

## O&M Plan for Irrigation Schemes

### Management System for Irrigation Operations and Maintenance

#### Organisation

The proposed irrigation schemes are on communal lands, under the jurisdiction of Rural District Councils. The land therein is communally owned, though legally owned by the State, with no title but simple unwritten, usufructual rights that are established by traditional practice. The Irrigation Scheme is established by villagers voluntarily bringing together their pieces of land through adoption of a constitution. The constitution provides for members to elect an Irrigation Management Committee which is mandated to manage the scheme to achieve their set goals. One of the major goals of the Scheme is to ensure sustainability through maintenance of the communally owned infrastructure, so that it is functional, efficient and in compliance with relevant standards. To achieve this objective, the IMC shall have an Operation & Maintenance (O&M) Plan to ensure the maintenance of the infrastructure. **Error! Reference source not found.** below details the organisation and interactions of the Scheme and service providers in the execution of the strategy.

#### Basin Management Committee

Chairpersons of the IMCs in the same catchment will form a Basin Management Committee (BMC) with the purpose of coordinating operations of all the irrigation committees. There is an opportunity to synergise activities of irrigation schemes within the same basin to leverage economies of scale when marketing or contracting specialist service maintenance companies. The technology and infrastructure to be installed at the various sites will be similar and it provides an opportunity for negotiating better rates with service providers. The BMC will also act as an interface with government agencies hence provide an opportunity for lobbying government support. The BMC forum will also provide an opportunity of experience sharing, lesson learning and cooperation in achieving sustainability of the programme.

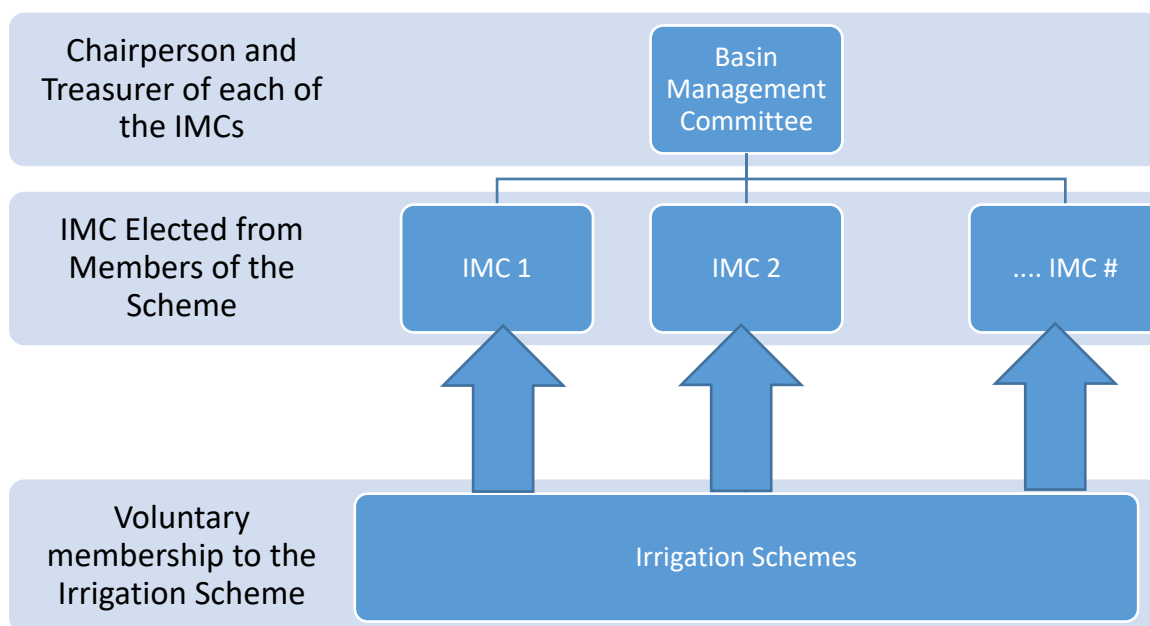


Figure 1: Basin Irrigation Management Organisation

### Irrigation Management Committee

The IMC shall provide consensus-based leadership and decision making on behalf of the Scheme to achieve the set goals of the scheme. They shall be responsible for the implementation of the O&M Plan. To embed sustainability, the IMC will also appoint subcommittees to produce specific outputs of the O&M Plan and coordinate the various outputs to achieve the goals of the Scheme. The IMC shall appoint small subcommittees to drive the various components of the O&M Strategy namely:

1. Finance Sub-committee
2. Marketing Sub-committee
3. Irrigation O&M Sub-committee

#### Finance Sub-committee

The Constitution allows for creation of an O&M Fund, also referred to as the Maintenance Fund (MF), from member contributions. The amount is set from a budget of financial requirements for a set period, generally yearly. The Finance sub-committee is responsible for the fiscal management of the Scheme, including the MF. The committee will collect on behalf of the scheme member contributions and any donations that may be received. They shall make sure the funds of the scheme are banked and properly accounted for. The committee will also make sure centrally procured inputs are procured and distributed to the farmers in time to make sure high yields are achieved.

