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Guyana Drainage and Irrigation Systems Rehabilitation Project

October 2003

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Guyana Drainage and Irrigation Systems Rehabilitation Project

July 2004

Issue and Revision Record

Rev	Date	Originator	Checker	Approver	Description
A	13 April 2004	Martin Burton John Roe	RD	RD	Draft Final
B	6 July 2004	Bob Davey	RD	RD	Final

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APPENDICES

ABBREVIATIONS and ACRONYMS

AC	Administrative Council
ASL	Agricultural Sector Loan
ASSP	Agricultural Services Support Program
ATP	Ability to Pay
API	Annual Parasite Index
ARIs	Acute Respiratory Infections
BBP	Black Bush Polder
BLS	Baseline Survey
BLSD	Baseline Survey Data
CDB	Caribbean Development Bank
CEHI	Caribbean Environmental Health Institute
CEMCO	Caribbean Engineering Management Consultant
CESI	IDB Committee on Environmental and Social Impact
CLU	Common Law Union
CPACC	Caribbean Planning for Adaptation to Global Climate Change project (GEF/OAS)
DDIA	Declared Drainage and Irrigation Area
D&I	Drainage and Irrigation
DDT	di-chloro diphenyltrichloroethane!
DFID	Department for International Development
E&A	E&A Consultants
EA	Environmental Analysis
EC	Executive Council
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
ENSO	EL-Nino Southern Oscillation
EPA	Environmental Protection Agency
ESIA	Environmental and Social Impact Assessment
ESMR	Environmental and Social Management Report
ESS	Environmental and Social Strategy
ESMP	Environmental and Social Management Proposal
ETo	Evaporate Transpiration
EU	European Union
FAO	UN Food and Agriculture Organization
FFS	Farmers' Field Schools
FGD	Focus Group Discussions
GCM	Global Climate Model
GD	Guyana Data
GDP	Gross Domestic Product
GEF	Global Environment Facility
GFC	Guyana Forestry Commission

GINRIS	Guyana Integrated Natural Resources Information System
GIS	Geographic Information System
GLASP	Guyana Land Administration Support Programme
GLSC	Guyana Lands and Surveys Commission
GNRA	Guyana Natural Resources Agency
GoG	Government of Guyana
GP	Group Promoter
GPS	Global Positioning System
GPLC	Guyana Power and Light Company
GRDB	Guyana Rice Development Board
GUYSUCO	Guyana Sugar Corporation
GWI	Guyana Water Inc
HDPE.	High Density Polyethylene
HH	Household
H&S	Health and Safety
HTS	HTS Development Ltd. (UK
IAST	Institute of Applied Science and Technology
IDB	Inter-American Development Bank
IFAD	International Fund for Agricultural Development
IHE	Initial Health Examination
IICA	Inter American Institute for Co-operation on Agriculture
IMT	Irrigation Management Transfer
INPIM	International Network on Participatory Irrigation Management
IPM	Integrated Pest Management
IPCC	International Panel Climate Change
IRR	Internal rate of Return
LDS	Land Development Scheme
LTR	Land Tenure Regularization
M&E	Monitoring and Evaluation
MHSSS	Ministry of Human Services and Social Security
MMC-ADA	Mahaica-Mahaicony-Abary Agricultural Development Authority
MoA	Ministry of Agriculture
MOM	Management Operation Maintenance
NA	Not Applicable
NARI	National Agricultural Research Institute
NDC	Neighbourhood Democratic Council
NDIA	National Drainage and Irrigation Authority
NDIB	National Drainage and Irrigation Board
NEDECO	Netherlands Engineering Consultants
NGO	Non-governmental organization
NRMP	Natural Resources Management Project
O&M	Operation and Maintenance
OAS	Organization of American States
PAHO	Pan-American Health Organization
PAP	Preliminary Action Plan

PCD	Project Concept Document
PEU	Project Executing Unit
PIC	Prior Informed Consent Procedure (under the Rotterdam Convention)
PLART	Public Lands Administration and Regularisation of Tenure Project
PRA	Participatory Rural Appraisal
PRSP	Poverty Reduction Strategy Paper
RAW	Rapid Assessment Work
RDC	Regional Democratic Council
SOI	Southern Oscillation Index
SPSS	Statistical Package for Social Scientists
SRKN	SRKN'Gineering
TOR	Terms of Reference
UNDP	United Nations Development Programme
UNICEF	United Nations International Children's Fund
USAID	US Agency for International Development
VCR	Video Cassette Recorder
WHO	World Health Organisation
WMO	World Meteorological Organisation
WTP	Willingness to Pay
WUA	Water Users Association

FOREWORD and SUMMARY

GUYANA DRAINAGE AND IRRIGATION SYSTEMS REHABILITATION PROJECT

The D&I rehabilitation works designed under the Guyana Drainage and Irrigation Systems Rehabilitation Project will be implemented, as Component 1: Civil Works of the Agriculture Support Services Program (ASSP), within an evolving institutional framework, encompassing water resources, D&I and agriculture. Accordingly, flexibility must be designed into the implementation process. The shape and functioning of this framework will determine whether or not ASSP will succeed over the long term. However, the works cannot be viewed or treated in isolation, since they cover only (approximately) one third of the Declared D&I area. The institutional framework will, in due course, have to be extended to the remaining two thirds and, with the recent passing into law of the 1999 D&I Bill, all irrigable land.

AGRICULTURE SUPPORT SERVICES PROGRAM

The Agriculture Support Services Program comprises:

1. D&I Rehabilitation *[ASSP Component 1: Civil Works]*

2. WUA support and strengthening, and NDIB institutional rehabilitation, strengthening and support *[Component 2: D&I Institutional Development]*

3. Support for improvements in rice agriculture – seed multiplication, research and extension *[Component 3: Rice Seeds Development]*

4. Support to strategy development for agricultural diversification *[Component 4: Agriculture Diversification]*

The first two components are strongly inter-related. Indeed, the rehabilitation process provides major opportunities to strengthen newly-formed Water User Associations.

The third component is essential if full value-added is to be obtained from the investment in rehabilitation of infrastructure.

The fourth component is not an immediate priority, but will eventually be important from the point of view of assisting the farming sector to reduce its dependence on rice and sugar by diversification into more varied cropping patterns incorporating higher value products.

Although land tenure regularisation (LTR) is not part of the ASSP, one of the conditions laid down for initiation of D&I rehabilitation in any project area is that 80% of the plots in that area have been regularised. Thus, LTR could be viewed as a fifth component. Indeed, it has effectively been recognised as such: US$350,000 will be provided to complete the issuing of titles in the nine project areas. The relationship of LTR to the overall success of ASSP is discussed below.

CONSULTANTS' APPROACH

The approach to our task, first stated in the Inception Report, and consistently maintained throughout the contract period, involves a holistic view of the ASSP, in order that what we do enhances the overall project concept of balanced institutional and physical development. Without a fully functioning and effective institutional framework, capital investment in rehabilitation of drains, canals and structures will be wasted.

We are now at the end of a ten month consultancy. Our work has covered mostly the physical ("hardware") and financial aspects of the D&I rehabilitation process; but through our socio-economic surveys and analyses, and by virtue of the experience of team members, we have also been able to make positive contributions to the institutional development components ("software"). We have taken the opportunity, in this Foreword and Summary, to reflect on ten months of experience and to review overall progress, the issues that need to be addressed, and possible ways of addressing them.

It is ***essential to maintain*** the ***considerable momentum*** that has been ***built up so far in the implementation process***, so that motivation is not lost in the interim period between the ending of financing from the ASL and the start of the drawdown of the now-agreed ASSP loan. This report is intended to contribute towards sustaining the necessary processes.

INSTITUTIONAL AND FINANCIAL SUSTAINABILITY REPORT

The four Special Analyses specified in the TOR that have been amalgamated into this IFSR provide guidance on farmers' likely attitude to the proposed WUAs, their ability and willingness to pay the costs of Managing, Operating and Maintaining the rehabilitated D&I systems, the division of MOM costs between public and private sectors, and the estimation of MOM budgets for the nine project areas.

The Socio-Economic surveys, which included work on respondents' attitude to WUAs, and their stated willingness to pay MOM charges, were largely carried out before much was known in the project areas of the plans to devolve responsibility for MOM of secondary D&I systems to WUAs. Group Promoters had not yet taken up their duties, and were in any case "starting from cold", having to learn as they worked. Consequently the data gathered tended to cover people's general views on the concepts, except where – as in Den Amstel/Fellowship – they had some previous experience of earlier attempts to establish WUAs; or Cane Grove, where farmers reported that in 2002 they attempted to set up their own self-help organisation to organise maintenance work for the D&I system, only to be thwarted on perceived political grounds.

Of all the subjects covered by this report, attitudes to WUAs have been subject to the greatest change over time. GPs' work in the project areas has resulted in the initial formation of nine WUAs by early July 2004, with a much enhanced but, as yet, far from perfect understanding by the average farmer of the overall ASSP plan and the process that has been set in train to achieve its objectives.

Comprehensive work has been carried out on the costs of MOM to both the private (WUAs) and public sectors. Discussions with farmers and WUA officials, and GPs, confirm that the method of calculation is readily understood, and the costs, though (inevitably!) higher than farmers would like, are seen as realistic.

It is clear from the financial and economic analyses that the MOM costs will be affordable, once the level of crop production has built up as a result of D&I rehabilitation, and the provision of new rice varieties and improved seed. However, these physical factors will have to be coupled with expanded agriculture extension services, improvements in the pace of the LTR process, and increased financial margins for rice production. What has yet to be negotiated between the parties – WUAs with the GRPA, MoA and GRDB, and the IDB, is how to move from the current situation of low (if any) payments to the level required to ensure infrastructure is maintained into the future. This is a complex matter and must become a major subject of discussion, now that the ASSP loan has been agreed. It will take dome time – two or even three years in some project areas – before D&I infrastructure is rehabilitated. Not until this is done will the full benefit of improved D&I be felt. Depending on the timing of ASSP Component 3: Rice Seeds Development, it may still longer before the increased financial margins anticipated (**Section 5.3**) are achieved. In this interim period it will probably be necessary to start with a lower D&I fee, perhaps excluding the charge for the primary D&I system. As margins improve, so fees could be increased, to the level needed both to "recover the lost ground" and ensure funding into the future is sufficient for full MOM. **Note:** Any such arrangements would have to be carefully and clearly set out, communicated to all concerned, and formally agreed.

Another financial matter, with equity overtones, is whether/how the higher cost of pumped irrigation water supplies to Black Bush Polder and Lots 52-74 should be harmonised with the lower costs of gravity supply from the Boerasirie and East Demerara Water Conservancies, and the planned new conservancy that will supply the Crabwood Creek project area. However, this cannot be done before the true long-term cost of gravity supply has been determined. Substantial, but currently unquantified, rehabilitation works are required on the existing conservancy dams and regulators, combined with establishment of facilities to estimate inflow to the conservancies and to gauge outflow to the irrigation schemes. This is one of the many issues that will have to be taken up by the new NDIA.

A further factor to be taken into account is that the water resources used by the ASSP project areas are shared by other irrigation command areas, and so have to be distributed equitably. The economic costs of water supply cannot be established for the nine project areas alone.

INTERNATIONAL EXPERIENCE of IMT

It is not a function of this report to elaborate on the way the ASSP fits into the international context. However, it does seem opportune now to stand back a little from the day-to-day concerns of project/process preparation and implementation in order take stock of where the D&I devolution process in Guyana currently lies in relation to the experience that has been built up painstakingly in other countries. Stakeholders' confidence can be boosted by the knowledge that their problems have been encountered and shared by workers in other countries; and lessons on addressing the issues that confront them can be drawn from others' experience.

In October 2003 an International Workshop on WUAs was held in Guyana, with the general objective of exposing stakeholders in the ASP/ASSP process to experience with WUAs and irrigation management transfer (IMT) elsewhere in the world. The workshop provided a forum for them to discuss principles and practice of IMT, among themselves, and with participants from overseas who had direct experience of the processes involved. Two of the international participants, Dr Mark Svendsen and Dr Rigoberto Rivera,

continue to be associated with the project as consultants on institutional development and training. They had prepared a joint report on what is needed to ensure the sustainability of D&I systems in Guyana[1]. Rivera had also carried out a comprehensive review of the literature on IMT world-wide over the last 20 years [2]. Together these provide a sound background to the IMT process that was then just starting, and is now fully underway, in Guyana.

Another international contributor to the workshop was Raymond Peter, who described his experience of IMT (on a massive scale) when he was Secretary of Irrigation in the Government of Andhra Pradesh. The paper[3] summarising his experience is also of great relevance to current activities in Guyana.

Use has been made of the references cited above, together with the reports of the International E-mail Conference on IMT, sponsored by FAO and INPIM in 2002, to establish a "template" against which to view on-going and future activities in Guyana.

The general requirements for successful irrigation management transfer can be summarised as:

High Level Support

- Strong political will and commitment

IMT Framework, Consultation and Planning Process

- Clear IMT framework, to make the irrigation agency accountable to the Farmer Organisations

  [Clearly, this framework must be closely linked with the legal framework for IMT, and any legislation that may be required to allow land reform.]

- Open and transparent participation and consultation process with stakeholders, from the earliest possible stage

  [In the case of Andhra Pradesh, to generate broad based stakeholder support, extensive consultations were held with farmers, irrigation agency staff, political parties, media and the different ministries of the Government over a period of nine months.]

- Early planning for changes, including staff shedding, that may be needed in the irrigation agency

  [This must include a strategy for overcoming the 'bureaucratic drag', which will slow up the change process by retaining (effective) power in the centre. Transparency and discussion (above) is a powerful lubricant, combined with a fair and open human resources policy.]

Legal Framework

- Clear and understandable legal and regulatory framework defining roles, responsibilities and recourse for all parties, with flexibility (through a regular review process if necessary) to allow adaptation to changing circumstances (See **Appendix E**)

[1] *Grasping the Nettle – Making Guyanese D&I Systems Perform and Last*, March 2003

[2] *Performance Analysis of D&I Devolution Policies in Some Countries*, April 2003

[3] *Irrigation Reforms in Andhra Pradesh, India*

Land (Tenure) Reform

- Land tenure reform/regularisation programmes, where necessary to encourage active and effective WUA formation and participation

  [Without secure rights there will be a lack of incentive for investment, and no collateral for loans. The lack of sense of ownership does not encourage the concept of self sufficiency and security.]

- A simple and clear process of implementation

  [WUAs should be fully engaged in implementation, so that the process can be used as a training and institutional strengthening tool, and to ensure that they remain engaged. (See **Appendix F**, which deals with WUAs role during construction.)*]*

- Ensure a process of gradual change by keeping government engaged, and use of a self-reinforcing mixture of top-down and bottom-up procedures

  [It is essential to recognise that the process will take a long time and government has to commit to provide support throughout. Hence the need to engage the whole political spectrum and civil society.]

Physical Factors

- Good physical condition of the infrastructure, adequate and well-managed water resources and secure water rights

  [Farmers are naturally reluctant to take over management of infrastructure that is a liability rather than an asset.]

Financial Factors

- Resource base for the WUA, e.g. water charges and other charges associated with the use of the infrastructure it manages, for example, fishing licenses

  [Access to loan finance will also be needed at some stage, and the legislative framework should allow for this.]

- A clear financing plan during the transfer period, *without engendering a sense of (continuing) dependency* – a difficult balance to achieve!!

  [Openness, transparency, and understandable procedures and agreements are once more the key.]

Training and Capacity Building

- High quality, focused, but flexible, training, over an extended period

  [Although the importance of training and support services is recognised as an important element of an IMT programme, there is generally a preference for funds to be channelled towards physical infrastructure with training programmes allocated only a small proportion of funds. As a result it is impossible for farmers to add value to the (frequently large) investment in rehabilitation – "Penny wise, pound foolish" … ??*]*

- Capacity building involving a post-transfer support programme for building technical, financial and administrative competence, within WUAs and supporting agencies

[A strong programme, parallel to IMT, to develop agriculture, agri-business and marketing is essential, if full value is to be added to the substantial investment in infrastructure rehabilitation.]

STATUS of ASSP

The objective of this section of the IFSR is to contribute to the next stage of ASSP: planning for and implementing change in NDIB/A, at the same time as continuing to develop and strengthen WUAs. It takes the form of a discussion of the findings/results of the analyses relevant to "sustainability" of the rehabilitated D&I infrastructure, further informed by the general experience of IMT brought to the project by members of the consultancy team. The objective is to provide data and ideas to aid those responsible for ASSP project planning and execution. It is not the function of the ISFR to make recommendations.

Linking ASSP and LTR

In addition, the ISFR is directed at supporting the suggestion that links be established, both within the project between the WUA building process and planning for ASSP Component 3: Rice Seeds Development, and – outside the project - with the on-going LTR process.

Such linkages would serve to establish, in the minds of farmers, the overall context in which they are being asked to support and pay for D&I rehabilitation, and so strengthen their commitment to the success of the "hardware" component of the ASSP. ***This***, we should recall***, is why the ISFR has been specified in our TOR!!***

A positive approach to D&I rehabilitation, WUA formation and payment of D&I fees would be encouraged, and the long term benefits to be gained from secure, formal land tenure would become clearer, encouraging accelerated lease and title take-up. From a resource management point of view, financial savings would also be possible, if the WUA infrastructure were to be used. However, a considerable degree of political and administrative commitment, supported by strong management, would be necessary to achieve such a comprehensive strategy – a major challenge.

In the following paragraphs the perceived status of the ASSP is set out, and comments made, broadly under the categories set out in the "international experience template" proposed above.

IMT Framework, Consultation and Planning Process

FRAMEWORK: National Drainage and Irrigation Board/Authority

Now that the D&I Bill 1999 has been passed into law, the NDIB will become the NDIA, with responsibility for regulating D&I, requiring it to *inter alia*:

- Facilitate formation and support of WUAs
- Prepare strategic plans for national D&I development
- Monitor development, management, operation and maintenance of D&I infrastructure
- Operate and maintain the public goods components of the D&I system
- Oversee the MOM of water conservancies

Such a wide-ranging role will require a high level of institutional rehabilitation and support over an extended period of time, if the institutional strength necessary to ensure sustainability is to be attained. Support from the very top will be essential for substantive institutional change. This must be backed by provision/training of senior and middle management who are committed to implementing change at all levels. The institutional reforms provide an opportunity to both establish credibility in the eyes of WUAs and improve the public perception of the current organisation through more effective service provision and support. *[For example, it will be most important, for the success of WUAs, that the primary D&I system is managed effectively – a matter of much current concern to farmers.]*

Opportunity to Learn

In seeking to effect change there are opportunities to learn from similar change-management experiences in Guyana, especially through a review of the experience gained in the now well established Commissions of Forestry and the Guyana Lands and Surveys.

Though a degree of autonomy is anticipated, the NDIA will remain under the Ministry of Agriculture. To ensure success there will be a need to clearly define effective lines of management between the parent Ministry and the organisation, particularly with regard to the overall management of the change process and the effective and timely flow of funds. The early implementation of sound financial management systems will be essential

Regional authorities will have to be strengthened, with full WUA and other stakeholder involvement, and a programme to upgrade the regional staff profiles to a more balanced professional/technical team structure. A progressive philosophy will be essential – and carried through in practice, with open M&E and audit procedures.

Personnel

Personnel requirements in both the centre and the regions will have to be measured critically against current availability and aptitude. At the outset whether or not all existing staff should be transferred to a contract basis, pending implementation of training programmes and improved performance needs to be carefully evaluated. This is a sensitive issue that can have long term implications for the success of the change process. An open and fair human resources policy will be required that is clearly understood by all, and has strong support from Senior Management.

Our experience over last 10 months – and that of other consultants in Guyana – is that senior and junior professionals and technicians are capable, willing and able to work under a "new paradigm" BUT want a real job with responsibility and authority, and a conducive management structure. They want, and need, to be in a position to make real contributions. This represents a major challenge for NDIB/A human resources policy and practice.

FRAMEWORK: Water User Associations

In parallel with the design (under the GDISRP) of ASSP Component 1: Civil Works, WUAs have been established under the Pilot Action Programme (PAP). International consultants worked with Group Promoters (GP) drawn from the project areas and NDIB, to encourage farmers to come together to form WUAs, and provided training. By early July Delegation Agreements had been signed by WUAs in all nine

project areas. This is only the first step, however, and much support will be required in the coming years to ensure that the young WUAs mature, and function effectively.

WUAS' Core Function

WUAs are the core of the project. If they do not function effectively, the investment in capital works will be wasted. It is essential that WUAs are treated as equal partners in the project design and implementation process. [**Note:** Provision has been made for this in the Construction Specification]. Their membership has unique local experience not otherwise available to other members of the design team, including knowledge of how the D&I systems were designed to operate – and can still be operated, given the right conditions.

Finance of MOM

Under the ASSP, WUAs are to become responsible for the Management, Operation and Maintenance (MOM) of the Secondary D&I systems. They will also be responsible for raising funds to pay for that MOM, through the setting and collection of D&I fees. In addition they will have to collect fees for the MOM of (part of) the primary systems. Hence it is essential that they share fully in the calculation of the fees from the earliest feasible time. If they are excluded, there is the risk of alienating members, at a critical stage of institution building. It may be considered unreasonable for the full fee to be levied immediately on implementation, on the basis that water users (and their "bottom lines") have not yet benefited from on-farm water management (OFWM) and agricultural extension. Even so, it is essential that there is a clear understanding between all parties that the full cost over a full maintenance cycle has to be provided, although the details of the mechanism should be left to the WUA to decide. If WUAs wish to take out loans to cover longer return period maintenance needs, the legal framework governing their operation must allow for this. In any case, if WUAs are to be operated as fully functioning small businesses, access to loan finance will be essential. It is by no means certain that this will be possible under current arrangements.

