

Commissioned by: UN Environment, CTCN, Adaptation Fund

Project Title: Implementation of Water-Food-Energy nexus using digital technologies for local communities in Mozambique

Proposed by: Agência de Desenvolvimento do Vale do Zambeze & Ministry of Science and Technology and High Education

Implemented by: HUB & Practica

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Deliverable: 2.2.a. Needs assessment of the future users of the technology



Implementation of Water-Food-Energy nexus using digital technologies
for local communities in Mozambique

Template for needs assessment of the future users of the technology

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This project has been proposed by Agência de Desenvolvimento do Vale do Zambeze.



With the support of the Ministry of Science and Technology and High Education



Implemented by PRACTICA & HUB



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Disclaimer

This document is an output of the Technical Assistance Response in Mozambique. The present report is the output of the project 'Implementation of Water-Food-Energy nexus using digital technologies for local communities in Mozambique'. The views and information contained herein are a product of the international TA implementation team led by PRACTICA & HUB.

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1. Introduction

This report is part of the deliverables for the project *Implementation of Water-Food-Energy nexus using digital technologies for local communities in Mozambique* project implemented by the consortium PRACTICA and HUB. The overall objective of the project is to develop a fit-for-purpose system for one selected farm in the Zambezi Valley in Mozambique that will include aquaculture, biodigester, bio composting, and hydraulic management systems (including water storage and solar pumping integrated systems for drip irrigation).

This deliverable guides the consortium in the first step of selecting favourable areas to implement technical assistance. Assessing the farmers' context and the feasibility of selecting a farm based on their needs and expectations of energy, water, animal food, and waste. With a direct impact on the size of the water-energy-food (WEF) system that will be designed.

Table 1 shows an overview of the inputs, final product and the [interest in why reason/motivation for](#) including these processes at the farm level. This table was used to explain the project's objective to the farmers at the sites visited.

Table 1. Overview of the processes involved in the technical assistance.

Process	Inputs	Final Product	Interest (reason)
Bio composting	<ul style="list-style-type: none"> Organic and animal excreta materials Water 	<ul style="list-style-type: none"> Organic fertilizer 	<ul style="list-style-type: none"> Reduce dependence on chemical fertilizing Improve of yields Improve soil at the farm level
Biodigester	<ul style="list-style-type: none"> Fresh organic material Animal manure (ruminant) Water 	<ul style="list-style-type: none"> Biogas (Metane) 	<ul style="list-style-type: none"> Reduce CO₂ emissions Reduce household expenses on charcoal or gas consumption Green energy
Aquaculture ¹	<ul style="list-style-type: none"> Water Baby fish (Alevin) Fish food 	<ul style="list-style-type: none"> Added Value fish 	<ul style="list-style-type: none"> Diversifying the diet Increase income through commercialization New products in the local and regional market
Horticulture	<ul style="list-style-type: none"> Water Seeds Fertilizer Pesticides 	<ul style="list-style-type: none"> Added value crops 	<ul style="list-style-type: none"> Diversify diet Increase income through commercialization New products in the market

¹ The consortium made very explicit the difference between Aquaculture and Aquaponics. Aquaculture as defined by FAO is the farming of aquatic organisms implying some form of intervention in the rearing process to enhance production. In this sense water can be used as a subproduct for irrigating crops. Whereas the definition of Aquaponics is the integration of aquaculture and hydroponics in which the crop roots are in direct contact with the water in which the fishes are in production. Based on the observations during the fieldwork, aquaculture exists in the area, whereas aquaponics does not.

2. Methodology

A suitable introduction of technologies requires careful assessment of the interaction and availability of various indicators, including the availability of resources, access to technologies, existing knowledge of the use of the proposed technologies, and the farmer's profile. The proposed methodology is divided into two steps to capture the multi-disciplinary data needed for this assessment.

2.1 Field mission to collect data from the preselected farms

Between ~~During~~ 17th to 24th April 2024, PRACTICA and HUB conducted a 10-day mission, ~~took place~~ to assess conditions on the pre-selected farms ~~by the~~ by Agencia. These visits verified the existence of suitable conditions, ~~s, s and identified~~ possible risks or barriers to implementing the project. The consortium created a template to assess the technical conditions ~~such as:~~ water availability (surface & groundwater), the profile of farmers doing horticulture, aquaculture, bio composting, land tenure, irrigated crops, and their agro-economic practices.

2.2 Analysis of the field information

Based on the findings from the field visit, the consortium prepared a ranking to compare the different conditions identified in the field, ~~to a which allows~~ for a comparison of the farms visited. ~~The core of t~~his report serves as a guide to select feasible farms for implementing this technical assistance. Final note: The final decision is taken in consultation with the donor (CTCN), the project proponent (ADVZ) and the consortium (Practica & HUB).