#### Irrigation O&M Sub-committee

The Irrigation O&M sub-committee is responsible for the day to day operations of the scheme including irrigation scheduling and making sure all repairs and maintenance works are attended to timely. The committee will respond to member reports of operational problems by providing guidance on how to deal with the problem. They achieve this by being the interface with service providers such as Irrigation Specialists Companies, Solar Power Specialists and Government agencies who can provide technical assistance. The committee on behalf of the IMC will make sure maintenance activities are carried out in accordance with the plan. The committee will also make sure service agreements and warranties are in place as detailed in the operations and maintenance plan.

#### *Marketing*

The Marketing sub-committee is responsible for the marketing of produce from the scheme. The committee will liaise with seed houses, out-grower contract providers, and agro-processing companies to make sure there is a market for all the produce. It is imperative to secure good markets for produce to ensure long term sustainability of the scheme. It is proposed that all produce will be sold communally to enhance economies of scale and leverage better pricing .

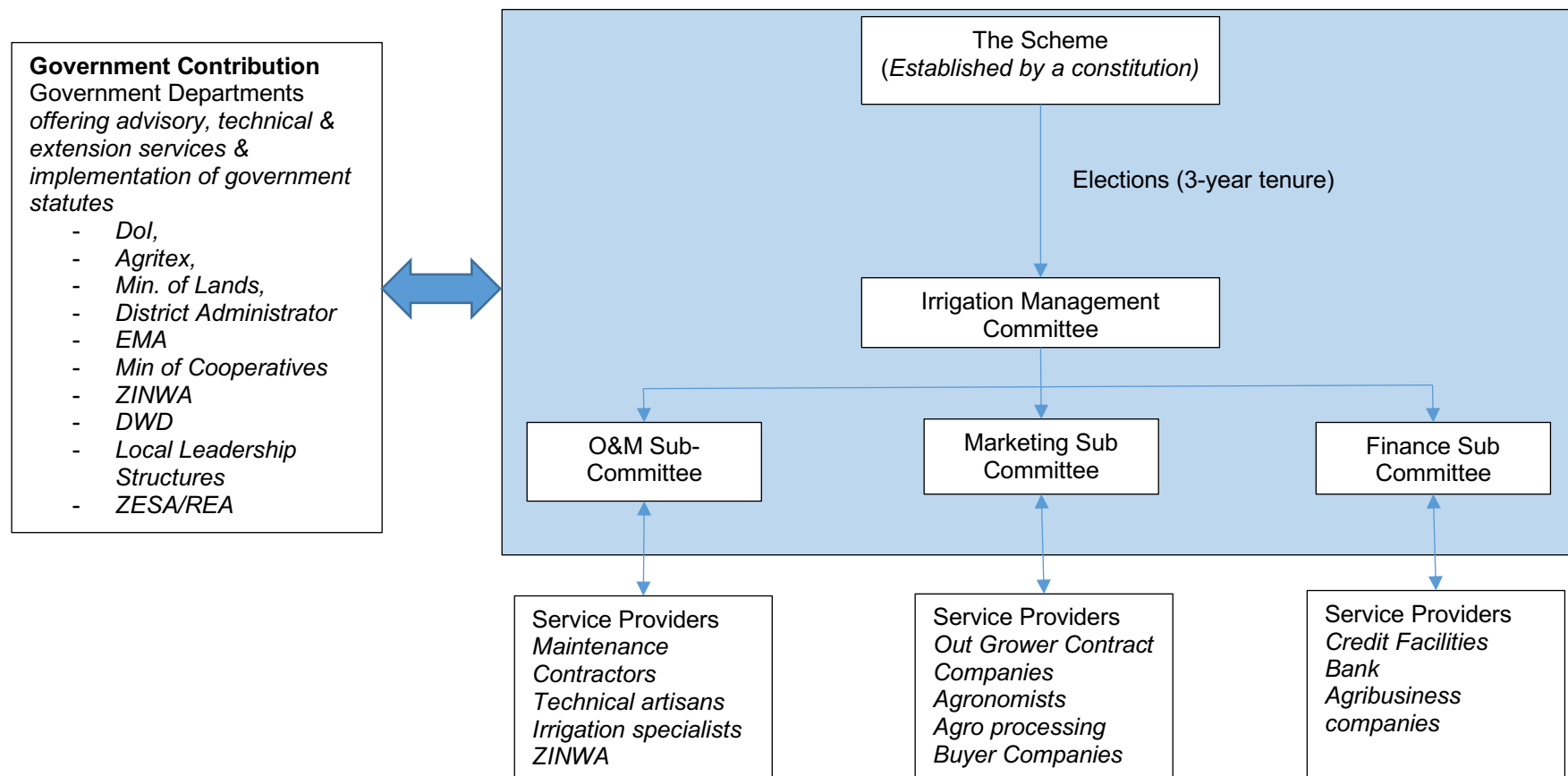


Figure 2: Organisation of the O&M+R Strategy

## Aims and Objectives of the O&M Plan

Operation and maintenance (O&M) are crucial for the sustainable running of the scheme leading to better water use and hence improved agricultural output. The two, O&M and agricultural productivity, have a cause effect relationship, that is, the sustenance of the one depends on the reliable performance of the other.

