A critical mass of high value exports is required before the proper support system can be economically justified, and this requires a joint government-private sector commitment at the national level. It must also be recognized that, even in the context of a stepped up national effort to promote fruit and vegetable exports, System B suffers serious disadvantages vis a vis other regions of Sri Lanka. It does not appear advisable for the MASL to be too far out front with bold, expensive initiatives in System B. The private sector is now well aware of System B's production potential and if System B has comparative advantages in the production of fruits and vegetables for export, the private sector will identify them. The recommended stance for the MEA and donors is to respond quickly and aggressively to targets of opportunity as they arise. Examples would be the Peace Air initiative and the Japanese okra inquiry.

Recommendations

- The MEA and others must be ready to support private sector initiatives in System B. The most important action for MEA to take at this time is to retrain the extension staff and utilize it to facilitate linkages with farmers. The EIED, AgEnt, and other resources should be utilized in support of System B export initiatives whenever necessary.

- Looking beyond System B, the GSL should assess the country's policy framework and support system for high value fruit and vegetable exports, including roads, communications, seed import policy, cargo space, post harvest handling facilities, and proper packaging. Where private investors need to take the lead, (e.g., air cargo space and post harvest handling) the government should offer incentive systems, technical expertise and other support as appropriate.

Strengthening Farmer Organizations

Progress has been uneven across the System. Table 7 shows that the most active DCOs are in Ellewewa, Dimbulagala, Vijayabapura, and Damminna blocks (Zones 1 and 5). Twenty-two of the 24 D-canals in System B that have been completely taken over, and 21 of the 25 that are under joint MEA/DCO management are in these two zones. All of the ESI contract work performed for MEA has been in these four blocks. Similarly, most of the DCO commercial activity is in these four blocks, although the DCOs in Sevanapitya and Senapura blocks (Zone 2) are not far behind.

At this time, the sustainability of the 60 or so DCOs with whom MARD has worked most closely appears promising. Many of these DCOs are now initiating their own commercial activities without MARD or MEA assistance. Several have expressed the intention to form farmer companies at the block level. Whether the D-canal takeovers are as sustainable remains to be seen. The next three to four years will be critical. If progress to date is reversed, it is very likely that the D-canal takeover will not occur thus setting back plans to make D-canal O&M in System B financially sustainable.

The situation is even more tenuous for the 45 DCOs who have made the least progress. These organizations have been registered and participate at the PCC meetings, but they have not undertaken any commercial activities and have made little progress toward taking over the D-canals. They have little chance of becoming self-sustaining until they receive the close training that was provided by MARD and the MEA to the more advanced DCOs.

Recommendations

- The MEA must continue to provide technical, organizational and financial support to the DCOs in Zones 1 and 5, and increase efforts to make the DCOs in the other zones into effective and cohesive farmer groups for both water management and for commercial activities. In as far as is possible, MEA should channel its development program through the farmer organization structure, thus making the farmer organization central to the farmers' needs and providing farmers with the opportunity to jointly manage all MEA programs. This will require continued committment and follow up from MEA's Managing Director and General Manager and MASL full support, including budgetary support.

- MEA's joint management program can succeed only if the joint management structure based on committees made up of farmers and MEA officers committees is effective. This means that those committees must continue provide solutions to the problems jointly identified by farmers and MEA officers. Otherwise, farmers will lose interest in attending committee meetings.

- At the national level, it is critical that the GSL renew its commitment to putting D-canal management in the hands of farmers and making D-canal O&M financially self-sustaining. This requires increasing the O&M fee charged by the MEA at the same time that DCOs are being formed. It must be made clear to farmers that D-canal O&M will be more effective and will cost them less and be more responsive to their needs if they take it over compared to leaving it in the hands of the MEA. As this is a poltically charged issue, it must be dealt with on the national level.

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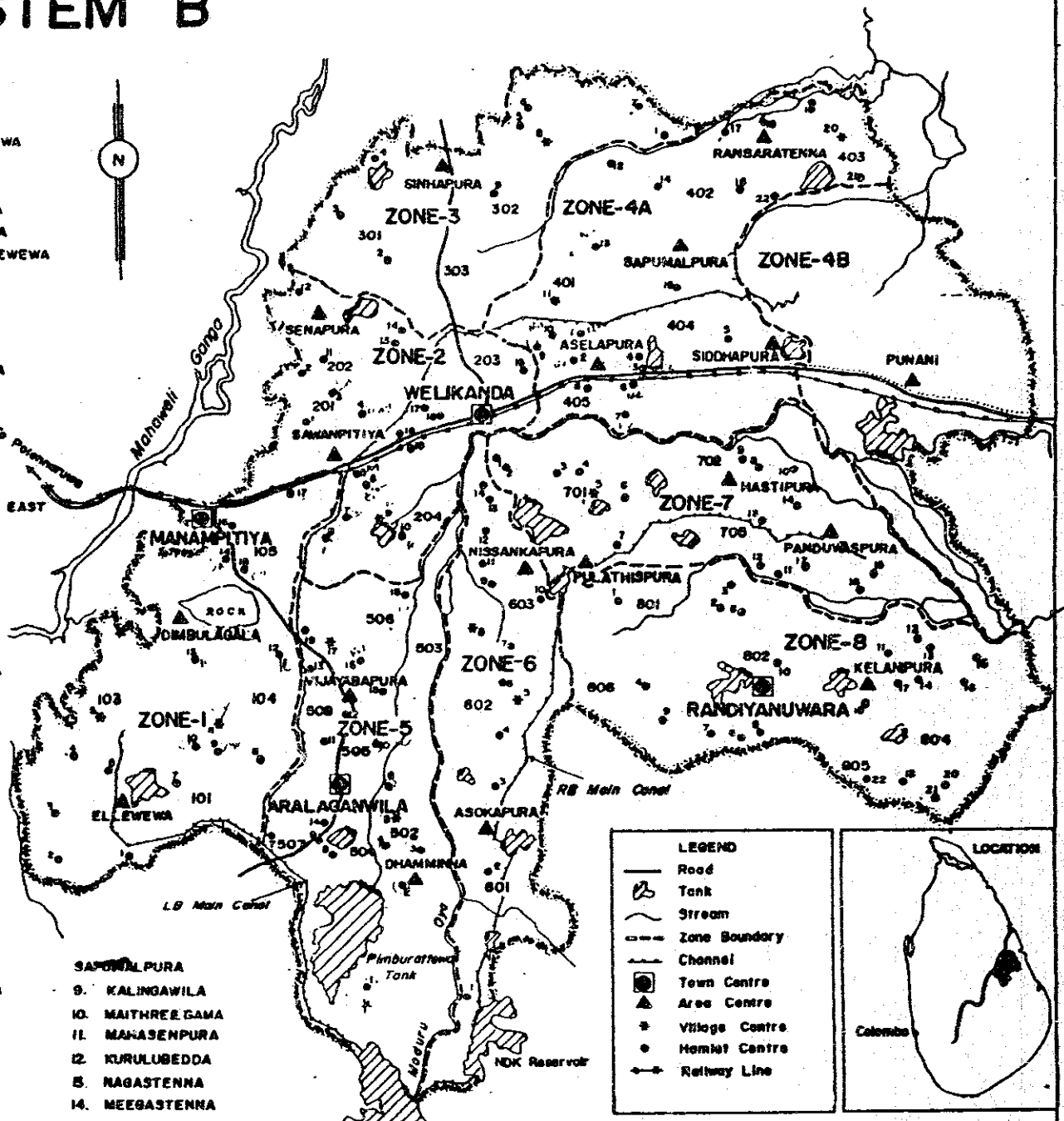
ANNEX 1

MAP OF SYSTEM B

SYSTEM B



ZONE- 1

ELLEWEWA

1. IHALA ELLEWEWA
2. BANDANAGALA
3. KALUKELLE
4. MAGULDAMANA
5. PELATIYAWEWA
6. PAHALA ELLEWEWA
7. MAHADAMANA

DIMBULAGALA

8. VEERANA
9. BINPOKUNA
10. MAHAULPOTHA
11. BOGASWEWA
12. VEHERAGAMA
13. MILLANA
14. DALUKANA
15. KUDAWEWA
16. MANAMPITIYA EAST
17. MAHAWEWA

ZONE- 2

SAWANPITIYA

1. KARAPOLA
2. MUTHUGALA
3. MADURANGALA
4. MALLINDA
5. MENIKWELA
6. BORAWEWA
7. GIRIDAMANA
8. ALUTHWEWA
9. MELUNWEWA
10. RIDEEPOKUNA

SENAPURA

11. SADUNPITIYA
12. KATUWANWILA
13. ATTUGALA
14. MALWELA
15. MAGULPOKUNA
16. MONARATENNA
17. RUHUNUKETTA
18. SUSIRIGAMA
19. BOATTA

SAPUMALPURA

9. KALINGAWILA
10. MAITHREEGAMA
11. MAHASENPURA
12. KURULUBEDDA
13. NAGASTENNA
14. MEEGASTENNA
15. RANGIRITENNA

RANSARATENNA

16. SURIYAGAMA
17. DUNINDAGAMA
18. SANDUNWILA
19. MIHIRITENNA
20. RANDIYAPOKUNA
21. SEEWALIWEWA
22. PULASTHIWEWA

ZONE- 3

SINGHAPURA

1. RANDENIWALA
2. MUTHUWELLA
3. KUDAPOKUNA
4. KANDAKADUWA
5. SURIYAWEWA
6. RUWANKETTA
7. MALWENNA
8. MAHAWELITENNA
9. PARAKUMYAYA

ZONE- 4A

ASELAPURA

1. NAMALGAMA
2. MAHINDAGAMA
3. RIDEETENNA
4. SAMANALATENNA
5. JAYANTHIYAYA
6. MENIKDENIYA
7. RUWANPITIYA
8. RANMALTENNA

SIDDHAPURA

ZONE- 5

DAMMINNA

1. KANDEGAMA
2. DAMMINNA
3. NIDHANWALA
4. IHALAWEWA
5. DIVILDAMANA
6. ARUNAPURA
7. ALUTHOYA

VIJAYABAPURA

8. ALAWAKUMBURA
9. BOGASHANDIYA
10. DEAWAGAMA
11. RATMALTENNA
12. GOMATHIYAYA
13. GIRIPOKUNA
14. KOLONGASHANDIYA
15. INGURUWEWA
16. MADURUTENNA
17. GABADAWEWA
18. GALTALAWA
19. MEDAGAMA

ZONE- 6

ASOKAPURA

1. KUDAWILA
2. MEEMINNAGOLLA
3. GANTHALAWA
4. MADURUDENIYA
5. MAHAWELIGAMA
6. WEERAGASTENNA

NISSANKAPURA

7. ILUKPITIYA
8. SANDASIRIGAMA
9. RANWELITENNA
10. AMBAGASPITIYA
11. MEERANDAWEWA
12. THALGASPITIYA
13. MORAGASTENNA
14. NUGAGAHENDIYA

ZONE - 7

PULATISPURA

1. PINIDIYAPOKUNA
2. MALDENIYA
3. TISARAGALA
4. SARUKETHA
5. MIHIRIGAMA
6. IDDAGODA
7. DIMBULANA

HASTIPURA

8. MONARAWELA
9. RANGIRIWEWA
10. SANDUNGALA
11. JAYABIMA
12. RUWANHELA
13. RIDEEWEWA

PANDUWASPURA

14. MALKADUWA
15. LANDEGAMA
16. HANSAWILA
17. PALIGUTENNA

ZONE- 8

RANDIYANUWARA

1. KUMBUKWEWA
2. AMBAWINNA
3. WELEGAMA
4. MAYAWEWA
5. KEKULUWALA
6. MEEWADATENNA
7. WANNI-ELA
8. KUDIMENGALA
9. WEERAGALA

KELANIPURA

10. SERUGALA
11. RAMBARAGOLLA
12. HORAGASBEDDA
13. NUGALANDA
14. KAPURUWANA
15. MALIGATENNA
16. NAMALAYAYA
17. ITTAKANDA
18. MORAGASHINNA
19. DEBARAGALA
20. KOTIMUKALANA
21. DAMBAHENA
22. MIYANGOLLA

MEA/FF

ANNEX 2

PROJECT OUTPUT INDICATORS

Table 1
Achievement of Logical Framework Targets

	Target	End-of-project status	Description/ Comment
Project goal: to obtain maximum benefits from System B land and water resources	15% return on incremental investments	10% return on MARD investment	Based on quantifiable benefits only. (See Annex 4.)
Project purpose: increase farmer income through increased productivity, improved markets and improved infrastructure	1) Avg. net farmer income increased by 50% over income from 2 paddy crops. 2) 10% of maha and 50% of yala planted to non-paddy crops. 3) 25% of farmer households engage in commercial exploitation of homestead 4) Farm portion of irrig. system operating at 70% efficiency 5) Recurrent costs of the irrigation system borne by GSL reduced by 25%.	1) Avg. net farmer income increased 16%. 2) 1.5% of maha and 4.9% of yala planted to non-paddy crops. 3) 80% of HH growing cash crops on homesteads. 4) This target was dropped. 5) ?	
Project Outputs			

