

OPERATION & MAINTENANCE (O&M) PLAN
INVESTMENTS IN LAST-MILE CONNECTIONS, RAINWATER HARVESTING AND STORAGE, AND
ON-FARM IRRIGATION TECHNOLOGIES

1 Scope for O&M activities

The O&M Plan for the proposed GCF-funded project focusses specifically on three sub-activities undertaken under **Output 1: Enhanced water security for agricultural production for vulnerable smallholder farmers in the face of climate-induced rainfall variability and droughts**. These sub-activities help overcome barriers to water security for climate-resilient production through investments in irrigation systems and technologies, including storage and water-efficient equipment. The three sub-activities pertaining to water investments are as detailed below.

- *Sub-activity 1.2.1:* Design and construct 4,765 connection and distribution systems including installation and maintenance of irrigation equipment to cope with climate variability.
- *Sub-activity 1.3.1:* Construct or upgrade 1,159 climate-resilient ponds (based on site-specific designs construct 675 new ponds and upgrade 484 existing ponds).
- *Sub-activity 1.4.3:* Install on-farm water efficiency systems for 8,621 poor/near-poor smallholders linked to performance-based investment support (linked to Activity 2.1).

Table 1: Province wise summary of water investments undertaken in the five provinces

No	Province	Sub-activity 1.2.1: Last-mile connectivity	Sub-activity 1.3.1: Supplementary irrigation	Sub-activity 1.4.1: On-farm practices and technologies
		Length of pipe (m)	Number of Ponds	Water efficiency systems
	TOTAL	2,451,750	1159	8,621
I	Khánh Hòa province	711,150	82	710
II	Ninh Thuận province	544,950	357	2829
III	Bình Thuận province	93,000	192	649
IV	Đắk Lắk province	372,550	260	2335
V	Đắk Nông province	730,100	268	2098

2 Management system for undertaking O&M activities

The O&M plan for the project-established water infrastructure and technologies is geared towards ensuring the mainstreaming of climate-resilient best practices within the local community. Accordingly, O&M for the project will be carried out through a predominantly community-centred system, with support from Government of Vietnam.

2.1 Main stakeholders and responsible parties

The following stakeholders shall play a significant role in ensuring the effective implementation and sustainability of the climate resilient O&M practices. Accordingly, based on preliminary consultations conducted with local authorities and households, in particular the intensive consultations during 3-10 May 2018, it is quite common that households nearby share ponds/water with each other. Most households show their willingness to share some land for pond building given that they often rely on rainfed irrigation for the single cropping cycle every year. While preliminary design and locations have been mapped during the preliminary assessment, finalization of specific locations and specifications at the sites will need to be carefully studied later on at the survey as well as design finalization stage. One of recent good practices is Binh Thuan PPC's decision pertaining to the plan for building water tanks and drought-resilient ponds for the period of 2017-2020, which provide financial and technical support to poor/near poor in drought-affected areas. The Plan also promotes for the self-construction of the ponds and O&M activities by beneficiary households as well as calls for water sharing options among beneficiaries. The O&M plan for the project is centered around the following key stakeholders:

1. ***Beneficiary Households and Users groups:*** The beneficiary households, as per the target demographic of the project, will be organized into Water Users Groups for last-mile connections, Pond Management Groups for shared ponds, or single entities for individual connections or ponds. These would typically

include poor and near-poor smallholder farmers and ethnic minorities targeted by the project, of which approximately 55% are women-headed households.

- i) **Water Users Groups (WUGs):** For the shared systems, Water Users Groups (WUGs) will be set-up or existing farmer groups will be engaged. In line with best practices on irrigation management in Viet Nam (see section 5.1 of the Feasibility Study), these groups, which include the beneficiary households, lead farmers and women representatives, will a) be selected based on selection criteria established during the project period once the final mapping of beneficiaries and systems is completed as per the preliminary assessments; and b) manage their own codes of conduct and be mentored by local commune technical staff. Project activities will facilitate training of local authorities and beneficiaries who will also be mentored while establishing the WUGs in accordance with best practices. The project activities will also facilitate the development and dissemination of pictorial and local language O&M guidance notes and manuals. The Department of Agriculture and Rural Development (DARD), Irrigation Sub-department and IMC technical staff will provide on-going technical support to all households with private and shared systems and throughout the project timeframe and immediately after.
 - ii) **Pond Management Groups (PMGs):** These will be farmer-led groups comprised of gender-balanced and inclusive representation of the households benefiting from the pond established to assure the O&M of the shared ponds. To encourage ownership, the group will be assembled at the pond design finalization stage, during construction (or rehabilitation), use and management process. PMGs will be based on existing farmer interest groups, cooperatives or other community sharing mechanisms to attract active community members and build on existing farmer-to-farmer networks. The rules and regulations for the use, management and O&M of the pond will be proposed, adopted and enforced by the members themselves, through majority agreement and ensuring gender equality and inclusiveness. The establishment of the pond management groups will be facilitated by local authorities such as the Commune People's Committee in collaboration with experienced NGOs, with technical and mentoring support provided by the DARD technical staff. Please see Annex II(a) *Sub-Assessment on Water Storage and Irrigation*, linked to the Feasibility Study.
 - iii) **Single users:** These will include single households benefitting from the last-mile connections installed or individual ponds constructed under the project.
2. **Local authorities:** The Provincial People's Committee (PPCs) and, the DARDs at different levels are the governmental counterparts for the project. In addition to co-financing some project activities as well as the O&M, these entities shall be responsible for providing overall guidance and technical advice to smallholder farmers and facilitating O&M activities, particularly at the communal level. The project will provide technical assistance to Local authorities through training and mentoring to ensure climate resilient best practices are incorporated into O&M.

