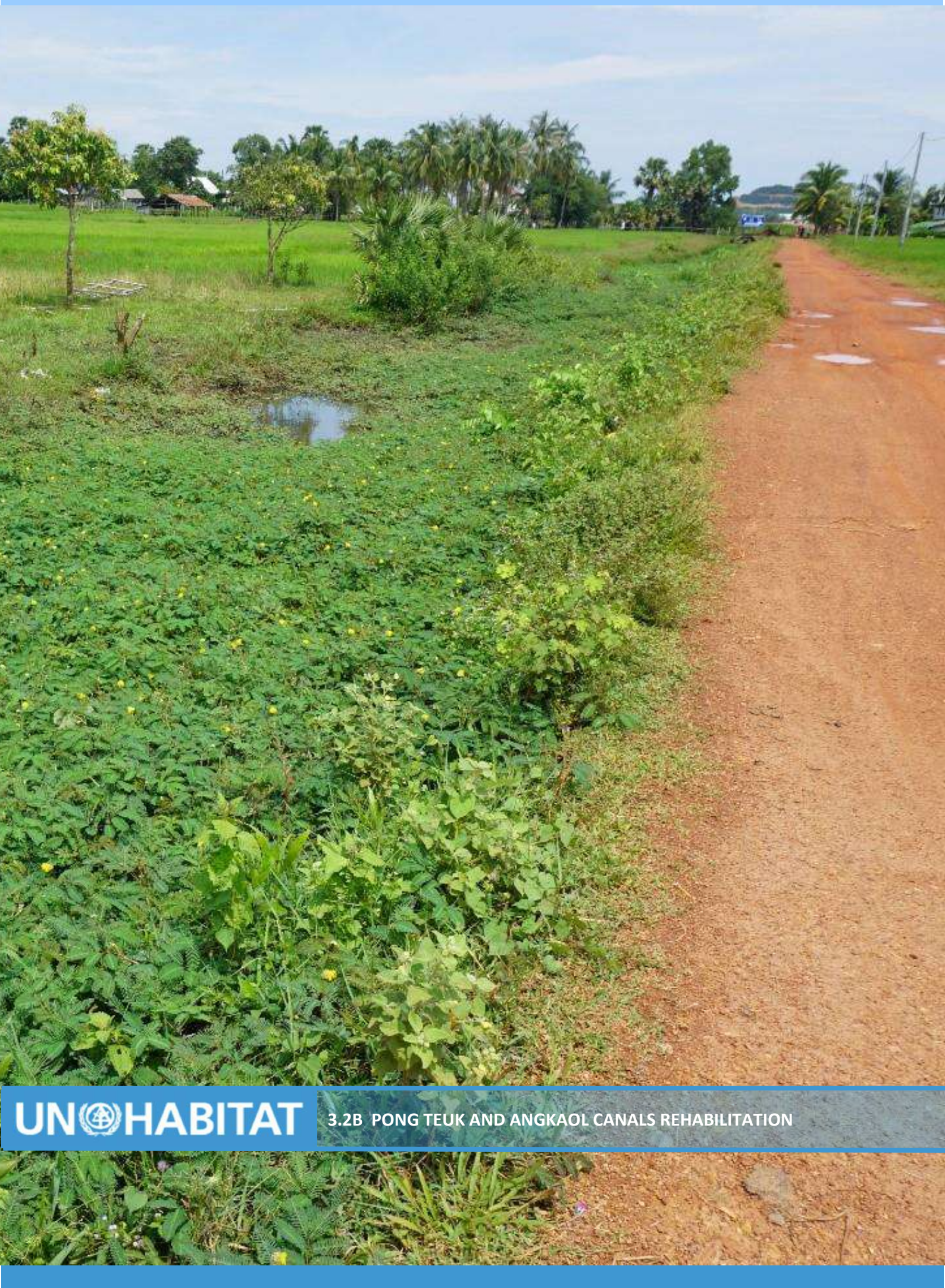


UN HABITAT

3.2B PONG TEUK AND ANGKAOL CANALS REHABILITATION

PONG TEUK AND ANGKAOL CANALS REHABILITATION

Pong Teuk and Angkaol Communes

INTRODUCTION

Pong Teuk and Angkaol Communes both have been affected by fluvial flooding due a lack of drainage capacity. Reservoirs in the communities are not well operated and the canals are silted up, which causes the capacity shortage. Besides draining during wet conditions, the canals provide an irrigation function for the rice paddy fields in the area. These canals therefore have the potential to provide year-round functionality – drainage in the rainy season and water for irrigation and domestic use in the dry season.