The aim is to achieve uninterrupted irrigation through better maintenance management at a low cost. Another aim is to maximize plant and equipment efficiencies and effectiveness, to achieve targeted rates of return on investment.

The principal objectives of the O&M Plan are:

- a) To ensure irrigation at minimal losses (leakage management and optimal collective cycles)
- b) To extend the useful life span of the irrigation infrastructure, through periodic maintenance routines
- c) To increase availability of installed equipment,
- d) To ensure the safety of people (personnel) using such equipment,
- e) To avoid exorbitant expenses on repair of equipment which might occur if the same equipment is not maintained.
- f) Develop an O&M Budget

## O&M Strategy

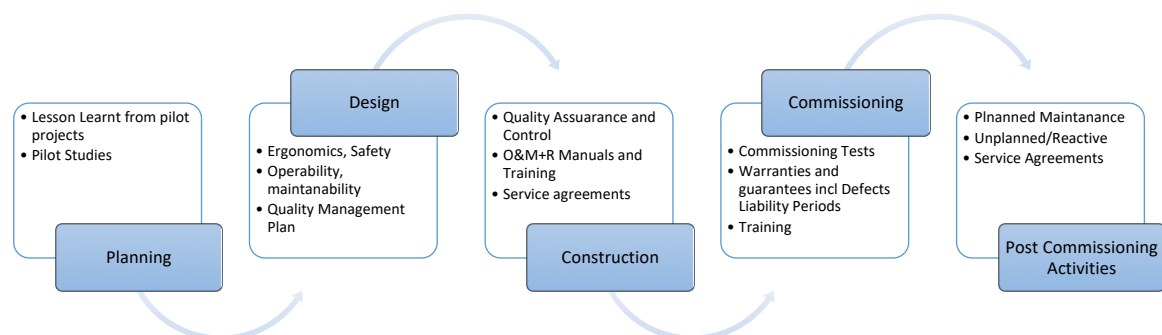
The objective of the strategy is to design ongoing operations and maintenance (O&M) and establish a system for measuring and tracking success. A key part of the strategy is to define roles and responsibilities and ensure responsible party carries out their O&M duties. O&M is broken into the following three (3) levels of interventions:

1. Pre-Commissioning Activities
2. Post Commissioning Farmer Level Activities
3. Post Commissioning Technical Level Activities

### Pre-Commissioning Activities

The O&M+R strategy will include a full robust quality assurance system in planning, designing and construction phases of the scheme. The strategy will thus be considered even at the planning stage to make sure the infrastructure being developed is designed in such a way that O&M is easy to implement.