Table 2. Score rating for the farms visited during the mission.

Key components	Description
Resources/Conditions	
Water availability	Sufficient water available year-round for irrigation and livestock, good water quality and easy accessibility to water source
Livestock	Enough variety and number of livestock present at the farm, overall health condition of the livestock
Area to expand	Amount of available land for expanding the activities
Potential to share knowledge	Conditions to engage in knowledge-sharing activities (close to university/easy access/ visibility/near to other farmers)
Existing technologies	
Solar pumping	The farm is equipped with the technology (currently working or not)
Drip irrigation	
Fish pond/ Aquaculture	
Biodigester	
Biofertilizer	
Farmer's experience with the topics	
Horticulture	The farmer has proven hands-on experience (present or past) with the topic
Aquaculture	
Biogas	
Bio fertilizing	
Farmer's profile	
Professionalism	Level of commitment and dedication to farm activities, degree of care and thoroughness in farm management

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Entrepreneurship	Ability to identify and/or create, and capitalize on agricultural business opportunities
Appropriateness of technology	Ownership of new technology

3. Template to collect data per technological process

Developing comprehensive templates to collect data per technological process plays a pivotal role in this assessment. These templates serve as a systematic tool that will capture a wide array of information encompassing various aspects of the farm, its environmental conditions and technological applications. Using consistent indicators will allow the collection of high-quality data that supports informed decision-making and enhance the overall participatory process of this technical assistance. The templates have been divided into subtopics and used as a guide during the farm visits. The topics covered are:

- a) General information from the farm
- b) Assessment of water sources and hydraulic information
- c) Biocomposting
- d) Aquaculture
- e) Biogas
- f) Socio-economic data of the farm

Detailed templates can be found below, providing information collected in deliverable 2.2.c.

3.1 General

Topic	Indicator	Options	Number/estimation	
Identification	ID Number			
	Location			
	GPS Coordinates			
	Name:			
	Gender	Male		
		Female		
	Level of education	None		
		Elementary		
		Secondary		
		High school		
	University			
Age				
Years of experience in crop farming				
Contact Number				

Farm profile	Main farm activities	Livestock	
		Poultry	
		Cereals	
		Horticulture	
		Fruit trees	
		Berries	
		Others	
	Total surface cultivated		
	Off-season irrigated crop surface		
	Infrastructure	Artificial pond	
		Reservoir	
		Greenhouse	
		Storage facilities	
		Others	
	Level of mechanisation	Tractor	
		Tiller	
		Animal traction	
		None	
	Access to electricity	Grid	
		Generator	
Solar			

3.2 Hydraulic Irrigation

Topic	Indicator	Options	Trend/number/estimation
Water source used for irrigation	Type	Underground	trend
		Surface	
	Availability	Permanent	period underground / surface
		Temporary	
	Quality	Salty	trend
		Freshwater	
	Depth of water	End of the rainy season	
		Peak dry season	
	If surface water	River	number

	Stream		
	Dam reservoir		
	Pond		
	Lake		
Water infrastructure	Hand-dug well	number/estimation, trend	
	Lined well		
	Borehole		
Distance from irrigated area	in the garden	trend	
	< 20 m		
	20 m to 50 m		
	50 m to 100 m		
	> 100m		
Capacity aquifer (m3/h)	open well		
	borehole		
Hydrogeology	alluvial	trend	
	sedimentary		
	weathered rock		
	bedrock		
Feasibility manual drilling	yes	trend	
	no		
Farm profile	Organization	family	number/estimation, trend
		entrepreneurial	
		communal	
	Land right	traditional law	trend
		land title	
	Irrigable land availability	hectare	estimation
	Irrigated campaign	1 campaign	trend and period
		2 campaign	
	Risk of flooding	Zero	trend
		Moderate	
	High		
Access to finance	Poor	distinction campaign / equipment loan, trend	
	Rural finance		
	Bankloansn or subsidies		

	Level of knowledge of irrigated crops	low medium high	trend
	Market channels irrigated crops	poor medium good	trend
Irrigated area/plot	Period of irrigation	cold warm	period
	Irrigated surface	individual group	trend surface and period
	Practice of irrigated crops	poor medium high	trend
	Slope	flat low <5% high >6%	trend
	Type of soil	light medium heavy	trend
	Irrigated crops	vegetable (<45 days cycle) vegetable (> 45 days cycle) fruits Other cash crops	type, trend
	Irrigation practice	Pumping methods	manual human-powered pump motor pump solar pump
Estimated discharge of pump in use		human-powered pump motor pump solar pump	field measurement
Water application		bucket	trend

		furrow/basin (gravity)	distinction per period and method
		pipe (California)	
		hose	
		drip	
		spray	
	Frequency of irrigation	bucket	
		furrow/basin (gravity)	
		pipe (California)	
		hose	
		drip	
		spray	