Other participants involved in O&M:

- Non-Government Organizations (NGOs) engaged during the establishment of various users groups and development of SOPs for climate resilient O&M practices.
- Private companies contracted for installation/execution of works shall also be required to provide demos for maintenance activities and minor repairs as part of their contractual obligations post installation of the connections for up to one-year post completion of works.

2.2 Roles and responsibilities of the stakeholders and responsible parties

1. **WUGs/PMGs and beneficiary households:** Once the WUGs/PMGs are established, they will be responsible for carrying out regular O&M activities including annual planning and fundraising meetings, which will be facilitated by the project through training and mentoring activities undertaken during the project period. They will be in-charge of daily monitoring of the water supply systems, at the household and/or village level. WUGs will need to be responsible for regular weekly monitoring of the water supply systems, including operations of last mile connections to WEIDAP systems and shared ponds, particularly during drought periods, and O&M of water saving technologies. The WUG responsibility includes minor maintenance tasks as well as distribution of water to the households from WEIDAP trunk systems and/or public shared ponds. The project will initiate and facilitate, through capacity building and peer-to-peer learning activities, continued monitoring of the availability and quality of the systems, simple O&M needs, and collection of annual O&M fees per household. The annual O&M fees will cover materials for regular minor maintenance as well as a contribution to sustain the WUG. WUGs are in charge of annual O&M planning, financial management of O&M funds, etc. Experienced NGOs will be engaged to support the organization of participatory meetings for selection/establishment of WUG/PMGs as well as provide necessary trainings to make sure this process is carried out in an inclusive and participatory manner.

2. *Local authorities:* The PPCs and, the DARDs at different levels play the role of supporting and supervising the activities of WUGs and PMGs and ensuring that agreements between farmers and groups are not disrupted. The overall role of communal PC in this case is critical to make sure no conflict will occur as a result of using shared resources. Communal PC will assign one part-time staff to work closely with WUG/PMGs on a regular basis. It also receives technical backstopping from DARD, as needed, to respond to critical events such as drought, floods.

2.3 Establishment mechanism of WUGs and PMGs

Table 2: Process for formation of Water Users Groups or Pond Management Groups:

Step 1: Preparation	<ul style="list-style-type: none"> Preliminary agreement: building and developing Water Users Groups with local authorities as well as relevant agencies and smallholder representatives/other representative lead farmers in the area. Roles and responsibilities are agreed for the different members of the Water Users Group. Consultations with related parties regarding the preliminary agreement: People's Committees, village heads, water users after sensitization on requirements and purposes of the group.
Step 2: Field survey, Registration and Grouping	<ul style="list-style-type: none"> Consultations with potential users in the field to confirm participation Households commit to participate in the groups Necessary information related to the activities of the group is communicated, groups are formally established, and a group leader is selected
Step 3: Establishment of the operational regulations of the group	<p>Ponds will be managed based on the regulations agreed to by the Water Users and Pond Management Groups; regulations are developed and confirmed by the People's Committee.</p> <p>Pond use regulations include daily ordinary management rules and management rules during conditions of water scarcity:</p> <ul style="list-style-type: none"> Ownership of ponds, water ownership in ponds Climate-risk informed pond management with bio-engineering techniques to avoid evaporation and water leaking, pond protection and safety The right to use water Priority water use rights Obligation to contribute to dredging ponds The right to share income from collateral benefits from the pond
Step 4: Completion of operational/Legal modalities	<ul style="list-style-type: none"> Establishment of landowner rights and land donations mechanism Process for estimation of the annual benefit/cost for pond maintenance and annual fees for group members Development and agreements on maintenance schedules: annual schedule and priority tasks, guidelines for coordinated dredging of ponds, funds for dredging ponds Establishment of dispute resolution mechanisms Finalization of agreements: preparation of documents, signatures and submission to communal PC for certification of agreements.
Step 5: Technical support to pond management groups - 1st training	<ul style="list-style-type: none"> Technical training on climate-risk informed water use planning, irrigation planning, production development plans Training skills in pond maintenance and operation Construction and supervision of construction during maintenance Training on financial management, revenue collection, commercialization of collateral products
Step 6: Evaluation after 1-2 years of operation	<p>For the second and/or subsequent training(s), the technical team will conduct a training needs assessment and carry out training for the pond management groups during the project period.</p>

2.4 Other project activities focused on establishing the long-term O&M framework

During the six-year implementation period, the activities undertaken will aim to establish the O&M framework, including the development of Standard Operating Procedures (SOPs), setting-up of systems, and building the capacity of stakeholders as well as smallholder farmers for ensuring the sustainability of climate-resilient O&M practices.