Generation and dissemination of new agricultural technologies	a) Production recommendations published for 10 crops. b) Continuing program of trials on farmers' fields. c) 10 diversified crops tested and introduced on farmers' fields	a) 10 recommendations published. b) seasonal programs ongoing. c) 10 plus	a) Big onion, cantaloupe, baby okra, chili, baby corn, greengram, organic fertilizer, mango, potato, capsicum. b) Agronomy, homestead production (annual and tree crops), IPM c) Cantaloupe, baby corn, baby okra, sweet potato, potato, greengram, Cowpea, butternut, etc.
Improvement of water management	a) water use reduced to within 20% of requirement	Target dropped.	Target not relevant because of abundant water.
Project outputs (continued)			
Establishment of farmer organizations	a) 250 of 917 turnout groups have effective responsibility and control at the turnout and farm levels. b) 25 out of a total of 55 ULFOs are legally registered, operate D-canals, and engage in commercial activities	a) 937 turnout groups have control of water management at turnout and farm levels b) 112 DCOs registered; 103 active	- 112 DCOs registered - 65 DCOs engage in commercial activities - 70 DCOs manage their D-canals fully or jointly with MEA

Development of farmer support services	a) 20 market studies completed b) 5 post-harvest handling facilities operating, of which at least one for export c) 5 commercial farms operating	a) 17 studies completed b) 5 post-harvest facilities c) 5 commercial farms	a) fruit chips (Vietnam); ANUGA; local market survey; Singapore (2 reports); Bahrain; Saudi Arabia; Dubai (3 reports); Hong Kong (2 reports); Kuwait; U.S. supermarket chain; Australia cantaloupe; Paris; baby corn business plan. b) Tess packhouse - Sunfrost gherkin brining center - CBS okra collection center - CIC baby corn collection center - 127 farm-level onion storage facilities c) Vajira; SPD combine; Sunfrost; CIC; Aththana
Construction of irrigation and drainage infrastructure	a) 200 km of canals b) 10 km. of access roads c) 250 km of drainage canals	a) 70 km b) 10 km c) 30 km	The main drains in Block 503 have been completed. The remaining 220 km of drains are bottomland drains awaiting settler arrival.

AND DAI CONTRACT DELIVERABLES

Table 2
DAI MARD II Contract Deliverables

Output	Target	EOP status	Output Description

Seasonal research programs	5	5	J. Burleigh: Chili IPM report J. Burleigh: Gherkin IPM report J. Burleigh: Chili in Ellewewa Reggie John: Grapes Reggie John: Baby corn, okra seasonal reports
Seasonal extension programs and reports	5	9	Gleason: Yala 1993 report Gleason: Maha 1993/94 report Gleason: Yala 1994 report Gleason: Maha 1994/95 report Gleason and Lalith: Special extension report MEA season reports: 4
Commodity production assessment report	20	23	Baby corn, baby okra, cantaloupe, chili, b' onion, zucchini, asparagus, garlic, hybrid onion, sweet corn, strawberry, aubergine, baby eggplant, mango, papaya, lime, lemon, groundnut, greengram, cowpea, gherkin, blackgram, medicinal plants
Semi-annual reports on commercial farms	5	0	
Mass media extension publications distributed to at least 3,000 farmers	8	9	YP deSilva: Big onion YP deSilva: Chili YP deSilva: Mango YP deSilva: Potato YP deSilva: Nursery Management Nimal Wickramarante: Water Management YP deSilva: Crop Recommendations I. Padmasiri: Mango Cultivation C. John: Grape Cultivation
Farmer training programs	10,000 farmers	37,400 farmers	

Specialized technical reports	8	12	GRN Gunawardena: On-farm Drainage in System B KR Neil Bandara: feasibility for 12 month irrigation H. Ratnayake: Medicinal Crops Gleason et al: Factors associated with crop diversif. K. Srivastava: Big onion storage report Cyril: Livestock production in System B Guise and Wilson: Post harvest management of okra C. Davis: Wetland development, reforestation, etc. YP deSilva et al: Elephant-human conflict Ajanta Perera: Water quality report Lin de Alwis: elephant protection in System B U.G.A. Abeygunawardena: DCO and FC evaluation methodology and presentation of results

Table 2: DAI MARD II Contract Deliverables (continued)

Output	Target	EOP status	Output Description
Market assessments	20	17	Fruit chips (Vietnam); ANUGA; Analysis of local products; local market survey; Singapore (2 reports); Dubai (3 reports); Hong Kong (2 reports); Bahrain; Saudi Arabia; Kuwait; U.S. supermarket report; Australia cantaloupe; Baby corn business plan; Parson's okra follow-up

Test marketings	8	10	Cantaloupe sea shipment to Hong Kong; cantaloupe air shipment to Hong Kong; Baby corn to Patel in London; Okra shipments to Frankfort, Rome, Zurich, Paris, Copenhagen; Cantaloupe to Dubai; Baby corn to Cologne
Commercialization Fund grants	50	150	Majority of grants to farmer organizations for commercial activities. (See text tables 1 and 2.)
Farmer organization income generating investments	30	152	Tractors: 25 DCOs Seed commercialization fund: 46 DCOs Weighing scales: 40 DCOs Sprayers: 6 DCOs Input shops: 11 DCOs
Review of construction plans	$5 mill.	$3.5 mill	Rs. 140 million at Rs. 40 exchange rate
Inspection of construction	$5 mill.	$2 mill.	Rs $80 million at Rs. 40 exchange rate
Reports covering on-farm water management research	5	1	1995 summary report
Quarterly progress reports	10	10	

ANNEX 3

CROP DIVERSIFICATION STATISTICS

Table 1
Crop Cultivation Progress
Mahaweli System B (1990 -1994)
Irrigable fields

Yala Season	Total area (ha.)	Paddy (ha.)	OC (ha.)	Percent OC	Total farmers	OC farmers	% OC farmers	Total income (Rs. thous.)	Income if paddy only (Rs. thous.)	Incr. in income (Rs. thous.)	% incr. in income	Increase per farmer Rs.)
1990	10,329.9	9,967.6	362.3	3.51%	10412	2945	28.28%	128,015	119,287	8,728	7.32	2,963.6
1991	10,106.0	9,628.1	477.8	4.73%	9937	3562	35.85%	51,853	49,205	2,647	5.38	743.2
1992	11,008.6	10,431.7	577.0	5.24%	9901	3423	34.57%	213,010	196,679	16,330	8.30	4,770.7
1993	12,370.3	11,780.6	589.7	4.77%	12647	4190	33.13%	164,532	157,609	6,923	4.39	1,652.2
1994	14,287.0	13,592.1	694.9	4.86%	14431	6476	44.88%	142,476	121,125	21,351	17.63	3,297.0
Total								699,885	643,906	55,979		

Maha Season	Total area (ha.)	Paddy (ha.)	OC (ha.)	Percent OC	Total farmers	OC farmers	% OC farmers	Total income (Rs. thous.)	Income if paddy only (Rs. thous.)	Incr. in income (Rs. thous.)	% incr. in income	Increase per farmer Rs.)
1990/91	10,557.6	10,513.9	43.7	0.41%	10,456	1,161	11.10%	98,607	97,867	740	0.76	637.2
1991/92*	10,956.0	10,852.5	103.5	0.94%				160,795	158,284	2,511	1.59	
1992/93	10,366.9	10,205.9	161.0	1.55%	10,388	1,924	18.52%	180,056	176,961	3,095	1.75	1,608.5
1993/94	12,807.0	12,609.4	197.6	1.54%	12,873	2,918	22.67%	73,571	71,899	1,673	2.33	573.2
1994/95	14,360.0	14,142.3	217.7	1.52%	14,360	3,163	22.03%	123,815	116,603	7,211	6.18	2,279.9
Total								636,843	621,613	15,229		

* Mahaweli Economic Agency data

Mahaweli System B
Homestead

Maha Season	Total cultivated area (ha)	Total homesteads	No. of cultivated homesteads	Total income (Rs. thous.)	Income per homestead (Rs.)
1992/93	490.9	13,125	6,925	23,568	3,403
1993/94	588.1	16,373	11,472	10,927	953
1994/95	1,327.5	19,057	15,248	38,902	2,551
Total				73,397	

Income in only paddy
Total income
Increase in income
(Rs. thous.)

	Total income	Income if only paddy	Increase in income	Percent increase
Yala seasons	699,885	643,906	55,979	8.69
Maha seasons (irrigated)	636,843	621,613	15,229	2.45
Maha homesteads	73,397		73,397	
Total (1990 - 1995)	1,410,125	1,265,519	144,605	11.43

Table 1A
Crops Cultivation Progress - Zone 1
Ellewewa Block (1990 -1994)
Irrigable fields

Yala Season	total area (ha.)	Paddy (ha.)	OC (ha.)	Percent OC	Total farmers	OC farmers	Percent OC farmers	Total income (Rs. thous.)	Income if paddy only (Rs. thous.)	Increase in income (Rs. thous.)	% increase in income	Increase per farmer (Rs.)
1990	1,892.9	1,812.2	80.7	4.26%	1911	673	35.22%	23,780	21,859	1,921	8.79	2,853.6
1991	1,957.8	1,819.1	138.8	7.09%	1962	937	47.76%	27,496	26,602	894	3.36	953.9
1992	1,999.6	1,808.3	191.4	9.57%	2008	1078	53.69%	41,845	35,768	6,077	16.99	5,637.6
1993	2,116.3	1,914.8	201.5	9.52%	2394	1110	46.37%	29,525	27,045	2,481	9.17	2,234.7
1994	2,121.0	1,918.4	202.6	9.55%	2121	1283	60.49%	24,725	17,982	6,743	37.50	5,255.9
Total								147,372	129,256	18,115		

Maha Season	Total area (ha.)	Paddy (ha.)	OC (ha.)	Percent OC	Total farmers	OFC farmers	Percent OC farmers	Total income (Rs. thous.)	Income if paddy only (Rs. thous.)	Increase in income (Rs. thous.)	% increase in income	Increase per farmer (Rs.)
1990/91	1,988.0	1,973.7	14.3	0.72%	2,001.0	422.0	21.09%	18,648	18,431	217	1.18	513.3
1991/92*	1,988.2	1,946.9	41.4	2.08%				29,323	28,395	927	3.27	
1992/93	1,990.0	1,911.2	78.8	3.96%	2,010.0	623.0	31.00%	35,636	33,965	1,671	4.92	2,681.7
1993/94	2,235.1	2,176.4	58.7	2.63%	2,235.0	724.0	32.39%	13,272	12,548	724	5.77	1,000.4
1994/95	2,244.0	2,170.7	73.3	3.27%	2,244.0	819.0	36.50%	20,443	18,221	2,222	12.19	2,712.8
Total								117,322	111,561	5,761		

* Mahaweli Economic Agency Data

Crop Cultivation Progress
Ellewewa Block
Homestead

Maha Season	Total cultivated area (ha)	Total homesteads	Number of cultivated homesteads	Total income (Rs. thous)	Income per homestead (Rs.)
1992/93	123.8	2,824	1,899	5,120	2,696
1993/94	164.4	3,046	2,275	2,856	1,255
1994/95	252.2	3,065	2,667	7,777	2,916
Total				15,753	

Income if only paddy Total Income Increase in income (Rs. thous.)	Total income	Income if only paddy	Increase in income	Percent increase
Yala seasons	147,372	129,256	18,115	14.02
Maha seasons (irrigated)	117,322	111,561	5,761	5.16
Maha homesteads	15,753		15,753	
Total (1990 - 1995)	280,446	240,817	39,630	16.46

Table 1B
Crops Cultivation Progress - Zone 1
Dimbulagala Block (1990 -1994)
Irrigable fields