Pricing of Irrigation Water

With respect to paying for water supplied through the Primary Irrigation System, either pumped (Region 6) or by gravity (Regions 3 and 4), there may be a case for relieving the WUAs of the full cost of pumping in the early years, on a sliding scale. However, (see **Appendix A1**) there is a strong case for re-assessing the true long-term costs of storing and supplying water from the conservancies. It may well be that these costs are in fact closer to those of pumped supply than has been thought. (See also *Water Resources and Hydrology Report*.) However, in the interests of national equity, serious consideration should be given to harmonising charges for pumped and gravity supplies.

CONSULTATION: Farmers' View of Water User Associations

Key conclusions emerging from PRA and discussions associated with the Baseline Surveys were:

- There is widespread expectation that government (the NDIB and councils) should provide D&I services, combined (paradoxically, as always) with near a universal dissatisfaction with the level of service provided.

- Current levels of understanding of potential WUA responsibilities and implications are low; extensive awareness and information work is needed before farmers can make informed decisions.
- LTR is necessary for successful WUA formation and operation. In project areas with small plot sizes, the land related issues are daunting, particularly where non-farm households comprise more than half the total. The timing of LTR take-up is a subject for review (below, and **Section 3.11**).
- There is little understanding of the link between LTR and D&I rehabilitation, or the relationship between the newly-increased GLSC annual land lease fees, NDC charges and D&I rates.
- The current changing patterns of land use, scale of operations and emigration, combined with perceived land grabbing by powerful farmers, vested interests, and patron-client relations between large farmers and NDCs, will make it difficult to form and sustain WUAs.

Issues such as these cannot be settled overnight, and certainly not directly by outside intervention; but a comprehensive legal framework, training and support services will certainly be necessary to achieve solutions. Establishment of strong civil society organisations, such as WUAs, is the only way to mitigate such conflicts.

One side of the argument holds that : *"WUAs can't be set up in such adverse circumstances."*

The other side counters with: *"The issues can only be resolved, over time, by community organisations like WUAs."*

Experience favours the latter.

PLANNING: Water User Associations and Project Planning

Efforts were made to involve the fledgling organisations in the preparation of tender designs for the contract bidding documents, but the time available for this process was extremely limited. However, now that feasibility studies and tender designs are complete, WUAs should be given copies and so become full partners in the planning process.

Note: WUAs have asked us how they can have particular design concerns taken account of. We have advised them to prepare their ideas (sources of informal technical advice are available if required) for submission to, and discussion with, the international consulting company that will be appointed to prepare detailed designs and supervise construction. The fact that WUAs wish to become involved in this way is a very positive sign; but the fact that they need to ask how to do so indicates that they are not yet fully integrated in the planning process. In view of the commendable speed with which they have been set up, this is not at all surprising. The challenge now is to provide the will and the means to respond positively to WUAs' proactive initiatives.

In any event, it will be essential to ensure that the WUAs are involved in the final designs that will eventually be prepared for construction purposes. This will enable them to become fully involved in the project cycle, for the management, operation, maintenance and evaluation parts of which they will be responsible. Once they have contributed to the final designs, they should then take part in the construction

supervision/quality assurance stage of the project, prior to taking over the D&I works for operation. (See **Appendix F**)

Legal Framework

In general, all farmers feel that there is a need for a solid legal framework to ensure that WUAs can function effectively. The direct experience in the Den Amstel/Fellowship project area is instructive here. In 1996 the area became one of the first in the country where an attempt was made to devolve power for MOM of D&I to water users. This effort failed for a number of reasons that were said to include the absence of an enabling legal and institutional environment for WUAs in the country. The 1999 D&I Bill was enacted in May 2004. This consolidates earlier statute and amendments, but WUA-specific legislation is still required. It is understood that this is under active consideration by GoG. For reference, an outline of the Andhra Pradesh (India) legislation is given in **Appendix E**. Historical anomalies between project areas in the law governing payment of land tax and D&I fees will have to removed in the drafting of WUA-specific legislation, to enable the establishment of a well-publicised and transparent legal framework.

Land Tenure Regularisation

Insecurity of land tenure can adversely affect farmers commitment to an efficient and sustainable D&I system. Experience in the project areas has shown that farmers holding some or all of their land under sub-leases are less likely to be involved in MOM of D&I, except in emergencies. The contention is often that they are already paying the landlords. To this end, the Guyana Lands and Surveys Commission (GLSC) Land Tenure Regularisation (LTR) programme is commendable. However, there still seems to be an urgent requirement to educate farmers about the need to acquire secure leases (or freehold ownership), as many currently perceive the cost to obtain their freehold titles as prohibitive and "*another cost they have to bear*".

It is understood that the intention is that the person farming the land will have to pay the D&I fee, not the leaseholder or land owner. In theory this should overcome the problem of who has the legal right to use the land. However, in practice any remnant of uncertainty will work against the smooth operation of WUAs and the systems they manage.

It would probably, for example, be necessary for farmers to renegotiate their contract with the leaseholder/ land owner, which may not be a straight forward process. Again it may be difficult to sanction a non-payer of D&I rates if he is not the title holder of the land he farms, particularly if the ultimate sanction is to be repossession. It is situations such as this that have to be covered by appropriate specialist legislation.

LTR - 80% Target

A target of 80% LTR has been set for the ASSP. It is not the role of this report to judge whether this level of take-up is either realistic or necessary. However, it must be said here that land-holders in general do not have the information needed to enable them to make a judgement on whether or not to up-lift their lease or title. Moreover, until farmers also understand how LTR will benefit them if it is linked with the ASSP interventions, take-up is likely to be low. In these circumstances it would seem wise to reduce the target below 80% in the expectation that up-take will accelerate once the overall picture is understood.

Progress of Land Tenure Regularisation

A programme of LTR is well underway, by the Guyana Lands and Surveys Commission, though the current uptake of leases/titles is somewhat below expectations. The expectation/requirement for 80% take up is unlikely to be realised *in full* during the next year or so. The view taken here is that the 80% is not immediately required, as the realisation that a modern lease or title is an integral part of improved agriculture will only come as understanding develops and farmers see that D&I rehabilitation is real. In the mind of the small scale farmer – operating without good infrastructure and seed, or extension support - there may be little benefit at the present time in a secure land title. Nor would there be much benefit in taking undue risks with respect to credit.

Also, with improved infrastructure, increased land values can be realised. As a consequence there may well be increased demand for secure title (leasehold or freehold).

We understand that, following an LTR Impact Assessment, considerable efforts are now being made by the GLSC to ensure the public in general, and farmers in particular, clearly understand the benefits of secure land titles and the full implications in the long term. From the perspective of irrigation development, the main advantages/benefits to individual farmers and the WUAs can be summarised as follows:

- The freehold conversion process serves to support long term Government Policy in the land sector, with the main advantage of moving agriculture land management from government to the private sector. This is considered essential to long-term development of the agriculture sector
- Regularisation of tenure also carries benefits such as an increased feeling of security, and improved access to credit, both of which would contribute over the medium/long term to success of ASSP
- WUA formation and ongoing development and strengthening, requires much the same process of information dissemination, building of knowledge and trust, and careful implementation as does tenure reform. Tenure reform could usefully be combined with on-going WUA support processes, which would provide opportunities to economise on resources.

Physical Factors

Water Resources and Hydrology

Although the success (= sustainability) of the project depends on the institutional framework, water resources and hydrological factors could adversely affect it if they are not managed correctly. These are summarised in **Section 2.3** and discussed in detail in the *Hydrology and Water Resources Report*. The most important issues in the short term concern the condition of the embankment dams of both the East Demerara and Boerasirie (Region 3) Conservancies. The water resources available for irrigation in Region 4 (East Demerara Water Conservancy) and Region 6 (Canje River) are currently marginal, and urgently require investigation in order that appropriate management systems can be agreed and implemented. Since water resource co-ordination will be one of the functions of the strengthened NDIA, it is necessary that early action be taken. (See also **Appendix A3**)

Note: Regional Water Management Committees, with representation of all stakeholders including WUAs, are to be established (within the next six months, it is understood), and their duties will include addressing such issues as these.

Rainfall, ClimateChange and Sea Level Rise

La Nina events are clearly associated with significant higher rainfall than normal, and El Nino events with significantly lower rainfall. Of particular note are the difference for the November to January wet season, when rainfall in El Nino years is generally about half of that in La Nina years.

Such data could be used to improve seasonal rainfall forecasts. It is important to convey forecasts in probabilistic terms, however. These forecasts could clearly in future be of significant operational value, assuming that water resources management is developed to the extent needed to make effective use of the data.

A review has been undertaken of General Circulation Model (GCM) predictions of future climate conditions in Guyana, using the HADCM3 model in particular and various emissions scenarios. Model outputs indicate that precipitation in Guyana is likely to reduce under scenarios of future climate change. The forecast changes are consistent throughout the year. A temperature rise of 1.0 - 1.5^{o}C may be expected by the 2040s. A temperature rise of this order could increase evaporation by up to 5% if other parameters remained unchanged.

Relative sea level is rising in Guyana, and it is rising faster than the global average. Since there is no operational tide gauge at Georgetown, recent data on actual tides are not available. This is a fundamental block on strategic planning. *It is extremely important that Guyana re-establish an effective system for monitoring sea-level, which is essential to the planning of future coastal defence and drainage works.*

D&I Infrastructure and Access to Project Areas

Black Bush Polder Public road access to the front of the project area is a potential issue here. Because of the distance of Black Bush Polder from the main road, the condition of the all weather access road is critical. At the moment this road is in a bad condition and is deteriorating further. As a result, access to the project area in the wet season is extremely poor, and difficult even in the dry. Fortunately, the road is covered under an IDB road rehabilitation feasibility study. It should be possible for the necessary "synergy" to be arranged between the two Bank projects, thus dealing with the issue.

Financial Factors

Current Situation

At present, the farmers' ability and willingness to pay for D&I services is strongly influenced by the depressed rice economy and the generally poor levels of D&I operation and maintenance services being provided by local and central government. In many of the project areas, the current low (and often negative) net income from rice cultivation severely restricts the rice farmers' ability to pay D&I fees. Furthermore, the inadequate provision of O&M services clearly reduces their willingness to pay the fees required to operate and adequately maintain the primary and secondary systems.

Currently rice cultivation is, at best, only a marginally profitable enterprise and, in many areas, financial losses are being incurred. If this situation continues, it is likely that many farmers will abandon rice production and depend on cash crops, ground provisions and livestock as their main sources of farm income. This has already occurred in Crabwood Creek and will probably become more widespread as farmers become less able to meet the fixed costs associated with rice farming (i.e. machinery, land rent and D&I fees). Given that the world market price prospects for rice are unlikely to improve significantly, these low levels of profitability could potentially remain for the foreseeable future.

Current Situation

In order to reverse the current downward spiral within the rice economy, it is essential that production costs per tonne are reduced to levels well below the prevailing farmgate prices. This can be achieved both by directly reducing production costs and improving rice yields. These improvements can only be attained if the D&I systems are being operated both efficiently and equitably. Therefore, in addition to rehabilitating the D&I infrastructure, it is critical that effective and sustainable Water User Associations (WUAs) are fully established and functioning in all the project areas. Rice farmers will then have the opportunity to increase crop productivity (through drainage and irrigation) and to lower production costs (e.g. reduced private pumping of water from canals and drains).

It is also important to note that, in some project areas (e.g. Vreed-en-Hoop/La Jalousie), farmers are achieving levels of productivity which are sufficient to generate positive net returns and this also enables them to meet D&I fees (about G$2,500 per acre). The funds generated are used to operate and maintain the D&I system in a reasonably satisfactory manner. In this situation, the establishment of a WUA would ensure that O&M standards are sustained in the future, obviating the need for further rehabilitation of the D&I infrastructure.

Potential Ability to Pay

Following D&I rehabilitation and the establishment of WUAs, it is evident from the farm budget analysis (**Section 5.3**) that, with a few exceptions, most farmers in the project areas should have the ability and incentive to pay the level of fees required to operation and adequately maintain their D&I systems. However, rice yields and net farm incomes could be increased further if improved cropping practices (e.g. block planting, farm water management and integrated pest management) were adopted. This would require the provision of considerably enhanced agricultural support services, i.e. research, extension and seed production (see **Chapter 6**), which would result in a notable increase in income from rice production. This higher level of income would not only provide farmers with a much stronger capacity to pay D&I fees, but also encourage them to fully participate in WUA activities.

Agriculture Extension

Improved agricultural support services are therefore regarded as an essential prerequisite to achieving the anticipated increases in net farm income required to meet the rise in fees necessary for the sustainable management of the D&I systems. Furthermore, a crop diversification programme could lead to an expansion in cash crop production in the project areas as a consequence of an increase in demand for horticultural produce in both the domestic and export markets.

The provision of effective on-farm research and extension support services will also make a significant contribution to increasing the adoption of improved cultural practices facilitated by D&I systems

rehabilitation and the establishment of sustainable MOM (through WUAs). This will help farmers to substantially improve their income from rice production and boost the rice economy as a whole. Without a modest investment in these support services, the opportunity of obtaining the full financial and economic benefits being provided by D&I rehabilitation will be lost.

Training and Capacity Building

Group Promoters are doing sterling work, but there is much more to be done. The "message" – not only of ASSP in all its facets, but also of the links between land tenure regularisation and the medium/long term development of agriculture - is not yet being heard loudly or widely enough. GPs will be fully occupied as the linkages between ASSP components and LTR are developed, particularly when D&I rehabilitation is complete, and improvements in agriculture can start in earnest. Their role will evolve from the current one of facilitating WUA formation to co-ordinating specialists' work in training and extension. ***GPs experience must not be lost***. They have much still to do and to contribute.

Women Group Promoters: No woman GP has been selected, though up to 50% (Den Amstel/Fellowship) of farmers are women. (In most project areas the percentage is lower). Nevertheless, it is very important to include women in the WUA building process. Women would probably be more likely to come forward for training in WUA management and ASSP project training sessions, for example, if a female role model were available as a GP.

Agriculture Extension: Farmers, without exception, feel let down by the extension services. They are aware that agricultural techniques (particularly for rice) must, and can, be improved, but have no means of finding out how to do it. In this context Component 3: Rice Seeds Development of the ASSP would be invaluable (see also above), but full agricultural extension support should also be made available – as is envisaged as part of Component 2: D&I Institutional Development.

Another excellent reason for including an agricultural extension component is that, properly managed and directed, extension can be used as a very effective WUA strengthening tool, using Farmers' Field Schools - which are already employed by GRDB and GRPA in their joint extension interventions. Work on multi-disciplinary FFSs in Nepal in 2002-2003 demonstrated that, by first engaging farmers in an activity that is of great interest and importance to them (improving the standard of agriculture, in that case), the rather abstract subject of WUAs, and how they can be strengthened and operate in the best interests of their members, was given an entry-point. The meaning and relevance of LTR, and its importance to the future of farming, could equally well be introduced.

1 INTRODUCTION

1.1 Overview

The Government of Guyana (GoG) and the Inter-American Development Bank (IDB) are preparing an investment package for the agriculture sector, the Agricultural Support Services Programme (ASSP, GY-0011). The ASSP loan would support investments made to complement policy changes introduced under the Agricultural Sector Loan (ASL, 965/SF-GY), which began in 1996. In addition to rice research and extension and a fund to encourage crop diversification, the ASSP is expected to finance the rehabilitation of selected D&I systems in the following nine project areas of Regions 3, 4 and 6:

System	Area		Region
	(Acres)	(ha)	
Vergenoegen/Bonasika	27,300	10,750	3
Den Amstel/Fellowship	880	345	3
Vreed-en-Hoop/La Jalousie	4,465	1,760	3
Canals Polder	21,700	8,545	3
Cane Grove	7,220	2,840	4
Golden Grove/Victoria	5,052	1,990	4
Black Bush Polder	27,600	10,865	6
Lots 52-74	22,352	8,800	6
Crabwood Creek	4,365	1,720	6

The GoG and IDB have agreed on three principles to guide the investments in the capital works within the primary and secondary systems (TOR Sections 2.2):

(a) ***Local participation in design, construction supervision and O&M of the completed systems***. It is envisaged that farmers, through Water User Associations (WUA), would be involved in the design and construction of the rehabilitation programme; and would have full responsibility for O&M of secondary D&I systems. Arrangements to divide financing of the O&M of primary systems equitably between government and the private sector (including farmers) would also be agreed by all stakeholders.

(b) ***Sustainability***, which would require: "… systems designed to be maintained; properly trained and motivated … personnel and sufficient financial allocations …"

(c) ***Modernisation,*** which is envisaged to encompass "… improvement of agricultural productivity on existing cultivated land" and the "… expansion of agricultural acreage …"

1.2 Consultant's Approach

1.2.1 Core Function

The core function of the Consultancy Services is to demonstrate that rehabilitation of D&I infrastructure is technically, financially and economically feasible, and then to prepare the detailed designs, specifications, bills of quantity and other documents required to invite bids for execution of the work. The infrastructure study and design is mostly "project" work, with definite objectives, and subject to firm progamming. Participatory design introduces an element of "process" into the project-based environment, which ideally should be allowed to run its natural course. But the time constraints under which we are operating have limited the process-based activities to the time available – not an ideal situation, but much better than nothing.

Local participation at all stages of the project cycle is essential as a first step toward sustainability. The design of D&I infrastructure can also contribute to sustainability, by providing for robust, easy to maintain structures that are simple to operate, and provide scope for monitoring water supply and distribution as an aid to effective and efficient water management.

1.2.2 Sustainability

However, the most important ingredient – by far – in the "sustainability mix" is the institutional framework within which the infrastructure is operated and maintained, and which is essential for the assessment and collection of fees to cover MOM costs. This is why the proposed WUAs are so important. Without fully functioning and effective WUAs, the capital investment in drains, canals and structures will be totally wasted.

Experience with WUAs in Guyana to date has been mixed, at best. The reasons for this and the lessons to be learned are explored in Appendix 3.1 of the project area detailed feasibility studies. However, even in the best of circumstances it is not realistic to assume that WUAs will be fully functioning and self-sufficient in less than five to ten years. During this period it will be essential to concentrate support to the fledgling institutions on their core functions:

- Water management and infrastructure maintenance and, in parallel so as to encourage farmers to come together to help themselves and each other,
- Improvements in agriculture, to help them to increase their income, or "modernisation" as set out in the TOR (see **Section 1.1**).

As the confidence and ability of the WUAs grows, they will be able to turn their attention to other matters, such as the processing and marketing of produce that would add further value. The imposition of too many roles and responsibilities on an immature WUA would lead to "institutional overload", failure of the organisation and loss of the investment.

1.3 IFSR Report

1.3.1 Purpose and Layout

This report covers institutional support and financial arrangements considered necessary for the sustainable development of the nine project areas covered by the Guyana Drainage and Irrigation Systems Rehabilitation Project (GDISRP). The report covers four of the five special analyses requested in Section 4.3 of the Terms of Reference, namely:

4.3.1 A report on farmers' participation for local water management for each project area

4.3.3 A report on the ability of farmer incomes to support D&I costs associated with O&M

4.3.4 A report recommending a model for allocating O&M costs between public and private sectors

4.3.5 A report on O&M budgets for each project area using tariffs and subsidies to pay for the O&M of private allocations of O&M costs

1.3.2 Format

These are dealt with in **Chapters 3, 4** and **5 and 6**, with their associated appendices. The ToR for the O&M Engineers also request a review of current O&M procedures in Guyana, and the O&M budgets produced by NEDECO in March 2000, which are covered by **Chapter 4** and **Appendix B**.

ToR Item 4.3.2 (A report detailing baseline conditions in each project area) does not usefully fit together with the above. The detailed feasibility studies for the project areas each contains a report of the Baseline Survey, as Appendix 4.

In addition to the above, physical issues that may have an effect on the sustainability of the project areas are summarised in **Chapter 2**, and the agricultural services that will be essential to support the successful implementation of the GDISRP are discussed in **Chapter 6**.

1.3.3 Status

The theme of this consultancy, first set out in the Inception Report, has been "sustainability". Although we have had very limited responsibility for the "software" components of the project, we have tried to take available opportunities to make constructive contributions. The report continues that theme.

This report updates the Draft Final submitted in April 2004. The original text has been subject to minor editing. Information has been added, together with the results of further analyses. Developments in the ASSP preparation process have been taken account of. The opportunity has been taken (in the Foreword and Summary) to consolidate the substantial body of work done world-wide on identifying the requirements for "sustainable" IMT. The major issues are, to a very large extent, common throughout, though the precise means of addressing them will vary with culture and circumstances. This provides the background against which the ASSP activities in Guyana can be assessed, and recommendations made for any necessary improvements.

2 PHYSICAL ISSUES

2.1 General

There are some external physical issues that may affect the sustainability of the D&I rehabilitation component of the ASSP; but all can be resolved if the necessary action is taken. However, successful implementation of the rehabilitation works – and management, operation and maintenance of them over the long term – will be very much dependent on the social background and institutional framework against which the physical works are carried out and used.