Specifically, the project will help establish and train the WUGs and PMGs as well as the smallholder farmers; agricultural extension workers will be trained to provide technical expertise to help farmers' groups with development, facilitation, and assistance in designing, installing, costing and ensuring the establishment of appropriate operations and maintenance systems; and farmers will be trained in planning and implementation of effective Operations and Maintenance of equipment and infrastructure, and farmers' groups will build their organizational capacities to program and manage irrigation, monitor usage, and develop O&M funding mechanisms for any community-held or shared equipment and infrastructure, including capitalization strategies. The relevant sub-activities capacitating climate resilient O&M as indicated in the proposal are as below.

1.2.3 Establishment of Water Users Groups for O&M of communal or shared systems, including potential funding mechanisms

1.3.3 Establish 185 pond-management groups for O&M, including structures and agreements on potential funding mechanisms

1.4.2 Train 30 DARD staff and champion farmers in 14 districts (one course in years 2, 4 and 6) to support farmers' groups in co-design, costing and O&M of climate-resilient, water efficient technologies

1.4.4 Train smallholder farmers in five provinces on climate-risk informed O&M of water efficiency technologies

2.5 Technical support during the project for setting up the O&M framework

During the project period, technical specialists and NGOs, will assist communes in establishing shared Water User Groups and Pond Management Groups. These hired teams will establish and codify the roles and responsibilities of the water users in the usage, management and protection of shared last-mile connection systems and pond systems, as well as formulate specific SOPs to ensure effective implementation of O&M plans.

The technical teams will develop the SOPs for management of shared pond groups:

- Assignment of pond operations management and maintenance responsibilities to beneficiary households
- Assignment of monitoring of management to local authorities through agreements among beneficiaries
- Certification of general use agreements by local authorities
- Written commitments/water user agreements will also be finalized addressing the following:
 - Daily pond management
 - Guidelines for coordinated dredging ponds, funds for dredging ponds
 - Mechanism for allocating water use in periods of water scarcity
 - Dispute resolution mechanism

3 Maintenance of Last-mile connections

Last-mile connection to WEIDAP are of two types i) connections with high-pressure and low-pressure piping systems (ring-main pipeline); and ii) connections to concrete channels with lids and open channel systems. Of these, only the high-pressure pipes (without booster pump) have relatively complex O&M, requiring detailed connection instructions and pressure testing. The remaining pipelines and booster pumps are commonly used in the area and their management and operation is relatively simple.

3.1 Maintenance tasks

The canal and ring main pipeline shall be managed by the local IMC based on a simple SCADA system including monitoring water storage in reservoirs or tanks, monitoring water levels in weirs, canals and monitoring pipe flow and pipe pressures in ring main pipes. Under the WEIDAP project a control center will be established, which will be based on the cellular network or Global System for Mobile Communications (GSM). The observed data will be analyzed and used to adjust flow releases to the main canals and flow to ring main pipe from the reservoirs.

The last-mile connections from WEIDAP to beneficiary farm plots will be managed by the farmers themselves or by Water User Groups. The project will ensure ownership by requiring beneficiary households to provide in-kind contributions of labor and use of small locally available construction tools, as part of design, construction and maintenance phases. The O&M of each system is supported by the corresponding construction companies who will instruct beneficiary farmers. O&M functions could include:

- Monitoring and maintenance of the opening/closure junctions to the main WEIDAP system
- Setting up and managing water meters (if needed by IMC)
- Flushing sediment from the piping system
- Inspection, repairs and replacement of equipment in the system.

3.2 O&M Schedule

Table 3: O&M schedule detailing tasks and frequency for activities to be undertaken

Task	Description/Details	Frequency
Flush the pipeline	Flush the pipeline to reduce the amount of sediment deposited in the pipes and valves; remove and flush valves as required.	Annual
Inspection and replacement of joints and valves	Check working condition of the joints, water control valves to ensure no leakage or damage. If there is any damage, replace immediately	Each irrigation cycle
Inspection and replacement of damaged pipelines	Check the status of pipeline operation, especially at underground buried sites if abnormal humidity is found at locations along the pipeline, or there is no irrigation flow; check meters and replace as needed.	Each irrigation cycle
Record the status of the system	Record a weekly operational log-sheet of the status of the system, what may need to be repaired and what is ready for replacement.	Each irrigation cycle

3.3 Funding of O&M activities for Last-mile connections

A total of USD 1,438,427 is expected to be incurred for O&M of last-mile connections of which, USD 152,304 will be incurred during the project period (2020-2025) and USD 1,286,123 will be incurred post project. The provincial governmental counterparts have committed to finance 40% of the regular O&M costs and 60% of the replacement costs, while the community will finance the rest in the form of cash and in-kind contributions.

- **Project period:** During the project period, no replacement costs are expected to be incurred. Of the USD 152,304 the provincial government will co-finance USD 62,920 (at 40% of total costs) towards regular O&M.
- **Post Project commitment:** The total expense of USD 1,286,123 includes costs towards regular O&M of USD 609,216 and costs of USD 676,907 towards replacement of components of on-farm technologies. The provincial government has committed to cover a total of USD 649,830 as part of the post-project O&M commitment. This includes expenses towards regular O&M of USD 243,686 (at 40%) and replacement costs of USD 406,144 (at 60%) (Refer Annex IV for details). Beneficiary households will finance a total of USD 636,292 covering regular O&M as well as replacements. Beneficiary households will finance O&M costs (cash and in-kind) for the following: checking and repairing of valves, replacement of damaged connectors clogged by the accumulation of sand in the tubes; repairing and replacement of the underground pipes damaged during excavation or construction of other works; Adjustment of the pipelines, in the event they pass through land demarcated for an alternative land-use.