The canal downstream from Roness Reservoir is silted up and needs re-lining to prevent flooding in wet periods. The canals downstream from O Thmar reservoir are overgrown by vegetation as seen in the picture above.

Problem statement

Poorly maintained canals have limitations in discharge capacity therefore cause flooding in the wet season. On the other end in the dry season water designated to an area is vital for its rice production. Losses due to bad water canal management causes water shortages and crop failures in periods of drought, which are likely to become more common as a result of declining rainfall due to climate change. The communities need a more resilient approach to water management allowing them to:

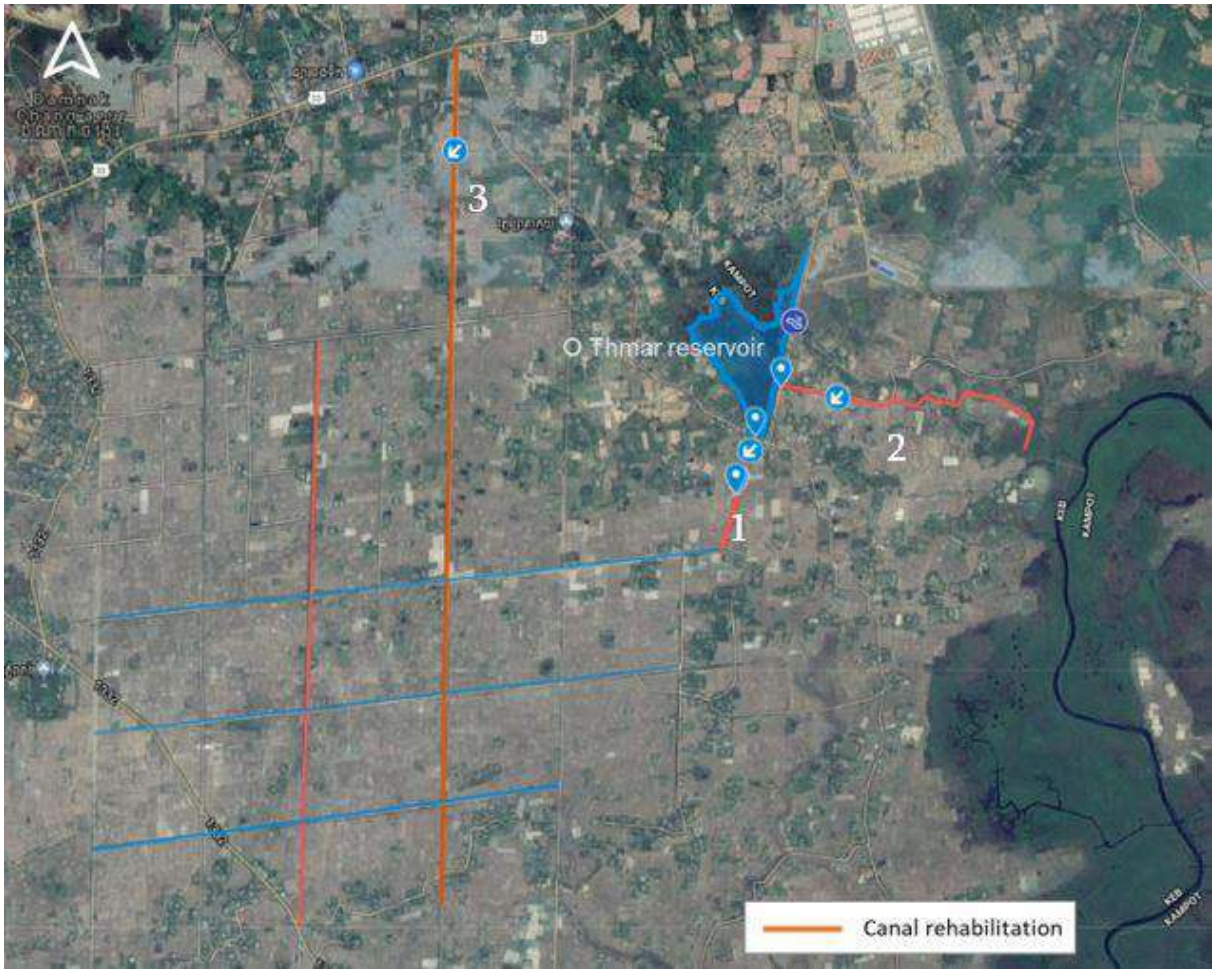
Resilience to natural hazards refers to the ability to protect lives, livelihoods and infrastructure from destruction and damage, and to the capability to restore areas after natural hazard has occurred. This project seeks to improve the resilience of the affected communes to the vulnerability low discharge capacity due to silted canals by the provision of:

- Canal maintenance and re-lining of the most silted up canals
- Capacity building on canal maintenance.