This section of the report gives an overview of the major physical issues that will have to be taken into account in planning the ASSP, together with suggestions for dealing with them. Where necessary, issues specific to particular project areas are raised.

It is clear from the feasibility studies that there should be no physical reason within the project areas themselves why D&I rehabilitation cannot be successfully implemented. For financial reasons rehabilitation, rather than renewal, of larger items of infrastructure, in particular pump stations, will be necessary.

2.2 Area-specific Issues

However, in three project areas physical factors over which the project will have no direct control may adversely affect implementation and, particularly, operation.

Vergenoegen/Bonasika Public road access to the southern part (55%) of this project area is very poor. It is understood that the head regulators on the A-, B- and C-line irrigation canals were rehabilitated in the late 1990s (CDB/IFAD). But it is reported that the canals have not been de-silted "for 20 years". Such major work is not within the scope of the project. Only if means can be found to construct an access road, and then rebuild and/or construct new D&I infrastructure, could farmers here gain any benefit from the ASSP. Further extensive studies would be needed.

Black Bush Polder Public road access to the front of the project area is also a potential issue here. Because of the distance of Black Bush Polder from the main road, the condition of the all weather access road is critical. At the moment this road is in a bad condition and is deteriorating further. As a result, access to the project area in the wet season is extremely poor, and difficult even in the dry. Fortunately, the road is covered under an IDB road rehabilitation feasibility study. It should be possible for the necessary "synergy" to be arranged between the two Bank projects, thus dealing with the issue.

Crabwood Creek Water supply for irrigation (from the proposed Halcrow conservancy) is contingent upon expansion of the Skeldon Estate by Guysuco, which is now (July 2004) proceeding.

In addition the embankments of the Boerasirie and East Demerara Water Conservancies require repair in places. Although consideration of these works falls outside the scope of this project, problems with the integrity of the embankments could put at risk ASSP investments. (See **Appendix A**.)

2.3 General Physical Issues

2.3.1 Influence of El Nino on Rainfall

Guyana is locally reported to experience acute droughts during El Nino events and heavy rainfalls and flooding during La Nina events. Analysis of the correlation between records of the Southern Oscillation Index (SOI) and monthly and annual rainfall for Georgetown indicates that there has been an increased frequency of El Nino years since the 1970s, and that during this time below average rainfall had been experienced in Georgetown. However, the direct correlation is extremely weak and could not form the basis of any objective forecast of seasonal rainfall.

However, application of techniques which mask the impacts of local climate variability show that La Nina events are clearly associated with significant higher rainfall than normal, and El Nino events with significantly lower rainfall. Of particular note are the difference for the November to January wet season, when rainfall in El Nino years is generally about half of that in La Nina years.

The data generated could be used to improve seasonal rainfall forecasts. It is important to convey forecasts in probabilistic terms, however. These forecasts could clearly in future be of significant operational value in Guyana, assuming that water resources management is developed to the extent needed to make effective use of the data.

2.3.2 Influence of Climate Change on Rainfall

A review has been undertaken of General Circulation Model (GCM) predictions of future climate conditions in Guyana, using the HADCM3 model in particular and various emissions scenarios. Model outputs indicate that precipitation in Guyana is likely to reduce under scenarios of future climate change. The forecast changes are consistent throughout the year. A temperature rise of 1.0 - 1.5^{o}C may be expected by the 2040s. A temperature rise of this order could increase evaporation by up to 5% if other parameters remained unchanged.

2.3.3 Sea Level Rise

Relative sea level is rising in Guyana, and it is rising faster than the global average. Since there is no operational tide gauge at Georgetown, recent data on actual tides are not available. This is a fundamental omission for strategic planning.

Analysis of tide tables for Georgetown by this study indicates a rise of 3 mm/yr since the 1950s. The coupled ocean-atmosphere general circulation model (CGCM 1) suggests a mean sea level rise along the coast of about 4 mm/yr for the next century. The Intergovernmental Panel on Climate Change (IPCC)

range of global sea level rise by the 2050s is 7 - 36 cm, which gives a middle range estimate of 4 mm/year. The upper range estimate corresponds to 7.2 mm/year. Within Guyana, the *Initial National Communication: Monitoring and Understanding Climate Change* (GoG 2002) gives a figure of approximately 10 mm/yr. Whichever scenario is chosen, the result will be a reduction in the number of hours during which gravity drainage can operate, and a progressively increasing dependence on pumped drainage.

The figure of 4 mm/yr is recommended for design purposes for this project. However, all designs should also be assessed against a value of 7.2 mm/yr, the upper range of recent IPCC forecasts[4].

In addition, it is extremely important that Guyana re-establish an effective system for monitoring sea-level, which is essential to the planning of future coastal defence and drainage works.

2.3.4 Water Resources

(i) Region 3 - Boerasirie Conservancy

In both Regions 3 and 4, the conservancies are the dominant feature of the water resource system. However, inflows to the conservancies are not gauged. The inflow locations are in any case remote and would be difficult to gauge reliably because of variable backwater influences. Water level records do exist for both conservancies, but unfortunately are not accompanied by records of outflow or release. For planning purposes, conservancy inflow records were generated using a rainfall-runoff model, calibrated on catchments considered to be representative of the conservancy catchments.

Sediment inflow is not a significant problem for either conservancy. The catchments are well vegetated and water within the conservancies is sediment-free.

The Boerasirie Conservancy has a total catchment area of some 436 km^2 including the reservoir itself, estimated from 1:50,000 scale topographic mapping (an estimate of the catchment area made by Hutchinson in the 1950s was 404 km^2). The area of the conservancy at spillway crest elevation is some 254 km^2, i.e. over half of the total catchment area. Both the conservancy itself and the remainder of the catchment are heavily vegetated with grasses, sedges, and seasonally-flooded forest, and underlain by white sand deposits. Relief is very low, and the stream slope along the longest watercourse is of the order of 0.00023.

There is no evidence that the frequency with which Boerasirie Conservancy empties has been increasing. It is, however, likely that some loss of storage will have occurred through eutrophication.

In relation to supply, the simulation results indicate that Boerasirie Conservancy is capable of meeting the demands expected to be equalled in 20% of years with 94% reliability (there were only two failures in the 35 year simulation period). Even with the demands expected to be equalled or exceeded in 10% of years,

[4] *Guyana's National Vulnerability Assessment to Sea Level Rise* (EPA 2002) assumed a higher rise approaching 10 mm/yr, based on an earlier IPCC report.

the annual reliability of supply is still 97%. This indicates that Boerasirie Conservancy has sufficient capacity to meet the demands placed upon it with an acceptable degree of reliability.

In relation to structural integrity, embankment levels around the conservancy are not consistent, and in a number of areas there is very little freeboard. The lowest point on the embankment is 18.745 m, and the highest point is 18.898 m. At its lowest point there is only 60 mm freeboard above the spillway crest, and at its highest point only 214 mm (figures as reported by the Secretary to the Conservancy Board).

Modelling indicates that under present conditions the Boerasirie Conservancy embankment will be overtopped in low sections by very modest flood events. A 1-day 100 year flood would result in overtopping by as much as 60 mm. Overtopping of embankments does occur at present and Conservancy staff are aware of the problem.

With improved outlet facilities, the Conservancy would be capable of dealing with the 7-day 1000 year flood, but with no freeboard. It is considered that a combination of embankment raising and increased flood relief capacity is required, perhaps through the introduction of an additional gated structure linked to the 8000 ft weir.

It is clear that measures must be taken to improve freeboard in Boerasirie Conservancy as a matter of some urgency[5].

(ii) Region 4 - East Demerara Conservancy

The East Demerara Conservancy has a total catchment area of 582 km^2. This estimate is based on catchment delineation on 1:50,000 scale topographic mapping and compares with a figure of 518 km^2 estimated by Hutchinson in 1951. As with the Boerasirie Conservancy, the conservancy itself is a significant part of the total catchment area. At an elevation of 17.53 m, the reservoir area is some 335 km^2. The remaining natural catchment area is heavily vegetated and of low relief. It is not underlain by white sand deposits, and is likely to have a higher storm runoff than the Boerasirie catchment. The slope of the longest stream path is 0.00061.

The Conservancy was established to serve users between the Mahaica and Demerara Rivers by damming the flows of the Lama and Maduni Rivers and their distributaries. The Conservancy embankment is some 45 miles in length, with 27 regulators and 3 relief structures at Lama, Maduni and Land of Canaan.

The agricultural areas benefiting from the Conservancy include:

• Sugarcane	13,360 ha	(33,012 ac)
• Rice	2,553 ha	(6,309 ac)
• Orchards, coconuts, vegetables	10,370 ha	(25,626 ac)

[5] It has been suggested that the storage capacity of the conservancy could be increased by excavating channels through the savannah within it. This would not be cost-effective. Better irrigation system and on-farm water management practices would be a much cheaper and more effective method of securing supply than increasing the water storage capacity of the Conservancy.

In relation to supply, despite having a larger catchment area than the Boerasirie Conservancy, the East Demerara Conservancy has a significantly lower live storage capacity. Modelling indicates that the East Demerara conservancy can meet the demands expected to be equalled in 20% of years with only about 70% reliability. Demands associated with a drought expected in 10% of years could only be met with about 50% reliability.

A reduction in the navigation water use in sugar areas supplied from the conservancy would significantly improve the reliability with which demands can be met. The annual reliability of supply could then be increased to 91%, which would be a reasonable figure for irrigation.

However, the East Demerara Conservancy is also used to supply potable and industrial water demands in Georgetown. The reliability with which these supplies should be met is significantly higher than for irrigation, and generally one would expect potable water demands to take precedence. It is not known what operational criteria are used to ensure a reserve supply for Georgetown.

In relation to structural integrity, the embankment levels and freeboard around the East Demerara Conservancy are generally higher than on the Boerasirie Conservancy, but no survey has been located indicating what the levels are. Site inspection showed that a number of the wing walls of the head regulators are at an elevation of 18.278 m. If the top of the conservancy dam is consistent with these wing wall levels, then modelling indicates that there is about 400 mm freeboard during a 7-day 1000 year flood. It should be noted, however, that this assumes free flow conditions at all outlet structures.

Despite, or because of, recent work to heighten the dam, much of the embankment is unvegetated and subject to erosion. A breach of the dam in 2001 caused serious flooding in Cane Grove and the surrounding area (Davis *et al.* 2002).

(iii) Region 6 - Canje River

In Region 6, water resources are derived from the Canje and Berbice rivers. A total of some 52,700 ha of rice and sugar are irrigated from the Canje River. The total agricultural area is 68,400 ha, and the land use is as follows:

- Rice 41%
- Sugar cane 36%
- Other crops 5%
- Pasture 18%

Rice and sugar cane are irrigated by pumped abstraction from the Canje River, which is gauged at Kariakuri, where the catchment area is 1,139 km^2 and the mean annual flow is about 20 m^3/s. The Canje River does not, on its own, have sufficient resource to meet irrigation demands. It is augmented by water from the Berbice River through the Torani Canal. Storage does not exist on either river, and saline intrusion up the Canje River during periods of low flow is a constraint to abstraction. There have been many episodes during which pumps have had to be shut down.

For the purposes of a preliminary appraisal of the Canje water resource, the estimates of river flows and Torani Canal transfers made in earlier studies were combined with the water demand estimates carried out

for this project. The results confirm that there is clearly a water resource availability issue to be resolved in the lower Canje, a problem that has been known about for many years[6].

Further investigation of the water resources of the Canje Basin should be carried out as part of a regional water resources development plan, including re-establishment of elements of the hydrometric network in the basin, surveys of the Torani Canal and lower Canje, collection of pumping records, hydraulic modelling to determine the position of the saline front in the Canje under different tidal and abstraction conditions, catchment modelling of the upper Canje to determine this river's water resource, and finally surveys, monitoring and modelling of the lower Berbice to allow the potential impacts of diverting water to the Canje to be assessed. (**Appendix A3**)

[6] Recent water balance calculations by GUYSUCO for their Skeldon Expansion Scheme, using coefficients from earlier studies, indicate that "there is just sufficient water resources in a 1 in 5 Dry year to supply the Skeldon expansion (4700 ha), Crabwood Creek water users (3400 ha) and new sugarcane farmers (4000 ha)" (Merry 2003).

3 FARMER PARTICIPATION IN DRAINAGE & IRRIGATION

3.1 Introduction

3.1.1 Background

General

The commentary below is derived from the "Farmers' Participation Reports", included in the detailed feasibility study reports. The field work done to gather data for these reports – mainly rapid assessment work (RAW) but, to some extent, the Baseline Surveys also - was done before Group Promoters had become fully established in the different project areas. Indeed, in some cases field work had to be done entirely without the benefit of GPs' support. As a result there was a general lack of understanding of the purpose of the project, and the part farmers would be expected to play in it. This problem was overcome to some extent with the distribution of a "Project Overview" sheet prepared for the purpose, and through the focus group discussions and other meetings that took place. However, there is still a long way to go along the "awareness path". The text below should be read with this fact in mind. With greater understanding of the project, some issues may reduce in importance. Equally, new issues will undoubtedly arise, and flexible, integrated mechanisms to deal with them will be required.

Group Promoters

Group Promoters are doing sterling work, but there is much more to be done. The "message" – not only of ASSP in all its facets, but also of the links between land tenure regularisation (LTR) and the medium/long term development of agriculture - is not yet being heard loudly or widely enough. GPs will be fully occupied as the linkages between ASSP components and LTR are developed, particularly when D&I rehabilitation is complete, and improvements in agriculture can start in earnest. Their role will evolve from the current one of facilitating WUA formation to co-ordinating specialists' work in training and extension. Their experience must not be lost. They have much still to do and to contribute.

3.1.2 Socio-Economic Baseline

A socio-economic profile has prepared for each of the nine areas, based on an extensive household questionnaire. **Tables 3.1, 3.2** and **3.3** below provide summary socio-economic profiles of the project areas in each Region. Full details, including explanations of data discrepancies, are available in the *Baseline Survey* Appendix of each of the nine *Detailed Reports*, one per project area. The survey was based on a 5% to 10% sample of the estimated number of households in each project area. The total population of each project area can be estimated from the mean household size found in the surveys and the number of households reported by NDCs. However, the actual population resident in each area remains uncertain since there is no census data later than 1991.

Issues

The raw statistics in the tables are interesting and provide a statistical baseline for future monitoring, but by themselves cannot paint a full picture of life in the polders. Special issues noted in the Baseline Survey reports are:

- *Poverty and exclusion*: farming households have a lower standard of living than non-farming households; there is an almost complete absence of any systematic government extension service for crop and livestock farmers.
- *Health*: diseases associated with poor hygiene and sanitation are very common in rural areas; the incidence of ill-health due to exposure to agrochemicals is shocking: in Lots 52-74 41% of respondents reported recent ill health in the family due to agrochemicals, most commonly skin rashes.
- *Power structures*: NDCs are perceived to be controlled by influential people and to work in their interests rather than those of small farmers; there is widespread concern that WUAs would be even less accountable than NDCs.
- *Gender differentiation*: the inequitable power structure extends to women, who are almost entirely absent from representation in NDCs; women seldom attended focus group discussions; women have extremely heavy work loads, partly but not entirely due to the absentee father syndrome.
- *Illegal manipulation of the lease situation prior to land tenure regularisation (LTR):* survey respondents in at least one area reported that larger, influential farmers had illegally obtained control over up to 80 ha of land prior to LTR and the transfer of leasehold to freehold
- *Illegal consolidation and expansion of farm holdings:* the process of land accumulation by larger farmers by renting land (often against the terms of leases) from smaller farmers who are in debt due to costs of production of rice being above farm gate receipts; the smaller farmers may be intimidated in this process, sometimes through the vandalising of hydraulic structures and/or fences.
- *Conflicts:* in addition to the unfair power play between large and small farmers, there are conflicts between farmers and cattle owners, and in a few areas between crop farmers and fish farmers concerning water supply, water quality and drainage; grazing areas often flood or dry out, in both cases resulting in pressure for cattle to move onto cropland; this process can turn violent: it was reported that four persons opposed to ranchers died violently in Crabwood Creek a few years ago; the murders remain unsolved.

Note: The Baseline Survey results can usefully be compared with the findings of the wider socio-economic survey carried out for the Guyana Land Administration Support Programme in 1998 (GLASP 1998).

Solution Over Time

Issues such as these cannot be settled overnight, and certainly not directly by outside intervention; but a comprehensive legal framework, training and support services will certainly be necessary to achieve solutions. Establishment of strong civil society organisations, such as WUAs, is the only way to mitigate such conflicts.

One side of the argument holds that : *"WUAs can't be set up in such adverse circumstances."*

The other side counters with: *"The issues can only be resolved, over time, by community organisations like WUAs."*

Our experience favours the latter.

Table 3.1 Region 3: Summary Socio-Economic Profiles

	Region 3			
	Verg/Bonasika	**Den Am/F'ship**	**VeH/La J'ousie**	**Canals Polder**
Mean Household Size	-	-	4.5	6
Reported No. of Households	840	320	1,500	1,359
Reported Population	1,300	-	-	5,436
Population estimated from Household Size	-	-	6,750	8,154
Ethnicity:				
Afro-Guyanese	21%	69%	3%	9%
Indo-Guyanese	64%	16%	97%	90%
Primary Income:				
Farming	51%	41%	82%	76%
Non-Farming	49%	59%	18%	24%
Female-Headed Households	6%	22%	3%	49%
Mean Farm Size (ha)	10.6	3.2	2.7	4.4
Farmers with:				
Abandoned Land	12%	22%	21%	52%
Irrigation Problem	71%	57%	33%	38%
Drainage Problem	68%	68%	92%	82%
Salinity Problem	26%	-	21%	21%
Access Problem	50%	41%	26%	50%
House Ownership	82%	84%	72%	77%
Household Water Supply	97% piped	100% piped	95% piped	97% piped
Electricity	88%	88%	97%	96%
TV	91%	78%	97%	84%
Sewage:				
Pit latrines	39%	56%	26%	60%
Septic tanks	61%	44%	74%	40%
Ill due to pesticides	21%	16%	31%	16%

Table 3.2 Region 4: Summary Socio-Economic Profiles

	Region 4	
	Golden Grove/Victoria	**Cane Grove**
Mean Household Size	-	6.5
Reported No. of Households	1,500	700
Reported Population	-	-
Estimated Population	-	4,550
Ethnicity:		
Afro-Guyanese	87%	-
Indo-Guyanese	11%	100%
Primary Income:		
Farming	44%	83%
Non-Farming	56%	17%
Female-Headed Households	16%	13%
Mean Farm Size (ha)	2.1	12.8
Farmers with:		
Abandoned Land	84%	17%
Irrigation Problem	56%	29%
Drainage Problem	68%	90%
Salinity Problem	29%	17%
Access Problem	36%	54%
House Ownership	64%	68%
Household Water Supply	80%	100%
Electricity	89%	95%
TV	82%	88%
Sewage:		
Pit latrines	73%	42%
Septic tanks	27%	58%
Ill due to pesticides	3%	27%

Table 3.3 Region 6: Summary Socio-Economic Profiles

	Region 6		
	Black Bush Polder	**Lots 52-74**	**Crabwood Creek**
Mean Household Size	4.4	5.2	4.1
Reported No. of Households	750	1,125	1,125
Reported Population	-	-	-
Estimated Population	3,300	5,850	4,613
Ethnicity:			
Afro-Guyanese	1.5%	7%	-
Indo-Guyanese	98.5%	92%	100%
Primary Income:			
Farming	79%	87%	78%
Non-Farming	21%	13%	22%
Female-Headed Households		3%	7%
Mean Farm Size (ha)	7.5	26.8	11.5
Farmers with:			
Abandoned Land	36%	29%	78%
Irrigation Problem	41%	39%	78%
Drainage Problem	94%	29%	51%
Salinity Problem	58%	29%	69%
Access Problem	58%	22%	45%
House Ownership	71%	66%	73%
Household Water Supply	91%	86%	97%
Electricity	49%	96%	95%
TV	56%	86%	90%
Sewage:			
Pit latrines	74%	38%	60%
Septic tanks	26%	62%	38%
Ill due to pesticides	18%	41%	32%

3.2 Water Users' Associations

The feasibility study has involved a specific, preliminary investigation of farmers' interest in participating in water management using participatory rural appraisal (PRA) techniques. The results are reported in the nine *Detailed Reports* for each project area, and an overview included in the *Feasibility Study of Principal Area: Main Report* (December 2003) and *Feasibility Study of Six Areas: Main Report* (March 2004).

Key points made by farmers during the investigation include:

- Services have to be improved before farmers will pay for them.

- For WUAs to be viable the legal framework requires improvement, specifically to enable WUAs to function as legal entities and to establish larger financial penalties for breaches of Association regulations,
- WUAs should focus on maximising agricultural use of occupied land, hence the need for land tenure regularisation.
- WUAs will need extensive capacity building and training in accounting, record-keeping and leadership.
- All stakeholders must be represented.
- It will be difficult to harness the big farmers and make them respect the Association's rules, especially given the history of illegal amalgamation of land over the years.