Season	Total area (ha.)	Paddy (ha.)	OC (ha.)	Percent OC	Total Farmers	OC farmers	Percent OF farmers	Total income (Rs. thous.)	Income if paddy only (Rs. thous.)	Increase in income (Rs. thous.)	% increase in income	Increase per farmer (Rs.)
Yala 1990	2,116.8	2,040.7	76.1	3.60%	2127	781.0	36.72%	26,295	24,444	1,851	7.57	2,369.4
Yala 1991	1,511.5	1,458.3	53.2	3.52%	1545	734.0	47.51%	20,894	20,530	364	1.77	495.4
Yala 1992	1,944.0	1,862.2	81.8	4.21%	1944	830.0	42.70%	36,951	34,772	2,179	6.27	2,624.7
Yala 1993	2,124.0	2,049.3	74.7	3.52%	2124	882.0	41.53%	27,663	27,045	618	2.28	700.5
Yala 1994	2,440.9	2,341.4	99.5	4.08%	2441	1,360.0	55.71%	23,679	20,695	2,984	14.42	2,193.9
Total								135,481	127,487	7,994		

Season	Total area (ha.)	Paddy (ha.)	OC (ha.)	Percent OC	Total farmers	OC farmers	Percent OC farmers	Total income (Rs. thous.)	Income if paddy only (Rs. thous.)	Increase in income (Rs. thous.)	% increase in income	Increase per farmer (Rs.)
Maha 1990/91	2,035.4	2,023.4	12.0	0.59%	2,105.0	385.0	18.29%	19,074	18,870	204	1.08	528.8
Maha 1991/92*	1,842.5	1,820.0	22.5	1.22%				27,069	26,545	524	1.97	
Maha 1992/93	2,014.0	1,981.3	32.7	1.62%	2,014.0	671.0	33.32%	35,007	33,817	1,190	3.52	1,773.0
Maha 1993/94	2,381.0	2,347.4	33.6	1.41%	2,448.0	850.0	34.72%	13,616	13,367	250	1.87	293.5
Maha 1994/95	2,422.0	2,384.0	38.0	1.57%	2,422.0	835.0	34.48%	20,971	19,667	1,304	6.63	1,561.8
Total								115,736	112,265	3,471		

Crop Cultivation Progress
Dimbulagala Block
Homestead

Season	Total cultivated area (ha)	Total # of HT	# of cultivated HT	Total income (Rs. thous.)	Income per homestead (Rs.)
Maha 1992/93	79.6	2,270.0	1,453.0	3,967.1	2,730.3
Maha 1993/94	76.7	2,868.0	1,888.0	1,453.4	769.8
Maha 1994/95	122.5	2,903.0	2,191.0	4,491.9	2,050.2
Total				9,912.4	

Income if only paddy
Total income
Increase in income
(Rs thous.)

	Total income	Income if only paddy	Increase in income	Percent increase
Yala seasons	135,481	127,487	7,994	6.27
Maha seasons (irrigated)	115,736	112,265	3,471	3.09
Maha homesteads	9,912		9,912	
Total (1990 - 1995)	261,129	239,752	21,378	8.92

Table 1C
Crops Cultivation Progress - Zone 5
Damminna Block (Yala 1990 - Maha 1994/95)
Irrigable fields

Season	Total area (ha.)	Paddy (ha.)	OFC (ha.)	% OFC	Total farmers	OFC farmers	% OFC farmers	Total income (Rs. thous.)	Income if paddy only (Rs. thous.)	Increase in income (Rs. thous.)	% increase in income	Increase per farmer (Rs.)
Yala 1990	1,094.0	1,034.2	59.8	5.46%	1,111.0	435	39.15%	13,984	12,633	1,351	10.69	3,104.8
Yala 1991	1,115.0	1,053.9	61.1	5.48%	1,115.0	409	36.68%	15,243	14,969	275	1.83	671.1
Yala 1992	1,228.0	1,169.4	58.5	4.77%	1,228.0	403	32.82%	23,609	21,965	1,644	7.48	4,079.4
Yala 1993	1,354.0	1,263.7	90.3	6.67%	1,353.0	670	49.52%	17,569	17,241	328	1.90	490.1
Yala 1994	1,416.0	1,371.3	44.7	3.16%	1,416.0	874	61.72%	13,126	12,005	1,122	9.34	1,283.2
Total								83,531	78,812	4,719		

Season	Total area (ha.)	Paddy (ha.)	OFC (ha.)	Percent OC	Total farmers	OFC farmers	% OFC farmers	Total income (Rs. thous)	Income if paddy only (Rs. thous.)	Increase in income (Rs. thous.)	% increase in income	Increase per farmer (Rs.)
Maha 1990/91	982.0	973.8	8.2	0.83%	1,044.0	135.0	12.93%	9,235	9,104	131	1.44	970.4
Maha 1991/92*	894.0	879.2	14.8	1.65%				13,230	12,823	407	3.17	
Maha 1992/93	1,232.0	1,216.6	15.4	1.25%	1,232.0	188.0	15.26%	21,345	21,028	318	1.51	1,688.8
Maha 1993/94	1,403.0	1,365.6	37.4	2.67%	1,403.0	330.0	23.52%	8,143	7,876	266	3.38	807.0
Maha 1994/95	1,400.0	1,374.0	26.0	1.86%	1,400.0	303.0	21.64%	12,378	11,368	1,010	8.88	3,332.7
Total								64,331	62,200	2,132		

* Mahawell Economic Agency data

Crop Cultivation Progress
Damminna Block
Homestead

Season	Total cultivated area (ha)	Total homesteads	Number of cultivated homesteads	Total income (Rs. thous.)	Income per homestead (Rs.)
Maha 1992/93	95.5	1,861.0	1,023.0	5,148	5,032
Maha 1993/94	69.8	2,053.0	1,451.0	1,201	828
Maha 1994/95	122.6	2,087.0	1,686.0	3,942	2,338
Total				10,291	

Income if only paddy Total income Increase in income (Rs. thous.)	Total income	Income if only paddy	Increase in income	Percent increase
Yala seasons	83,531	78,812	4,719.0	5.99
Maha seasons (irrigated)	64,331	62,200	2,131.6	3.43
Maha homesteads	10,291		10,290.9	
Total (1990 - 1995)	158,153	141,012	17,141.5	12.16

Table 1D
Crops Cultivation Progress - Zone 5
Wijayabapura Block (1990 -1994)
Irrigable fields

Season	Total area (ha.)	Paddy (ha.)	OC (ha.)	Percent OC	Total farmers	OC farmers	% OC farmers	Total income (Rs. thous.)	Income if paddy only (Rs. thous.)	Increase in income (Rs. thous.)	% increase in income	Increase per farmer (Rs.)
Yala 1990	1,662.9	1,609.7	53.2	3.20%	1,567.0	321.0	20.49%	20,344	19,203	1,141	5.94	3,555.5
Yala 1991	1,833.8	1,756.2	77.6	4.23%	1,574.0	518.0	32.91%	25,379	24,908	471	1.89	910.0
Yala 1992	1,981.0	1,914.0	67.0	3.38%	1,698.0	409.0	24.09%	37,740	35,434	2,306	6.51	5,639.1
Yala 1993	1,883.0	1,763.9	119.1	6.33%	1,883.0	617.0	32.77%	25,433	23,976	1,457	6.08	2,361.8
Yala 1994	1,885.0	1,755.5	129.5	6.87%	1,885.0	796.0	42.23%	20,045	15,981	4,064	25.43	5,105.2
Total								128,942	119,502	9,440		

Season	Total area (ha.)	Paddy (ha.)	OC (ha.)	Percent OC	Total farmers	OC farmers	% OC farmers	Total income (Rs. thous.)	Income if paddy only (Rs. thous.)	Increase in income (Rs. thous.)	% increase in income	Increase per farmer (Rs.)
Maha 1990/91	1,863.7	1,861.0	2.7	0.14%	1,569.0	62.0	3.95%	17,329	17,278	51	0.30	827.4
Maha 1991/92*	1,983.3	1,982.8	0.5	0.03%				28,934	28,919	15	0.05	
Maha 1992/93	1,700.0	1,683.8	16.2	0.95%	1,700.0	142.0	8.35%	29,258	29,016	242	0.83	1,703.5
Maha 1993/94	1,925.0	1,891.4	33.6	1.74%	1,925.0	382.0	19.84%	11,009	10,807	202	1.87	528.3
Maha 1994/95	1,930.0	1,896.1	33.9	1.76%	1,930.0	389.0	20.16%	16,827	15,672	1,155	7.37	2,968.9
Total								103,356	101,691	1,665		

* Maha Economic Agency data

Crop Cultivation Progress
Wijayabapura Block
Homestead

Season	Total cultivated area (ha)	Total homesteads	Number of cultivated homesteads	Total income (Rs. thous.)	Income per homestead (Rs)
Maha 1992/93	74.0	2,313.0	793.0	4,058	5,117
Maha 1993/94	92.1	2,623.0	1,779.0	1,753	985
Maha 1994/95	90.5	2,624.0	1,815.0	3,483	1,919
Total				9,293	

Income if only paddy
Total income
Increase in income
(Rs. thous.)

	Total income	Income if only paddy	Increase in income	Percent increase
Yala seasons	128,942	119,502	9,440	7.90
Maha seasons (irrigated)	103,356	101,691	1,665	1.64
Maha homesteads	9,293		9,293	
Total	241,591	221,193	20,398	9.22

Table 1E
Crops Cultivation Progress - Zone 2
Sevanapitiya Block (1990 -1994)
Irrigable fields

Season	Total area (ha.)	Paddy (ha.)	OC (ha.)	Percent OC	Total farmers	OC farmers	% OC farmers	Total income (Rs. thous.)	Income if paddy only (Rs. thous.)	Increase in income (Rs. thous.)	% increase in income	Increase per farmer (Rs.)
Yala 1990	1,870.6	1,831.0	39.6	2.12%	1,925	320.0	16.62%	22,890	21,601	1,289	5.97	4,026.9
Yala 1991	2,050.0	1,981.8	68.2	3.33%	2,050	450.0	21.95%	28,144	27,845	299	1.07	663.3
Yala 1992	1,811.9	1,778.2	33.7	1.86%	1,812	376.0	20.75%	33,546	32,416	1,130	3.49	3,005.9
Yala 1993	1,901.0	1,876.8	24.2	1.27%	1,901	263.0	13.83%	24,394	24,205	188	0.78	715.6
Yala 1994	2,289.0	2,215.4	73.6	3.22%	2,289	815.0	35.61%	21,941	19,406	2,535	13.06	3,110.8
Total								130,915	125,474	5,441		

Season	Total area (ha.)	Paddy (ha.)	OC (ha.)	Percent OC	Total farmers	OC farmers	% OC farmers	Total income (Rs. thous.)	Income if paddy only (Rs. thous.)	Increase in income (Rs. thous.)	% increase in income	Increase per farmer (Rs.)
Maha 1990/91	1,947.9	1,944.4	3.5	0.18%	1,960	98.0	5.00%	18,128	18,059	69	0.38	704.1
Maha 1991/92*	2,158.8	2,147.0	11.8	0.54%				31,631	31,314	317	1.01	
Maha 1992/93	1,860.0	1,852.6	7.4	0.40%	1,860	142.0	7.63%	31,894	31,747	147	0.46	1,035.2
Maha 1993/94	1,924.0	1,916.1	7.9	0.41%	1,924	236.0	12.27%	10,847	10,801	46	0.43	194.9
Maha 1994/95	2,299.0	2,283.2	15.8	0.69%	2,299	361.0	15.70%	19,327	18,668	659	3.53	1,824.7
Total								111,826	110,589	1,238		

* Mahaweli Economic Agency data

Crop Cultivation Progress
Sevanapitiya Block
Homestead

Season	Total cultivated area (ha)	Total homesteads	Number of cultivated homesteads	Total income (Rs. thous.)	Income per homestead (Rs.)
Maha 1992/93	39.8	1,744	909	1,816	1,998
Maha 1993/94	61.6	2,127	1,523	1,254	823
Maha 1994/95	88.4	2,499	1,822	3,097	1,700
Total				6,167	

Income if only paddy
Total income
Increase in income
(Rs. thous.)