4 Maintenance of water harvesting and storage facilities (ponds) in rainfed regions

O&M of the shared ponds will be assured through the establishment of farmer-led Pond Management Groups (PMGs), comprised of gender-balanced and inclusive representation of the households benefiting from the pond. The group will be assembled at the pond design stage, so they can be involved throughout the entire design, construction (or rehabilitation), use and management process. Ponds for rainwater harvesting and storage are of two types.

Private ponds (upgraded or newly built for single beneficiary households): These kinds of ponds have relatively small volumes with a capacity of less than 1000 m³ of water. These ponds are typical in the project area, and smallholders are generally already familiar with their operations and maintenance.

Shared ponds (upgraded or newly constructed for use by groups of beneficiary farmers): These ponds are designed as large-scale water storage facilities, with a total capacity of 10,000 – 40,000 m³ of water storage, depending whether they serve either a few nearby households or a village. In total the project will support 282 shared ponds with more than 15,000 estimated household beneficiaries, thus 55 households per pond on average. For such interventions, the sustainability of O&M depends on the beneficiary household ownership and commitment of the Pond Management Groups, established by the project, in cooperation with the local authorities. The PMGs will mainly be responsible for carrying out regular planned maintenance tasks for the community/shared ponds with initial support from the provincial authorities. Repairs (both minor and major) are unplanned maintenance tasks and will be additional to the regular maintenance tasks. Repairs will be carried out on an as needed basis. In addition to establishing them, the project shall facilitate the development of SOPs for climate resilient O&M and further help the PMGs explore possible funding mechanism for long terms sustainability.

During the project period technical assistance teams will also help develop simple illustrative tables that would i) enable pond users to determine the annual water balance in the ponds under specific conditions; ii) be used in monitoring water balances in ponds and proposing prospective changes to water-use requirements during subsequent planning cycles; iii) help beneficiaries define parameters for the pond design; and iv) calculate the extent of land for donation/sharing for water harvesting area that will help frame commitment forms/land agreements for vetting by the local authorities. The communal PC together in coordination with the technical consultants will formulate the implementation plan for their respective communes for submission to the project management team and the local DARD.

Table 4: Number of private ponds and shared ponds by province

No	Province	Private ponds		Shared ponds	
		newly built	upgraded	newly built	upgraded
	TOTAL	490	387	185	97
I	Khánh Hòa province	36	29	10	7
II	Ninh Thuận province	183	106	41	27
III	Bình Thuận province	66	86	18	22
IV	Đắk Lắk province	98	95	43	24
V	Dak Nong province	107	70	73	18

4.1 Maintenance tasks

Ponds will be dredged and maintained annually at the end of the dry season when ponds are depleted. Pond maintenance includes but is not limited to the following:

- (i) Maintenance of water collection system: Dredge and open rainwater and surface water collection systems
- (ii) Dredge ponds: Dredge sediment in ponds and repair land slippage
- (iii) Repair of the perimeter protection system to ensure safety
- (iv) Repair of water supply systems: ducts, pipes and pumps

4.2 O&M Schedule

Table 5: O&M schedule detailing tasks and frequency for activities to be undertaken

Task	Description/Details	Frequency
Check for pond erosion	Check for bank erosion, land slippage or risk of erosion around the pond; if serious, appropriate measures must be taken	Each irrigation cycle
Checking the water collection capacity and drainage capacity in the rainy season	Check the water collection canals and sediment filters for ponds and drainage channels from the ponds after each heavy rain and before the rainy season	Before the rainy season and after each rainy season heavy rain
Check pond storage and the need for dredging ponds	Remove sediments that have accumulated in the bottom of the pond. Be sure that all safety regulations are followed with respect to confined space entry. Dispose of sediment	Annually or as needed

	in the manner deemed appropriate by the local regulating authority.	
Check the water distribution system	Check the operational status of the pump and the suction and discharge system, ensure that the system works well and does not leak	Each irrigation cycle and after heavy rain
Water quality monitoring	Check water quality in ponds based on water color and indicator organisms in ponds. If ponds are tapped for water for domestic use, necessary tests will be carried out, as needed, by local authorities	Annually or as needed
Check safety levels of pond	Check to ensure the safety barrier around the pond is sound to avoid accidents	Daily
Record the status of the system	It is good practice to keep a weekly operational log-sheet to record the status of the system, quality and quantity of water in the ponds, actions done and priorities for next periods of time.	Each irrigation cycle

4.3 Funding of O&M activities (Ponds)

The total of USD 2,891,720 is expected to be incurred for O&M, of which USD 667,320 would be incurred during the 6-year project period and USD 2,224,400 post project implementation. These costs include only regular O&M expenses as replacement costs are not anticipated over the length of the proposed O&M plan. O&M costs for project duration will be covered by the Government and beneficiary households (local communities) with the governments contributing approximately 29% of the total O&M cost over the 16-year period (i.e up to 2035) with the remainder contributed by the local community.