Location

The location of the irrigation channels is situated in Kep Province for both Angkaol and Pong Teuk Communes. The maps below show the locations of the canals.

Map 1 "Angkaol Commune Canals for Rehabilitation"



Map 2 *"Pong Teuk Canal Rehabilitation location"*

Beneficiaries

The group benefiting from these infrastructures is combined farmers and villagers who depend on the water as a source and the upstream living communes who rely on the canals to function as drains which discharge the excess of rainwater. The group of beneficiaries is described in detail in section 3.2a – the same people will benefit from activities under output 3.2a and 3.2b

BUDGET

Canal Rehabilitation

The cost of the canal rehabilitation is based on the total length of the three canals combined. The total length is 8,600 meters. Taking out debris with an excavator counts for the largest cost in rehabilitation of the canals. Taking out the debris can also be done by hand, using a large amount of unskilled labour. This will take more time. It is recommended in this investment to get the debris out with an excavator and start an education programme on canal maintenance. Training on canal maintenance will be undertaken as part of Output 1.3.

DESCRIPTION	QUANTITY	UNIT PRICE	COST
Removal of debris	8600m^3	$6	$51,000
Labour (unskilled)	250 days	15	$3,750
Labour (skilled)	60 days	30	$1,800
Equipment	500hr	39	$19,500
		TOTAL	**$76,050**

DATA COLLECTION

Inputs

Rehabilitation of the canals is based on the information collected during the field visit. Visual inspections showed a lack of maintenance of the canals, causing blockages of major structures such as culverts and gates. The canals should be designed based on the discharge capacity set by the orifices and sluice in the irrigation system. Visual inspection shows the following dimensions for the orifices and sluices in the O Thmar and Roness Reservoir. The canals therefore need to be designed on the maximum discharge capacity of the sluices.

	SLUICE GATE 1 SOUTH O THMAR RESERVOIR	SLUICE GATE 2 EAST O THMAR RESERVOIR	SLUICE GATE RHONES RESERVOIR
Head loss [H1]	3 m	3 m	1 m
Width	1 m	2 m	2 x 1.5 m
Height [W]	1.5 m	1.5m	1 m
Maximum discharge wet season[Q]	6.7 m3/s	12.5 m3/s	3.4 m3/s

Rainfall data is essential in understanding the behaviour of the water system. the graph below shows the averages rainfall per month for the last 34 years in nearby Sihanoukville. Over 85% of annual rainfall occurs in the rainy season from June to October.