Key conclusions were:

- There is widespread expectation that government (the NDIB and councils) should provide D&I services, combined with near universal dissatisfaction with the level of service provided.
- Current levels of understanding of potential WUA responsibilities and implications are low; extensive awareness and information work is needed before farmers can make informed decisions.
- LTR is a pre-requisite for successful WUA formation and operation, but in some areas (e.g. Den Amstel/Fellowship and Golden Grove/Victoria) the lease situation is chaotic. The timing of LTR take-up is a subject for review (**Section 3.11**).
- There is little understanding of the link between LTR and D&I rehabilitation, or the relationship between the newly-increased GLSC annual land lease fees, NDC charges and D&I rates.
- The current changing patterns of land use, scale of operations and emigration, combined with land grabbing by powerful farmers, vested interests, and patron-client relations between large farmers and NDCs, will make it difficult to form and sustain WUAs.

3.3 Awareness of the ASSP

General knowledge about the programme and WUA establishment is still weak. Farmers, and NDC staff, wish to learn a lot more about what ASSP actually entails for them and their area before making firm commitments on WUAs.

Current initiatives by the GPs to work together and use various media to transmit their messages are encouraging and commendable. The GPs are trying their utmost to build public understanding and consensus for the project, and of the need for inclusion of WUAs as a focus for farmer-management of D&I. However, dissenting elements have arisen in some project areas, making their task much more difficult. Vested interests, promoting negative messages, would prefer the *status quo* to remain, with infrastructure continuing to be provided "free" by government – a situation much preferred by rent-seekers.

Without a strong message that "the world has moved on" there is a risk that such dissenters will prevail, prejudicing the outcome of the project.

A concerted media campaign to create awareness of ASSP would be invaluable in overcoming this major issue. The campaign could be combined with another on the importance of land tenure regularisation to successful improvement of D&I and the formation of WUAs

3.4 Formation of WUAs

A programme to form Water Users' Associations (WUA) is underway. By early July Delegation Agreements had been signed for all nine project areas. Efforts were made to involve these fledgling organisations in the preparation of tender designs for the contract bidding documents. However, the time available for this process was extremely limited. In any event, it will be essential to ensure that the WUAs are involved in the final designs that will be eventually be prepared for construction purposes. This will enable them to become fully involved in the project cycle, for the management, operation, maintenance and evaluation parts of which they will be responsible. Once they have contributed to the final designs, they could then take part in the construction supervision/quality assurance stage of the project, prior to taking over the D&I works for operation. (See **Appendix F**)

3.5 WUA Capacity Building and Strengthening

3.5.1 General

Almost without exception, the farmers consulted during the RAW said that, for a WUA to be feasible, they would need extensive capacity building and training in, for example, accounting, record keeping, and leadership. The necessary training should be provided as part of the WUA support programme during implementation of the project.

Integrating the WUAs into the project implementation management process, and agriculture extension, is a powerful institution strengthening tool, particularly if the Farmers' Field School (FFS) mechanism is used (**Section 3.7**). However, it is advisable that provision for the essential support and training inputs is made within the construction management team itself, in order that integration is as complete as possible. Each WUA will have different needs. The building of capacity and confidence through a steady process of aiming for, and achieving, "little victories" has been found to be most effective.

3.5.2 Multi-Disciplinary Approach

The objective of the IFSR is to contribute to future stages of ASSP.

It is clear from **Sections 3.2, 3.3, 3.4** and **3.5.1** that much remains to be done before farmers are in a position to make a reasoned assessment of what GDISRP, WUAs, and the other components of the ASSP could mean to them and their farming activities. They are well aware that they need help to get to grips with the management and administration involved, and are looking for support. In addition, they do not have sufficient information on the rationale and process of LTR to be able to factor it into the overall picture, which must also involve D&I rehabilitation, institutional reform and improved agriculture

extension. This foggy state of affairs is neither in the best interests of the farming community, nor of the nation as a whole.

However, as is usually the case, a problem provides the opportunity to introduce a new way of doing things. We suggest the establishment of "live" links, both within the project between the WUA building process and planning/implementation of the proposed rice research and extension programme, and – outside the project - with the on-going LTR process. Such linkages would serve to establish, in the minds of farmers, the overall context in which they are being asked to support and pay for D&I rehabilitation, and so strengthen their commitment to the success of the "hardware" component of the ASSP. ***This***, we should recall***, is why the ISFR has been specified in our TOR!!***

A positive approach to D&I rehabilitation, WUA formation and payment of D&I fees would be encouraged, and the advantages to be gained from secure land tenure would become clearer, encouraging lease and title take-up. From a resource management point of view, financial savings would also be possible, if the WUA administrative infrastructure were to be used. However, a considerable degree of political and administrative commitment, supported by strong management, would be necessary to achieve such a comprehensive strategy – a major challenge.

3.6 Inclusion of All Farmers

It is apparent that there is often a distinct area of conflict between the larger and smaller farmers, with the smaller farmers often feeling excluded and marginalised – and physically intimidated in some cases. Some of the participants in FGDs said that an organisation like a WUA would be important for the smaller farmers because they cannot afford to do D&I works themselves but depend on them being done. This is a universal issue in the formation of WUAs, and can only be dealt with by slowly and patiently building up a sense of confidence and self-worth among the smaller farmers, so that they are able to have their views recognised.

On the other hand, big farmers often do not depend on the smaller ones for communal D&I work, because they can do the O&M work themselves (or have the influence in current conditions to get it done), and by implication would not necessarily be motivated or interested to participate positively to the working of a WUA in the community. However, with D&I of secondary systems devolved to project area level, it will be essential for a consensus to be reached between large and small farmers on the best way to raise funds. Once more, a slow and careful process – facilitated by fully supported GPs – is necessary.

3.7 Agriculture Extension

Farmers, without exception, feel let down by the extension services. They are aware that agricultural techniques (particularly for rice) must, and can, be improved, but have no means of finding out how to do it. In this context the proposed Rice Research and Extension Action Plan (RREAP) would be invaluable.

Another excellent reason for including an agricultural extension component is that, properly managed and directed, extension can be used as a very effective WUA strengthening tool, using Farmers' Field Schools - which are already employed by GRDB and GRPA in their joint extension interventions. Work on multi-

disciplinary FFSs in Nepal in 2002-2003 demonstrated that, by first engaging farmers in an activity that is of great interest and importance to them (improving the standard of agriculture, in that case), the rather abstract subject of WUAs, and how they can be strengthened and operate in the best interests of their members, was given an entry-point. The meaning and relevance of LTR, and its importance to the future of farming, could equally well be introduced.

This experience is summarised in an article by Davey[4], which is included as **Appendix G** to this report, and was made available to the GRDB and MoA early in this consultancy. Though the conditions are different in Guyana, the principles remain valid. As discussed in **Section 3.5.2**, farmers currently do not have an understanding of what is available to them – now and in the near future – to help them to improve their agriculture and livelihoods.

3.8 Women Group Promoters

No woman GP has been selected, though up to 50% (Den Amstel/Fellowship) of farmers are women. In most project areas the percentage is lower. Nevertheless, it is very important to include women in the WUA building process. Women would probably be more likely to come forward for training in WUA management and ASSP project training sessions, for example, if a female role model were available as a GP.

3.9 The "Dependency Syndrome"

It is always very difficult for farmers to make the step-change from *"government plans and provides services"* to *"we plan and provide our own services"* Observing the poor or non-existent maintenance carried out by government agencies never seems to make the transition any easier, and there is resistance to the change process. Many factors play a role in this "dependency syndrome", among which are lack of community organisation, a feeling that they themselves are not capable of organising MOM, that "the system" will not allow them to do it; and above all, perhaps, the fear of the unknown. It must be said that the dependency syndrome is common world-wide, where government (for whatever reason) has become unable to fulfil its commitments.

This is yet another issue that requires time, patience and persistence, and continuous support as the young WUAs grow more confident. Once more "little victories" have to be planned for and achieved, to convince farmers that they are, indeed, perfectly capable of managing their own D&I system. Some of the ways in which this can be done are pointed out above. A full institutional development plan would deal with all these things, and others, in much more detail; and would be linked to the D&I rehabilitation implementation programme.

[4] Davey, Robert (2002) *Joined Up Irrigation in Sunsari Morang Irrigation Project – the Story So Far* (Article for UK ICID News & Views)

3.10 Rice-Cattle Conflicts

In some project areas the shortage of grazing has resulted in conflicts between rice farmers and cattle owners. The paradox is that most rice farmers also own cattle! However, the problem is very much one of land use management, and could be resolved through an institution like a WUA. In order to help with the physical aspect of the issue, allowance has been made in the planning of D&I infrastructure rehabilitation, where possible, for improvements to pasture drainage to give greater carrying capacity. This will also help a little with the diversification of agriculture, which is seen to be essential by GoG.

3.11 Land Tenure

Insecurity of land tenure can adversely affect farmers commitment to an efficient and sustainable D&I system. Experience in the project areas has shown that farmers holding some or all of their land under sub-leases are less likely to be involved in MOM of D&I, except in emergencies. The contention is often that they are already paying the landlords. To this end, the Guyana Lands and Surveys Commission (GLSC) Land Tenure Regularisation (LTR) programme is commendable. However, there still seems to be an urgent requirement to educate farmers about the need to acquire secure leases (or freehold ownership), as many currently perceive the cost to obtain their freehold titles as prohibitive and "*another cost they have to bear*".

A target of 80% LTR has been set for the ASSP. It is not the role of this report to judge whether this level of take-up is either realistic or necessary. However, it must be said here that land-holders in general do not have the information needed to enable them to make a judgement on whether or not to up-lift their lease or title. Moreover, until farmers understand how LTR will also benefit them if it is linked with the ASSP interventions, take-up is likely to be low. In these circumstances it would seem wise to reduce the target below 80% in the expectation that up-take will accelerate once the overall picture is understood.

It is understood that the intention is that the person farming the land will have to pay the D&I fee, not the leaseholder or land owner. In theory this should overcome the problem of who has the legal right to use the land. However, in practice any remnant of uncertainty will work against the smooth operation of WUAs and the systems they manage.

It would probably, for example, be necessary for farmers to renegotiate their contract with the leaseholder/ land owner, which may not be a straight forward process. Again it may be difficult to sanction a non-payer of D&I rates if he is not the title holder of the land he farms, particularly if the ultimate sanction is to be repossession. It is situations such as this that have to be covered by appropriate specialist legislation.

In the ***Den Amstel/Fellowship*** project area plot size is very small (0.5 to 10 acres), and farming is mostly done on a part-time basis. Many of the land owners/leaseholders are living abroad. In the context of a chaotic land tenure situation this very much inhibits community involvement and WUA formation.

Most of the land in the ***Golden Grove/Victoria*** project area is already freehold (90%, it is reported) and so LTR is not planned. However, the area is a mix of small/medium plots (0.5 to 30 acres), and large farms (200 to 1,000 acres) – parts of which are now being let out in small parcels. Many landowners live abroad, and just over half the households are non-farm. In spite of their great commitment and energy, the GPs

will have a very difficult task in front of them to establish a workable WUA, and will require intensive support from all levels.

3.12 Legal Framework

In general, all farmers feel that there is a need for a solid legal framework to ensure that WUAs can function effectively. The direct experience in the Den Amstel/Fellowship project area is instructive here. In 1996 the area became one of the first in the country where an attempt was made to devolve power for MOM of D&I to water users. This effort failed for a number of reasons that were said to include the absence of an enabling legal and institutional environment for WUAs in the country. The 1999 D&I Bill was enacted in May 2004. This consolidates earlier statute and amendments, but WUA specific legislation is still required. It is understood that this is under active consideration by GoG. For reference, an outline of the Andhra Pradesh (India) legislation is given in **Appendix E**.

Note: There exists specific legislation exempting the Cane Grove LDS from payment of land taxes or from paying realistic D&I fees. Until the necessary measures are put in place to allow setting and collection of D&I rates by a WUA, it is difficult to anticipate any subsequent effective farmer MOM of the Cane Grove project area.

3.13 The Younger Generation

Substantial areas of land have been abandoned in Den Amstel/Fellowship, Golden Grove/Victoria and Crabwood Creek. Many among the existing generation of farmers would like to bring this land back into production, but it is an open question as to whether the younger generation would wish to continue in farming. This is an especially pertinent question in Den Amstel/Fellowship and Golden Grove/Victoria where plot sizes are small and/or land is not suitable for large scale rice farming. However, in Crabwood Creek farmers are used to the idea of large scale farming – much expensive agricultural equipment has been lying idle since rice farming ceased for lack of water. Here it seems that there may be a good chance of a transition into rice farms large enough to provide economies of scale.

4 MANAGEMENT, OPERATION and MAINTENANCE

4.1 Introduction

The Terms of Reference (Clauses 4.3.4 and 4.3.5) require a report recommending a model for allocation of O&M costs, and a report on O&M budgets for each project area. In addition Clause 5.6 - O&M Engineer, requires a review of existing and planned O&M practices for D&I systems in Guyana, and a review and update of the O&M schedule and costs estimate produced by NEDECO in March 2000[7]. This chapter covers these items.

The term O&M used in the Terms of Reference has been broadened to MOM - management, operation and maintenance - in order to reflect the important role that management plays in the organisation and running of D&I systems.

4.2 Current Management, Operation and Maintenance Practices

Management, operation and maintenance practices for Declared D&I systems have been studied in the nine feasibility study schemes, and also to a limited degree in one or two GUYSUCO estates. The purpose of visits to the GUYSUCO estates was to obtain information on operation and maintenance procedures and costs, for comparison with those used in the nine schemes. Detailed information on the MOM practices and costs for each scheme are provided in the nine feasibility study reports.

4.2.1 Overview

Drainage and irrigation are essential for productive agriculture in the coastal strip of Guyana, with the primary emphasis being on drainage. The need for drainage places significant additional burdens on the costs associated with irrigated agriculture.

Of the nine schemes studied, seven are supplied with water from conservancies, whilst for two schemes irrigation water is pumped from the Canje river. The conservancies play an important role in flood protection, and also act in two ways for irrigation - storing water for use as required, and heading up the water to provide gravity supply.

4.2.2 Management

Under the Principal D&I Act (Revised in 1977) the management, operation and maintenance of Declared D&I schemes was the responsibility of the Hydraulics Division of the Ministry of Agriculture. Under the Transfer of Functions Act 1983 the law was changed and responsibility for D&I was devolved to the RDCs and the NDCs. The central board was disbanded and all powers to set and collect D&I rates, and to

[7] Schedule and Cost Estimate for Operation and Maintenance of Guyana's Drainage and Irrigation Infrastructure, NEDECO, March 2000.

enforce laws was passed to the RDCs. A system developed whereby the NDCs collected the D&I rates and passed these on to the RDCs. With the 1994 D&I Amendment Act, the 1983 Act was repealed, and NDIB was re-established as the responsible agency under the Ministry of Agriculture to set and collect D&I rates, and enforce laws related to D&I. The 1995 Policy Directive recognised the potential problem facing NDIB in the case of an immediate transfer and allowed for a gradual transfer of functions back from the Regions. Unfortunately, this transfer period is still in effect, with many of the D&I functions still being carried out by the RDCs and NDCs, with some support from NDIB. The law has recently been revised again, with the passing of the 1999 D&I Bill into law, to allow for the formation of water users associations, and to form the NDIB into the NDIA.

The NDIB has been seriously weakened by these changes, and has lost experienced staff in the process. NDIB's difficulties were exacerbated in 2001 when its offices were burnt down and a considerable amount of its archives and records were lost. To date the NDIB has been housed in temporary accommodation within the Ministry of Agriculture compound.

The current organisational structure for the MOM of the D&I systems in Guyana is outlined in **Figure 4.1**. The current staffing levels for NDIB are presented in **Table 4.1**. As can be seen from **Table 4.1** the NDIB is currently a relatively small organisation, with severe staffing constraints. The Chief Engineer position is filled by a consultant engineer who has been in place for a period of 1 year. Several other positions are unfilled, or filled by appointment of acting staff from more junior positions.

Currently the RDC is the organisation most closely involved in the drainage and irrigation systems at field level. The RDC Regional Engineer (RE) is responsible for operation and maintenance of the D&I system. Each year the RE prepares a budget for O&M of the D&I systems, which is submitted through the Regional Executive Officer (REO) and RDC Chairman to the Ministry of Agriculture. The Ministry then allocate funds to each RDC, with a specified allocation for O&M. This allocation is often less than the sum requested in the budget (**Table 4.2**).

The Regional Engineer has responsibility for all infrastructure works within the Region, covering D&I, roads and buildings. He is generally a civil engineer, with a broad rather than specific understanding of drainage and irrigation. Reporting to the Regional Engineer are the Senior Superintendent of Works (SSOW), the Superintendent of Works (SOW), the Overseers and the Rangers. Sluice and pump station operators report to the Overseers through the Rangers.

Table 4.1 NDIB Staffing (November 2003)

Category	Approved position	Position filled (No.)	Position vacant (No.)	Remarks
Senior Management	Chief Executive Officer	1		
	Secretary to the Board	1		
Administration	Office Manager	-	1	Senior Finance Officer acting in this position at present
	Confidential Secretary	-	1	1 No. typist/clerk acting in position
	Procurement Officer	1		
	Computer Operator	1		
	Typist/Clerk	5		1 No. acting as Confidential Secretary; 1 No. acting as Accounts Officer II
	Documentation Officer	1		
	Office Assistant	1	1	
	Storekeeper	2		
Accounts Division	Senior Finance Officer	1		
	Accountant	-	1	1 No. person acting in position
	Assistant Accountant	1		Acting as Accountant
	Accounting Officer II	2	1	1 No. acting as Assistant Accountant 1 No. Clerk acting as AOII
Engineering Division	Consultant Engineer	1		
	Senior Section Engineers	-	2	
	Section Engineers	-	2	
	Engineers	8		
	Site Engineers	-	2	1 No. Technician Engineer acting in position
	Inspector of Works	4	1	1 No. Field Foreman acting in position
	Assistant Draughtsman	-	1	
Maintenance Division	Heavy Equipment Operator	5		1 No. salaried, 4 No. daily paid
	Serviceman	6		Daily paid
	Foreman Mechanic	1	1	
	Welder	1		Daily paid
Support and security	Vehicle drivers	7		
	Security Guards	23		3 No. salaried, 20 No. daily paid
	Cleaners	1		
Summary				
	Professional engineering staff	10		
	Administrative support staff	16		
	Technical support staff	17		
	Drivers, watchmen, etc	31		
	Total	74		

Source: NDIB

Table 4.2 Capital and Recurrent D&I Budget for 2003 – Regions 3, 4 and 6

Location/Budget	Amount requested Million G$	Amount allocated Million G$	Percentage allocation to request	Amount allocated per unit area G$/acre
Region 3				
Capital	156	29.5	19%	436
Recurrent	78	75.2	96%	1111
Total	234	104.7	45%	1547
Region 4				
Capital	83	12.6	15%	395
Recurrent	176	47.0	27%	1472
Total	259	59.6	23%	1867
Region 6				
Capital	70.5	65	92%	642
Recurrent	125.4	70.4	56%	695
Total	195.9	135.4	69%	1337

At the local level the D&I system is supported by the NDC, with some NDCs providing more support than others. Lots 52/74 and Vreed-en-Hoop/La Jalousie, for example, provide very strong support to the D&I sector, and are performing functions very similar to those proposed for Water Users Associations. NDC staffing generally comprise a Chairman, Overseer, Assistant Overseer, Superintendent of Works, Rangers and possibly labourers. Some NDCs have mechanical plant and equipment and will therefore also have plant operators, drivers and mechanics.

The NDCs are often charged with the responsibility for collection of the D&I rate, though here again there are variations in practice. In Canals Polder the D&I fee is incorporated in the Land Rent, with 20% of the sum collected being allocated to D&I works. In Vreed-en-Hoop/La Jalousie the NDC make direct charge for D&I charges, whilst in Blackbush Polder no D&I fees are charged (**Table 4.3**)

Table 4.3 Examples of Fee Collection Procedure, Amount and Recovery Rate

Scheme	Collection procedure	Fee rate (G$/acre)	Reported fee recovery rate (%)	Remarks
Canals Polder	20% of Land Rent	89	80%	Money paid into the NDC bank account with the RDC, but retained for use within the NDC
Vreed-en-Hoop /La Jalousie	Direct charge	2500	70-80%	Money paid into the NDC bank account with the RDC. 22% deducted by RDC to contribute to O&M of the primary systems.
Blackbush Polder	No charge made	n/a	n/a	O&M on the Black Bush Polder scheme is totally subsidised by Government, with no contribution from farmers. This is counter-productive for farmers as the level of service and maintenance is extremely poor relative to Vreed-en-Hoop and Lots No.52/74

Two conservancies are of interest for the project – East Demerara Conservancy supplying irrigation schemes in Region 4, and the Boerasirie Conservancy supplying irrigation schemes in Region 3. Both conservancies are managed by a Conservancy Board, formally constituted under acts of Parliament – see **Appendices A1** and **A2**.