	Total income	Income if only paddy	Increase in income	Percent increase
Yala seasons	130,915	125,474	5,441	4.34
Maha seasons (irrigated)	111,826	110,589	1,238	1.12
Maha homesteads	6,167		6,167	
Total (1990 - 1995)	248,908	236,063	12,845	5.44

Table 1F
Crops Cultivation Progress - Zone 2
Senapura Block (1990 -1994)
Irrigable fields

Season	Total area (ha.)	Paddy (ha.)	OC (ha.)	Percent OC	Total farmers	OC farmers	% OC farmers	Total income (Rs. thous.)	Income if paddy only (Rs. thous.)	Increase in income (Rs. thous.)	% increase in income	Increase per farmer (Rs.)
Yala 1990	1,497.9	1,452.1	45.7	3.05%	1,521.0	345.0	22.68%	18,317	17,297	1,021	5.90	2,958.3
Yala 1991	1,396.1	1,327.0	69.2	4.95%	1,406.0	432.0	30.73%	19,241	18,964	277	1.46	641.2
Yala 1992	1,399.7	1,346.0	53.7	3.84%	1,211.0	327.0	27.00%	26,467	25,006	1,461	5.84	4,468.2
Yala 1993	1,675.0	1,636.4	38.6	2.30%	1,675.0	382.0	22.81%	21,914	21,328	586	2.75	1,534.8
Yala 1994	1,737.0	1,658.6	78.4	4.51%	1,737.0	772.0	44.44%	17,001	14,726	2,274	15.44	2,945.9
Total								102,939	97,320	5,619		

Season	Total area (ha.)	Paddy (ha.)	OC (ha.)	Percent OC	Total farmers	OC farmers	% OC farmers	Total income (Rs. thous.)	Income if paddy only (Rs. thous.)	Increase in income (Rs. thous.)	% increase in income	Increase per farmer (Rs.)
Maha 1990/91	1,498.6	1,495.7	2.9	0.20%	1,535.0	58.0	3.78%	13,946	13,893	53	0.38	906.9
Maha 1991/92*	1,474.8	1,465.0	9.8	0.66%				21,600	21,367	233	1.09	
Maha 1992/93	1,572.0	1,560.2	11.8	0.75%	1,572.0	158.0	10.05%	27,023	26,831	192	0.71	1,213.3
Maha 1993/94	1,619.0	1,607.2	11.8	0.73%	1,619.0	215.0	13.28%	9,181	9,089	92	1.01	426.5
Maha 1994/95	1,633.0	1,620.2	12.8	0.79%	1,633.0	233.0	14.27%	13,592	13,260	332	2.50	1,424.9
Total								85,341	84,440	901		

* Mahaweli Economic Agency data

Crop Cultivation Progress
Senapura Block
Homestead

Season	Total cultivated area (ha)	Total homesteads	Number of cultivated homesteads	Total income (Rs. thous.)	Income per homestead (Rs.)
Maha 1992/93	78.1	2,113.0	848.0	3,460	4,080
Maha 1993/94	50.8	2,132.0	1,278.0	1,028	804
Maha 1994/95	81.2	2,148.0	1,625.0	2,275	1,400
Total				6,762	

Income if only paddy
Total income
Increase in income
(Rs. thous.)

	Total income	Income if only paddy	Increase in income	Percent increase
Yala seasons	102,939	97,320	5,619	5.77
Maha seasons (irrigated)	85,341	84,440	901	1.07
Maha homesteads	6,762		6,762	
Total (1990 - 1995)	195,042	181,761	13,281	7.31

Table 1G
Crops Cultivation Progress - Zone 4A
Aselapura Block (Yala 1990 - Maha 1994/95)
Irrigable fields

Season	Total area	Paddy (ha.)	OFC (ha.)	% OFC (ha.)	Total farmers	OFC farmers	% OFC farmers	Total income (Rs. thous.)	Income if paddy only (Rs. thous.)	Increase in income (Rs. thous.)	% increase in income	Increase in income per farmer
Yala 1990	194.8	187.6	7.2	3.68%	223.0	70.0	31.39%	2,405	2,249	156	6.94	2,228.6
Yala 1991	241.1	232.0	9.1	3.78%	284.0	81.0	28.52%	3,319	3,275	44	1.34	543.2
Yala 1992	633.0	553.5	79.5	12.55%	633.0	262.0	41.39%	12,973	11,322	1,650	14.58	6,298.9
Yala 1993	1,317.0	1,275.6	41.4	3.14%	1,317.0	266.0	20.20%	18,039	16,769	1,270	7.57	4,774.4
Yala 1994	1,258.0	1,208.3	49.7	3.95%	1,258.0	312.0	24.80%	12,518	10,665	1,853	17.38	5,939.4
Total								49,254	44,281	4,973		

Season	Total area (ha.)	Paddy (ha.)	OFC (ha.)	% OFC	Total farmers	OFC farmers	% OFC farmers	Total income (Rs. thous.)	Income if paddy only (Rs. thous.)	Increase in income (Rs. thous.)	% increase in income	Increase in income per farmer
Maha 1990/91	242.0	241.9	0.1	0.03%	242.0	1.0	0.41%	2,245	2,244	2	0.07	1,500.0
Maha 1991/92*	403.7	401.1	2.6	0.65%				5,939	5,888	51	0.86	
Maha 1992/93**												
Maha 1993/94	1,319.0	1,304.4	14.6	1.11%	1,319.0	181.0	13.72%	7,496	7,405	92	1.24	505.5
Maha 1994/95	1,334.0	1,323.1	10.9	0.82%	1,334.0	164.0	12.29%	11,220	10,832	388	3.58	2,367.1
Total								26,901	26,369	532		

* Maha 91/92: Mahawell Economic Authority data
** Maha 92/93: Security situation prevented conducting cultivation census in Aselapura Block.

Crop Cultivation Progress
Aselapura Block
Homestead

Season	Total cultivated area (ha)	Total homesteads	Number of cultivated homesteads	Total income (Rs. thous.)	Income per homestead (Rs.)
Maha 1992/93					
Maha 1993/94	72.8	1,524.0	1,278.0	1,383	1,082
Maha 1994/95	141.9	1,303.0	1,196.0	4,314	3,607
Total				5,696	

Income if only paddy
Total income
Increase in income
(Rs. thous.)

	Total income	Income if only paddy	Increase in income	Percent increase
Yala seasons	49,254	44,281	4,973	11.23
Maha seasons (irrigated)	26,901	26,369	532	2.02
Maha homesteads	5,696		5,696	
Total (1990 - 1995)	81,852	70,650	11,202	15.86

Table 2
Gross and net returns to crop production;
Yala seasons, 1990 to 1994; Mahaweli, System B

Big onion	Gross return (Rs/ha)	Net return (Rs/ha)	Return to labour (Rs/day)
Yala 1990	80,740	61,156	161
Yala 1991	35,106	12,600	12
Yala 1992	100,420	64,621	151
Yala 1993	112,570	80,980	153
Yala 1994	101,743	62,569	120

Butternut	Gross return (Rs/ha)	Net return (Rs/ha)	Return to labour (Rs/day)
Yala 1990	54,353	46,053	174
Yala 1991			
Yala 1992	24,655	7,695	30
Yala 1993	81,760	50,320	94
Yala 1994	61,783	34,730	70

Chilli	Gross return (Rs/ha)	Net return (Rs/ha)	Return to labour (Rs/day)
Yala 1990	54,035	34,233	87
Yala 1991	34,013	15,291	43
Yala 1992	98,167	68,643	140
Yala 1993	39,688	7,181	13
Yala 1994	79,328	44,287	92

Cowpea	Gross return (Rs/ha)	Net return (Rs/ha)	Return to labour (Rs/day)
Yala 1990	30,047	21,790	63
Yala 1991	21,998	16,379	49
Yala 1992	38,000	22,425	75
Yala 1993	26,735	18,139	47
Yala 1994	35,056	21,107	54

Gherkin	Gross return (Rs/ha)	Net return (Rs/ha)	Return to labour (Rs/day)
Yala 1990	88,797	44,685	69
Yala 1991	69,853	27,745	35
Yala 1992	74,927	57,657	150
Yala 1993	50,435	13,410	12
Yala 1994	68,872	22,436	36

Greengram	Gross return (Rs/ha)	Net return (Rs/ha)	Return to labour (Rs/day)
Yala 1990	22,590	17,289	72
Yala 1991	14,678	10,002	31
Yala 1992	30,005	20,490	67
Yala 1993	29,535	20,318	99
Yala 1994	37,335	26,364	74

Groundnut	Gross return (Rs/ha)	Net return (Rs/ha)	Return to labour (Rs/day)
Yala 1990	21,417	9,197	29
Yala 1991			
Yala 1992	64,312	59,845	210
Yala 1993	40,410	31,946	104
Yala 1994	49,473	30,324	68

Bristal	Gross return (Rs/ha)	Net return (Rs/ha)	Return to labour (Rs/day)
Yala 1990			
Yala 1991			
Yala 1992	64,820	43,120	131
Yala 1993	67,017	45,210	127
Yala 1994	60,943	33,578	67

Red onion	Gross return (Rs/ha)	Net return (Rs/ha)	Return to labour (Rs/day)
Yala 1990	341,700	283,895	606
Yala 1991	103,333	60,456	122
Yala 1992	60,000	27,445	51
Yala 1993	81,711	28,138	52
Yala 1994	164,536	84,740	113

Okra	Gross return (Rs/ha)	Net return (Rs/ha)	Return to labour (Rs/day)
Yala 1990			
Yala 1991			
Yala 1992			
Yala 1993	40,575	25,125	54
Yala 1994	36,233	13,182	29

Paddy	Gross return (Rs/ha)	Net return (Rs/ha)	Return to labour (Rs/day)
Yala 1990	21,328	11,403	145
Yala 1991	26,409	13,583	109
Yala 1992	35,130	17,887	127
Yala 1993	28,787	12,733	136
Yala 1994	26,583	8,478	64

ANNEX 4

COST-BENEFIT ANALYSIS

Final MARD expenditures are expected to total about $19.5 million, of which about $1.5 million were for activities unrelated to increased agricultural production and farmer incomes. Most of these were for environmental protection. The attached table shows that, although the project started in 1988, large project expenditures did not begin until 1990.

MARD documented the following quantifiable benefits achieved by the project:

1. Crop diversification on irrigated land during the yala season.

The project monitored the impact of crop diversification during yala on farmer incomes beginning in 1990. (See Statistical Annex Table __ for details by year and by block.) In yala 1994, 4.9 percent of irrigated lands were planted to other crops. For future years it is assumed that the percent of area planted to OCs will grow by 10 percent per year for eight years until it stabilizes at 10 percent of the total yala irrigated area. An increasing number of System B farmers have shown themselves willing and able to increase production as their knowledge of cultural practices and markets increases. The best example in recent years has been bananas which grew from almost no production in 1992 to become the second largest OC in System B. The projections also assume that OC prices relative to paddy will stay constant. If OC prices increase relative to paddy, as they have over the life of the project, the increased incomes resulting from crop diversification will be higher than what is shown in the table.

2. Crop diversification on irrigated land during the maha season.

Again, the figures for 1990-1995 were taken from project impact monitoring reports. For future years, it is assumed that the irrigated area planted to OCs during maha will grow by 5 percent per year, increasing from 1.5 percent in 1994/95 and stabilizing at 2.5 percent in 2004/05. There are no production constraints to achieving this target. As farmers become increasingly knowledgeable about OC markets, it is expected that they will chose to allocate more of their land to OC production.

3. Production of other crops on non-irrigated homesteads.

Project records show that the area planted to OCs on the homesteads increased dramatically after MARD increased the emphasis on homesteads in its extension program. By maha 1994/95, production of OCs on homesteads had reached $800 million. The benefit calculation assumes that the project had a minor impact on homesteads in 1992 and 1993, and that, in maha 1994/95, homestead production of OCs was double what it would have been without the project. For future years, the table assumes that the value of increased production attributable to the project will continue to grow gradually before levelling off at $500 million per year. The continued growth is based on the fact

that producing OCs on homesteads as a cash crop is a very recent development and will continue to grow as farmers become exposed to its benefits and improve their farming skills.

4. Production of tree crops on homesteads.

Project surveys show that System B farmers have planted thousands of trees on their homesteads, but there is no data on value of production. In recent years, most of the trees planted have come from the MARD-financed nursery. The figures in the table assume that production attributable to the project is still low but as the trees mature the value of production will increase. Since there is no data on tree crop production, these figures should be considered illustrative. They are meant to recognize an important project benefit.

5. Increased production resulting from improved and expanded irrigation infrastructure.

MARD undertook two major infrastructure improvement activities. One was the development of Block 503. The potential irrigated area in the block totals 1,000 hectares but, because of construction delays, only 300 hectares were developed. Using the average income earned per hectare in Damminna Block which is located next to Block 503, the income to be earned from the development on these 300 hectares is $110,000 per year. The second activity was the improvement of the tertiary irrigation and drainage systems in Zones 1 and 5. MEA engineers estimate that these improvements increased the productivity of 4,000 hectares by 25 percent. Using a more conservative estimate of 15 percent, the value of this benefit is about $200,000 per year. The total benefit of the two construction activities is $310,000 per year.