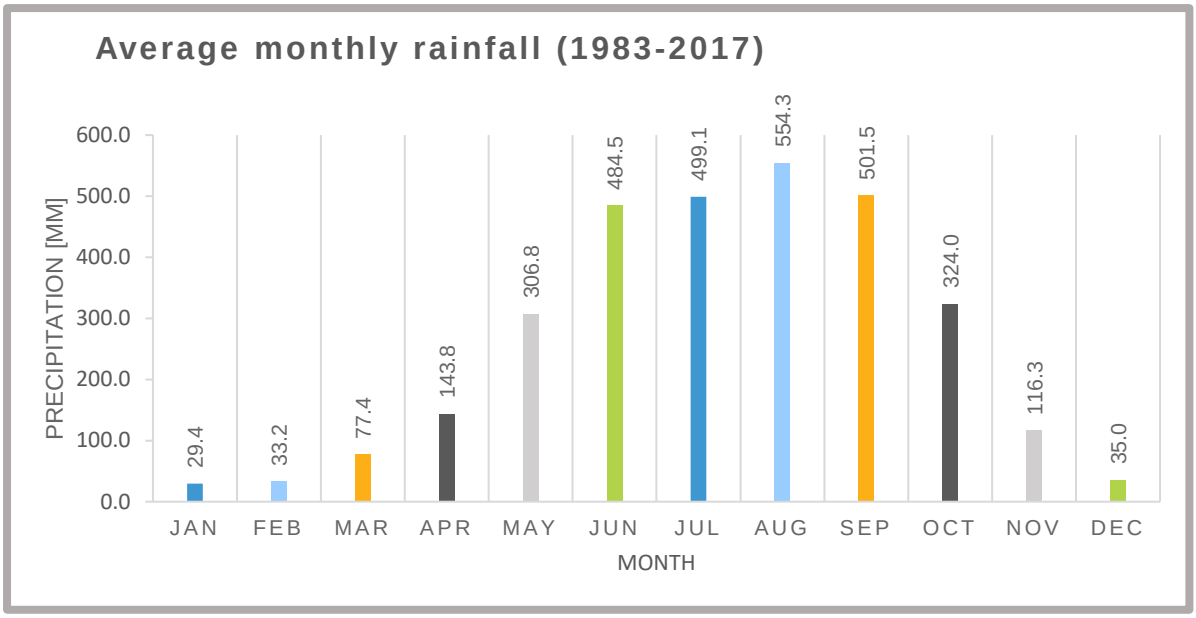


Figure 1 "Average monthly rainfall between 1983-2017 in Sihanoukville"

Based on this information we can conclude that in the dry season flows are limited to the availability of water left in the reservoir. This flow needs to be directed to the rice paddies using efficient methods – this will be supported by more effective functioning of the three targeted canals in this activity.

Consultations

The following governmental organizations and communities were consulted about the activities described under output 3.2b

17-10-2018 – Kep Province Department of Meteorology and Water Resources
18-10-2018 – Angkaol Commune
19-10-2018 – Pong Teuk Commune

Further information on the consultations undertaken to form the proposal can be found in Part II, Section H

Site Records

The canals in Angkaol Commune were shown to the proposal formulation team us by the Deputy Commune Chief. She pointed out to us that the canals are not functioning as they are supposed to. The water system is largely silted and mostly overgrown by vegetation. Providing rehabilitation of the canals in combination with an education programme such as that proposed under Component 1, output of the project can increase the resilience of the commune to flood and drought.

The canals in Pong Teuk Commune suffer from a different kind of siltation, the canals and streams in Pong Teuk are covered in solid waste. The solid waste is blocking culverts and bridges, causing floods when high water levels occur. The investment in Pong Teuk will focus on capacity building on solid waste management and canal maintenance. The streams will benefit significantly from removing the solid waste. Structural canal rehabilitation as proposed for Angkaol Commune isn't appropriate for the streams and waterways in Pong Teuk. The waterways are more natural and therefore more difficult to line. Education on maintenance of natural streams and solid waste management is therefore a more efficient approach for Pong Teuk Commune. Education on solid waste management is provided in Output 1.3 of the project.

IMPLEMENTATION

Design

The channels will be shaped like the picture below. A small area for the discharge in the dry season and widening top for maximum flow capacities which occur in the wet season.

Given the discharges generated by the sluice gates at maximum discharge capacity.

The channel slopes on both sides are preferably 1:5 and the deepened part has a slope of 1:3.

The discharge in the dry season is estimated at 1 m^3/s using a manning roughness coefficient of 0.035 for natural canals, results in a width of 0.5 m, and a water level height of 0.6 for the sluices near O Thmar. The Roness downstream flow is estimated slightly greater, resulting in a bottom width of 1m and 0.65m water level.

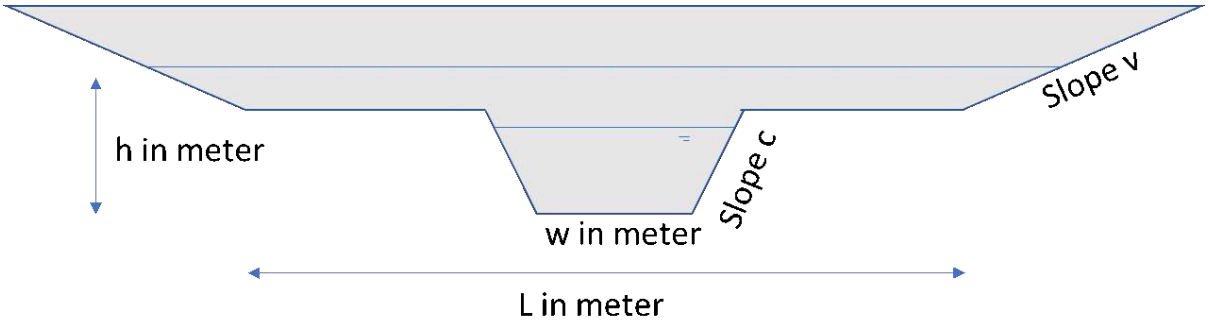


Figure 2 ***"Cross section canal periductular to flow direction"***

The canal design derived from the maximum discharge capacity is given in the table below.