At this stage, the following issues shall be considered:



*Figure 3: Pre-commissioning O&M+R Activities*

### *Planning*

The design team will draw lessons from projects recently completed in Zimbabwe and other developing countries to improve operation and maintenance design considerations. The designer will interview users, review records, observe users and carry out analysis of current systems to identify areas of improvement. There will also be an assessment of the competence levels of the beneficiaries to determine the level of complexity of the operations and maintenance activities. Most of the irrigation schemes are in a rural setting and will be operated by minimally trained personnel. The equipment should thus be easy to operate. The type of warranties, guarantees, insurances to be built in the procurement contract budgets should be clearly identified. At this stage, the design team will also allow for an O&M+R training budget, including continued training during warranty periods (e.g. Defects Liability Period)

### *Design*

The design processes shall include the O&M+R plans as part of design considerations. Whole life costs will be utilised to select the best design and system configuration. The following are key issues considered during design:

- Robust design
- Ease of operation by utilising packaged systems with push button approach interface
- Ease of maintenance by utilising remote monitoring by use of GSM technology or Internet by Specialist service providers.
- Develop O&M+R training requirements to be built into the contract
- Quality Management Plan
- Specification of contract warranties and guarantees for solar system components and other plant installations.

### *Construction*

The construction team will cooperate in the delivery of the infrastructure to specifications. The Supervisor will implement the Quality Management Plan and perform continuous monitoring for

adherence. Quality assurance and quality control will be conducted to monitor quality on site during construction. The construction contractor will develop the following:

- Develop O&M+R materials (provide manuals, training aides, tools and spares/consumables)
- Provide O&M training to the scheme members
- Employ scheme members as a way to provide basic installation and repair skills
- Provide continuous support during defects liability/warranty periods for each component
- Provide continuous training (refresher training) during defects liability/warranty periods.
- Provide documentation of system as-built drawings, equipment datasheets, warranties/guarantees for system components.
- Technology/knowledge transfer to government agencies and parastatals to be used in continued backstopping and support to the farmers.

### *Commissioning*

The commissioning process will seek to confirm that the works are providing the performance set out in the specifications. This will be done through rigorous set out testing and commissioning procedures. The Commissioning will have the following deliverables:

- Solar Commissioning Reports
- Pumping Plant Commissioning Reports
- Irrigation Commissioning Reports
- System Inspection Report – compliance with codes, standards and specifications
- Preventative Maintenance Plan
- Identification of service providers and preparation of generic service level agreements for use by the IMC
- Provision of warranties and guarantee documentation for file and use by the IMC
- Provision of tools and spares to be used during the warranty periods, including their suppliers.
- Provision of continuous training (refresher training) on a schedule to cover the warranty periods.

### Post Commissioning Maintenance

The O&M Manual will provide standard operating procedures, troubleshooting instructions, error and fault reporting procedures and contacts. The following maintenance will be considered

#### *Planned Maintenance*

- Predictive Maintenance  
Data loggers will be installed on solar inverter and VSD to collect data which will be statistically analysed to determine maintenance requirements of solar power and pumping plants. Water meters, fault reports and any repair work will be collected and analysed to assess the need for maintenance intervention. Condition surveys of components of the installations will also be used to assess the likelihood of failure due to wear and tear.
- Preventive Maintenance  
Regular planned activities will be carried out to keep the installations in good working order. These will include bearing and lubricant condition, monitor bearing temperatures, lubricant level, and vibration, shaft seal condition, electrical installation inspections and testing, panel cleaning and vegetation management.

#### *Ad hoc Maintenance*

The IMC O&M subcommittee will coordinate with various stakeholders to carry out ad hoc maintenance activities that may arise because of equipment/installation breakdown. A service agreement shall be put in place by the IMC with Specialist companies to provide ad hoc maintenance. The service agreement will provide an emergency response and recovery system.

Maintenance will be carried out by the farmers and specialist service partners with support from government agencies. The section below proposes allocation of O&M activities to various stakeholders.

### Post Commissioning Farmer Level Activities

The post-commissioning activities are farmer-driven and depend heavily on farmer buy-in and appreciation of the importance of implementing the O&M Plan. Training will be carried out in parallel to construction to make sure that once the project is complete the installations are immediately utilised. This is also to generate interest and buy-in of farmers upfront.

These activities will entail day-to-day operation of the installations. Farmers will primarily be responsible for most of the routine maintenance of the infield irrigation system of their plots. Each farmer will be responsible for activities associated with regular (daily, weekly, monthly, etc.) and general upkeep of the irrigation infield works against normal wear and tear. This include repairs to pipework in their own plots, care and maintenance of field erosion damage, hose pipes, sprinklers and hydrant valve connectors.

The IMC will appoint and supervise a pump operator on the day-to-day operations of the pump and the solar power system. The pump operator will keep records of system performance and any repair and maintenance work. The IMC and the pump operator shall liaise with local Department of Irrigation, Agritex and ZINWA for technical assistance to attend to operational challenges of the system. The government departments shall provide operational support such as advice on irrigation scheduling, pumps and solar plant troubleshooting and system monitoring.