6. The value of improved D-canal operation and maintenance.

A major project benefit is the transfer of D-canal O&M from the MEA to farmers. The MEA estimates that proper D-canal O&M costs about Rs. 3,000 per hectare. However, in recent years, the MEA has been spending less than Rs.1,000 per hectare assuring that the D-canals will deteriorate and eventually have to be rehabilitated at very high cost. The benefit stream in the cost-benefit table assumes that, the transfer of D-canal O&M to farmers assures that the proper operation and maintenance of the canals will finally be financially feasible. The value of this improved maintenance is equated to Rs. 2,000 per hectare, i.e., the difference between the level of O&M expenditure that would have prevented major rehabilitation later and the actual amount of MEA expenditures in recent years.

At present, 4,000 hectares have been transferred to farmer organizations, and another 4,000 hectares will be transferred next year. The value of transferring 4,000 hectares is about $240,000 per year. When all 14,000 irrigated

acres have been transferred, the benefits will total about $600,000 per year. The cost-benefit table assumes that benefits started at $100,000 in 1995 and will gradually increase to $500,000 in 1998/99, reflecting reflects the fact that many farmer organizations will be inexperienced and several years will be required before they are fully competent to operate and maintain their D-canals.

The benefits listed above are based on two key assumptions. First, it is assumed that MARD has successfully initiated a crop diversification process that is likely to continue after the project has ended. Farmers now know that OCs are more profitable than paddy and have learned appropriate cultural practices. Similarly, traders now routinely purchase OCs in System for sale in other areas. OC production can now be expected to grow on its own as farmers become more sensitive to market opportunities. One of the important intangible benefits resulting from the project is the MEA's increased capacity to support crop diversification. This includes a more knowledgeable extension staff, a functioning seed farm, a well equipped and efficient tree nursery, and improved research support from the Ministry of Agriculture. Another intangible benefit has been the increased trader activity and improved marketing channels for traditional Ocs. The continued growth in OC production during the yala and maha seasons is a quantification of these benefits.

Second, it is assumed that the benefits to farmers and the GSL of D-canal takeover by DCOs are large enough and sufficiently recognized for the process started by MEA and MARD to continue. The lessons learned from MARD's farmer organization efforts are another intangible benefit. The very tangible progress that has occurred in Zones 1 and 5, as perceived by the MEA helps assure that its high level of interest in farmer organization development in recent years will not disappear with the end of MARD and the departure of the MEA Managing Director.

It should be emphasized that the projected benefits do not depend on any significant growth in exports. Although there are reasons for optimism, it has not yet been established that System B will successfully enter export markets as a result of MARD's efforts. Based on experience to date, there can be little doubt that most of the OC production from ten percent of the yala area and 2.5 percent of the maha area will be for domestic markets.

As can be seen from the following table, subtracting project costs from the projected benefits yields an internal rate of return of ten percent.

PROJECT COSTS AND BENEFITS
($ thousands)

Year	Cost	Diversification Benefits: Irrigated lands: yala	Irrigated lands: maha	Homestead: annual	Homestead: trees	Sub-total	Infra. devel.	Irrigation O&M	TOTAL	NET BENEFITS
1987/88	100	0	0	0	0	0	0	0	0	-100
1988/89	100	0	0	0	0	0	0	0	0	-100
1989/90	3700	0	0	0	0	0	0	0	0	-3700
1990/91	2000	220	20	0	0	240	0	0	240	-1760
1991/92	3000	65	60	0	0	125	0	0	125	-2875
1992/93	2600	370	70	100	0	540	0	0	540	-2060
1993/94	4000	140	35	200	30	405	0	0	405	-3595
1994/95	2500	425	150	400	50	1025	310	100	1435	-1065
1995/96	0	468	158	425	70	1120	310	200	1630	1630
1996/97	0	514	165	450	90	1220	310	300	1830	1830
1997/98	0	566	174	475	100	1314	310	400	2024	2024
1998/99	0	622	182	500	100	1405	310	500	2215	2215
1999/00	0	684	191	500	100	1476	310	500	2286	2286
2000/01	0	753	201	500	100	1554	310	500	2364	2364
2001/02	0	828	211	500	100	1639	310	500	2449	2449
2002/03	0	911	222	500	100	1733	310	500	2543	2543
2003/04	0	950	233	500	100	1783	310	500	2593	2593
2004/05	0	950	244	500	100	1794	310	500	2604	2604
2005/06	0	950	250	500	100	1800	310	500	2610	2610
2006/07	0	950	250	500	100	1800	310	500	2610	2610
2007/08	0	950	250	500	100	1800	310	500	2610	2610
2008/09	0	950	250	500	100	1800	310	500	2610	2610
2009/10	0	950	250	500	100	1800	310	500	2610	2610
2010/11	0	950	250	500	100	1800	310	500	2610	2610
2011/12	0	950	250	500	100	1800	310	500	2610	2610
2012/13	0	950	250	500	100	1800	310	500	2610	2610
2013/14	0	950	250	500	100	1800	310	500	2610	2610
2014/15	0	950	250	500	100	1800	310	500	2610	2610
2016/17	0	950	250	500	100	1800	310	500	2610	2610
2017/18	0	950	250	500	100	1800	310	500	2610	2610

INTERNAL RATE OF RETURN: 9.97%

PROJECT COSTS AND BENEFITS
($ thousands)

Year	Cost	Diversification Benefits					Infra.	Irrigation	TOTAL	NET
		Irrigated lands		Homestead						
		yala	maha	annual	trees	Sub-total	devel.	O&M		BENEFITS
1987/88	100	0	0	0	0	0	0	0	0	-100
1988/89	100	0	0	0	0	0	0	0	0	-100
1989/90	3700	0	0	0	0	0	0	0	0	-3700
1990/91	2000	220	20	0	0	240	0	0	240	-1760
1991/92	3000	65	60	0	0	125	0	0	125	-2875
1992/93	2600	370	70	100	0	540	0	0	540	-2060
1993/94	4000	140	35	200	30	405	0	0	405	-3595
1994/95	2500	425	150	400	50	1025	310	100	1435	-1065
1995/96	0	468	158	425	70	1120	310	200	1630	1630
1996/97	0	514	165	450	90	1220	310	300	1830	1830
1997/98	0	566	174	475	100	1314	310	400	2024	2024
1998/99	0	622	182	500	100	1405	310	500	2215	2215
1999/00	0	684	191	500	100	1476	310	500	2286	2286
2000/01	0	753	201	500	100	1554	310	500	2364	2364
2001/02	0	828	211	500	100	1639	310	500	2449	2449
2002/03	0	911	222	500	100	1733	310	500	2543	2543
2003/04	0	950	233	500	100	1783	310	500	2593	2593
2004/05	0	950	244	500	100	1794	310	500	2604	2604
2005/06	0	950	250	500	100	1800	310	500	2610	2610
2006/07	0	950	250	500	100	1800	310	500	2610	2610
2007/08	0	950	250	500	100	1800	310	500	2610	2610
2008/09	0	950	250	500	100	1800	310	500	2610	2610
2009/10	0	950	250	500	100	1800	310	500	2610	2610
2010/11	0	950	250	500	100	1800	310	500	2610	2610
2011/12	0	950	250	500	100	1800	310	500	2610	2610
2012/13	0	950	250	500	100	1800	310	500	2610	2610
2013/14	0	950	250	500	100	1800	310	500	2610	2610
2014/15	0	950	250	500	100	1800	310	500	2610	2610
2016/17	0	950	250	500	100	1800	310	500	2610	2610
2017/18	0	950	250	500	100	1800	310	500	2610	2610

INTERNAL RATE OF RETURN: 9.97%

Annexure 5

List of Project Reports

PUBLICATIONS – MARD/MDS PROJECTS

Ser. #	MONTH & YEAR	AUTHOR(S)	TITLE	ENGLISH	SINHALA
1	DECEMBER 1988	DONALD W.HASLEM D.M.PANAPITIYA	FLOOD PLAIN DEVELOPMENT FOR ZONE 4A	X	
2	DECEMBER 1988	DR. ALAN EARLY	FARMER ORGANIZATION AND WATER MANAGEMENT IN SYSTEM B	X	
4	FEBRUARY 1989	V.A.GILLESPIE	RECONCIDERATION OF SYSTEM B MECHANICAL MAINTENANCE REQUIREMENTS	X	
5	FEBRUARY 1989	K.SATGUNASINGAM M.D.PANAPITIYA A.WEERASURIYA	CONSTRUCTION IN ZONE 4A STATUS REPORT	X	
6	MARCH 1989	DR. JANE GLEASON	THE USE OF LINEAR PROGRAM– MING IN FARMING SYSTEMS RESEARCH IN MAHAWELI, SYSTEM B	X	
7	APRIL 1989	W. MARVIN REDDITT	COMPUTER ASSISTED DESIGN AND BLOCKING OUT IN SYSTEM B	X	
8	APRIL 1989	DR.MARVIN E.JENSEN	AGRO–METEOROGICAL NETWORK EVALUATION & RECOMMENDATIONS FOR DATA COLLECTION AND ANALYSIS	X	
9	APRIL 1989	DR.MAX GOLDENSOHN & DR. ALAN EARLY	THEORY INTO PRACTICE: PROCEEDINGS OF THE MARD/MDS TEAM BUILDING WORKSHOP	X	
10	MAY 1989	DR. JAYANTHA PERERA	PROCEEDINGS OF BLOCK–TASK FORCE TEAM BUILDING WORKSHOP		X
11	MAY 1989	DR. S.T.W. KIRINDE	GHERKIN CULTIVATION: PROVISIONAL ADVISORY LEAFLET		X
12	MAY 1989	K. SATGUNASINGAM	TOPOGRAPHIC SURVEYS FOR SYSTEM B	X	
13	MAY 1989	M.PANAPITIYA	SOIL AUGUR AS AN EXTENSION TOOL	X	
14	JUNE 1989	DR. S.T.W.KIRINDE	THINGS THAT WE SHOULD KNOW ABOUT FERTILIZER		X
15	JUNE 1989	DR. JAYANTHA PERERA	UNIT TASK FORCE TEAM– BUILDING WORKSHOP:PROCEEDINGS		X
16	JUNE 1989	DR. CARL N. HITTLE DR. MAX GOLDENSOHN	PROCEEDINGS OF FARMING SYSTEMS RESEARCH/EXTENSION WORKSHOP OF JUNE 1,1989	X	
17	AUGUST 1989	GENE F. WHITE	CONSTRUCTION MANAGEMENT FOR ZONE 4A	X	
18	AUGUST 1989	H. BAUTISTA	STUDY TOUR REPORT	X	
19	AUGUST 1989	DR.A.EARLY	OPERATIONS AND MAINTENANCE ENHANCEMENT IN THE MAHAWELI SYSTEM B	X	
20	AUGUST 1989	DR. A.EARLY	MONITORING,EVALUATION,FEEDBACK AND MANAGEMENT IN MARD	X	
21	AUGUST 1989	FLOYD BREEZE	COST CENTRE ACCOUNTING FOR SYSTEM B	X	
22	SEPTEMBER 1989	MARD TEAM	LESSONS LEARNED PAPER	X	
23	SEPTEMBER 1989	VICTOR GILLESPIE	OPERATIONS MANUAL FOR COST CENTRE ACCOUNTING	X	
24	SEPTEMBER 1989	MAHINDA PANAPITIYA	DRAINAGE REPORT – YALA 1989	X	
25	SEPTEMBER 1989	DR. J. PERERA	BLOCK TASK FORCE TEAM BUILDING WORKSHOP PROCEEDINGS	X	
26	SEPTEMBER 1989	DR. J. PERERA	ETHNOCENTRIC VISIONS OF INNOCENCE AND ISOLATION (REPLY TO DR. MERREY OF IIMI)	X	
27	SEPTEMBER 1989	MARD TEAM	ANNOTATED BIBILIOGRAPHY OF WORKS RELEVANT TO THE MARD	X	
28	OCTOBER 1989	C. PERERA	WEED PREVENTION		X
29	OCTOBER 1989	DR. V MELONE	EXTENSION NEEDS AND TRAINING PROPOSALS	X	
30	OCTOBER 1989	DR.R. SUBASINGHE	POND MANAGEMENT FOR GROWING ORNAMENTAL FISH		X
31	NOVEMBER 1989	G. DE SILVA	POTATO CULTIVATION FOR THE DRY ZONE		X
32	NOVEMBER 1989	C. PERERA	DISEASE PREVENTION IN MAHA		X
33	NOVEMBER 1989	DR. SUSAN EXO	MONITORING AND EVALUATION SYSTEMS FOR MARD/MDS	X	
34	NOVEMBER 1989	M. REDDITT	COMPUTER ASSISTED DESIGN PHASE II	X	
35	NOVEMBER 1989	DR. J. GLEASON	GHERKIN OUTGROWER PROGRAM YALA 1989	X	
36	NOVEMBER 1989	I.K. WEERAWARDENA DR. M. GOLDENSOHN	INFORMAL MARKET SURVEY FOR HIGH VALUE CROPS	X	
37	NOVEMBER 1989	MARD/MDS	ANNUAL WORKPLAN UPDATE	X	
38	DECEMBER 1989	M. SMEDLEY	PRE–FEASIBILITY STUDY FOR GHERKIN PICKLING PLANT	X	