	CANAL 1 O THMAR SOUTH SLUICE	CANAL 2 OTHMAR EAST SLUICE	CANAL 3 A,B RONESS DOWNSTREAM
Wet season discharge Q [m^3/s]	6.7	12.5	13.4
Wet season bottom width L [m]	4	6	6
Bottom width w [m]	0.5	0.5	1
Slope c [m/m]	1/3	1/3	1/3
Slope v [m/m]	1/5	1/5	1/3
Water level h [m]	1.2	1.40	1.4

Community Engagement

The community engagement in the water resources management on canal maintenance is particularly essential to those benefiting from this source. Maintenance on the canals will provide two main measures to become more climate adaptable. First one is the maintaining of the canals will include the removal of vegetation in and around the stream. By doing this the canal is suitable for bigger discharge volumes and therefore flooding will occur less regularly. The second advantage of the maintenance accounts for periods of low discharge volumes. In this state the infiltration and evaporation losses should be kept minimal to provide the water to the crops in the most efficient way. Removing debris, vegetation and lining the canals will improve the efficiency of water transport.

The canal rehabilitation programme is part of the capacity building subject in the proposal. Capacity building for both communities should facilitate:

- Training in solid waste management
- Training in canal maintenance combined with education on the functioning of the water system.

Construction

The following aspects need to be taken in to consideration before executing the work.

- Work needs to be done between to cropping cycles to secure water for crops
- The soil work can best be done in the dry season, to prevent washing out of extra sediments and guarantee access to any equipment.
- The majority of the work can be done with unskilled workers.

Contractor Requirements

The contractor should take into account international safety and labour regulations. For more information of the environmental and social safeguard requirements, see Part II, Section K of the Proposal, Annex 3, and the activity screening, below

Key Risks & Safeguarding Issues

The safeguarding issues are added in the table on the last page of this project sheet. One of the considerations is the accessibility of the canals to be restored, possibly access over third-party property is required. The canals itself on the other hand are situated on public land.

While rehabilitating the canals, this should be done one part at the time to allow migration of fishes and other water animals in the canal. If the discharge is continued during rehabilitation risks to damaging biodiversity can be limited.

TECHNICAL DRAWINGS

The calculation on the maximum discharge capacity (table 1) generated by the sluice gates is done by the following equation. The value used for K is highlighted in blue.

$$Q = K\, b_e w^{1.5} \sqrt{2g} = A\, w^{0.5}\, K \sqrt{2g} \qquad (8\text{-}7)$$

where the coefficient K is a function of the ratio $n = y_1/w$ as shown in Table 8.3.

Table 8.3 Coefficients for free flow below a sluice gate

Ratio	Contraction coefficient	Discharge coefficient Eq. 8-6	Coefficient Eq. 8-7	$K\sqrt{2g}$ Eq. 8-7
$n = y_1/w$	δ	C_d	K	$m^{1/2}\, s^{-1}$
1.50	0.648	0.600	0.614	2.720
1.60	0.642	0.599	0.641	2.838
1.70	0.637	0.598	0.665	2.946
1.80	0.634	0.597	0.689	3.052
1.90	0.632	0.597	0.713	3.159
2.00	0.630	0.596	0.735	3.255
2.20	0.628	0.596	0.780	3.453
2.40	0.626	0.596	0.823	3.643
2.80	0.625	0.598	0.905	4.010
3.00	0.625	0.599	0.944	4.183
3.50	0.625	0.602	1.038	4.597
4.00	0.624	0.604	1.124	4.977
4.50	0.624	0.605	1.204	5.331
5.00	0.624	0.607	1.279	5.664