- **Project Period:** Of the USD 667,320 total for O&M, the central government (MARD) will co-finance USD 193,523 and the beneficiary households will contribute USD 473,797 which includes cash as well as in-kind contributions.
- **Post project:** Of the total USD 2,224,400 costs estimated post project the provincial governments have committed to finance USD 645,076 (at 29%) with local community contributions (cash and in-kind) of USD 1,579,324. (Refer Annex IV for details)

For private (Individual) ponds, the O&M shall be financed entirely by the beneficiary households. For the shared ponds, the proportion of funding to be covered by each of the beneficiary households should be based on water usage from the ponds by the respective households. Water usage of each of the households will be monitored and determined by the Pond Management Group, which will conduct meetings to evaluate actual annual water use. Beneficiaries will decide on self-maintenance or employment of private companies, depending on recommendations by the Pond Management Groups and specific seasonal/annual conditions. Average pond maintenance cost is calculated for a period of 15 years (i.e. five years of the six-year project period, 2020-2025 and post project period of 10 years, 2026-2035) of pond use as detailed in Table 9.

Water-User/Shared-pond sure between relevant local Authority and the beneficiary households or PMGs will be negotiated and finalized. Once finalized, the communal PC will hand over O&M responsibilities to the household beneficiaries or PMGs responsible for management and maintenance of the ponds. Communal PC will direct and guide the beneficiaries with regards to mobilizing necessary resources for sustained renovation and maintenance of the ponds and rainwater harvesting systems. Over the whole process, an NGO will be engaged to facilitate participatory discussions and provide necessary technical support as required.

4.4 Critical components for sustainable O&M: Land Tenure and shared ponds ownership

The project will carry out further consultations with key stakeholders at project initiation to finalize pond siting at the communal level. Under activity 1.3, permissions from landowners in the form of land commitments shall be requested/agreed upon for the construction of shared ponds. During the initial consultations conducted most of the households with sufficient area of land have already expressed their willingness to share lands with neighbors for construction of small-scale ponds. The project will facilitate a sustainable governance mechanism for these groups, via establishment of written agreements whereby landowners will be expected to agree upon the terms of use of the shared ponds and the possible extension of use to other neighbors. The project will also establish a grievance redress mechanism to address any issues arising out of beneficiary mapping. Refer to Annex VI on safeguards.

In areas where larger scale shared ponds will be proposed, communal authorities have agreed to allocate public land available in the for of in-kind co-financing (refer annex IV) as consulted with and agreed by local authorities. Land use rights will be formally established through agreements among beneficiary communities (represented by village leaders) and communal PC.

In general, shared pond agreements will stipulate the inclusion of the following provisions:

- *Regulation regarding ownership of ponds by land owners:* Households sharing lands with neighbors or using their own land to build ponds will be owner(s) of the ponds. Apart from vulnerable groups, the project may consider participation by non-poor smallholders in communally shared ponds. This will be on a voluntary basis and involve careful consultations with relevant stakeholders at communal level. For large scale ponds on public lands, the Communal People Committee (PC) is the pond owner, and the pond is managed by a WUG/PMG involving local water users.
- *Water use rights of the shared pond:* This will be regulated in an agreement developed with technical assistance from project staff in discussion with stakeholders (local authority, WUG)
- *Rights and obligations in the implementation of annual maintenance of ponds:* Annual maintenance and dredging of ponds is a mandatory requirement to ensure sustainable water storage and efficient supplementary irrigation. Annual maintenance costs for shared ponds will be shared by provincial government and contributed to by all local beneficiary households; one group of households may be responsible on an annual rotational basis for dredging each year under supervision and support of DARD and communal PC.
- *Regulation of the right to collateral benefits from the pond* (if any) such as water for domestic use, fish, aquatic plants, etc. If there are other products from the pond beyond the primary product (water for irrigation), they will be distributed among the beneficiaries according to established ex ante agreements of the Water Users Group.
- *Agreement that water in the pond is managed based on the principle of equity and consensus.* Changes in water demand among beneficiary households must ensure the following principles:
 - Changes do not alter the water balance, i.e. do not cause water shortages during the year.
 - Changes must be agreed by all households participating in the Water Users Group.
 - Water is used economically and appropriately. Rice irrigation is not permitted.

5 Maintenance of on-farm irrigation systems

GCF financing will be applied to provide 8,621 vulnerable poor/near-poor, ethnic minority and women farmers with affordable climate resilient on-farm water efficiency technologies, which will be co-developed through a participatory process under activity 1.4 of the project.

Accordingly, during the project period,

- i) Technical specialists and local authorities will be responsible for:
 - Screening and selection of suitable applications for funding according to the prescribed framework;
 - Quick and timely disbursement of input technologies to beneficiaries;
 - Monitoring the implementation of the use of funds for the right purpose.
- ii) Smallholder farmers will be trained on climate-risk informed O&M of water efficiency technologies including minor repairs and troubleshooting by DARD/trained trainers such as lead farmers.
- iii) Demo training of farmers on O&M will also be done by the technology providers during system installation and the subsequent one-year warranty period. Households will officially cover the O&M cost themselves for post-project period.