PUBLICATIONS – MARD/MDS PROJECTS

Pub. #	MONTH & YEAR	AUTHOR(S)	TITLE	ENGLISH	SINHALA
39	JANUARY 1990	DR. J. GLEASON	YALA SEASON DIVERSIFICATION REPORT – YALA 1989	X	
40	JANUARY 1990	DR. S.T.W. KIRINDE	COWPEA,GREENGRAM,BLACKGRAM MANUAL		X
41	FEBRUARY 1990	K.N. WICKRAMARATNE	WATER MANAGEMENT TRAINING NEEDS ASSISSMENT	X	
42	FEBRUARY 1990	F. BREEZE	COST–CENTRE ACCOUNTING–IMPLEMENTATION & TESTING	X	
43	MARCH 1990	MARTIN WEST, DR. JANE GLEASON	REVIEW OF ONION SEED PRODUCTION IN SYSTEM C	X	
44	MARCH 1990	DR. J. GLEASON	REPORT ON OPTIMIZATION MODELS – YALA 1989	X	
45	MARCH 1990	MARTIN WEST	ASPARAGUS & GARLIC EXTENSION BOOKLETS	X	X
46	MARCH 1990	VICTOR GILLESPIE	FARMER PARTICIPATION IN THE OPERATION AND MAINTENANCE OF IRRIGATION PROJECTS	X	
47	MARCH 1990	VICTOR GILLESPIE	DESILTING OPERATIONS LBMC 1989 PROGRESS REPORT	X	
48	MARCH 1990	DR. R. SUBASINGHE	FINAL REPORT ON FISH TRAINING CONSULTANCY	X	
49	APRIL 1990	MAHINDA PANAPITIYA	DRAINAGE IN SYSTEM B MAHA SEASON REPORT 1989/90	X	
50	APRIL 1990	DR.MAX GOLDENSOHN	NIRD WORKSHOP PROCEEDINGS	X	
51	APRIL 1990	DR. S.T.W. KIRINDE	EXTENSION RECOMMENDATIONS FOR GROUND NUT & COWPEA CULTIVATION	X	X
52	MAY 1990	DR. SUSAN EXO	MONITORING & EVALUATION MANUAL	X	
53	MAY 1990	DR. SUSAN EXO	MARD/MDS MONITORING & EVALUATION REPORT NO.1	X	
54	MAY 1990	DR. SUSAN EXO	SECOND REPORT ON DEVELOPMENT OF A MONITORING & EVALUATION SYSTEM FOR MARD/MDS	X	
55	MAY 1990	K.N.WICKRAMRATNE	RECOMMENDATIONS FOR ON–FARM WATER MANAGEMENT FOR OTHER CROPS	X	
56	MAY 1990	DR. J. PERERA	FARMER ORGANIZATIONS IN SYSTEM B, A NEW APPROACH TO AN OLD PROBLEM	X	
57	MAY 1990	H.HARMON	MARKETING SRI LANKA ASPARAGUS IN THE UNTIED STATES	X	
58	MAY 1990	H. HARMON	PENETRATING THE AMERICAN MARKET FOR PROCESSED FOODS	X	
59	MAY 1990	DR. J. PERERA	CULTIVATION OF OTHER CROPS & SETTLER–FARMER INCOME	X	
60	MAY 1990	DR.J. PERERA	INDUCTION TRAINING PROGRAM FOR ICOO	X	
61	JUNE 1990	M.D.PANAPITIYA & J.JAYAWARDENA	CONSIDERATION OF FARMERS BEHAVIOR TO IMPROVE PLANNING OF IRRIGATION PROJECTS IN DROUGHT PRONE AREAS	X	
62	JUNE 1990	DR. J. GLEASON	GHERKIN OUTGROWER REPORT–MAHA 1989–90	X	
63	JUNE 1990	M.McGOVERN	ZONE 4A CONSTRUCTION STATUS REPORT UPDATE	X	
64	JUNE 1990	W.H.A.S.DINATISSA, DR.J.GLEASON	POTATO TRIAL RESULTS FROM SYSTEM 'B'	X	
65	JUNE 1990	MARTIN WEST	COURGETTE, OKRA,SWEET CORN RECOMMENDATIONS	X	X
66	JUNE 1990	DR. MAX GOLDENSOHN	COMMERICAL FARMING IN SYSTEM B	X	
67	JUNE 1990	MARTIN WEST	REPORT ON GARLIC TRIALS IN SYSTEM 'B'	X	X
68	JUNE 1990	MARTIN WEST	ASPARAGUS PROGRESS REPORT THROUGH JUNE 1990	X	X
69	JUNE 1990	DR. SANFORD THAYER	ENGINEERING ECNOMICS & COST BENEFIT ANALYSIS	X	
70	JULY 1990	JACK ROSS & DR. JOEL HAMILTON	POST–HARVEST NEEDS ASSESSMENT FOR SYSTEM 'B'	X	
71	JULY 1990	DR. JANE GLEASON	MAHA 1980/90 GHERKIN REPORT	X	
72	JULY 1990	DR. S.T.W. KIRINDE	GROUNDNUT HARVEST,STORAGE & DRYING MANUAL		X
73	JULY 1990	DR. MAX GOLDENSOHN	CROP DIVERSIFICATION IN SYSTEM B' CONSTRAINTS & OBSTACLES	X	
74	JULY 1990	I.K. WEERAWARDENA	COMMERCIAL FARMERS WORKSHOP PROCEEDINGS	X	
75	AUGUST 1990	DR. CARL N. HITTLE & DR. S.T.W. KIRINDE	ON FARM TRIALS YALA 1989		X
76	AUGUST 1990	DR. BRUCE COBLENTZ	WILD BOAR PROBLEMS & SOLUTIONS IN SYSTEM 'B'	X	

PUBLICATIONS – MARD/MDS PROJECTS

Reg. #	MONTH & YEAR	AUTHOR(S)	TITLE	ENGLISH	SINHALA
77	AUGUST 1990	DR. B.W. EAVIS	ONION STORAGE IN SRI LANKA REVIEW OF ALTERNATIVES	X	
78	AUGUST 1990	DR. LOWELL BLACK	OBSERVATIONS ON CHILLIE DISEASES IN SRI LANKA(NARROW LEAF DISORDER)	X	
79	AUGUST 1990	DR. VIOLET MELON	MAHAWELI EXTENSION SYSTEM AND ITS LINKS WITH AGRICULTURE RESEARCH	X	
80	SEPTEMBER 1990	D.M.PANAPITIYA & H.M.G.HERATH	USAID/MDS STUDY TOUR REPORT EGYPT & PAKISTAN	X	
81	SEPTEMBER 1990	DR. E.R.N.GUNAWARDENA	ON–FARM WATER MANAGEMENT TRAINING FOR MAHAWELI SYSTEM B	X	
82	SEPTEMBER 1990	AJANTHA DE SILVA RARC/ARALAGANWILA	THE SPATIAL VARIATION OF ON–FARM USE OF IRRIG. WATER–MAHA 1989/90	X	
83	SEPTEMBER 1990	DR.JANE GLEASON	CROP PRODUCTION IN SYSTEM B MAHA 1989/90	X	
84	SEPTEMBER 1990	MIKE McGOVERN	CONSTRUCTION PROGRESS AND ISSUES	X	
85	OCTOBER 1990	HENRY HARMON	THE SINGAPORE MARKET FOR FRESH FRUITS AND VEGETABLES	X	
86	OCTOBER 1990	DR. JANE GLEASON	REPORT ON OPTIMAL CROP COMBINATION MAHA 89/90	X	
87	OCTOBER 1990	DR.CHRIS SEUBERT	RECOMMENDATIONS FOR THE PSR/E PROGRAM OF MARD	X	
88	OCTOBER 1990	MICHAEL SMEDLEY CYNTHIS BELLIVEAU HENRY HARMON	PRE FEASIBILITY STUDY FOR A PASTA FACTORY IN SRI LANKA	X	
89	OCTOBER 1990	DR. A.I. MOHYUDDIN	INTEGRATED PEST MANAGEMENT FOR HIGH VALUE CROPS: AN ASSESSMENT OF CURRENT STATUS AND FUTURE OPTIONS	X	
90	OCTOBER 1990	J.E. GLEASON N.P. TITTAGALLA W.H.A.S. DINATISSA	REPORT ON OPTIMAL CROP COMBINATIONS MAHA 1989/90; MAHAWELI SYSTEM B	X	
91	NOVEMBER 1990	N.P.TITTAGALA DR. JANE GLEASON	REPORT ON CULTIVATION CENSUS MAHAWELI SYSTEM 'B'	X	
92	DECEMBER 1990	NIMAL WICKRAMARATNE VICTOR GILLESPIE	PROCEEDINGS OF THE COST CENTRE ACTIVITY ACCOUNTING WORKSHOP (JULY 1990)	X	
93	DECEMBER 1990	MRS. I. PADMASIRI	EXPORT QUALITY FRUIT TREE PROPAGATION IN SYSTEM B	X	
94	DECEMBER 1990	DR. JANE GLEASON	DIVERSIFICATION REPORT YALA 1990	X	
95	DECEMBER 1990	DR. T. ABEYASEKERA I.K. WEERAWARDENA	CREDIT MANUAL	X	
96	DECEMBER 1990	MDS TEAM	POSSIBLE MDS CAPITAL EXPENDITURE IN SYSTEM 'B' ZONES 1 & 5	X	
97	JANUARY 1991	MIKE McGOVERN	FINAL REPORT – MDS CONSTRUCTION MANAGEMENT	X	
98	JANUARY 1991	K.D.MAITHIRIPALA DR.CARL N. HITTLE MARTIN WEST DR.G.W.SELLECK	YALA 1990 ON FARM TRIALS GROUNDNUT.GREENGRAM,LARGE ONION CHILLI CAPSICUM & ZUCCHINI	X	
99	JANUARY 1991	FLOYD BREEZE VICTOR GILLESPIE	COST ACTIVITY ACCOUNTING CODES ESSENTIAL OPERATIONAL ELEMENTS	X	
100	JANUARY 1991	DR. NANDANI GUNAWARDENA	HOMESTEAD PRODUCTION AND COMMERCIALIZATION IN SYSTEM B	X	
101	FEBRUARY 1991	DR. J. GLEASON W.H.A.S.DINATISSA	WHOLE FARM TRIALS YALA'90 IMPLEMENTING THE RESULTS OF WHOLE FARM ANALYSIS	X	
102	FEBRUARY 1991	P.MATTHEW CAULEY	THE SOILS OF SYSTEM B SOME GUIDELINES OF THEIR SUITABILITY,USE AND MANAGEMENT FOR OTHER CROPS	X	
103	FEBRUARY 1991	DR.JANE GLEASON	GHERKIN OUTGROWERS REPORT SYSTEM B; YALA 1990	X	
104	MARCH 1991	A.H.M.JAYASURIYA	SOME SOIL–VEGETATION RELATIONSHIPS IN MAHAWELI SYSTEM B	X	
105	MARCH 1991	PIYASENA GANEWATTA	GUIDELINES ON FARMER ORGANIZATIONS	X	
106	MARCH 1991	DR. SUSAN EXO	3RD REPORT ON THE DEVELOPMENT OF A MONITORING & EVALUATION SYSTEM FOR MARD/MDS	X	
107	MARCH 1991	DR. SUSAN EXO	A DESCRIPTION OF THE MONITORING AND EVALUATION SYSTEM USED IN THE MARD/MDS PROJECTS	X	
108	MARCH 1991	FREDERICK E. HENRY	PACKINGHOUSE AND COLD CHAIN REQUIREMENTS SYSTEM B	X	
109	APRIL 1991	MARTIN WEST I.L. NAYEEM	MEA/EIED/MARD ASPARAGUS PROGRAM SECOND PROGRESS REPORT	X	
110	MARCH 1991	DR. E.R.N.GUNAWARDENA	ON–FARM WATER MANAGEMENT TRAINING IN MAHAWELI SYSTEM 'B'	X	
111	MARCH 1991	DR. G.W. SELLECK	GENERAL RECOMMENDATIONS FOR OTHER CROPS IN SYSTEM 'B'	X	
112	MARCH 1991	Y.P.DE SILVA	CHILLI CULTIVATION		X