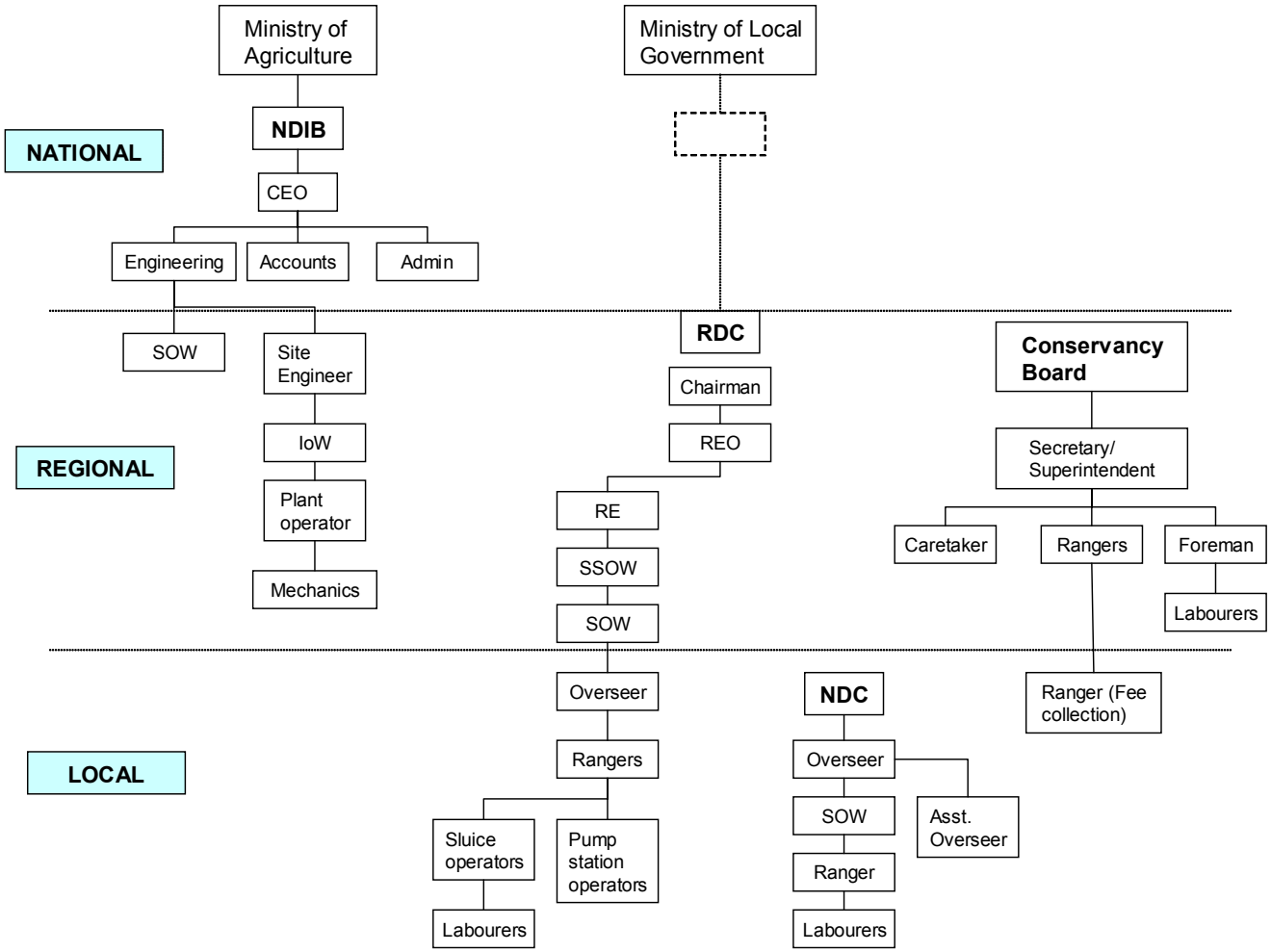

Figure 4.1 Current Organisational Structure for MOM of D&I Systems

Boerasirie Conservancy has four Board members and a Secretary/Superintendent who is responsible for implementing and overseeing the decisions of the Board. Under the Secretary/Superintendent there are a foreman and labour team, and a number of Rangers who look after and operate the sluices and carry out maintenance inspections of the Conservancy dam. In addition one or two Rangers are deployed in liaising with defaulters on fee payment, a practice that has proved successful in raising the level of fee recovery in recent years.

East Demerara Water Conservancy (EDWC) has eight board members and a Secretary who is in charge of the day-to-day management, operation and maintenance of the Conservancy. The Secretary has a staff compliment comprising 1 Superintendent, I Foreman, 14 Rangers 2 machine operators and 2 boat operators. The Conservancy Board collects fees from water users, with a fee collection rate of around 84% (though the majority of this comes from GUYSUCO and Guyana Water Incorporated (GWI - potable water supply). The fees are computed on the annual management, operation and maintenance costs of the Conservancy and significantly higher than those charged by the Boerasirie Conservancy (**Table 4.4**).

Table 4.4 Water Fees Charged by Boerasirie and EDWC

Item	Boerasirie water fees (G$/acre)	EDWC water fees (G$/acre)
Sugar cane	185	600
Rice	100	400
Mixed/cash crops	33	400
GWI	N/a	2.6% of total budget

4.2.3 Operation

The operation of the irrigation systems in Guyana is reasonably straightforward, with relatively simple system layouts and control structures. There are two main types of layout, as presented in **Figure 4.2**. In Case (b) the length of the drainage channels is almost double than in Case (a), and has significant implications for maintenance costs, as will be discussed later. There are control structures (head regulators) at the intake to the secondary canal and at the intakes to each of the irrigated field plots. In some systems the secondary canal head regulators are gated, in others they are simple stop log structures. Intakes to the irrigated field plots are also either gated or fitted with stop logs. The ends of the secondary canals are either closed off with earth bunds, or with gated or stop logged tail escape structures.

Due to the extremely flat topography the operational procedures for these irrigation systems are, in principle, relatively straightforward. Irrigation water is let into the secondary canal, ponded at design water level and then released into the irrigated field plots. In some cases intermediate check structures are required on the secondary canals to pond the water in reaches.

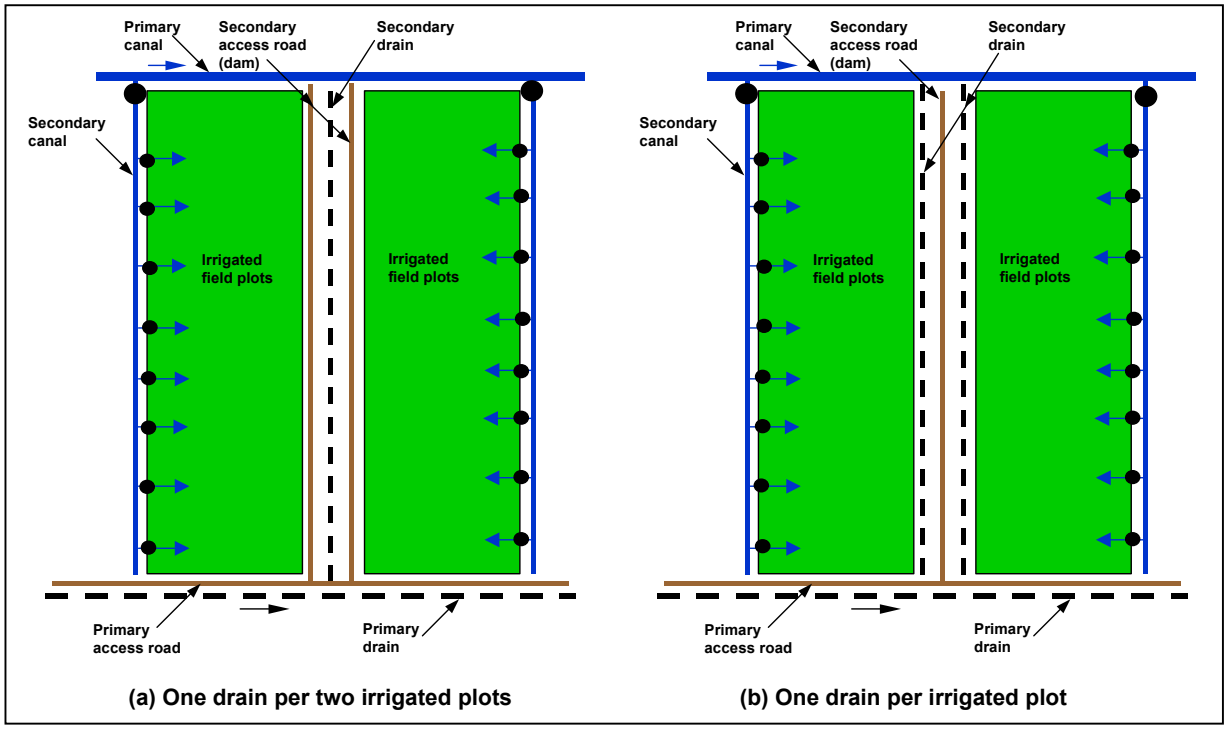

Figure 4.2 Different Types of Field Layout within D&I Systems

It is in this operational context that some systems, such as Black Bush Polder, are failing. Farmers are having to pump irrigation water from the secondary canals into their fields using tractor mounted pumps, because the design water level cannot be maintained in the secondary canals. There are three potential causes of this situation:

(a) The secondary canal tail escape is damaged, water is leaking from the tail and water cannot be ponded;

(b) Farmers are taking water out of the secondary canal onto their fields quicker than it is coming in;

(c) Insufficient head is being maintained in the primary canal (and thus in the secondary canal), to raise the water level to design water level.

The solution for situation (a) is to repair the tail escape so that it doesn't leak. For situation (b) and (c) an irrigation schedule has to be prepared, and agreed to by all farmers, to rotate the available irrigation supplies to sections of the irrigation system. This process enables a matching of supply and demand in that section, such that the primary and secondary canals design water levels can be maintained and irrigation water supplied to the irrigated plots under gravity flow. Significant savings can be made by the farmer not having to pump water from the secondary canal. **Table 4.5** shows data collected in Black Bush Polder from farmers who currently pump water onto their fields. This expenditure is significantly more that the G$871/acre/season pumping costs at the main canal intake.

Table 4.5 Pumping Irrigation Water onto Fields (Data from Black Bush Polder)

Farmer No.	Area	Days pumped	Duration of pumping	Total hours pumped	Total hours pumped per unit area	Total reported fuel consumed	Total cost	Total cost per season per unit area
	(acres)	(days)	(hrs/day)	(hours)	(hours/acre)	(gals)	(G$)	(G$/acre/season)
1	45	18	10	180	4.00	180	86,400	1,920
2	15	5	24	120	8.00	120	57,600	3,840
3	15	15	12	180	12.00	180	86,400	5,760
4	27	14	24	336	12.44	336	161,280	5,973
5	100	-	-	160	1.60	160	76,800	768
							Average	**3,652**

Notes:
1. Diesel fuel cost G$480/gal
2. The variation in cost per unit area may be partly accounted for by the variation in the lifting height

Cultivation of irrigated crops takes place mainly in the two wet seasons (November/December and May/June) so that irrigation is supplementary to rainfall. Continuous flow is therefore not required in the canal system. When irrigation water is required the farmers pass their requirements to the NDC who in turn pass them on to the RDC and/or the Conservancy. Irrigation water is then provided (by opening the conservancy outlets or pumping from the river) for a stated period, with farmers taking water as they require within this period. Only in Vreed-en-Hoop/La Jalousie is there an organised irrigation schedule, with all farmers knowing which days and hours they are able to take water. Other irrigation schedules have been in place in the past, such as in Black Bush Polder, but have fallen into disuse.

In contrast to many irrigated agricultural systems worldwide, operation of the drainage system in Guyana is often more complex and more important that operation of the irrigation system. Drainage water has to be removed to prevent loss of crops, and to prevent flooding of residential areas. As the general level of the land in the coastal strip is below sea level water has to be ponded in the drains until a falling tide when the sea water level is lower and the sluice gates can be opened to discharge the drainage water. As the tide rises so the sluice gates have to be closed. There are two tidal cycles in a day, with the tide timetable shifting during the year. The duration of sluice gate opening depends on the location, but generally ranges between 7-12 hours per day. In some cases the drainage water has to be pumped, either to supplement the discharge escaped through the sluices or instead of discharging through the sluices. Serious problems occur where the discharge through the sluices is impeded due to build up of sediment deposits[8] on the downstream side of the sluice. Measures to remove this sediment include excavation with a dragline or dredger, or using the drainage waters to flush the downstream channel.

The water demand and water use by the GUYSUCO sugar estates has an impact on the water supply situation in neighbouring schemes. A unique feature occurs on the GUYSUCO sugar estates is the use of irrigation canals for navigation, with the water ponded at high levels in the canals to maintain navigation for the barges used to transport cut cane from the fields to the factory. Thus sugar estates have two main

[8] This is an ongoing, natural process, the coastal plain of Guyana has been formed by the deposition of sediment carried down from the hinterland by the Berbice, Demerara, Essequibo and Corentyne rivers.

needs for water, firstly to maintain the water levels in the irrigation/navigation channels, and secondly for periodic wetting up and flooding of cane fields. Water is rarely used for irrigation; the cane crop obtains sufficient water from rainfall and to some degree from groundwater. In this context GUYSUCO is not therefore competing with the rice farmers during the rainy seasons. At the end of the ratoon period cane fields are ploughed and then kept submerged under water for a period of 6 months, this process increases the soil fertility by breaking down the organic matter under anaerobic conditions. Due to the generally high clay content the soils are highly impermeable, so the seepage losses from the irrigation/navigation canals and the ponded fields are relatively small. Nevertheless supplies are needed to replenish the losses that there are, and to flood new fields.

4.2.4 Maintenance

The current levels of maintenance of the drainage and irrigation systems are inadequate to sustain them in full operational order. As a consequence the physical infrastructure is deteriorating, causing the need for rehabilitation. As is often the case in such situations little effort appears to be made to make the most effective use of the funds available; it is just accepted that funds are inadequate and managers respond to crises or complaints from farmers rather than having a planned maintenance schedule. In stark contrast, the maintenance schedules on the GUYSUCO estates are well planned and executed.

Each year the RDC submits a costed maintenance plan to the Ministry of Finance, with a copy to the NDIB. The Ministry reviews this plan and generally makes cutbacks based on the funding available (**Table 4.2**). The RDC then has to revise their plan and resubmit for approval by the Ministry of Finance. Funds are then allocated to the RDC in accordance with this submitted plan, though it is reported that funds are, on occasion, diverted for other uses in the Region.

The maintenance work is generally carried out by contractor. The RDCs do not have sufficient operational equipment or labour to carry out the work themselves.

4.3 Management, Operation and Maintenance costs

4.3.1 Nature of MOM costs

Costs incurred in running drainage and irrigation systems can be divided into management, operation and maintenance categories:

Management costs	• Office staff costs • Office accommodation, capital and running costs • Operational staff costs
Operation costs	• Operation Running costs– pumping costs, operations transport, fuel, servicing, etc • Maintenance staff costs
Maintenance costs	• Maintenance materials • Maintenance work • Capital and running costs for maintenance plant and equipment

It is often difficult to break down the MOM costs strictly into these divisions; for example field staff carry out a mixture of operation and maintenance tasks. Sometimes all staff costs are allocated to management, with operation costs being restricted to the running costs for pumping irrigation and drainage water. Allocation of costs to maintenance is relatively straightforward, and encompasses contracted and direct labour work, purchase of maintenance materials, and capital and running costs for maintenance plant.

4.3.2 Public/Private Allocation of Costs

Management, operation and maintenance costs for D&I systems can be allocated dependent on whether they provide a public or private service. Until recently provision of all drainage and irrigation services within the Declared Areas was provided as a public good by Government. With increasing fiscal constraints the Government has looked to reduce its role in funding the D&I sector, and in 1995 issued a Cabinet Directive defining the division between the public and private D&I sectors. These definitions are summarised in **Table 4.6**.

Table 4.6 Public and Private Good Elements of D&I Systems

Element of D&I System	Type of Service	Responsibility for Funding O&M
Primary irrigation canals	Private	Users of irrigation water
Primary drainage canals	Public	Government
Secondary drainage and irrigation channels	Private	Users of secondary drainage and irrigation channels
Tertiary drainage and irrigation channels	Private	Users of tertiary drainage and irrigation channels
Conservancies: (i) Flood control (ii) Irrigation water supply	(i) Public (ii) Private	Both users of irrigation water and beneficiaries of flood control services

The distinction between the public and private goods can be defined as (EDRC, 1997):

Public Goods or Services: Goods characterised by very low levels of subtractability and excludability, in contrast with private goods. Low subtractability implies that a good or service is available to all consumers at the same time, and consumption by one consumer does not use up or reduce the supply available for another consumer. Low excludability implies that if a good is provided to a consumer in a defined region then other consumers in that region cannot easily be excluded from consuming the same good. Public goods are generally provided under public ownership, although several can be provided, through contract and regulation, under private ownership.

Private Goods or Services: Goods or services characterised by very high levels of subtractability and excludability. Subtractability means that one person's consumption of the good reduces the quantity available for others. Excludability means that the producer can resist use of the product to those consumers that are willing to pay for it, while excluding those who do not meet this or other criteria. Private goods can be produced under private ownership or public ownership. Except under special circumstances, for example, production in conditions of natural monopoly and where the government lacks the capacity to regulate, production of private goods increasingly is undertaken under private ownership.

Figure 4.3 shows the different components of the drainage and irrigation system, and their classification into the public or private sector. Provision of irrigation water is characterised by high levels of subtractability and excludability, consumption by one user directly reduces the amount available for another, and consumption can be restricted to consumers who are prepared to pay for it, or to contribute towards the provision of the service (such as by offering labour for maintenance activities). The secondary drains and dams are associated with the irrigated plots, and can be classified as a private good that benefits only those irrigating in that command area, and are not of benefit to the public in general. An exception to this might be where the secondary dam is used as a public road, in which case it should be classified as a public, rather than private, good.

Flood protection and drainage works can be classified as public goods as they exhibit low levels of subtractability and excludability. Conservancies have a dual function of flood control and storage of water for irrigation, where conservancies have not been built other flood protection measures, such as flood embankments are often required. For any given conservancy, division of the proportion that is attributable to the public or the private sector is extremely difficult, being dependent on the contribution the construction of the conservancy has made to flood control, and the cost of alternative measures for provision of flood control. Whilst secondary drains associated with the irrigated plots are classified as private goods, the façade drain is classified as a public good, being associated with the drainage of inhabited areas (low levels of subtractability and excludability). Similarly the public roads located alongside the primary drain can be classified as public goods.

The division of public and private good elements outlined in the 1995 Cabinet Directive is considered to be a rational division of D&I services, which fits well with the establishment of Water Users Associations and the transference of management, operation and maintenance responsibilities for the secondary systems. The divisions made in the Cabinet Directive also have the advantage of relative simplicity, an important consideration when needing to convey the division of costs (and thus fees) to water users.

4.3.3 Current D&I Fee Collection and Expenditure Procedures

As will be seen from the discussion below the current D&I collection and expenditure procedures are torturous, seriously hindering any attempt for transparency and accountability of D&I funds:

- D&I expenditure is encountered by RDCs on vested works in Declared D&I areas; by NDCs on non-vested works in Declared and Undeclared areas; Conservancy Boards in conservancies and some supply channels; GUYSUCO on sugar estates, and individual farmers on their own lands;
- The NDIB is legally empowered to assess and levy D&I rates in the Declared Areas. However NDIB do not currently assess, levy, collect or receive any D&I rates, nor does it finance any regular maintenance and operation of the D&I system. Currently the D&I rate collection is administered by the RDC, though strictly speaking it does not have legal authority to do so. Often the RDC enlists the help of the NDC in assessing and collecting the D&I Rates;

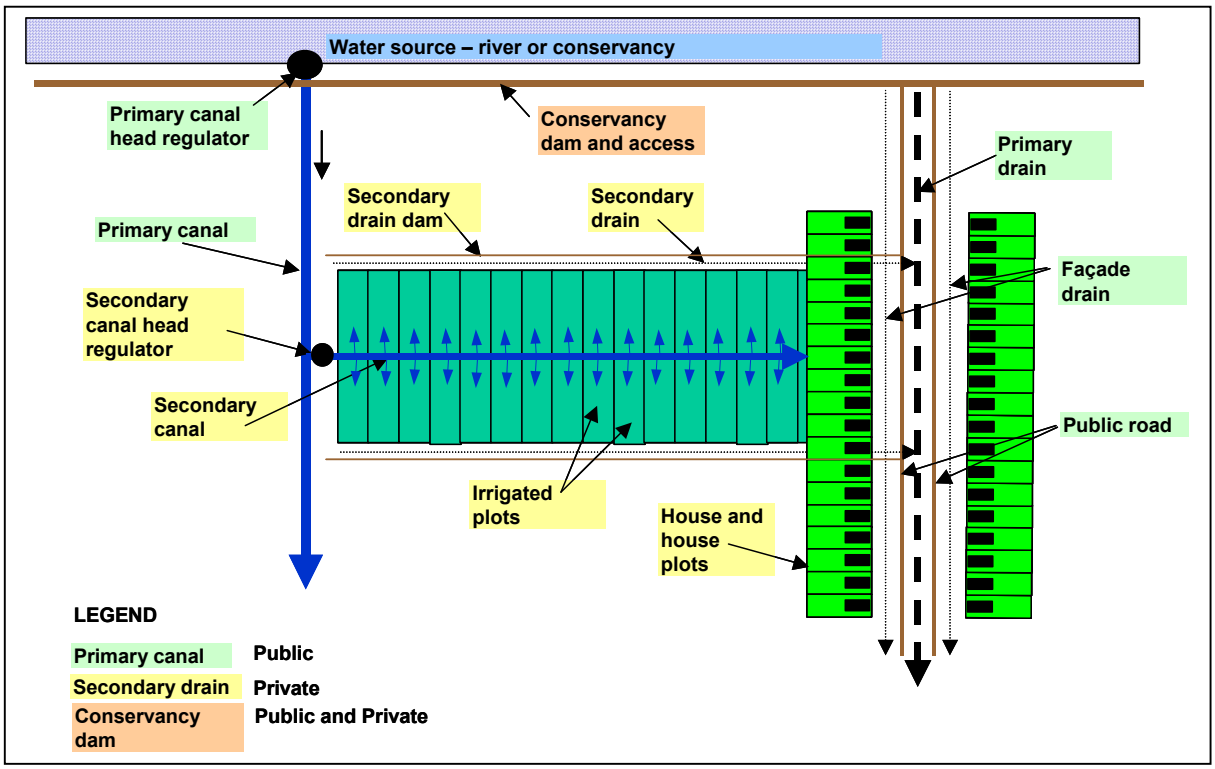

Figure 4.3 Diagrammatic Representation of Public and Private D&I Infrastructure

- The RDC is responsible for financing the O&M of D&I within the Region. The RDC prepares a budget estimate covering all its responsibilities that is then sent to the Ministry of Finance. This estimate is then debated with each RDC in turn, and a final budget allocation agreed. In theory the RDC must recalculate its estimate to match the final allocation, it is not clear that this is actually done in the case of D&I expenditure. In addition a capital budget allocation is made by the Ministry to the NDIB. NDIB may, upon request from the RDC, use this allocation to support the RDC with D&I works.
- In both Declared and Undeclared Areas the D&I tariffs are levied, billed and collected by the NDCs, or by the RDCs in areas where there are no NDCs (except in Region 5 where MMA/ADA are responsible for D&I, and set and collect D&I rates). In many cases the NDCs calculate all the local taxes and rates due, add them together and assess the general rate to be charged against the assessed value of property within the NDC. Thus the NDC calculates the rates for O&M of the vested works in D&I Areas; for O&M of the non-vested works in Declared and Undeclared Areas; for O&M of the Conservancies (rates are notified by the Conservancy Boards); and for numerous services such as potable water, education and health. It is no surprise that the D&I rate gets "lost" within this process.
- In some cases money collected by the NDCs is banked with the RDCs. This can be a cause of friction between the NDC and RDC, as the RDC is able to take money from the NDC account which it believes is owned to it by the NDC.