Table 1 below details the main activities proposed to be carried under Post-Commission Member Level Activities.

*Table 1: Proposed Post Commission Member Level Activities*

<b>Task</b>	<b>Description/Details</b>	<b>Frequency</b>
Inspect and clean infield pipework	Disassemble, clean and replace infield pipework. Disassemble and clean sprinklers as needed. Perform the flushing procedure by scouring the system as detailed in the O&M Plan	Daily or when sprinkler is observed not to be operating well. Flushing the entire system may be coordinated monthly for all farmers
Inspect and carry out conservation works to combat erosion	With the advice of DOI and Agritex prepare contour ridges, gabions and other conservation works to protect the irrigation infrastructure.	After each significant rainfall event
Record operations and maintenance tasks	It is good practice to keep a daily operational log-sheet to record water production flow rates and when flushing procedures were undertaken.	Daily
Inspect and repair perimeter fencing	Regularly check the integrity of the perimeter fence, identify vermin infestation in poles, rusting, collapsing poles and repair as appropriate.	Once a year or as required.
Check infield piping and valves for leaks	Check infield piping and valve for cracks, holes or leaks. Repair as needed.	With every irrigation cycle



## Post Commissioning Technical Level Activities

Key activities of the O&M phase include the implementation of the preventive maintenance plan and unplanned major repairs. This will be implemented through a service level agreement with a Specialist Services Company (Irrigation and Solar Power). To derive economies of scale, schemes will be grouped together to have a single Service Agreement through the BMC. The BMCs role will be limited to negotiation of Service Agreements and the IMC will make sure there is provision for budgets for the O&M activities and approving and monitoring the expenditure thereof. DOI and ZINWA will assist the BMCs and IMCs with the administration of Service Level Agreements with various service providers.

The Specialist Services Company and the IMC will cooperate in enforcing and maintaining warranties, tracking the maintenance schedule (including repair and replacement), reporting and attending faults to the relevant party and record keeping. The IMC's administrative role includes maintaining a list of suppliers of spares and services and, procurement thereof. Records for materials, spares and tools in stock will also be maintained and updated as and when required.

Government agencies and departments have committed to provide support to the IMC in the form of:

- ongoing technical backstopping to the IMC and the farmers
- continued O&M+R training to the scheme
- assistance to farmers in improving technology – updating irrigation methods to cope with changes due to climate change and technology
- conservation works support
- technical assessments of faults and or equipment problems for engagement with Specialists Services Companies.
- engineering support services such as irrigation scheduling
- maintenance workshop services where possible
- technical support on procurement of replacement spare parts

The major activities to be carried out under this activity are detailed below in Table 2 Operations and Maintenance and Table 3 Repair and Replacement.

*Table 2; Proposed Post Commission Technical Level Activities*

<b>Task</b>	<b>Description/Details</b>	<b>Frequency</b>
Record operations and maintenance tasks	It is good practice to keep a daily operational log-sheet of key performance indicators of the systems e.g. generation capacity, fault/error reporting, pumping flow rate and any repair and maintenance carried.	Daily
Clean solar arrays	Manually clean solar arrays using non-corrosive biodegradable approved detergents and water. Detergents should only be used if there are bird droppings which are difficult to clean.	A minimum of once per year. For sites where bird droppings are common cleaning should be done quarterly. In windy areas where dust is prevalent frequency of cleaning can be increased
Inspection and testing of electrical components of the solar system	Inspection of wires, junction boxes, combiner boxes, fuses, AC/DC disconnects, service panels, string testing.	Annually or as when needed.

Inverter and VSD Inspection	Inspection and testing of Inverter and variable speed drive, checking for errors, output and performance tests. Checking compliance with warranties.	Annually or as when needed
Solar Array Inspection	Inspect all wiring of solar panels, test solar panels efficiencies and performance. Physical inspections and removal of vermin infestation and bird nests.	Annually or as needed
Security System Inspection and testing	Inspection and testing of components such as batteries, invertors, fence chargers and alarm system.	Annually or as needed
Foundations and Structural Engineering Inspection	Physical inspection of foundations and support structure of the solar array to check and repair any failures.	Every 5 years
Vegetation Management	Inspect and carry out weeding or other appropriate vegetation management. Will depend on the system size and prevailing climatic condition of the area.	Annually or as needed
Monitoring and Communication Equipment Inspection	Inspect, service and repair communication system used in remote monitoring of the solar system.	Annually or as needed
Pump performance inspection	Inspect, test and repair and optimise pump performance. Monitor Pressure gauge performance. Capacity test and pressure test of the system to confirm compliance with specifications	Annually or as needed
Check all piping and valves for leaks	Check all piping and valve for cracks, holes or leaks. Repair as needed. Inspect all openings in the storage tanks for leaks and gaps	Beginning of new crop and monthly or as needed
Training of users and Operators	Continuous training of users and operators by the construction contractor or DOI on the Operation and maintenance of the operations.	Quarterly during DLP and as needed post DLP