PUBLICATIONS — MARD/MDS PROGRAM

Rec. #	MONTH & YEAR	AUTHOR(S)	TITLE	ENGLISH	SINHALA
113	MARCH 1991	Y.P.DE SILVA	BIG ONION CULTIVATION		X
114	MARCH 1991	Y.P.DE SILVA	NURSERY MANAGEMENT		x
115	MARCH 1991	DR.E.R.N.GUNAWARDENA	ON FARM WATER MANAGEMENT TRAINING IN SYSTEM B (2ND. EDITION)	X	
116	MARCH 1991	DR. A.T. ABEYSEKERA I.K. WEERAWARDENA	CREDIT MANUAL IN SYSTEM B CURRENT STATUS	X	
117	MARCH 1991 (OCT. 1990)	DR. A.I. MOHYUDDIN	INTEGRATED PEST MANAGEMENT FOR HIGH VALUE CROPS.	X	
118	MAY 1991 (5–20 FEB.1991)	DR. G.W.SELLECK	DEVELOPING SKILLS IN RESEARCH MANAGEMENT	X	
119	MAY 1991	C. JOHN	FIRST VITICULTURE REPORT PERIOD COVERED 7/89 – 12/90	X	
120	MAY 1991 (APRIL 1991)	MARTIN WEST I.L. NAYEEM	ASPARAGUS PROGRAM SECOND PROGRESS REPORT	X	
121	MAY 1991	STUDY TOUR PARTICIPANTS	REPORT OF THE STUDY TOUR TO OBSERVE O&M PRACTICES – THAILAND	X	
122	MAY 1991	J.E.GLEASON N.P.TITTAGALLA	THE INTERACTIVE WHOLE FARM APPROACH: A MULTI DISCIPLINARY EFFORT TO RAPID AGRICULTURAL CHANGE	X	
123	MAY 1991	NIMAL WICKRAMARATNE	WATER MANAGEMENT		X
124	MAY 1991	M.D.PANAPITIYA	DRAINAGE IMPROVEMENT IN PILOT AREA MENIKE ELA OUTLET DRAIN	X	
125	MAY 1991	A.M.A. ABEYSINGHE	SITUATIONAL ANALYSIS AND RECOMMENDATIONS ON AGRICULTURAL CREDIT IN THE MAHAWELI AREAS	X	
126	JUNE 1991	JERRY M. SCHAACK	OPERATION AND MAINTENANCE FOR YEAR AROUND IRRIGATION OF SYSTEM B', VOLUME I – MAIN REPORT	X	
127	JUNE 1991	JERRY M. SCHAACK	OPERATION AND MAINTENANCE FOR YEAR AROUND IRRIGATION OF SYSTEM B', VOLUME II, ANNEXES 1 THRO' 16	X	
128	JUNE 1991	JERRY M. SCHAACK	REVIEW OF OPERATION & MAINTENANCE OF SYSTEM 'B'IRRIGATION FACILITIES MADURU OYA PROJECT, SRI LANKA	X	
129	JUNE 1991	AJANTHA DE SILVA	HEAD ENDERS & TAIL ENDERS THE SPATIAL VARIATION OF ON–FARM USE OF IRRIGATION WATER IN SYSTEM B – YALA 1990 RESEARCH	X	
130	JUNE 1991	DR. NANDINI GUNAWARDENA	HOMESTEAD CULTIVATION AND PRODUCTION, MAHA 1990/91	X	
131	JUNE 1991	PIYASENA GANEWATTA	FARMER ORGANIZATION STATUS REPORT	X	
132	JULY 1991	DR. LOWELL L. BLACK	OBSERVATIONS ON CHILLI DISEASES IN SRI LANKA WITH EMPHASIS ON NARROW LEAF DISORDER – PART II	X	
133	JULY 1991	MARD PUBLICATION	OPERATION & MAINTENANCE FORTNIGHT		X
134	JULY 1991	DALLAS E. JOHNSON	USE OF STATISTICAL AND BIOMETRICAL METHODS IN SRI LANKA	X	
135	AUGUST 1991	Y.P.DE SILVA	ON–FARM TRIALS 1990/91	X	
136	AUGUST 1991	P.ABEYGUNAWARDANA	SYSTEM B FARMERS ATTITUDES TOWARDS THE BADADA POLA NEWSLETTER	X	
137	AUGUST 1991	DR. MAX D. GOLDENSOHN	POVERTY ALLEVIATION	X	
138	AUGUST 1991	P. ABEYGUNAWARDANE & HERATH GUNATILAKE	ANALYSIS OF PRICES & PRODUCTION OF SELECTED SYSTEM B PRODUCTS	X	
139	AUGUST 1991	VICTOR A. GILLESPIE	END OF TOUR REPORT (SEPTEMBER 1988 THROUGH AUGUST 1991)	X	
140	SEPTEMBER 1991	DR.CARL N. HITTLE	EVALUATION OF THE MCILHENNY PEPPER VARIETY IN SYSTEM B	X	
141	SEPTEMBER 1991	DR.CARL N. HITTLE	FARMING SYSTEM EXTENSIONISTS (FSE) REPORT	X	
142	SEPTEMBER 1991	MRS. PADMASIRI	EXPORT QUALITY FRUIT TREE PROPAGATION IN SYSTEM B PART II	X	
143	SEPTEMBER 1991	DR. A.I. MOHYUDDIN	INTEGRATED PEST MANAGEMENT FOR PESTS OF HIGH VALUE CROPS	X	
144	SEPTEMBER 1991	DR. CARL N. HITTLE DR. G.W.SELLECK	ON–FARM TRIALS MAHA 1989/90	X	
145	SEPTEMBER 1991	DR. JANE GLEASON N.P.TITTAGALA	REPORT ON THE CULTIVATION CENSUS MAHA 1991 – MAHAWELI SYSTEM B	X	
146	OCTOBER 1991	JUNE ADMISTER	MANAGEMENT REPORT – FINAL REPORT UNIVERSITY OF IDAHOW	X	
147	OCTOBER 1991	HONORI BAUTISTA	END OF TOUR REPORT – FARMER ORGANIZATION	X	
148	OCTOBER 1991	K.SATGUNASINGAM MAHINDA PANAPITIYA MIKE McGOVERN	IRRIGATION,DRAINAGE AND INFRA–STRUCTURE CONSTRUCTION & IMPROVEMENTS PROGRAM IN ZONE 1&5	X	
149	OCTOBER 1991	HENRY C. HARMON	MARKETS FOR SELECTED AGRICULTURAL PRODUCE FROM SRI LANKA DUBAI, UAE AND BAHRAIN	X	

PUBLICATIONS – MARD/MDS PROJECTS

Item #	MONTH & YEAR	AUTHOR(S)	TITLE	ENGLISH	SINHALA
150	OCTOBER 1991	JANE GLEASON HENRY HARMOM OLIVER FERNANDO	SINGAPORE AND DUBAI TRIP REPORT	X	
151	OCTOBER 1991	DAVID A. REED	AGROFORESTRY AND WINDBREAKS	X	
152	OCTOBER 1991	HENRY C. HARMON	AGRICULTURAL PRODUCE FROM SRI LANKA	X	
153	OCTOBER 1991	Y.P.DE SILVA	INDIA STUDY TOUR END OF TOUR REPORT	X	
154	OCTOBER 1991	JUDY EDMISTER	FRUIT DRYING & GRAIN STORAGE	X	
155	NOVEMBER 1991	JANE GLEASON DINATISSA	MAHA 1990/91 DIVERSIFICATION AND WHOLE FARM TRIALS REPORT	X	
156	NOVEMBER 1991	JACKOLINE BOARDMAN	PACK HOUSE AND COLD CHAIN REVIEW IN SYSTEM B	X	
157	NOVEMBER 1991	MICHAEL McGOVERN	CONSTRUCTION MANAGEMENT FINAL REPORT	X	
158	SEPTEMBER 1991	CARL N. HITTLE	FARMING SYSTEMS EXTENSIONIST (FSE) REPORT	X	
159	OCTOBER 1991	DAVID A. REED	AGROFORESTY AND WINDBREAKS	X	
160	OCTOBER 1991	Y.P.De. SILVA	INDIA STUDY TOUR END OF TOUR REPORT	X	
161	OCTOBER 1991	HONORIO B. BAUTISTA	FARMER ORGANIZATIONS SYSTEM B, MAHAWELI ECONOMIC AGENCY, WELIKANDA END OF REPORT	X	
162	OCTOBER 1991	K. SATGUNASINGHAM M. PANAPTIYA M. McGOVERN	IRRIGATION DRAINAGE AND INFRASTRUCTURE CONSTRUCTION AND IMPROVEMENT PROGRAME IN ZONE 1 & 5	X	
163	NOVEMBER 91	J.E. GLEASON W.H.A.S. DINATISSA	MAHA 1990/91 DIVERSIFICATION AND WHOLE FARM TRIALS REPORT no.15	X	
164	NOVEMBER 91	J.E. GLEASON & HH H.H. OLIVER FERNANDO	SINGAPORE AND DUBAI TRIP REPORT	X	
165	OCTOBER 1991	JUDY EDMISTOR	FRUIT DRYING & GRAIN STORAGE	X	
166	DECEMBER 1991	DAI, CSU, OSU, HARZA	MARD/MDS PROJECTS TECHNICAL ASSISTANCE TEAM 1991 ANUAL REPORT & 1992 ANNUAL WORK–PLAN	X	
167	SEPTEMBER 1991	INDRANI PADMASIRI	EXPORT QUALITY FRUIT TREE PROPAGATION IN SYSTEM B PART II	X	
168	REPEATED REPORT NO. 140 BY AN ERROR				
169	NOVEMBER 1991	J.V. POSSINGHAM	THE TECHNIQNSS & PROSPECTS FOR GROWING GRAPES IN SYSTEM B	X	
170	DECEMBER 1991	MARVIN E. JENSEN	SUPPLEMENT AGRO–METEROLOGICAL NETWORK MEA/SYSTEM B	X	
171	DECEMBER 1991	DR. A.I. MOHYUDDIN	INTERGRATED PEST MANAGEMENT FOR PESTS OF HIGH CROPS	X	
172	JANUARY 1992	MARVIN E. JENSEN	COLORADO INSTITUTE FOR IRRIGATION MANAGEMENT	X	
173	JANUARY 1992	R.A. MORRIS & J.E. GLEASON	CROP MIXES FOR ONE–HECTARE FARMS RECEIVING 12 – MONTH IRRIGATION IN SYSTEM B	X 22222	
174	FEBRUARY 1992	G.W. SELLECK, P. M. M. ABRYRATNE AND D.M.S.B. DASSANAYAKE	LEGUMES, GRAIN CROPS, BULB CROPS, CHILLI, CAPSICUM AND VEGETABLES (YALA 1991 SEED FARM TRIALS)	X	
175	FEBRUARY 1992	HENRY HARMON JANE E. GLEASON	MARKETS FOR SELECTED AGRICULTURAL PRODUCTS FROM SRI LANKA – REPUBLIC OF KOREA		
176	FEBRUARY 1992	EUGENE J. DOERING	ON–FARM DRAINAGE REQUIREMENTS FOR SYSTEM B	X	
177	FEBRUARY 1992	G.W. SELLECK	THE STATUS OF WEED CONTROL IN DEVELOPED COUNTRIES	X	
178	MARCH 1992	BILL SELLECK	WEEDS	X	
179	MARCH 1992	G.W. SELLECK & D.M.S.B. DASANAYAKE	YALA 1991 ON–FARM TRIALS	X	
180	MARCH 1992	MARTIN WEST & Y.B.M.K. YAPA	SEED FARM ADAPTABILITY TRIALS. NO. II MAHA 1990/91 YALA 1991 MAHA 1991/92	X	
181	MARCH 1992	J.E. GLEASON	DIVERSIFICATION REPORT, YALA 1991	3	
182	MARCH 1992	JAMES TOLISANO	AN ENVIRONMENTAL ASSESSMENT OF THE MAHAWELI AGRICULTURE AND RURAL DEVELOPMENT PROJECT	X	
183	MARCH 1992	I.K. WEERAWARDANE	LOCAL MARKET SURVEY	X	
184	MARCH 1992	JANE E. GLEASON & N.P. TITTAGALLA	REPORT ON CULTIVATION CENSUS MAHAWELI SYSTEM B YALA 1991	X	
185	MARCH 1992	DOUG POOL	GUIDE TO AID – FUNDED PROCUREMENT	X	
186	MARCH 1992	JACKIE BOARDMAN	COLD CHAIN STORAGE TRIALS IN SYSTEM B FIRST QUARTER 1992	X	
187	MARCH 1992	SUNIL DIMANTHA	SOIL & LAND USE	X	
188	APRIL 1992	AJANTHA DE SILVA, RO	THE SPATIAL VARIATION OF ON–FARM USE OF IRRIGATION WATER IN SYSTEM B	X	