- It is not clear whether the D&I budget allocated to the RDC is ring-fenced for use only on D&I works, or whether it can, or is, used to support activities in other areas (such as health, roads, education). Whilst the RDC has to write an annual report on its expenditure to the Ministry of Finance it does not appear to be a requirement that a detailed account has to be submitted of D&I works carried out. Certainly the actual works carried out are not the works detailed in the budget estimate. In the budget estimate the RDC estimates the requirements based on standard calculations of maintenance needs for all its assets (canal length times number of cleanings times unit rate), not on a needs based assessment. When the D&I allocation is made then the RDC carries out work on a priority basis;
- It is unclear whether the D&I rates actually collected are added to the D&I funds allocated by the Ministry of Finance, or whether they go into the general "pot". There is certainly no feedback to farmers on the D&I fees collected, the D&I funds allocated by central Government, and the nature and location of the D&I expenditure. Such a situation creates ambiguity and lack of transparency for the water users.
- In general the budget estimates by the RDCs include only limited allocations for capital works, such as repair of structures. If major works are required they are the subject of a separate request, either to the Ministry of Finance, or to NDIB. There is no semblance of an asset management plan for the D&I infrastructure.

4.3.4 Previous Estimates of MOM Costs

Several studies have been carried out in recent years on management, operation and maintenance costs, and the ability of farmers' to pay these costs. The sections below briefly summarise two of these reports, followed by a detailed analysis of the March 2000 NEDECO report on O&M costs.

(i) Harvard Institute for International Development Report, September 1997

The Harvard Institute for International Development was commissioned by the GoG to review the provision and costs of management, operation and maintenance of the sea defence, flood control and drainage and irrigation systems. They concluded that adequate funds needed to be arranged for the rehabilitation of the sea defence and D&I systems, and that a system of revenue collection from beneficiaries should be evolved so that the infrastructure is maintained on a regular basis.

They rejected the option of placing this O&M cost burden on the general budget, and argued that the beneficiaries should pay for the services whenever it was possible to identify the users and quantify the benefits accruing to them. For this purpose they identified four alternative taxes to determine if a special levy might be added and earmarked for O&M. These taxes included; property taxes; trade taxes; income taxes; and consumption taxes.

Property tax was identified as attractive from a theoretical aspect but not practical due to the effort need to value land and immovable property. Trade taxes were rejected as they could not ensure stable revenue streams due to CARICOM agreements and trends in world trade liberalisation. Furthermore taxes in this form are being phased out in agreement with international norms and standards. Personal and corporate

income taxes were also ruled out due to the narrow tax base, high existing tax rates and a large number of exemptions. Further taxation in this context might retard business investment and economic growth.

The preferred option was the consumption tax because of its broader tax base. A 4.4% surcharge on the consumption tax would yield the GS 550 million per year required to cover O&M of the seas defences, and a further 2.3% would generate G$288 for the O&M of the D&I system.

The authors calculated the private good component of the O&M costs of the D&I systems and recommended that they be charged as a user charge based on the area of land under cultivated. The study also investigated the ability to pay these D&I rates by farmers (with 1996 prices of paddy) , and concluded that they would be able to pay these rates, in addition to paying annual land rent of G$2,000 per acre. They did warn, however, that if the price of rice dropped further then the affordability would be called into doubt.

For collection of the D&I tariffs they recommended that it was best for the tariff to be collected by the agency responsible for providing the services. This implies that NDIB/NDIA and its regional offices should be responsible for service fee collection, though in the short term these fees can be collected through the NDCs and RDCs. The authors were uncompromising on the issue of collection of D&I rates, giving the main reasons for low fee recovery as being due to:

- The low quality of services provided due to poor operating conditions and the resultant dissatisfaction amongst farmers;
- Failure to enforce the provisions of the law which allows non-fee payers to go unpunished;
- Limited collection capacity (staff);
- Poor record keeping and information flows, making it difficult to assess the amount actually collected.

They concluded by stating “Thus a kind of vicious cycle has developed. A lack of funds has resulted in the provision of poor services, which has been the cause of poor recovery of dues or rates from the beneficiaries.”

In their calculations the authors recommended and used the land in cultivation within each Region, not the total number of acres that could be cultivated (the command area). Their justification for this was that if divided by the command are the rates would be very low, and the rates would be difficult to collect given the poor state of the government’s land tenure records. Additionally, they argued, only those who are farming are benefiting from the irrigation system.

The authors concluded by strongly emphasising the central role of the private sector. NDIB should concentrate on managing the operation of the hydraulic system and contract out the maintenance work to the private sector. In addition water users associations should be encouraged to take responsibility for the maintenance[9] of the D&I systems at the local level. The authors assert that the involvement of users will ensure both efficiency and economy in providing these services.

[9] The report specifically states maintenance, rather than operation and maintenance.

(ii) Kenneth Young Report, March 2000

This report was prepared for the Inter-American Development Bank and the Ministry of Finance in support of the ASP (Agriculture Sector Program) initiated in 1996. It was prepared to assist the GOG to prepare a financial plan for the operation and maintenance of D&I systems, covering the collection of fees from beneficiaries and government budgetary support. The report is based on the full economic cost estimates for O&M charges for different cost elements prepared by NEDECO.

The report provides a summary of the 1995 Cabinet Directive and a review of the NEDECO reports. Using the NEDECO data the report presents the projected full economic costs of O&M by Region, divided into public and private categories and concludes that the public goods revenues available to GOG from the consolidated fund are sufficient to fund the projected public share of the annual O&M costs up to 2009. In 2010 there is projected to be a shortfall in the GOG consolidated fund of G$52.4 million. To cover this ongoing shortfall after 2010 the report recommends either increasing property tax, and/or a tax on pensions over a certain threshold. With regard to the private sector O&M cost component the report concludes that the new assessed O&M rates should be easily affordable by farmers starting out in 2000, and should be affordable at the rates proposed by NEDECO in 2010, unless there is a dramatic fall in farm production or market price for rice farmers.

The report discusses constraints in collecting revenue from land operators in Guyana and concludes that fee recovery will not be an issue following proposed programmes to strengthen local government authority records, devising of alternative ways of sanctioning non-paying users of D&I systems, formation of WUAs, and establishment of NDIB regional offices. The report emphasises that it is important that local government authorities, WUAs and NDIB regional office staff are properly organised with trained personnel, and that the new D&I billing and collection procedures are carefully planned.

(iii) Schedule and Cost Estimate for Operation and Maintenance of Guyana's Drainage and Irrigation Infrastructure, NEDECO, March 2000

In 2000 NEDECO carried out a detailed analysis of O&M costs for both Declared and Undeclared D&I systems within Guyana. The cost estimates were based on the Walk Through Surveys (WTS) carried out in 1999. The initial plan was to base the O&M Plan and Schedule on the fully detailed and D&I inventory arising from the WTS, and then to integrate this into a computerised database to set up a detailed O&M inventory and cost calculation method that would allow NDIB staff to update, adjust and recalculate O&M needs and costs on a regular basis. Time delays and lack of full inventories for the D&I infrastructure meant that this plan could not be fully implemented and the study had to be simplified, with an inherent decrease in accuracy. Sea defence works, GUYSUCO estates and other private estates, and secondary drainage systems in NDCs and municipalities were not included in the cost estimates.

A summary of the key details and tables in the NEDECO report is presented in **Appendix B**. Comments on the study are given below:

1. The study was for the whole country, with detailed maintenance cost estimates being prepared for each scheme based on the available data on canal and drain lengths, and types and number of infrastructure

2. Though the detail for the canal and drain lengths was available and could be used as a basis for costing associated maintenance work, the figures used for structures was standardised and averages taken. This is adequate for a national study, but is not detailed enough for the estimates required for the nine feasibility study schemes

3. NEDECO adopted a similar division of public and private D&I activities to that set out in the 1995 Cabinet Directive, save that they divided the primary irrigation into 50% public and 50% private elements. For Conservancies they acknowledged the difficulty of determining the actual division of public and private costs, and proposed a 50:50 split. They classed NDIA national and regional staff as 100% public sector.

4. The schedule was a 10 year plan for O&M funding of D&I works in all Declared Areas and Undeclared Areas. The schedule phased in the O&M work to follow the planned rehabilitation programme, thus producing a schedule for Government for the period 2000 to 2010 for funding D&I management, operation and maintenance.

5. The formation of Water Users Associations was planned for, though it was not possible to know the timescale for WUA formation. An assumption was made that the WUA would be formed and operational following completion of rehabilitation.

6. The report presents typical unit rates and frequencies for channel maintenance, and hydraulic structure recurring maintenance costs, and annual replacement cost based on structure value estimates with depreciation over 50 years. The procedures adopted for channels (deweeding, desilting) and recurring structures costs (replacing timber gates, wooden piles, etc.) are systematic and logical. The structure replacement cost estimates are adequate, given the lack of data available within Guyana on structure replacement intervals.

7. Estimates were made for pump stations based on 20% depreciation per annum (this is rather conservative given that some pumps have been operational, with reasonable maintenance, since 1928!), yearly estimates of diesel and/or electricity consumption and estimates of regular and periodic maintenance needs. To simplify the analysis NEDECO classified the pump station operating costs as maintenance costs (this is not strictly speaking correct, of course).

8. Estimates were made for staffing, with a detailed staffing list produced for NDIA HQ and Regional staff. Standard norms were used for estimating the number of field staff required (Overseers, Rangers, sluice operators, etc.).

9. Using the above unit rates and frequencies maintenance cost estimates are produced for each D&I system, and then summarised for each Region. These costs are then divided into Primary Irrigation, Primary Drainage and Secondary System in order to determine the public and private sector cost elements, and the administration costs (staffing, offices, etc.) and conservancy costs added to these maintenance costs to produce the grand final cost for each year from 2000 to 2010.

The NEDECO report follows accepted practice for studies of this type, and has adopted a logical framework for the calculation of the management, operation and maintenance costs for D&I systems in Guyana.

4.4 Feasibility Study Costing of MOM

4.4.1 Overview

For the nine feasibility studies costs were calculated for D&I management, operation and maintenance. Details are provided in the following sections on the procedures used for determining these costs.

4.4.2 Management Costs

Management costs were calculated for the present and future scenarios. Management costs were taken to cover all staff salaries (administration, operation and maintenance), transport costs and office running costs. Present management costs were estimated for:

- NDIB
- RDCs and NDCs
- Conservancies

Data were obtained from NDIB on staffing levels and salaries, facilities, equipment and facilities and running costs. For RDCs and NDCs data were obtained on staffing, and average salary rates applied An example is provided in **Table 4.7** where RDC and NDC staff time is allocated to the Vreed-en-Hoop/La Jalousie scheme. Costs for some RDC staff (Engineer, support staff) were allocated to the scheme area in proportion of the scheme area to the total command area within the Region, or to the proportion of time they were working on the scheme (Overseer, Rangers, sluice and pump operators, etc.). Vehicle costs were similarly apportioned, and an allocation made for office running costs.

Table 4.7 Example Allocation of RDC & NDC Staffing Time & Costs (Vreed-en-Hoop/La Jalousie)

	RDC Costs				Scheme costs (NDC)			
Staff	**No.**	**% time**	**Total monthly cost**	**Chargeable annual salary**	**No.**	**% time**	**Total monthly cost**	**Chargeable annual salary**
Area:	**4,465**	**acres**	**G$**	**G$**			**G$**	**G$**
(a) Staffing costs								
Engineer	1	7%	120,000	100,800	0	0%	120,000	0
Senior Superintendent of Works	1	7%	47,300	39,732	0	0%	47,300	0
Overseer	1	50%	30,000	180,000	1	50%	30,000	180,000
Rangers	1	100%	30,000	360,000	1	100%	30,000	360,000
Sluice operators	3	100%	30,000	1,080,000	0	0%	30,000	0
Pump operators			25,000	0	0	0%	25,000	0
			Sub-total	**1,760,532**			**Sub-total**	**540,000**
Support staff	3	7%	28,000	70,560	0	0	28,000	0
	(a) TOTAL staffing			**1,831,092**	**TOTAL staffing**			**540,000**
(b) Running costs								

Vehicle	1	7%	83,000	69,720	0	0%	83,000	0
Motorcycle	1	17%	8,750	17,850	1	50%	8,750	52,500
Office running costs	1	100%	5,000	60,000	1	100%	2000	24,000
	(b) TOTAL running costs			**147,570**		**TOTAL running costs**		**76,500**
			TOTAL	**1,978,662**			**TOTAL**	**616,500**
			TOTAL per acre	**443**			**TOTAL per acre**	**138**

For the future scenario management costs were estimated for:

- NDIA
- Conservancies
- Water Users Associations.

The future NDIA costs were based on two scenarios:

- An intermediate stage where the system has been rehabilitated and WUAs formed, but NDIB not reorganised into the proposed NDIA structure;
- A Future Planned scenario where the proposals for forming the NDIA have been implemented.

There is a degree of uncertainty on when the NDIA will be formed, an estimate is that this will be completed by Project Year 5.

There are no anticipated changes to the organisational structure or costs for the water conservancy boards, thus future management costs have been based on current estimated costs.

Assumptions have been made for each scheme on the number of WUAs that will be formed, and the staffing levels. The additional costs for each WUA are the salary of the Treasurer and General Secretary, there are few proposed changes to the current field staffing levels which are considered sufficient. It is assumed that the WUA Chairman works part-time and receives a salary for his work.

4.4.3 Operation Costs

Operation costs were limited to the costs for operation of the drainage and irrigation pumps. The annual pumping costs were calculated based primarily on the number of pumps, their estimated pumping hours and the fuel consumed, with allowances made for maintenance and spare parts (**Table 4.8**). Pump and motor replacement costs were allowed for as a separate capital cost item.

The estimates of pumping hours were based on the days that the pumps would be required to operate. These estimates were based on historical data obtained from discussions with RDC management and pump operators, and on duration of the crop season. Allowance was made for the anticipated reduction of days pumped due to improved water management procedures following rehabilitation.

Table 4.8 Procedure for Estimating Annual Pump Operating Costs

	Irrigation					
	Command area =	**27,600**	**acres**			
	No. pumps =	3				
	Capacity =	144	cusecs	10	gals/hour	
	No. operating =	2				
	Operates (days and hours)	250	days	24	hour/day	
	Volume =	6221	million cusecs/year			
No.	**Item**	**Unit**	**Unit cost**	**Quantity**	**Amount '000 G$**	
1	Diesel fuel	gals	360	120000	43,200	
2	Fuel transportation by barge	Sum	-	-	200	
3	Spare parts	Sum	-	-	800	
4	Maintenance	Sum	-	-	300	
5	Pump operators	Covered under staffing				
6	Maintenance staff	Covered under staffing				
				Total	44,500	
	Drainage			**Total per acre**	1,612	G$/acre
	No. pumps =	3				
	Capacity =	40	cusecs	8	gals/hour	
	No. operating =	3				
	Operates (days and hours)	40	days	10	hour/day	
	Volume =	173	million cusecs/year			
No.	**Item**	**Unit**	**Unit cost**	**Quantity**	**Amount '000 G$**	
1	Diesel fuel	gals	360	9600	3,456	
2	Fuel transportation by barge	Sum	-	-	0	
3	Spare parts	Sum	-	-	300	
4	Maintenance	Sum	-	-	300	
5	Pump operators	Covered under staffing				
6	Maintenance staff	Covered under staffing				
				Total	4,056	
				Total per acre	147	G$/acre

4.4.4 Maintenance Costs

Maintenance costs are a function of:

- The type of asset (canal, drain, structure, etc)
- Type of maintenance work required (deweeding, desilting, gate replacement, etc.)
- Frequency of maintenance work (monthly, each season, each year, each 5 years, etc.)
- Quantity (length, volume, number, etc.)

- Unit rate

These data were tabulated (**Table 4.9**) and calculated for each system and the maintenance costs determined for each category of work (primary canals, primary drains, secondary canals, secondary drains, etc.). Where the maintenance frequency is greater than one year the cost of the work is determined and then annualised. A detailed example calculation is presented in **Appendix C**.

Table 4.9 Maintenance Costs Calculation Format

Asset type	Maintenance item	Unit	Rate	Frequency (per year)	Quantity	Amount (G$)	Annualised amount (G$)
Primary canal	Manual deweeding	ln.ft	1.67	12.00	21,096	422,764	422,764
	Mechanical desilting	cu.yds	60.0	0.14	51,568	3,094,080	433,171
	Trimming and shaping	sq.yds	10.0	0.14	154,704	1,547,040	216,586
					Primary canals sub-total	**5,063,884**	**1,072,521**

Details of the types of canals and structures, the maintenance work required, the maintenance frequency, the unit rates and the outline specification used in the calculation of maintenance costs, together with the sources of information used to prepare these tables, are summarised in **Appendix Tables C2.1, C2.2** and **C2.3**. A variety of measures were used to determine the unit rates and frequencies of maintenance work. The primary source of frequency of work was questioning of experienced field staff. The determination of the unit rates varied depending on the item, some information was available from RDC Engineers, NDC technical personnel and field staff, other data had to be built up from basic cost elements (following basic contracting principles, to include materials, labour, transport, fitting, overheads, etc.).

There is a limited range of drainage and irrigation structures in the D&I systems in Guyana, and fairly well defined maintenance requirements. Repair and replacement items, frequencies and rates are well known from experience, with relatively minor local differences. Sea sluice structures require more regular maintenance that similar freshwater structures, such as gated head regulators. Timber bridges require regular replacement of the Greenheart decking material and less frequent replacement of the substructure and wooden piles. Replacement of these timber structures with concrete structures is now taking place, significantly reducing the regular maintenance costs for these items.

Due to the design layout the lengths of drains and canals per unit area are relatively high. A significant portion of the maintenance cost arises from this channel density and the speed at which vegetation grows in the fertile coastal plains of Guyana. A priority maintenance activity identified by all D&I stakeholders is the manual cleaning of the drains and irrigation channels, without which the channels quickly become blocked, channel flow velocity and capacity is markedly reduced and sedimentation rates (in drains) increased. Failure to keep the channels clear results in the vegetation becoming too dense for manual clearance, and more expensive mechanical methods have to be used. The impact on flow capacity of a failure to manually deweed is greatest on the smaller secondary channels, where the rapid growth quickly chokes the channel. This reduction in capacity results in reduced water availability for farmers at the tail end of the secondary canals.

Associated with the drains and canals are dams/berms, which require different degrees of maintenance depending on whether they are used for access or not. Generally access is not permitted on irrigation dams/berms as damage can lead to breaches, flooding of surrounding land and reduction in flow to lower

sections. Where used for access these dams/berms need regular maintenance to fill in depressions and to level and grade the dam in order not allow rainfall to pond. Where not used for access, dams need to be periodically debushed so as not to provide a haven for rice pests.

The quantities for each maintenance item were obtained from channel and structure surveys carried out by the design team surveyors, and from plans made for rehabilitation of the systems. Drain and channel lengths were checked with existing D&I data, and a final asset register produced in association with the Design Team based on existing and proposed works.