5.1 Maintenance tasks

The most common type of repairs required for on-farm irrigation systems mainly relate to sprinklers, drip heads and control devices, which are commonly available in the local market and can be easily replaced by households.

The expected tasks towards the maintenance of the installed technologies include:

- Monitoring of the pumping, distribution and sprinkler or drip systems
- Regular checking of water quality
- Monitoring of Irrigation schedules

5.2 O&M Schedule

Table 6: O&M schedule detailing tasks and frequency for activities to be undertaken

Task	Description/Details	Frequency
Check pumping system	Check power supply, water intake and outtake for obstructions, etc.	Each irrigation cycle
Water quality monitoring	Water quality is the decisive factor in the longevity of the irrigation system – check for sediment, refuse, etc. Check water quality in ponds based on water color and indicator organisms in ponds. If ponds are tapped for water for domestic use, necessary tests will be carried out, as needed, by local authorities	Each irrigation
Check the distribution system, including pipes and valves	Check from the outlet of the pump or from the end of last-mile connection, check connection level, leakage status and buried locations	Each irrigation
Check heads of sprinklers or drips	Check sprinklers or drip lines for blockage or irregular irrigation flow and replace them immediately to ensure proper irrigation.	Each irrigation
Record irrigation schedule	Record irrigation information after each irrigation including the condition of the system to make comparative adjustments to the irrigation schedule and the volumes of irrigation water required based on experience of crop yield, source water availability and other technical guidelines.	Each irrigation

5.3 Funding of O&M activities (On-farm irrigation systems)

The total costs for O&M of on-farm technologies is estimated at USD 1,862,136 which includes USD 310,556 towards regular O&M and USD 1,551,780 towards replacement costs.

Project Period: The O&M of the on-farm irrigation systems will largely be carried out by household beneficiaries except during the one-year warranty period. In subsequent years within the project period, the suppliers will continue to provide technical support and assist with small repairs, which will only be done under their guidance. As a result, the O&M cost for on-farm technologies is expected to be minimal for the government as well as communities during the project period.

Post project period: Aside from regular O&M, the on-farm irrigation system will need to be replaced after 5-7 years, with a new irrigation system. The cost for such a replacement will be covered mainly by the household beneficiaries. However, after about 5 to 10 years, when replacements are undertaken by the beneficiary households, the entire cost of such replacements may also be paid by the government, depending upon specific criterion, through subsidies provided to the poor and near poor in accordance with the government policy¹ on support for advanced irrigation and water conservation. However, it is expected that the majority of beneficiary households will eventually manage to entirely self-fund such costs for replacements owing to their economic elevation from the poor and near poor category.

¹ Decree 77/2018 / ND-CP: Regulation on support for small hydraulic development, infrastructure and water infrastructure; Article 5. Support for advanced irrigation and water saving: support up to 50% of materials, construction machines and equipment for investment in the construction of advanced and water-saving irrigation systems for shallow plants with a support level not exceeding VND 40 million / ha;

6 Design Lifespan and replacement assumptions for water investments.

The following tables (Table 7 and Table 8) provide details on expected lifespan of sub-components for the water investments undertaken through the project and estimated major replacements expenses that are expected to be incurred post project implementation up to the year 2035. Table 7 shows that replacement costs are likely to be incurred every 3-5 years for sprinkler heads, every 5 years for valves, 5-10 years for pumps and drip heads, and every 10 years for PVC pipes.

Table 7: Assumption for the replacement frequency of the water investments

Infrastructure type	Expected useful life
1. Last-mile connections	
PVC pipeline	10 years
Valves	5 years
Pumps	5-10 years
2. Water harvesting and storage systems	
Pond embankments	10 years
Valves	5 years
Pumps	5-10 years
3. On-farm technologies	
Head of sprinkler	3-5 years
Head of drips	5-10 years

Table 8 below details regarding the replacement cycles for various water infrastructure investments, the timing of when replacement costs are likely to be incurred and the assumption for financing of such costs. Accordingly, replacements for last-mile connections and water harvesting systems are expected every 5-10 years, 7-years post project completion, while on-farm technologies will require replacement every 5 years, 5-years post project completion.

Table 8: Description of Major Repairs/Replacements

Replacements	Timing	Financing assumption
Partial replacements for last-mile connection: Pumps, PVC pipeline, valve (5-10 year expected life)	Within the 7-year post-project period	60% of costs would be provided by the Government and the remaining 40% would be financed by the beneficiary households
Partial replacements for pond supplementary irrigation: Pumps, PVC pipeline, valve (5-10-year expected life)	Within the 7-year post-project period	29% of costs would be provided by the Government and the remaining 71% would be financed by the beneficiary households
Partial replacements for on-farm irrigation devices (5-year expected life)	Within the 5-year post-project period	Cost would be covered by the beneficiary Households. Farmer are expected to be able to afford these costs five years after project completion due to the incremental income benefits occurring from the project.