#### Replacement of infrastructure.

Table 3 provides the design assumptions for the replacement frequency of the irrigation infrastructure. The table details the replacement activities to be carried out under technical level activities.

*Table 3 Assumptions for Replacement Frequency of System Components*

Infrastructure type	Expected useful life	Estimated budget cost (each) USD	Funding Assumptions
Hosepipes	2 years	45	Scheme members contribution in the form of labour (In kind Contribution) and procurement of materials under Direct Contribution
Batteries, invertors, fence chargers for security system	3 years	800	Scheme members contribution from deductions from produce sales (Maintenance Fund)
Solar Inverter and Variable Speed Drive	10 years	10,000	Scheme members contribution from deductions from produce sales (Maintenance Fund)
Sprinklers	10 years	25	Scheme members contribution from deductions from produce sales (Maintenance Fund)
Pumps	10 years	5,000	Scheme members contribution from deductions from produce sales (Maintenance Fund)
Pipe fittings - valves	10 years	2,500	Scheme members contribution from deductions from produce sales (Maintenance Fund)
Solar Arrays	20 years	45,000	Scheme members contribution from deductions from produce sales (Maintenance Fund)
Pipework	40 years	Depending on pipes	Scheme members contribution from deductions from produce sales

Table 3 shows that regular replacements are expected for farmer level items such as hosepipes (two years) and technical level items for the security system (three years). Inverters and variable speed drives, sprinklers, pumps are generally overhauled or replaced every 10 years and warranties associated with such components will be made to cover this period where possible.

Solar arrays will decrease efficiency by 15% by year 20 and instead of removing completely the panels and replacing all of them, it is proposed to simply add an additional 15% of solar power in year 20. It is important to continually assess the viability of decommissioning of the solar arrays and selling them off to domestic users and replace with new ones. The continued development of solar technology and continued price reduction will be key factors to monitor on the best way to address the reduction in capacity of the solar array.

### O&M Funding

The provision of irrigation services will be funded by farmer contributions, which will engender ownership and commitment to securing irrigation for the scheme members. The contribution would be in the form of :

- Seasonal financial contribution to the communal maintenance fund (Maintenance Fund (MF))
- Direct procurement of individually owned infield equipment spares (Contribution for Own Equipment (COE))
- Provision of labour to attend to O&M activities. (In-kind Contribution (IC))

The financial contribution will be proportional to the land available to each farmer to promote equity, however, the fund shall be utilised communally. To avoid potential conflicts, farmers will be allocated equally sized plots as much as possible to make sure contributions are equal across scheme members. The contribution will support basic operation needs including all irrigation activities, planned/preventative maintenance, repairs and replacement of installed facilities, etc.

The CAPEX Budget (Construction Contract) will provide a 1-year Defects Liability Period and all costs associated with maintenance will be funded from this allowance. Year One (1) of operations will therefore provide an opportunity for farmers to build up the MF in advance. The aim of contributing to the MF is to build a sense of ownership and appreciation of the O&M plan. It is not expected that farmers will have very high initial yields, as they will be on a learning curve after adopting irrigation farming. The contribution will therefore be equal for all farmers and based on estimates of total O&M financial requirements.

The IMC with advice from the Marketing Subcommittee and Government Agencies (Agritex) will carefully select the crop to be grown every season and secure market at competitive rates. The crops will be sold collectively and member contributions deducted from individual farmers payments. The contributions will be banked with the preferred commercial bank as the O&M fund.