Adapted from Franke 1968

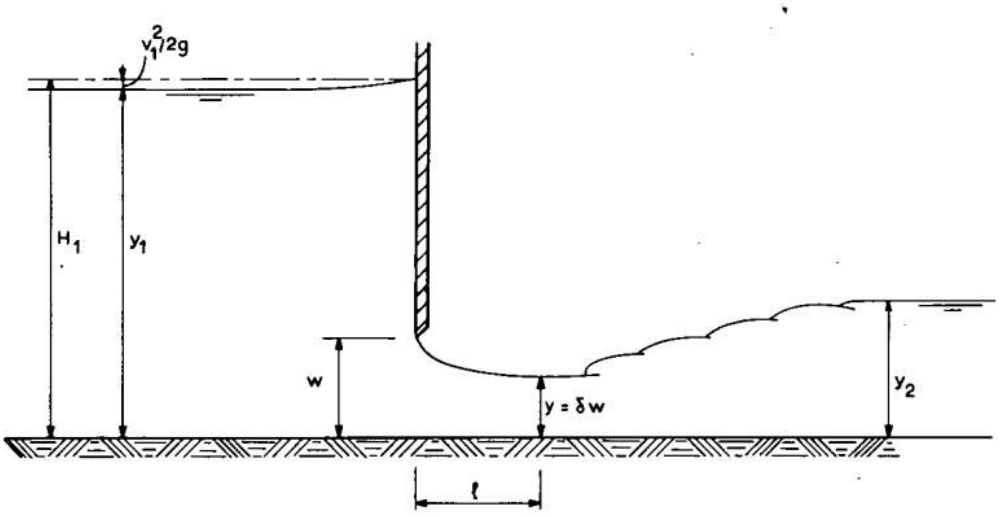


Figure 3 *"Head loss over sluice gate with w indicating the sluice gate height in m and H1 the water level above in m"*

PHOTOS

Figure 4 "Orifices 1 southern irrigation branch O Thmar Reservoir"

Figure 5 "Canal 1 situation downstream from O Thmar Reservoir"

Figure 6 "Canal 1 close to second water gate after downstream O Thmar sluice gate"

Figure 7 "Double sluice gate east O Thmar Reservoir"

Figure 8 "Silted canal downstream double sluice gate east of O Thmar Reservoir"

Figure 9 "Canal 3 downstream from Roness Reservoir"

Figure 10 "Pong Teuk solid waste in natural stream"

ENVIRONMENTAL AND SOCIAL SAFEGUARD PRINCIPLE	RISK MITIGATION ACTIONS INCORPORATED IN THE DESIGN
Compliance with the law Projects/programmes supported by the Fund shall be in compliance with all applicable domestic and international law.	The waterbodies are public land by law. Therefore no interference with domestic or international law is at stake. The investment is in full compliance with the law as detailed in Part II, Section E of the proposal.
Access and Equity Projects/programmes supported by the Fund shall provide fair and equitable access to benefits in a manner that is inclusive and does not impede access to basic health services, clean water and sanitation, energy, education, housing, safe and decent working conditions, and land rights. Projects/programmes should not exacerbate existing inequities, particularly with respect to marginalized or vulnerable groups.	The canal rehabilitation improves the water supply to the commune. With the capacity building programme included in the project in Component 1, the community can benefit from the rehabilitation even more by maintaining the shape of the canals. The program and the rehabilitation will not affect access and equity principles. The canals will not be privatised and there will be no barrier to any community members' benefit from them.
Marginalised and Vulnerable Groups Projects/programmes supported by the Fund shall avoid imposing any disproportionate adverse impacts on marginalized and vulnerable groups including children, women and girls, the elderly, indigenous people, tribal groups, displaced people, refugees, people living with disabilities, and people living with HIV/AIDS. In screening any proposed project/programme, the implementing entities shall assess and consider particular impacts on marginalized and vulnerable groups.	The improvements on the water system will not marginalise vulnerable groups. It is expected that women will gain benefit from the activity thanks to improved access to water (meaning less time and distance required
Human Rights Projects/programmes supported by the Fund shall respect and where applicable promote international human rights.	There is no evidence that the construction will impact human rights. Land rights are unaffected, as described above. Labour rights are also described above.
Gender Equity and Women's Empowerment Projects/programmes supported by the Fund shall be designed and implemented in such a way that both women and men 1) have equal opportunities to participate as per the Fund gender policy; 2) receive comparable social and economic benefits; and 3) do not suffer	The improved water management system will benefit both men and women. It will have benefits for women in terms of increased water access and women having to travel less distance to collect water.