The management, operation and maintenance cost items and the leading descriptors for the nine feasibility study schemes are summarised in **Appendix Table C2.4**, together with the O&M costs calculated for each scheme by NEDECO in their March 2000 report. The key descriptors for each project are:

- Command area
- Form of irrigation supply (conservancy or pumped)
- Drainage disposal method (gravity, gravity plus pumped, or pumped)
- Length of all channels (canals and drains, both primary and secondary)
- Number of structures.

The total MOM costs range between G$3,349 and G$9,621/acre (US$45 to US$132/ha), with the maintenance costs comprising between 64-76% of these total costs for the gravity supply schemes[10]. Where there are high operating costs due to pumped drainage or irrigation, the maintenance element is a smaller proportion. In most cases 40-60% (**Appendix Table C2.5**) of the total maintenance cost is spent on maintenance of the secondary drains and canals (excluding structures), with a strong correlation being shown between the total channel lengths (primary/secondary, canals/drains) and maintenance costs (**Figure 4.4**).

In addition to the maintenance costs associated with differences in the channel density per acre, the variation in the total MOM costs between schemes arises from the pumped drainage or irrigation elements, with operating costs ranging between G$1,742 and G$1,989/acre for pumped irrigation, and G$118 and G$2,956/acre for pumped drainage.

The estimated MOM costs for the feasibility studies are generally lower than those estimated by NEDECO in their March 2000 report, even allowing for the fact that the NEDECO figures given in **Appendix Table C2.4** do not include conservancy and staffing costs (these costs were not calculated by scheme in the NEDECO estimates, they were added on to regional totals). There is a significant difference in the estimates for Den Amstel/Fellowship, Vreed-en-Hoop/La Jalousie, and Crabwood Creek. For Den Amstel/Fellowship and Vreed-en-Hoop/La Jalousie the length of channels per unit area is high, making the cost estimates very sensitive to different assumptions regarding channel maintenance. The NEDECO estimates recommended regular (expensive) mechanical de-weeding of channels, with infrequent manual de-weeding, whilst the feasibility study estimates are based on regular (monthly) manual de-weeding, no mechanical de-weeding and periodic mechanical de-silting. Based on experience with regular manual de-weeding in some schemes, and by GUYSUCO on its sugar estates, it is believed that this offers a more

[10] In well-maintained, gravity-fed systems, a maintenance expenditure of 70% of total MOM expenditure is about the norm.

reliable and more cost-effective approach to channel maintenance. For Crabwood Creek, the NEDECO figure is very low, and does not appear to have allowed for the post-rehabilitation infrastructure.

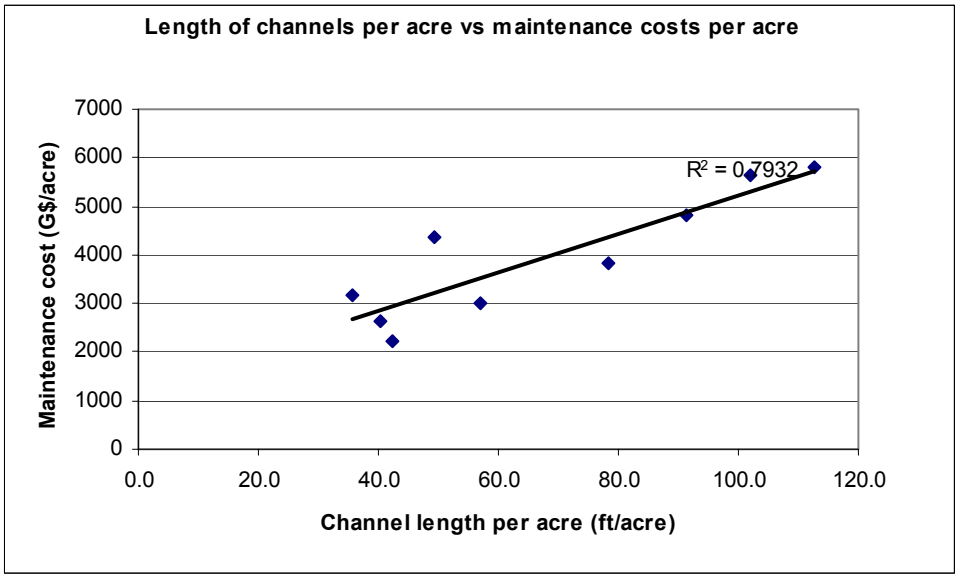

Figure 4.4 Relationship Between Channel Length and Maintenance Cost

Following the completion of the maintenance costs exercise in the nine schemes the following observations were made:

Main cost areas:

Generally the main cost areas are the works relating to:

(a) Weeding and cleaning of channels

(b) The replacement of timber structures at periodic intervals, particularly the timber bridges and revetments associated with concrete structures

(c) De-bushing of the secondary dams

In the computations, the costs associated with (c) were eliminated, as it was felt that the section of the secondary canal dam adjacent to the farmer's field could be easily maintained on a regular basis by the farmers, as an extension of their on-farm activities. A provision could usefully be made in the WUA by-laws to this effect, that such farmers are responsible for this work, for which they might get a reduction in their fee rate. Additionally this section of land could be used for cash crop farming to bring additional income to the farmer.

Possible areas for further cost reduction.

The following were identified as possible areas where maintenance cost savings could be made:

(a) *Weeding and cleaning*. A rate of G$1.67/foot was used in the costs calculation based on data provided from a number of sources. However, GUYSUCO (Blairmont and Rose Hall estates) currently maintain their systems at a rate of G$0.67/ft. It is felt that if a proper, regular and effective system of channel maintenance is put in place, the actual cost of maintenance could be reduced, over time, to be in line with the current GUYSUCO rates.

(b) *De-silting, trimming and shaping*. Five years and seven years were identified as the periods at which de-silting of the drains and canals, respectively, will have be carried out. It is possible that adequate maintenance in terms of weeding and cleaning will allow free flow of silt-laden water in the drains to be carried to the sluices and out to sea, thus reducing the amount of silt settling in the drains. This could result in the period between desilting being extended in the drains.

Timber bridges and timber revetments associated with concrete structures. The replacement of timber bridges with concrete structures, and timber revetments with gabion/boulder protection will reduce the costly maintenance associated with these items. Replacing these structures should be considered during the maintenance phase, with the possibility of grants being given by government to WUAs to upgrade these structures over time, as replacement of key items becomes due.

5 FARMERS' ABILITY TO PAY D&I CHARGES

5.1 Introduction

During the feasibility studies undertaken for the rehabilitation of 9 drainage and irrigation projects, financial analysis was carried out to determine the likely implications of the proposed investments on farm production and income. The increases in net farm income generated by the projects then provided a clear indication of the farmers' ability to meet future management, operation and maintenance (MOM) costs. It is anticipated that the D&I developments, and subsequent upgrading of MOM, will create more favourable and sustainable conditions for the adoption of improved farming practices. Both crop productivity and cropping intensity are therefore expected to increase. In addition to assessing the impact on farm returns, the analysis also considered the effects on the costs of production including changes in input use, machinery and labour requirements.

In the 'with project' situation, the following alternative benefit scenarios were considered:

- Benefit Scenario A: D&I rehabilitation only;
- Benefit Scenario B: D&I rehabilitation + rice development; and
- Benefit Scenario C: D&I rehabilitation + rice development + crop diversification.
- Under Benefit Scenario A, it is anticipated that there will be an expansion of rice cropping into areas which are currently not being cultivated due to water-logging or lack of irrigation water. In addition, average paddy yield is also envisaged to increase by between 10% and 15% due to better management practices (e.g. block planting and enhanced irrigation) resulting directly from an improved D&I system. If applicable, a reduction in the cost of pumping irrigation water to farmers' fields, as frequently practised, was also included. With the exception of Golden Grove/Victoria, the areas and productivity of horticultural crops in the project areas were assumed to remain unchanged.
- Under Benefit Scenario B, it is anticipated that there will be significant improvements in the agricultural support services being provided to rice farmers. Complementary programmes to enhance support services are expected to include (i) upgrading of rice research and the establishment of on-farm demonstration plots, (ii) improved seed multiplication, cleaning/sorting, certification and distribution; and (iii) enhanced provision of extension services and quality of extension advice. Under this scenario, paddy rice yields are assumed to increase by a further 10% to 12%. Additional improvements in cropping practices (e.g. integrated pest management) to reduce production costs were also included.

Under Benefit Scenario C, in addition to the above developments in rice production, it is also anticipated that a crop diversification programme will lead to a limited expansion of vegetable and fruit production.

5.2 Crop Budgets

5.2.1 Crop Yields, Input Use, Machinery and Labour Requirements

Information on the present crop yields was gathered from the Baseline Survey (for paddy rice), the Guyana Sugar Corporation (GUYSUCO), and the Ministry of Fisheries, Crops and Livestock (for horticulture crops). While data on crop management practices, levels of input use (i.e. seeds, fertilisers and pesticides), labour and machinery requirements, with respect to different farm sizes, were collected during focused group discussions (FGDs) with farmers and local extension officers. In the future 'with project' situation, the assumptions regarding crop yields and management practices were based on information provided by senior staff from Guyana Rice Development Board (GRDB), GUYSUCO and the Ministry of Fisheries, Crops and Livestock. The future 'with project' yield assumptions also took account of the farmers' capacity to adopt the improved management practices as well as potential constraints at the farm level (e.g. soils, water control, timeliness of operations, etc).

The range of crop yields (in both the 'with' and 'without' project situations) used in the feasibility studies are given in **Table 5.1,** while crop inputs (seed, fertiliser, pesticide), labour and machinery requirements are presented in the detailed crop budgets for each project area (Appendix 5.1 of Feasibility Study reports**)**. The highest paddy yields were recorded in Vreed-en-Hoop/La Jalousie (4.4 tonnes/ha) and the lowest in Crabwood Creek (3.13 tonnes/ha).

It should also be noted that the Baseline Survey indicated that were only small differences in paddy yields between the various farm sizes (this confirmed the findings of the GLASP Socio-economic Survey conducted in 1998). Similarly, no clear pattern emerged with respect to yield differences between the two cropping seasons (i.e. Nov/Dec. planting and May/June planting). Consequently, the same levels of crop productivity were assumed for both seasons. However, there were notable differences in both the level and structure of paddy production costs which were taken into account in the analysis.

Table 5.1 Crop Yields

Crop	Crop Yields per Acre		
	Without Project	With Project (Scenario A)	With Project (Scenario B & C)
Paddy Rice	1.27 - 1.78 tonnes	1.59 - 1.97 tonnes	1.78 – 2.16 tonnes
Sugarcane	33 tonnes	35 tonnes	35 tonnes
Vegetable (Tomato)	2.0 tonnes	2.0 tonnes	2.0 tonnes
Plantain	5.0 tonnes	5.0 tonnes	5.0 tonnes
Fruit (Pineapple)	4.0 tonnes	4.0 tonnes	4.0 tonnes
Cassava	6.0 tonnes	6.0 tonnes	6.0 tonnes
Tree Crop (Mango)	3.0 tonnes	3.0 tonnes	3.0 tonnes

Source: Baseline Survey (2003/4), Guyana Rice Development Board, GUYSUCO, and the Ministry of Fisheries, Crops and Livestock.

5.2.2 Financial Prices

Farmgate and market prices for paddy rice and horticultural crops were collected from farmers during the field survey, as well as GRDB and the 'New' Guyana Marketing Corporation. Local market prices are subject to significant quality and seasonal variations and this was taken into account when estimating farmgate prices. Labour wage rates and hire charges for tractors and combine harvesters were also collected directly from farmers during the FGDs. Seed, fertiliser, pesticide and machinery prices were gathered from local private suppliers. The input and output prices applied in the analysis are presented in the detailed crop budgets (Appendix 5.1 of the Feasibility Study reports).

5.2.3 Financial Gross Margins

The crop yields, input usage, labour and machinery requirements were then valued in 2003 farmgate prices in order to derive financial gross margins for each of the main crops grown within the project areas. To highlight differences between the various farm sizes, paddy gross margins were derived for small, medium and large farmers. The financial crop budgets (in both the 'with' and 'without project' situations) are detailed in the Feasibility Study reports, and the range of crop gross margins are summarised in **Table 5.2**. Large farmers in Vreed-en-Hoop/La Jalousie recorded the highest net returns from paddy production (G$8,819 per acre), while small farmers in Blackbush Polder incurred the greatest losses (G$ - 6,986 per acre).

Table 5.2 Crop Gross Margins

Crop	Crop Gross Margin (G$ per acre)			
	Without Project		With Project	
Paddy - Benefit Scenario A	*Low*	*High*	*Low*	*High*
Small Farm	- 6,986	6,534	1,925	10,364
Medium Farm	-1,993	8,689	3,815	12,254
Large Farm	- 1,311	8,819	5,049	12,676
Paddy - Benefit Scenarios B & C	*Low*	*High*	*Low*	*High*
Small Farm	- 6,986	6,534	6,054	12,515
Medium Farm	-1,993	8,689	8,364	15,455
Large Farm	- 1,311	8,819	9,624	16,768
Other Crops - All Scenarios				
Sugarcane	27,932		38,432	
Vegetable (Tomato)	236,524		236,524	
Plantain	179,627		179,627	
Fruit (Pineapple)	176,816		176,816	
Cassava	84,743		84,743	
Tree Crop (Mango)	141,450		141,450	

Source: Feasibility Study reports (Appendix 5.1 - Financial Crop Budgets)

It is evident from **Table 5.2** that, at the present levels of productivity, commercial rice cultivation is only a marginally profitable enterprise and, in some project areas, financial losses are being incurred on a wide scale, e.g. Blackbush Polder. While in other project areas, e.g. Crabwood Creek, most farmers have now abandoned paddy production. Farmgate paddy prices are low and, given the current world market price projections for rice (World Bank, 2003), this situation is not likely to change in the immediate future. This depressed rice economy is clearly having a significant negative effect on rice farmers' ability and willingness to pay D&I fees in order to provide the necessary funds required to operate and maintain the primary and secondary systems in a satisfactory manner.

To regain profitability, rice farmers will therefore have to: (i) significantly increase crop productivity, (ii) lower their present high levels of pesticide use, and (iii) improve their post-harvest transport and storage facilities, in order to reduce production costs per tonne to levels well below the prevailing farmgate prices. Rice production will then be able to make an important contribution to farm household income. It is anticipated that, to a limited extent, this could be attained under Benefit Scenario A, but greater achievements would be obtained under Benefit Scenarios B and C.

Table 5.2 also shows that the net returns from sugarcane production are satisfactory and that there would be a modest increase in the 'with project' situation. With the support of GUYSUCO, and provided that Guyana's preferential access to the high priced, EU and USA markets is maintained, this situation is likely to continue in future.

Net returns from vegetables (e.g. tomato) as well as plantain, cassava, fruit crops (e.g. pineapple) and tree crops (e.g. mango) are substantially higher than the net returns from paddy and sugarcane. These attractive returns from horticultural crops are, however, offset by the risks associated with the large variations in seasonal prices and, for some projects, transport constraints (e.g. distance from Region 6 to Georgetown). There is also limited potential to expand production, due to the small domestic market in Guyana and the lack of adequate infrastructure and facilities to benefit from export market opportunities.

It should also be noted that the productivity of horticultural crops, and consequently their gross margins per acre, were assumed to remain unchanged for all three benefit scenarios. This avoided overestimating the potential benefits from an increase in the production of these high value crops, which would have a significant influence on project viability and the farmers' ability to pay D&I fees.

5.2.4 Farm Incomes

For each project area, farm budgets were prepared for small (5 acres), medium (20 acres) and large (50 acre) farms in both the 'with' and 'without project' situations. The present crop patterns for the different farm size categories were derived from data collected through FGDs with farmers. In the future 'with project' situation, the cropping patterns were also based on FGDs as well as an assessment of the production and marketing opportunities/constraints to expanding rice, vegetable and fruit production. The overall cropping patterns used in the financial analysis are given in **Table 5.3**.

Table 5.3 Cropping Patterns: With and Without Project (% of Cultivatable Area)

Planting Season/Crop	Canals Polder		Vreed-en-Hoop		Blackbush Polder		Den Amstel		Vergenoegen	
	Without Project	With Project (A & B)	Without Project	With Project (A & B)	Without Project	With Project (A & B)	Without Project	With Project (A & B)	Without Project	With Project (A & B)
November/December Planting Season										
Paddy	20%	21%	96%	96%	79%	92%	60%	94%	53%	55%
Vegetable	10%	10%	2%	2%	3%	3%	5%	5%	10%	10%
May/June Planting Season										
Paddy	20%	21%	96%	96%	79%	92%	60%	94%	53%	55%
Vegetables	10%	10%	2%	2%	3%	3%	5%	5%	10%	10%
'Perennial'										
Sugarcane	55%	55%	0%	0%	0%	0%	0%	0%	0%	0%
Plantain/Cassava	5%	5%	0%	0%	1%	1%	0%	0%	32%	32%
Fruit	5%	5%	0%	0%	1%	1%	0%	0%	2%	2%
Cropping Intensity	125%	127%	196%	196%	166%	190%	130%	198%	160%	164%

Source: Maps of Project Areas and Focus Group Discussions with Farmers

Table 5.3 (cont'd) Cropping Patterns: With and Without Project (% of Cultivatable Area)

Planting Season/Crop	Golden Grove		Cane Grove		Lots 52/74		Crabwood Creek	
	Without Project	With Project (A & B)	Without Project	With Project (A & B)	Without Project	With Project (A & B)	Without Project	With Project (A & B)
November/December Planting Season								
Paddy	18%	24%	79%	81%	93%	93%	5%	65%
Vegetables	9%	14%	13%	13%	2%	2%	4%	4%
May/June Planting Season								
Paddy	18%	24%	79%	81%	93%	93%	5%	65%
Vegetables	9%	14%	13%	13%	2%	2%	4%	4%
'Perennial'								
Sugarcane	0%	0%	0%	0%	0%	0%	2%	2%
Plantain/Cassava	12%	20%	2%	2%	0%	0%	27%	27%
Fruit/Tree Crop	40%	40%	2%	2%	0%	0%	0%	0%
Cropping Intensity	106%	135%	188%	192%	190%	190%	47%	175%

Source: Maps of Project Areas and Focus Group Discussions with Farmers

The crop areas for each farm model were then applied to the respective financial crop gross margin in order to derive the likely net returns from crop production in both the 'with' and 'without project' situations. Following the deduction of fixed costs (e.g. rent and machinery/equipment depreciation), net farm incomes in the 'with' and 'without project' situations, as well as incremental net farm income, were then obtained. Net farm incomes were determined both before and after deducting D&I fees. The detailed farm budgets for each project area are presented in Appendix 5.2 of the Feasibility Study reports, and the results of this analysis indicated that net farm incomes (after D&I fees) would increase by the amounts show in **Table 5.4**. With these improvements in net farm income, the project will significantly enhance the welfare of all types of farm household within the project areas, particularly under Benefit Scenarios B and C.

5.3 Farmers' Ability to Pay D&I Fees

The management, operation and maintenance (MOM) costs for the primary and secondary systems, to be funded by WUA members, were calculated by the O&M Engineers (See **Chapter 4**). These private MOM costs were then deducted from the net farm incomes in both the 'with' and 'without project' situations. Future private MOM were estimated to range from G$2,595 per annum (Crabwood Creek) to G$6,711 per annum (Den Amstel). With regard to the farmers' capacity to meet these future MOM costs, the additional D&I fees were then expressed as a percentage of the incremental net farm income (before D&I fees) for each type of farm. The results of this analysis are summarised in **Table 5.5**, which is taken from the Feasibility Study Reports, Appendix 5.2 - Farm Budgets.

As a 'rule of thumb', additional D&I fees as a percentage of incremental net farm income should not exceed 35%. This guideline permits sufficient incremental net income (after D&I fees) to be generated by the projects in order to encourage the full participation of farmers in O&M activities, as well as providing an adequate allowance for the substantial risks and uncertainties associated with crop production. It is evident from the **Table 5.5** that, with the exception of small and medium farms in Canals Polder, Blackbush Polder, Crabwood Creek and Cane Grove, the 35% ceiling is usually met under Benefit Scenario A (i.e. D&I rehabilitation only). This suggests that most farmers should have an adequate incentive to pay the full D&I fees.

However, the implementation of complementary rice development and crop diversification programmes (i.e. Benefit Scenarios B and C) will result in more substantial increases in net farm incomes. This integrated approach to agricultural development will therefore enable farmers to have a much stronger capacity to pay D&I fees and this will help to ensure that the WUAs responsible for the management, operation and maintenance of the D&I systems are financially sustainable.