PUBLICATIONS – MARD/MDS PROJECTS

Sup. #	MONTH & YEAR	AUTHOR(S)	TITLE	ENGLISH	SINHALA
189	APRIL 1992	E.R.N. GUNAWARDANE	ON–FARM DRAINAGE INVESTIGATIONS IN MAHAWELI SYSTEM B	X	
190	MAY 1992	HENRY C. HARMON JANE E. GLEASON	THE REPUBLIC OF MALDIVES THE MARKET FOR FRESH FRUITS AND VEGETABLES	X	
191	MAY 1992	DR.J.V POSSINGHAM	TECHNIQUES AND PROSPECTS FOR GROWING GRAPES IN SYSTEM B REPORT II	X	
192	JUNE 1992	JERRY SCHAACK	EVALUATION OF THE OPERATION AND MAINTENANCE PROGRAM AND FACILITIES FOR SYSTEM B	X	
193	JULY 1992	MDS PROJECT	MDS PROJECT STATUS AT CLOSE–OUT	X	
194	JULY 1992	DR.J.V POSSINGHAM	TECHNIQUES AND PROSPECTS FOR GROWING GRAPES IN SYSTEM B REPORT III	X	
195	JULY 1992	J.E. GLEASON	CULTIVATION REPORT MAHA 1991/92	X	
196	JULY 1992	MRS. INDRANI PADMASIRI I.L. NAYEEM	EXPORT QUALITY FRUIT TREE PROPAGATION IN SYSTEM B	X	
197	AUGUST 1992	HERATH GUNATILAKE D.S.A. KULASEKARA GENE T. THOMPSON	FINAL ASSESSMENT MAHAWELI DOWNSTREAM SUPPORT PROJECT SRI LANKA (383–0103)	X	
198	AUGUST 1992	CRAIG B. DAVIS	A WETLAND ASSESSMENT OF ZONES 1 & 5 MAHAWELI AGRICULTURE AND RURAL DEVELOPMENT PROJECT	X	
199	NOVEMBER 1992	G.W. SELLECK AND J.E. GLEASON	CROP ROTATIONS FOR YEAR–ROUND PRODUCTION IN SYSTEM "B"	X	
200	NOVEMBER 1992	GEOFFREY PETERS	A STUDY TOUR OF AUSTRALIA'S MELON INDUSTRY		
201	DECEMBER 1992	HENRY HARMON L. JAYASINGHE	THE KUWAIT MARKET FOR FRUITS VEGETABLES AND NUTS	X	
202	DECEMBER 1992	JACKIE BOARDMON	END OF TOUR REPORT	X	
203	DECEMBER 1992	G.W.SELLECK	SEED FARM TRIALS YALA 1992	X	
204	DECEMBER 1992	MINH NGUYEN	EXPORT CROP PRODUCTION		
205	JANUARY 1993	MARTIN WEST I.L.NAYEEM	EXPORT BABY OKRA ASSESMENT FOR MAHAWELI SYSTEM B	X	
206	JANUARY 1993	W. RATNAYAKE	END OF TOUR REPORT	X	
207	APRIL 1993	DR. J.V.POSSINGHAM	THE TECHIQUES & PROSPECTS FOR GROWING GRAPES IN SYSTEM "B" REPORT IV	X	
208	MAY 1993	HENRY C. HARMON	MARKET UPDATE (DUBAI) VEGETABLE SEEDING	X	
209	MAY 1993	DAVID PARSONS	MODULE CONSULTANCY IN SRI LANKA	X	
210	JULY 1993 *	Y. P. DE SILVA	REPORT ON THE AUSTRALIAN MANGO TOUR (*The tour made on March 1993)	X	
211	JULY 1993	EDWARD REINNAUER	BUSSINESS PLAN FOR THE PRODUCTION & EXPORT OF BABY CORN	X	
212	AUGUST 1993	JANE GLEASON LALITH WEERASINGHE	MAHA 1992/93 DIVERSIFICATION & CULTIVATION CENSUS REPORT	X	
213	AUGUST 1993	G.R.N. GUNAWARDENA	ON–FARM DRAINAGE IN MAHAWELI SYSTEM B	X	
214	AUGUST 1993	K.R. NEIL BANDARA	FEASDIBILITY STUDY ON YEAR ROUND CULTIVATION IN SYSTEM B	X	
215	AUGUST 1993	H. RATNAYAKE (CISIR)	INTERIM REPORT ON MEDICINAL CROP PRODUCTION	X	
216	JUNE 1993	MARTIN WEST Y.B.M.K. YAPA I.L. NAYEEM	EXPORT BABYCORN ASSESSMENT FOR MAHAWELI SYSTEM B	X	
217	NOVEMBER 1993	JANE GLEASON W.R.B. LALITH P.W.A. PERERA	INVESTIGATION OF FACTORS ASSOCIATED WITH CROP DIVERSIFICATION IN IRRIGABLE LANDS IN SYSTEM B	X	
218	NOVEMBER 1993	MARTIN WEST Y.B.M.K. YAPA	EXPORT CANTALOUPE MELON ASSESSMENT FOR MAHAWELI SYSTEM B	X	
219	NOVEMBER 1993	DR. JANE GLEASON W.R.B. LALITH	YALA 1993 DIVERSIFICATION & CULTIVATION CENSUS REPORT	X	
220	NOVEMBER 1993	DR. K.J. SRIVASTAWA	B ONION REPORT	X	
221	DECEMBER 1993	MAX D GOLDENSOHN	SUSTAINABILITY ASSESSMENT	X	
222	JANUARY 1994	MAX D. GOLDENSOHN	FINAL REPORT – MARD I	X	
223	JANUARY	EDWARD C. REINAUER	REPORT ON SEA SHIPMENT OF CANTALOUPES TO HONG KONG	X	
224	JANUARY 1994	DR. CYRIL	POTENTIAL FOR LIVESTOCK PRODUCTION IN MAHAWELI SYSTEM B	X	
225	JANUARY 1994	CISIR	CONSULTANCY ON POSTHARVEST MANAGEMENT OF OKRA CISIR	X	
226	JANUARY 1994	CRAIG DAVIS	WETLAND DEV., REFORESTRATION, & PESTICIDE RESIDUE ASSESSMENT IN SYS B	X	
227	JUNE 1994	Y.P. DE SILVA LAKNATH P. WEERASINGHE AJITH LAL	A STUDY ON ELEPHANT/HUMAN CONFLICT IN SYSTEM B	X	
228	JUNE 1994	IVAN SILVA, K.A.D.S. CHANDRASIRI S.K. CHANDRASEKARA	REVIEW OF O&M OF SYSTEM B IRRIGATION FACILITIES MADURU OYA PROJECT SRI LANKA	X	

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229	JUNE 1994	CRAIG DAVIS	WETLAND DEVELOPMENT REFORESTATION AND PESTICIDE RESIDUE ASSESSMENT IN SYSTEM B (PART II)	X	
230	JUNE 1994	G.W. SELLECK, D.M.S.B. DASSANAYAKE MALA DE SILVA	MAHA 92/93 ON–FARM & SEED FARM TRIALS	X	
231	AUGUST 1994	J.E.GLEASON, W.R.B.LALITH WEERASINGHE	MAHA 1993/94 DIVERSIFICATION & CULTIVATION CENSUS REPORT	X	
232	DECEMBER 1994	J.E.GLEASON, W.R.B.LALITH	YALA 1994 CROP DIVERSIFICATION & CULTIVATION CENSUS REPORT	X	
233	DECEMBER 1994	J.E.GLEASON, W.R.B.LALITH	REPORT ON OKRA BUY–BACK CONTRACTS YALA 1994, MAHAWELI SYSTEM B	X	
234	FEBRUARY 1995	MATT TOKAR	POSTHARVEST HANDLING TRAINING PROGRAM	X	
235	MARCH 1995	EDWARD REINAUER	ANUGA '93 REVISITED & MARKET UPDATE MALDIVES	X	
236	MARCH 1995	EDWARD REINAUER	END OF TOUR REPORT	X	
237	MAY 1995	DR. J.R. BURLEIGH V. VIGNANAKULASINGAM	MANAGEMENT OF GHERKIN IN SYSTEM B FOR INSECT PESTS & DISEASES WITH REDUCED RELIANCE ON PESTICIDES	X	
238	MAY 1995	DR. J.R. BURLEIGH V. VIGNANAKULASINGAM	PESTICIDE USE BY CHILI FARMERS IN ELLEWEWA BLOCK – A CASE STUDY	X	
239	MAY 1995	DR. J.R. BURLEIGH V. VIGNANAKULASINGAM	MANAGEMENT OF CHILI IN SYSTEM B FOR INSECT PESTS & ISEASES WITH REDUCED RELIANCE ON PESTICIDES	X	
240	APRIL 1995	MAHINDA PANAPITIYA	RIPARIAN FORESTRY WORK IN SYSTEM B	X	
241	JULY 1995	REGIE S. JOHN RUKMAN R. DE SILVA	AGRONOMIC RESEARCH ON HIGH VALUE CROP CULTIVATION IN MAHAWELI SYSTEM B – PART I GRAPE SECTION B FERTILIZER	X	
242	JULY 1995	REGIE S. JOHN RUKMAN R. DE SILVA	AGRONOMIC RESEARCH ON HIGH VALUE CROP CULTIVATION IN MAHAWELI SYSTEM B – PART I GRAPE SECTION A FERTILIZER	X	
243	JULY 1995	JANE GLEASON W.R.B. LALITH	REPORT ON CROP DIVERSIFICATION IN SYSTEM B COST OF PRODUCTION & RETURNS TO CROP CULTIVATION MAHA 94/95	X	
244	JULY 1995	JANE GLEASON W.R.B. LALITH	REPORT ON THE HOMESTEAD TREE CENSUS MAHA SYSTEM B 1993/94 & 1994/95	X	
245	JULY 1995	NIMAL WICKCKRAMARATNE A.M.JAYAWARDENA	PRACTICES FOR YEAR AROUND IRRIGATION IN MAHAWELI SYSTEM B	X	
246	JULY 1995	C. JOHN	GRAPE – VINE CULTIVATION	X	
246A	JULY 1995	C. JOHN	GRAPE – VINE CULTIVATION		X
246B	JULY 1995	C. JOHN	GRAPE – VINE CULTIVATION		TAMIL
247	JULY 1995	BRUCE SPAKE U.G. ABEYGUNAWARDENA N. WICKRAMARATNE	METHODOLOGY FOR PARTICIPATORY EVALUATION OF O&M IN DISTRIBUTORAY & FIELD CANAL	X	
248	AUGUST 1995	K.A.D.S. CHANDRASIRI K.O.U. KARUNANAYAKE K. SATGUNASINGAM	REVIEW OF O&M OF MAIN & BRANCH CANAL	X	
249	AUGUST 1995	INDRANI PADMASIRI C. GAMAGE	FRUIT TREE PROPAGATION & PRODUCTION PROGRAM	X	
250	AUGUST 1995	AJANTHA DE SILVA(RARC/A) NIMAL WICKREMARATNE	CONVEYANCE LOSSES DISTRIBUTORY CANALS OF MADURU–OYA IRRIGATION PROJECT	X	
251	AUGUST 1995	T.C. WELIKALA TRAINING CORDINATOR	TRAINING ACTIVTIES IN SYSTEM B (INCOUNTRY AND OVERSEAS)	X	
252	AUGUST 1995	DR. AJANTHA PERERA DR. JAMES R. BURLIEIGH PROF. CRAIG DAVIS	THE FATE OF 3,4– DICHLOROPIONAMIDE(3,4–DPA) IN WETLANDS ADJOINING PADDY	X	
253	AUGUST 1995	U.G. ABEYGUNAWARDENA JOE FERNANDO K.D.SIRIPALA BRUCE SPAKE	SYSTEM B FARMERS' ORGANIZATIONS – MARD II, FINAL REPORT		
254	AUGUST 1995	INDRANI PADMASIRI	PAPAYA CULTIVATION IN SYSTEM B	X	
255	AUGUST 1995	ROGER PAUL	MARD FINAL REPORT	X	
256	AUGUST 1995	Y.P. DE SILVA	FINAL REPORT	X	

EXTENSION BOOKLETS

5 Nos.	YPD SILVA	CHILLI, B'ONION, MANGO, POTATO AND NURSERY MANAGEMENT		X
1 No.	NIMAL WICKREMARATNE	WATER MANAGEMENT		X
1 No.	YPD SILVA	CROP RECOMMEDATION HAND BOOK		X
1 No.	I. PADMASIRI	MANGO CULTIVATION		X