*Table 4: Member Contribution to O&M Budget*

Description	In-Kind Contribution (IC)	Contribution for Own Equipment (DC)	Financial Contribution to Communal Fund (MF)	Total Amount
	USD	USD	USD	USD
Total O&M+R Costs for 10 years	2,779,050	1,179,800	4,050,400	8,009,250
Per year costs	277,905	117,980	405,040	800,925
Average 10 Year Total O&M+R Contribution per Farmer Per Year	47	20	69	136
Proposed annual farmer contribution to O&M+R Fund	47	21	70	138

**Error! Reference source not found.** above show the maintenance budget for 10 years and the various funding allocations. The members will fund 34% of the budget through IC and 76% in monetary terms (DC and MF). The IC works will include various infield irrigation repairs and maintenance, volunteering to be operators, repairs to perimeter fence and providing labour to technical level.

Table 5 below shows the detailed forecasts for the annual O&M costs and the infrastructure replacements for the first 10 years of the operation of the scheme.

Table 5: Irrigation Annual O&M costs over a 10-Year Period (USD)

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11
<b>Post Commissioning Member Level O&amp;M+R Activities</b>											
Bi-annual O&M Costs for infield works, land preparation, erosion control etc. @ 120 USD/ha	-	\$ 214,320	\$ 214,320	\$ 214,320	\$ 214,320	\$ 214,320	\$ 214,320	\$ 214,320	\$ 214,320	\$ 214,320	\$ 214,320
Contribution to Operator employment costs per scheme @ 225/quarter	-	\$ 18,900	\$ 18,900	\$ 18,900	\$ 18,900	\$ 18,900	\$ 18,900	\$ 18,900	\$ 18,900	\$ 18,900	\$ 18,900
Labour contribution for infield works - quantified at 30 USD~3days work for each irrigator		\$ 176,970	\$ 176,970	\$ 176,970	\$ 176,970	\$ 176,970	\$ 176,970	\$ 176,970	\$ 176,970	\$ 176,970	\$ 176,970
Annual own equipment costs for in-field works and land preparation, at 20 USD/irrigator		\$ 117,980	\$ 117,980	\$ 117,980	\$ 117,980	\$ 117,980	\$ 117,980	\$ 117,980	\$ 117,980	\$ 117,980	\$ 117,980
<b>Total Member Level Costs</b>	-	\$ 410,190	\$ 410,190	\$ 410,190	\$ 410,190	\$ 410,190	\$ 410,190	\$ 410,190	\$ 410,190	\$ 410,190	\$ 410,190
Of which:											
In-Kind Contribution (IC)	-	\$ 176,970	\$ 176,970	\$ 176,970	\$ 176,970	\$ 176,970	\$ 176,970	\$ 176,970	\$ 176,970	\$ 176,970	\$ 176,970
Contribution for Own Equipment (COE)	-	\$ 117,980	\$ 117,980	\$ 117,980	\$ 117,980	\$ 117,980	\$ 117,980	\$ 117,980	\$ 117,980	\$ 117,980	\$ 117,980
Maintenance Fund (MF)Contribution	-	\$ 233,220	\$ 233,220	\$ 233,220	\$ 233,220	\$ 233,220	\$ 233,220	\$ 233,220	\$ 233,220	\$ 233,220	\$ 233,220
<b>Post Commissioning Technical Level O&amp;M Activities</b>											
Annual O&M Costs for Solar System, est. at USD 10,000 for replacement of Solar Inverter and Variable Speed Drive every 10 years, 800 for batteries every 3 years, full replacement of solar panels after 20 years at 45,000 - divided into annual contributions.	-	\$ 74,130	\$ 74,130	\$ 74,130	\$ 74,130	\$ 74,130	\$ 74,130	\$ 74,130	\$ 74,130	\$ 74,130	\$ 74,130
Annual O&M costs for labour to maintain/clean solar system - est. at 1 day's work annually per irrigator at 5 USD		\$ 29,495	\$ 29,495	\$ 29,495	\$ 29,495	\$ 29,495	\$ 29,495	\$ 29,495	\$ 29,495	\$ 29,495	\$ 29,495
Annual O&M costs for security and fencing installations; est at 20 USD per ha		\$ 35,720	\$ 35,720	\$ 35,720	\$ 35,720	\$ 35,720	\$ 35,720	\$ 35,720	\$ 35,720	\$ 35,720	\$ 35,720
Annual O&M Costs for Irrigation Water Distribution (Pipework, reservoirs etc) excluding infield Works , est. at 20 USD worth of labour per ha	-	\$ 35,720	\$ 35,720	\$ 35,720	\$ 35,720	\$ 35,720	\$ 35,720	\$ 35,720	\$ 35,720	\$ 35,720	\$ 35,720
Annual O&M Costs for the water source (headworks etc); est. at 20 USD worth of labour per ha	-	\$ 35,720	\$ 35,720	\$ 35,720	\$ 35,720	\$ 35,720	\$ 35,720	\$ 35,720	\$ 35,720	\$ 35,720	\$ 35,720
Annual O&M Costs for Pumping Plant (estimated at 2500 USD/10 years per scheme), Pump replacement costs after 10 years est. at 5000 per pump - divided into annual contributions	-	\$ 26,250	\$ 26,250	\$ 26,250	\$ 26,250	\$ 26,250	\$ 26,250	\$ 26,250	\$ 26,250	\$ 26,250	\$ 26,250
Annual O&M spares stock replenishment, e.g. sprinklers, pipeworks; estimated at 20 USD/ha	-	\$ 35,720	\$ 35,720	\$ 35,720	\$ 35,720	\$ 35,720	\$ 35,720	\$ 35,720	\$ 35,720	\$ 35,720	\$ 35,720
<b>Total Technical Level Costs</b>	-	\$ 272,755	\$ 272,755	\$ 272,755	\$ 272,755	\$ 272,755	\$ 272,755	\$ 272,755	\$ 272,755	\$ 272,755	\$ 272,755
Of which:											
In-Kind Contribution (IC)	-	\$ 100,935	\$ 100,935	\$ 100,935	\$ 100,935	\$ 100,935	\$ 100,935	\$ 100,935	\$ 100,935	\$ 100,935	\$ 100,935
Contribution for Own Equipment (COE)	-	-	-	-	-	-	-	-	-	-	-
Maintenance Fund (MF) Contribution		\$ 171,820	\$ 171,820	\$ 171,820	\$ 171,820	\$ 171,820	\$ 171,820	\$ 171,820	\$ 171,820	\$ 171,820	\$ 171,820