Table 5.4 Incremental Net Farm Income by Benefit Scenario

Benefit Scenario & Farm Type	Incremental Net Farm Income (G$)								
	Canals Polder	Vreed-en-Hoop	Blackbush Polder	Den Amstel	Vergen-oegen	Golden Grove	Cane Grove	Lots 52/74	Crabwood Creek
Scenario A: (D&I rehab. only)									
Small (5 acres)	15,525	24,675	40,310	39,611	15,295	180,384	10,522	37,251	13,077
Medium (20 acres)	131,474	91,559	115,966	159,802	80,521	698,794	73,022	129,590	115,102
Large (100 acres)	474,671	288,739	377,940	n/a	320,173	n/a	266,837	376,810	392,624
Scenario B: (D&I rehab. only + rice development)									
Small (5 acres)	15,525	44,029	70,458	66,753	28,055	175,094	27,108	72,346	30,571
Medium (20 acres)	217,415	229,417	274,293	314,301	187,584	773,926	199,195	293,345	233,370
Large (100 acres)	863,441	1,239,868	798,840	n/a	612,937	n/a	635,117	806,860	689,999
Scenario C: (D&I rehab. only + rice development + crop diversification)									
Small (5 acres)	57,000	111,102	159,594	125,583	96,097		92,572	165,608	110,635
Medium (20 acres)	347,669	314,566	444,967	385,258	286,990		404,941	442,564	321,549
Large (100 acres)	928,583	803,925	959,721	n/a	725,368		832,675	900,122	744,266

Source: Feasibility Study Reports (Appendix 5.2 - Farm Budgets)

Table 5.5 Additional D&I Fees as % of Incremental Net Farm Income

Project/Farm Type	Additional D&I Fees as % of Incremental Net Farm Income		
	Scenario A	Scenario B	Scenario C
Canals Polder:			
Small (5 acres)	41%	41%	16%
Medium (20 acres)	24%	19%	11%
Large (100 acres)	17%	10%	10%
Vreed-en-Hoop/La Jalousie:			
Small (5 acres)	28%	18%	8%
Medium (20 acres)	30%	15%	11%
Large (100 acres)	25%	13%	11%
Blackbush Polder:			
Small (5 acres)	32%	21%	11%
Medium (20 acres)	40%	22%	15%
Large (100 acres)	34%	19%	17%
Den Amstel/Fellowship:			
Small (5 acres)	32%	22%	13%
Medium (20 acres)	32%	19%	16%
Large (100 acres)	n/a	n/a	n/a
Vergenoegen/Bonasika:			
Small (5 acres)	18%	11%	2%
Medium (20 acres)	14%	7%	4%
Large (100 acres)	9%	5%	4%
Golden Grove/Victoria:			
Small (5 acres)	10%	10%	n/a
Medium (20 acres)	10%	9%	n/a
Large (100 acres)	n/a	n/a	n/a
Cane Grove:			
Small (5 acres)	57%	34%	13%
Medium (20 acres)	43%	22%	12%
Large (100 acres)	34%	18%	12%
Lots 52/74:			
Small (5 acres)	26%	15%	7%
Medium (20 acres)	28%	15%	10%
Large (100 acres)	25%	14%	12%
Crabwood Creek:			
Small (5 acres)	39%	21%	7%
Medium (20 acres)	22%	12%	10%
Large (100 acres)	17%	11%	10%

5.4 Conclusions

At present, the farmers' ability and willingness to pay for D&I services is strongly influenced by the depressed rice economy and the generally poor levels of D&I operation and maintenance services being provided by local and central government. In many of the project areas, the current low (and often negative) net income from rice cultivation severely restricts the rice farmers' ability to pay D&I fees. Furthermore, the inadequate provision of O&M services clearly reduces their willingness to pay the fees required to operate and adequately maintain the primary and secondary systems.

Rice cultivation is, at best, only a marginally profitable enterprise and, in many areas, financial losses are being incurred. If this situation continues, it is likely that many farmers will abandoned rice production and depend on cash crops, ground provisions and livestock as their main sources of farm income. This has already occurred in Crabwood Creek and will probably become more widespread as farmers become less able to meet the fixed costs associated with rice farming (i.e. machinery, land rent and D&I fees). Given that the world market price prospects for rice are unlikely to improve significantly, these low levels of profitability will therefore remain for the foreseeable future.

In order to reverse this current downward spiral within the rice economy, it is essential that production costs per tonne are reduced to levels well below the prevailing farmgate prices. This can be achieved through both directly reducing production costs and improving rice yields. These improvements can only be attained if the D&I systems are being operated both efficiently and equitably. Therefore, in addition to rehabilitating the D&I infrastructure, it is critical that effective and sustainable Water User Associations (WUAs) are fully established and functioning in all the project areas. Rice farmers will then have the opportunity to increase crop productivity (through drainage and irrigation) and to lower production costs (e.g. reduced private pumping of water from canals and drains).

It is also important to note that, in some project areas (e.g. Vreed-en-Hoop/La Jalousie), farmers are achieving levels of productivity which are sufficient to generate positive net returns and this also enables them to meet D&I fees (about G$2,500 per acre). The funds generated are then used to operate and maintain the D&I system in a reasonably satisfactory manner. In this situation, the establishment of a WUA would ensure that O&M standards are sustained in the future which will obviate to need for further rehabilitation of the D&I infrastructure.

Following D&I rehabilitation and the establishment of WUAs, it is evident from the farm budget analysis that, with a few exceptions, most farmers in the project areas should have the ability and incentive to pay the level of fees required to operation and adequately maintain their D&I systems. However, rice yields and net farm incomes could be increased further if improved cropping practices (e.g. block planting, farm water management and integrated pest management) were adopted. This would require the provision of considerably enhanced agricultural support services, i.e. research, extension and seed production (see Chapter 6), which would result in a notable increase in income from rice production. This higher level of income would not only provide farmers with a much stronger capacity to pay D&I fees, but also encourage them to fully participate in WUA activities.

Improved agricultural support services are therefore regarded as an essential prerequisite to achieving the anticipated increases in net farm income required to meet the rise in fees necessary for the sustainable management of the D&I systems. Furthermore, a crop diversification programme could lead to an expansion in cash crop production in the project areas as a consequence of an increase in demand for horticultural produce in both the domestic and export markets.

6 AGRICULTURAL SUPPORT SERVICES

6.1 Introduction

The farm budget analysis (outlined in **Chapter 5**) indicated that rice cultivation in Guyana is only a marginally profitable enterprise and, in many of the project areas, financial losses are being incurred. If the current low levels of profitability remain, it is likely that many farmers will abandoned rice production and increasingly depend on cash crops, ground provisions and livestock as their main sources of farm income. Without the ability or willingness to pay for D&I services, there will not be sufficient funds to maintain the D&I infrastructure in a satisfactory condition. This will then result in greater deterioration of the primary and secondary systems which will inevitably lead to a decline in crop productivity and a further fall in the net returns from rice production.

In order to reverse this downward trend, it is critical that production costs per tonne are reduced to levels well below the prevailing farmgate prices. This can be achieved through both directly reducing production costs and improving rice yields. Guyana is becoming less dependent on preferential access to the higher priced European market and consequently has to export increasing quantities of rice to alternative markets in the Caribbean and Latin America. It is therefore urgent that Guyana increases it's competitiveness in the world market.

Following D&I rehabilitation and the establishment of effective and sustainable WUAs, the farm budget analysis indicated that most farmers in the project areas should have the ability to pay the level of fees required to operation and maintain the D&I systems in a satisfactory manner. However, rice yields and net farm incomes could be further increased if improved cropping practices (see below) were adopted. This, however, would require a substantial improvement in the provision of agricultural support services, i.e. research, extension and seed production. With the adoption of better management practices, it is expected that there would be a marked increase in net returns from rice production. *The provision of effective agricultural support services is therefore regarded as an essential prerequisite to achieving the anticipated increases in crop productivity and farm income.*

6.2 Water Management and Improved Cropping Practices

Following the rehabilitation of the D&I infrastructure, and the establishment of effective operation and maintenance of the D&I systems by WUAs, rice farmers will have the opportunity to significantly improve their field water management techniques. This will then lead to further enhancement of the following cultural practices.

6.2.1 Land preparation

In order to prepare a level seedbed and to provide the optimum soil conditions for seedling growth (e.g. weed free, ideal moisture content), effective water control is essential. By allowing the flooding and

drainage of the seedbed when required, field water management is critical to the timeliness of cultivations (particularly harrowing, raking and levelling) which will ensure that a suitable seedbed is prepared.

6.2.2 Sowing

Pre-germinated seed is usually sown on a seedbed flooded to a level which makes sure that no soil is exposed (to minimise growth of weeds, particularly red rice, and volunteers from the previous paddy crop). Water control is therefore essential at this critical stage of crop production.

6.2.3 Weed Control

Field water management, particularly during the early growth stages, is the one of the key elements of effective weed control using cultural practices. Weed control starts with the burning of the post-harvest stubble of the previous crop (to kill weed seeds) and continues, with the appropriate water management, during land preparation, sowing and seedling development. During the early stages of seedling development, a field should not be left exposed for more than 3 days. It is also important to keep dams, drains and canals free of weeds to reduce dispersion of weed seeds into paddy fields. Weed control using cultural practices will therefore minimise (or possibly eliminate) the need for herbicides and so reduce production costs.

6.2.4 Irrigation

After crop establishment, water levels of between 7cm to 10 cm should be maintained during the growing stages to ensure effective weed control and irrigation for the paddy crop. The provision of irrigation water is critical at the seedling, tillering and heading stages. Fields should be drained at 85 to 90 days after sowing. Harvesting takes place between 105 to 115 days after sowing (depending on the variety).

6.2.5 Pest Management

An effective D&I system is critical to pest management because, with water control, farmers will be able to 'block plant'. In addition to improving the timeliness of land preparation, sowing and harvesting, block planting also permits effective pest management, particularly with respect to the control of the paddy bug, as planting blocks are at the same stage of maturity throughout the growing season. Pest control is also assisted by other cultural practices such as the removing (by hand) grass weeds, red rice, and volunteer plants within the paddy fields. To reduce host plants, weed control on dams, drains and canals is also important. These cultural practices help to reduce dependence on insecticides, as the main method of pest control, and consequently reduce production costs.

These improved management practices are in evidence at the Burma Rice Research Station (at a field scale) and in project areas with satisfactory D&I systems and progressive farmers (e.g. Vreed-en Hoop/La Jalousie and Cane Grove). The wider adoption of these practices will lead to:

- Increase in crop yield; and

- Decrease in the use of herbicides and insecticides.

These improved techniques will therefore enable farmers to reduce production costs per tonne and hence improve the profitability of rice production in Guyana.

6.3 Integrated Approach to Rice Development

These improved cropping practices could be widely adopted by rice farmers throughout the project areas, but this will require an integrated approach to rice development. The immediate investment priorities, aimed at increasing the competitiveness of rice production in Guyana, comprise:

- Rehabilitation of the D&I systems;
- Improved management, operation and maintenance (MOM) through sustainable WUAs;
- Adoption of improved rice varieties, suitable to Guyana's agro-ecological conditions and with a strong market demand;
- Effective on-farm research and extension services to support rice farmers trying to improve crop yield and reduce their dependence on herbicides, fungicides and insecticides; *and*
- Production and distribution of quality, certified seed.

Improved rice varieties from alternative sources, including Latin America and the Caribbean, will play a very important role in the long term development of rice production, through the provision of genetic material which is higher yielding, disease resistant, and suitable for the agro-ecological conditions prevailing in Guyana, as well as being appropriate to the demands of the emerging export markets. However, new varieties are not a panacea for the current problems of rice farming in Guyana. Immediate priority should also be given to significantly improving the quality of the seed of the proven varieties currently used by farmers, and encouraging farmers to purchase certified seed rather than continually use their own seed. This requires an expansion of seed production, as well as upgrading of processing, certification and distribution of paddy seed, to ensure that farmers have timely access to quality seed. The importance of quality, certified seed production cannot be overstated.

The provision of effective on-farm research and extension support services will also make a significant contribution to increasing the adoption of improved cultural practices facilitated by D&I systems rehabilitation and the establishment of sustainable MOM (through WUAs). Consequently, this will help farmers to substantially improve their income from rice production and generally boost the rice economy as a whole. Without a modest investment in these support services, the opportunity of obtaining the full financial and economic benefits being provided by D&I rehabilitation will be lost.

In May 2001, the Guyana Rice Development Board (GRDB) co-ordinated the preparation of a Strategic Plan for the Rice Industry of Guyana. The strategy, which was formulated by a representative group of key stakeholders from the rice industry, adopts an integrated approach to the development of rice production and processing, and includes the above components, i.e. D&I rehabilitation, improved MOM, introduction of new varieties, quality seed production, and enhanced research/extension. The 10 year plan envisaged "an integrated, sustainable, and profitable industry producing and marketing rice for the benefit of Guyanese people".

6.4 Rice Research and Extension Action Plan

In 2003, the Rice Research and Extension Action Plan was formulated by IDB consultants in close co-operation with the GRDB and the Rice Producers Association (RPA). This action plan comprises the following five components:

- Variety improvement;
- Crop management;
- Technology transfer;
- Seed production; and
- Institutional strengthening.

6.4.1 Variety Improvement

The main aim of the variety improvement component is to ensure that Guyana has good access to sources of high yielding rice varieties, suitable to the country's agro-ecological conditions, which could be widely adopted by farmers. At present, two groups of rice varieties are available for commercial production in Guyana: (i) extra long grain types of Rustic germplasm, and (ii) a long grain type (BR 444) selected from a CIAT cross. The present breeding programme at the Burma Rice Research Station is heavily biased towards extra long grain varieties. These Rustic genotypes are historically low yielding and were developed in the USA prior to the development of the high yielding, semi-dwarf genotypes. There is also no economic advantage to this breeding strategy as Guyana does not receive a premium for extra long grain in the European market, and there is no evidence that the Latin American and Caribbean markets are willing to pay higher prices for this type of rice. Greater focus should therefore be given to development of long grain varieties as improved germplasm is readily available in many Latin American countries.

It is therefore proposed that GRDP join FLAR (Latin American Fund for Irrigated Rice). FLAR is a rice producers association, funded mainly by member countries, which provides germplasm and improved rice production technologies to its members. FLAR also provides training facilities for professional and technical staff. FLAR's present programme includes: (i) provision of wide access to a germplasm bank (containing about 1,960 entries); (ii) plant breeding to ensure the continuing development of new varieties that combine high yield, pest/disease resistance, and good grain quality; (iii) crop management to ensure more rational and efficient use of inputs; (iv) market intelligence to identify and exploit trends in traditional and new markets; and (v) institutional strengthening to maintain viable national organisations for cost effective rice development.

At present, Guyana does not have the resources or professional/technical staff to implement an effective rice research programme in isolation. By joining FLAR, Guyana will be able to undertake more cost effective research and technology transfer. Guyana would immediately benefit from access to elite germplasm as well as improved crop management technologies. FLAR will also enable GRDB to upgrade the technical skills of its research staff, especially in plant breeding, plant pathology and crop management.

The variety improvement component will therefore comprise: (i) joining FLAR; (ii) staff training; (iii) accessing and testing elite germplasm; and (iv) vehicles, equipment and materials.

6.4.2 Crop Management

The crop management component aims to address the need to improve rice cropping practices, following the rehabilitation of the D&I infrastructure, the upgrading of MOM, and the introduction of new rice varieties. Under this component, proven and sustainable rice production technologies will be introduced and tested under field conditions in close collaboration with farmers and extension staff. Special attention will be given to: (i) integrated pest management techniques, (iii) increasing the low efficiency of fertiliser use; and (iv) water management and (iii) improving weed control.

It is also important to note that lack of suitable germplasm is not the only reason for the low levels of rice productivity in Guyana. The present rice varieties have a genetic potential in excess of 6 tonnes per hectare but, due to inadequate cropping practices (e.g. poor water management, inefficient crop nutrition, poor seed quality, and inappropriate pest control methods), this potential is rarely attained. The yield-gap is also substantial with on-farm trials achieving an average yield of 35.2 bags/acre (5.54 tonnes/ha) which is 43% higher than the national average of 24.7 bags/acre (3.88 tonnes/ha). Consequently, without the adoption of improved crop management practices, the introduction of new varieties will only produce marginal increases in yield and so the genetic potential will be not be realised. Improved crop management practices are therefore an essential prerequisite to the successful introduction of new rice varieties.

The types of crop management practices which could be introduced include improved land preparation techniques, alternative planting systems, more efficient fertiliser application, effective weed control techniques, integrated pest management, improved water management, better harvesting techniques, and more appropriate post-harvest handling, drying and storage methods. During the initial two to three years of the programme, it is envisaged that attention will be focused on improving crop management practices for the existing varieties and production systems. However, during the last three years, varieties with greater yield potential should become available and so cropping practices will have to be adapted to meet their specific requirements.

In the long term, however, it is apparent that there may have to be more significant changes to the rice production system. There is considerable evidence that the present intensive cropping system (i.e. two crops per year), which involves puddling and water seeding, may not be capable of sustaining high productivity. Intensive irrigated rice cultivation and puddling have some profound negative effects on soil chemical and biological processes, e.g. slowing the rate of humus decomposition and soil nitrogen mineralisation. To address these yield limitations, alternative systems have to be developed which suit the local agro-ecological conditions. For example, dry land preparation (for at least one crop per year) could be introduced and tested. A shift to dry land preparation and seeding also permits other techniques, such as no tillage cultivation, to be explored.

This crop management component will therefore include (i) staff training, (ii) station and on-farm verification trials, and (iii) vehicles, equipment and materials.

6.4.3 Technology Transfer

The main objective of the technology transfer component will be to significantly improve the extension service and to strengthen the linkages between research, extension and farmers. At present, extension officers (from GRDB and RPA) are almost exclusively focused on seed production and certification, while researchers have be unable to provide the extension service with a supply of new production technologies to transfer. The rice extension service currently employs 9 full time extension officers from GRDB (including the Extension Manager) and 16 officers from RPA. However, few officers have sufficient training, transport and organisational support to be effective. Most officers are also unaware of modern, high yielding crop production practices.

Immediate priority should therefore be given to organising the service, training extension officers, and preparing/initiating a programme to bridge the current yield-gap using proven technologies. Technical support would be provided by FLAW. To increase the effectiveness of technology transfer, it is envisaged that the programme would establish local farmer groups to target the extension messages. These groups will then assist in farmer-to-farmer exchange to disseminate information on new techniques. Group activities will include field days, farmer meetings, and visits to on-farm trials. Demonstration plots, comprising the improved production packages, will also be established. Initially, the programme will be focused in Regions 3, 4 and 6 but will later extend throughout the country.

These traditional extension techniques will provide a sound basis for technology transfer but, in Guyana, far greater use could be made of the mass media, i.e. television, radio and newspaper/magazines, to disseminate information on new rice production techniques. Greater consideration should therefore be given to these effective, but less expensive mechanisms, to widely distribute extension messages.

The technology transfer component will therefore include: (i) research and extension staff training; (ii) establishment of on-farm demonstration plots; (iii) establishment and support of farmer groups, and (iv) vehicles, equipment and materials.

6.4.4 Seed Production

The availability of good quality, certified seed is a fundamental requirement of a high yielding rice production system and is absolutely critical to the establishment of a profitable rice industry in Guyana. Without access to quality seed, efforts to improve crop management and introduce new rice varieties will have little impact. The seed production component therefore aims to significantly enhance the production of good quality, certified seed.

At present, GRDB produces foundation seed and some commercial seed at the Burma Rice Research Station (BRRS) in Region 4. GRDB seeds are then either distributed to farmers for multiplication or to RPA and MMA which have developed their own seed production programmes. In total, about the existing seed production facilities supply about 25% of the national seed requirements.

Under the seed production component, the GRDB would construct two seed production facilities (in Regions 3 and 6), each with an annual capacity of 20,000 bags. These facilities will then be leased out to independent operators, e.g. RPA, on a long term cost recovery basis. This component will also improve

and extend the seed certification system within the Quality Control Unit of GRDB. Technical assistance will also be provided in: (i) design and construction of seed processing facilities, and (ii) seed plant management and certification. Training will also be provided for local seed plant managers, plant operators and seed certification staff.

The long term aim of this component is to expand the demand for good quality, certified seed to a level which would be sufficient to attract private investment. This will then lead to the development of commercial seed production in Guyana.

The seed production component will therefore include: (i) construction and commissioning of two seed processing facilities; (ii) technical assistance; (iii) staff training, and (iv) vehicles, equipment and materials.

6.4.5 Institutional Strengthening

The main objective of the institutional strengthening component is to enhance the organisational capacity and facilities required to implement the Rice Research and Extension Action Plan and to ensure that the programme is sustainable. The organisational structure of the BRRS, and the management systems/procedures operating within the research and extension services, will be rationalised and improved. This will include variety management/release, research and extension planning, human resource development, reports/publications, and administrative support. In addition, this component will also address the issues of: (i) GRDB funding, (ii) salaries of research staff and extension officers. Finally, provision has been made for the upgrading of the buildings, laboratories, vehicles and equipment at BRRS.

6.4.6 Preliminary Cost Estimates

The Rice Research and Extension Action Plan includes detailed costs for each component, but these have yet to be agreed and finalised by the GoG and IDB. The preliminary cost estimates, totalling G$693.7 million (US$3.47 million), are presented in **Table 6.1**.

Table 6.1 Rice Research and Extension Action Plan – Cost Estimates

Component	Cost Estimate	
	G$ million	US$
Variety improvement	137.5	687,250
Crop management	88.1	440,650
Technology transfer	124.3	621,410
Seed production	224.2	1,121,000
Institutional strengthening	119.6	598,000
Total	**693.7**	**3,468,310**

Source: Rice Research and Extension Action Plan (Draft), 2003

It is envisaged that the overall plan will be implemented by GRDP, in collaboration with RPA, over a period of six years. The programme is expected to cover all rice producing areas in Guyana, so the investment cost per acre is estimated to be about G$4,625 (i.e. G$693.7 million programme for the national rice area of 150,000 acres) or US$57 per hectare.

Given that the potential long term financial, economic and social benefits of this programme far exceed the relatively modest investment cost, it is strongly recommended that the Rice Research and Extension Action Plan forms an integral part of the IDB funded Agricultural Sector Support Programme.