disproportionate adverse effects during the development process.	Men and women will be given equal opportunity to provide their labour to the construction process, under the People's Process approach. Whenever women provide their labour, the project will ensure that they have access to separate bathrooms and hygienic products. All labourers (male and female) employed under the project will be given a mandatory briefing on the prevention of sexual harassment and exploitation prior to commencing their work.
Core Labour Rights Projects/programmes supported by the Fund shall meet the core labour standards as identified by the International Labour Organization.	Safety equipment will be required for workers on the site and provided for them. This activity will draw upon unskilled labour from the community. All workers in the project will be informed of their rights to organise, including joining formal labour unions, in accordance with the law. Unskilled labourers will be paid $300 per month (assuming an 8-hour working day, 5 days per week, this is 50% higher than the national minimum wage). All workers employed by the project (including under agreement of cooperation) will be aged 18 or over) See above provisions for women's labour.
Indigenous People The Fund shall not support projects/programmes that are inconsistent with the rights and responsibilities set forth in the UN Declaration on the Rights of Indigenous Peoples and other applicable international instruments relating to indigenous peoples.	The gate repair does not influence the UN Declaration on the Rights of Indigenous Peoples. There is no evidence of any indigenous people or undocumented migrants living in the target area.
Involuntary Resettlement Projects/programmes supported by the Fund shall be designed and implemented in a way that avoids or minimizes the need for involuntary resettlement. When limited	The works all involve work on public state owned land. Therefore, no involuntary resettlement is required. No one is currently occupying the land that is being used, and the

involuntary resettlement is unavoidable, due process should be observed so that displaced persons shall be informed of their rights, consulted on their options, and offered technically, economically, and socially feasible resettlement alternatives or fair and adequate compensation.	repair work on the canals will not involve flooding or any other displacement that could force the resettlement of nearby people.
Protection of Natural Habitat The Fund shall not support projects/programmes that would involve unjustified conversion or degradation of critical natural habitats, including those that are (a) legally protected; (b) officially proposed for protection; (c) recognized by authoritative sources for their high conservation value, including as critical habitat; or (d) recognized as protected by traditional or indigenous local communities.	The area where the gates are constructed is solely agricultural land. No natural habitat is endangered by canal repair works. Although accessing the terrain temporarily might be crossing private property. To prevent damage to crops, rehabilitation work needs to be planned in between cropping cycles.
Conservation of Biological Diversity Projects/programmes supported by the Fund shall be designed and implemented in a way that avoids any significant or unjustified reduction or loss of biological diversity or the introduction of known invasive species.	Rehabilitation of the canals can cause temporarily disturbance of species living in the canals. By doing the work in section and keeping the water flow at all times will limit the damage to species.
Climate Change Projects/programmes supported by the Fund shall not result in any significant or unjustified increase in greenhouse gas emissions or other drivers of climate change.	The rehabilitation of the canals will increase the resilience to flooding in the area, because the discharge capacity is increased. While the works will involve some equipment transportation, the operation of the canals will not involve any GHG emissions.
Pollution Prevention and Resource Efficiency Projects/programmes supported by the Fund shall be designed and implemented in a way that meets applicable international standards for maximizing energy efficiency and minimizing material resource use, the production of wastes, and the release of pollutants.	Resource efficiency is improved by relining the canals. The larger discharge capacity makes the commune less vulnerable to climate change and allows for more efficient resource management.
Public Health Projects/programmes supported by the Fund shall be designed and implemented in a way	The rehabilitation of the canals prevents flooding, therefore reduces chances of

that avoids potentially significant negative impacts on public health.	negative effects on public health by reducing the spread of contaminated water.
Physical and Cultural Heritage Projects/programmes supported by the Fund shall be designed and implemented in a way that avoids the alteration, damage, or removal of any physical cultural resources, cultural sites, and sites with unique natural values recognized as such at the community, national or international level. Projects/programmes should also not permanently interfere with existing access and use of such physical and cultural resources.	No cultural heritage is influenced by these works. There are no points of cultural interest, physical or intangible heritage in the area the works are being undertaken.
Land and Soil Conservation Projects/programmes supported by the Fund shall be designed and implemented in a way that promotes soil conservation and avoids degradation or conversion of productive lands or land that provides valuable ecosystem services.	Rehabilitation of the canals increases the area that potentially can be irrigated and used as fertile ground for the community. There is no evidence to suggest that land and soil conservation will be affected, and the physical works do not use any chemicals or other pollutants that may damage land or soil fertility.