Annex XIII (b1) Operations and Maintenance Plan  
GREEN CLIMATE FUND FUNDING PROPOSAL



O&M+R Cost (including in kind contribution)	-	\$ 682,945	\$ 682,945	\$ 682,945	\$ 682,945	\$ 682,945	\$ 682,945	\$ 682,945	\$ 682,945	\$ 682,945	\$ 682,945
Cumulative O&M costs	-	\$ 405,040	\$ 810,080	\$ 1,215,120	\$ 1,620,160	\$ 2,025,200	\$ 2,430,240	\$ 2,835,280	\$ 3,240,320	\$ 3,645,360	\$ 4,050,400
Cumulative Theoretical Maintenance Fund Contributions (70 USD per irrigator per year)		\$ 412,930	\$ 825,860	\$ 1,238,790	\$ 1,651,720	\$ 2,064,650	\$ 2,477,580	\$ 2,890,510	\$ 3,303,440	\$ 3,716,370	\$ 4,129,300
Cumulative In-kind Contribution (IC)	-	\$ 277,905	\$ 555,810	\$ 833,715	\$ 1,111,620	\$ 1,389,525	\$ 1,667,430	\$ 1,945,335	\$ 2,223,240	\$ 2,501,145	\$ 2,779,050
Cumulative Contribution for Own Equipment (COE)	-	\$ 117,980	\$ 235,960	\$ 353,940	\$ 471,920	\$ 589,900	\$ 707,880	\$ 825,860	\$ 943,840	\$ 1,061,820	\$ 1,179,800
Cumulative Maintenance Fund (MF) Contribution	-	\$ 405,040	\$ 810,080	\$ 1,215,120	\$ 1,620,160	\$ 2,025,200	\$ 2,430,240	\$ 2,835,280	\$ 3,240,320	\$ 3,645,360	\$ 4,050,400

## Conclusion

CRIDF experiences have proven that farmers can earn between USD 600,00 and USD 1,700 per 0.2ha plot per year. It is therefore a reasonable assumption to conservatively estimate average output per year per plot at USD 1,200. On this basis, the annual member maintenance contribution (IC+COE+MF) is USD 138,00. It is noted that the annual contribution is 12% of total revenue which is in the acceptable and recommended range of not more than 20%. The design strategy of putting O&M as a high priority allows the schemes to have a minimal maintenance downtime. The arrangement of having Service Agreements at the basin level also leverages economies of scale and subsequently lowers the maintenance costs for installation. The inclusion of year 1 maintenance costs in the CAPEX budget provides a reprieve to the farmers as they learn the new system of farming. Liaison and involvement of government agencies at the local level during design and construction of projects will build a relationship with the schemes that will ensure continuous backstopping and support.