7 Financial summary

The proposed O&M plan costs have been estimated for a timespan of 16 years (i.e. (2020-2035), which includes the 6-year project implementation period (i.e. 2020-2025) and a 10-year period subsequent to project completion (i.e. 2026-2035) for practical considerations. O&M activities are expected to be undertaken both during project implementation and post project completion. During the implementation period, O&M expenses will be incurred only for i) the last mile connections (1.2.1); and ii) the constructed or upgraded ponds i.e the water harvesting and storage systems (1.3.1). Post project activities, which include regular O&M and major repairs/replacement, are expected to be carried out by the respective stakeholders on a regular basis or as per the planned schedule. Post-project replacement costs are expected to be incurred based on the lifespans of the component/sub-components of the water investments which are as detailed in subsequent sections.

Financing for the O&M plan is supported entirely by the Government and beneficiary households. GCF financing will only be employed towards the establishment of the critical framework necessary for the effective implementation of the climate resilient O&M practices. In the O&M plan, costs have been estimated for a period

of 16 years, which includes the six-year project period from 2020-2025 and a 10-year period from 2026-2035, post project completion. The total costs are estimated at USD 6,192,283, of which USD 819,624 are expected to be incurred during the project period and USD 5,372,659 are expected to be incurred for the 10 years subsequent. Only regular O&M costs are expected to be incurred during the project period.

Co-financing and post project commitment: Of the total O&M outlay, USD 1,549,35 has been committed by the central and provincial governments (refer annex IV for details). Of this, USD 254,444 (cash) is in the form of co-financing towards regular O&M during the project period and USD 1,294,906 (cash) is in the form of post project O&M commitment, which includes USD 888,762 towards regular O&M and USD 406,144 to support the local community with replacement costs or major repairs.

Community financing: the beneficiary households will finance bulk of the costs to the tune of USD 4,642,932 (cash and in-kind), of which USD 565,180 will be incurred during the project period and USD 4,077,752 will be incurred post project, which includes USD 2,255,210 that will be incurred towards regular O&M and USD 1,822,543 that will be incurred towards replacement costs or major repairs. Community contributions will be in the form of cash (i.e. recurring costs for minor repairs, regular maintenance, and sharing of replacement costs) as well as in-kind (i.e. labor costs for undertaking monitoring and repairs, installation and replacement, peer-to-peer cooperative support). Community financing will be mobilized through the WUGs and PMGs that will drive the implementation and monitoring of the O&M activities.

Table 9: Summary of costs for regular O&M and replacement over a 16-year period starting 2020 to 2035.

Activity	Funding source	2020-2025 (Project Period: 6 Years)			2026-2035 (Post Project Period: 10 Years)			2020-2035 (Project Duration: 16 Years)		
		Reg. O&M	Replacement	Total	Reg. O&M	Replacement	Total	Reg. O&M	Replacement	Total
1.2: Last-mile connections	Govt.	60,922	-	60,922	243,686	406,144	649,830	304,608	406,144	710,752
	Community	91,382	-	91,382	365,530	270,763	636,292	456,912	270,763	727,675
	Total	152,304	-	152,304	609,216	676,907	1,286,123	761,520	676,907	1,438,427
1.3: Water harvesting & storage systems	Govt.	193,523	-	193,523	645,076	-	645,076	838,599	-	838,599
	Community	473,797	-	473,797	1,579,324	-	1,579,324	2,053,121	-	2,053,121
	Total	667,320	-	667,320	2,224,400	-	2,224,400	2,891,720	-	2,891,720
1.4: On-farm practices & technologies	Govt.	-	-	-	-	-	-	-	-	-
	Community	-	-	-	310,356	1,551,780	1,862,136	310,356	1,551,780	1,862,136
	Total	-	-	-	310,356	1,551,780	1,862,136	310,356	1,551,780	1,862,136
TOTAL	Govt.	254,444	-	254,444	888,762	406,144	1,294,906	1,143,207	406,144	1,549,351
	Community	565,180	-	565,180	2,255,210	1,822,543	4,077,752	2,820,389	1,822,543	4,642,932
	Total	819,624	-	819,624	3,143,972	2,228,687	5,372,659	3,963,596	2,228,687	6,192,283

Table 10 below shows the year-wise forecasts for the annual O&M costs associated with the Last-mile connection, rainwater harvesting and storage systems, and the on-farm technologies along with the infrastructure replacements at the end of the expected useful lives

Table 10: Detailed cost estimation of O&M

Activity No	Description	Funding Source	Project period (6 years)						Post project period (10 years)										Project Period Total	Post project Total	Project Duration Total
			2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	(2020-2025)	(2026-2035)	(2020-2035)
1.2	Last-mile connection construction:																				
1	Regular O&M activities including monitoring and minor repair works	Govt.		4,061	8,123	12,184	16,246	20,307	24,369	24,369	24,369	24,369	24,369	24,369	24,369	24,369	24,369	24,369	60,922	243,686	304,608
		Community		6,092	12,184	18,276	24,369	30,461	36,553	36,553	36,553	36,553	36,553	36,553	36,553	36,553	36,553	36,553	91,382	365,530	456,912
2	Replacement of key components such as pipes/pumps/valves calculated on an average annual cost basis according to the lifecycle of the respective components	Govt.	-	-	-	-	-	-	-	-	-	-	-	-	-	135,381	135,381	135,381	-	406,144	406,144
		Community	-	-	-	-	-	-	-	-	-	-	-	-	-	90,254	90,254	90,254	-	270,763	270,763
	Sub total	Govt.	-	4,061	8,123	12,184	16,246	20,307	24,369	24,369	24,369	24,369	24,369	24,369	24,369	159,750	159,750	159,750	60,922	649,830	710,752
		Community	-	6,092	12,184	18,276	24,369	30,461	36,553	36,553	36,553	36,553	36,553	36,553	36,553	126,807	126,807	126,807	91,382	636,292	727,675
	Total for 1.2		-	10,154	20,307	30,461	40,614	50,768	60,922	60,922	60,922	60,922	60,922	60,922	60,922	286,557	286,557	286,557	152,304	1,286,123	1,438,427
1.3	Supplementary irrigation																				
1	Pond upgrades including monitoring and minor repairs	Govt.	-	1,796	3,591	5,387	7,183	8,978	8,978	8,978	8,978	8,978	8,978	8,978	8,978	8,978	8,978	8,978	26,935	89,784	116,719
		Community	-	4,396	8,793	13,189	17,585	21,982	21,982	21,982	21,982	21,982	21,982	21,982	21,982	21,982	21,982	21,982	65,945	219,816	285,761
2	New ponds including monitoring and minor repairs	Govt.	-	2,274	4,547	6,821	9,094	11,368	11,368	11,368	11,368	11,368	11,368	11,368	11,368	11,368	11,368	11,368	34,104	113,680	147,784
		Community	-	5,566	11,133	16,699	22,266	27,832	27,832	27,832	27,832	27,832	27,832	27,832	27,832	27,832	27,832	27,832	83,496	278,320	361,816
		Govt.	-	8,832	17,664	26,497	35,329	44,161	44,161	44,161	44,161	44,161	44,161	44,161	44,161	44,161	44,161	44,161	132,484	441,612	574,096

Annex XIII (b) – Operations & Maintenance (O&M) Plan

GREEN CLIMATE FUND FUNDING PROPOSAL

		Comm nity	-	21,624	43,248	64,871	86,495	108,11 9	108,11 9	108,11 9	108,11 9	108,11 9	108,11 9	108,11 9	108,11 9	108,11 9	108,11 9	108,11 9	324,35 6	1,081 ,188	1,405,54 4
3.1	Maintenance of water collection system		-	2,820	5,640	8,460	11,280	14,100	14,100	14,100	14,100	14,100	14,100	14,100	14,100	14,100	14,100	14,100	42,300	141,000	183,300
3.2	Dredge ponds: Dredge sedimentation in ponds and repair landslide		-	22,560	45,120	67,680	90,240	112,800	112,800	112,800	112,800	112,800	112,800	112,800	112,800	112,800	112,800	112,800	338,400	1,128,000	1,466,400
3.3	Repair of the perimeter protection system to ensure safety		-	1,692	3,384	5,076	6,768	8,460	8,460	8,460	8,460	8,460	8,460	8,460	8,460	8,460	8,460	8,460	25,380	84,600	109,980
3.4	Repair of water supply systems: ducts, pipes and pumps		-	3,384	6,768	10,152	13,536	16,920	16,920	16,920	16,920	16,920	16,920	16,920	16,920	16,920	16,920	16,920	50,760	169,200	219,960
	Sub total	Govt.	-	12,902	25,803	38,705	51,606	64,508	64,508	64,508	64,508	64,508	64,508	64,508	64,508	64,508	64,508	64,508	193,523	645,076	838,599
		Comm nity		31,586	63,173	94,759	126,346	157,932	157,932	157,932	157,932	157,932	157,932	157,932	157,932	157,932	157,932	157,932	473,797	1,579,324	2,053,121
	Total for 1.3			44,488	88,976	133,464	177,952	222,440	222,440	222,440	222,440	222,440	222,440	222,440	222,440	222,440	222,440	222,440	667,320	2,224,400	2,891,720
1.4	On-farm practices and technologies																				
1	monitoring and repair etc	Govt.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Comm nity	-	-	-	-	-	31,036	31,036	31,036	31,036	31,036	31,036	31,036	31,036	31,036	31,036	31,036	-	310,356	310,356
2	Replacement of equipments	Govt.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Comm nity	-	-	-	-	-	-	-	-	-	-	-	310,356	310,356	310,356	310,356	310,356	-	1,551,780	1,551,780
	Sub total	Govt.																	-	-	-
		Comm nity	-	-	-	-	-	31,036	31,036	31,036	31,036	31,036	31,036	341,392	341,392	341,392	341,392	341,392	-	1,862,136	1,862,136
	Total for 1.4		-	-	-	-	-	31,036	31,036	31,036	31,036	31,036	31,036	341,392	341,392	341,392	341,392	341,392	-	1,862,136	1,862,136
	Grand total	Govt.	-	16,963	33,926	50,889	67,852	84,815	88,876	88,876	88,876	88,876	88,876	88,876	88,876	224,258	224,258	224,258	254,444	1,294,906	1,549,351
		Comm nity	-	37,679	75,357	113,036	150,715	188,393	225,521	225,521	225,521	225,521	225,521	535,877	535,877	626,131	626,131	626,131	565,180	4,077,752	4,642,932
	Grand total for O&M		-	54,642	109,283	163,925	218,566	273,208	314,397	314,397	314,397	314,397	314,397	624,753	624,753	850,389	850,389	850,389	819,624	5,372,659	6,192,283