3.3 Biocomposting

Theme	Indicator	options	Trend/number/estimate
Agricultural production	Agricultural System	Intensive	Mechanized
		Extensive	Traditional/lower rate of mechanization
	Type of crops	Cereals Legumes Horticulture	Area (ha)/Rainfed/irrigated
	Fertilizing	Synthetic fertilizers	Application frequencies
		Organic	Type (manure, vermicompost, biofertilizer)
		Liming (Correção-Correction), pH	Type(Lime, Gray and Plaster)
Livestock production	Type of animals	Chickens	Numbers of animal
		Cattle	
		Pigs	
		Goats or ears	
Residence	Distance between infrastructure	Home - Pharmacy - (Access to medicine for animals)	Lives on the farm
		Home - Breeding Room	House is far from the farm Breeding site is far from the agricultural field

3.4 Aquaculture

Theme	Indicator	options	Trend/number/estimate
Fish production	Professionalization of the System	Intensive	high tech
		Extensive	Low-tech system (no sensors)
	Type of fish	Tilapia	Area (ha)/Rainfed/irrigated
		Other	
	Mix		
	Food	Food	Application frequencies
Agricultural Waste		Type (crops)	
Liming (Correção-Correction), pH		Type(Lime, Gray and Plaster)	
Fish production	Type of animals	Male	Numbers of animal
		Female	
		Alevin	
Sensors	What type of sensors are in place at the farm level	pH	Availability in the area
		Temperature	Availability in the area
		Oxygen	Availability in the area

3.5 Biodigestor

Topic	Indicator	Options	Trend/number/estimation
Farm/Resources	Access to labour	0,1 FTE	Number
		0,2 FTE	
		0,3 FTE	
		0,4 FTE	
	Knowledge on anaerobic digestion	Can explain simple concept (anaerobic digestions, steps, bacteria that creates biogas)	Estimation
		Knows parameters to watch (temperature, pH, CH4, gas m3)	
		Knows hazards (H2S-Toxic)	

		components, explosion)	
		2 years of experience successfully operating a digester	
	Motivation	Willing to spend significant time studying biogas	Estimation
		Shown intrinsic motivation in the past	
		Willing to co-invest in finance	
	Tools	No tools available	Estimation
		Can perform simple repairs	
		Repairs most agricultural tools and vehicles himself	
	Access to equipment (pvc pipes, manometer, thermometer, special plastic bag)	No access to equipment	Estimation
		Simple parts are available	
		Most parts of the digester system are available	
		Digester system can be sourced locally	
	Access rural finance (approx 500-1000 USD)	yes	distinction campaign / equipment loan, trend
		no	
Digester feedstock	Manure (kg/day)	Cattle	number/estimation
		Swine	
		Goats	
		Chickens	
		Human (faecal) waste	

	Kitchen waste (kg/day)	11% dry matter (soup)	number/estimation
		18% dry matter (vegetation)	
		30% dry matter (solid waste)	
	Agricultural waste (kg/day)	11% dry matter (soup)	number/estimation
		18% dry matter (vegetation)	
		30% dry matter (solid waste)	
		80% dry matter (dry solids)	
	Harvest times per year	1 campaign	trend and period
		2 campaigns	
		3 campaigns	
	4 campaigns		
	Continuous		
Digester output	Fertiliser appliance per year	1 campaign	trend and period
		2 campaigns	
		3 campaigns	
		4campaignss	
		Continuous	
	Biogas use fluctuation	Daily	trend and period
	Weekly		
	Monthly		
	Unpredictible		
Environment	Amount of wastewater available	1:1 with feedstock	trend and period
	(Water available throughout the whole year is preferred)	1:2 with feedstock	
		1:3 with feedstock	
		1:4 with feedstock	
	Temperature regime	Seasonal	trend and period
		Constant	

3.6 Socio-economics

Topic	Indicator	Options	Trend/number/estimation
Services	Access to services	Water	
		Electricity	
		Road	
		Internet and Phone connectivity	
Land Tenure	Legpossessionion of the farm	Concession	
		Contract	
		DUAT	
		Other	
Production	Crop production in the pcampaignaing	Quantity (Tons/kg)	
	Yield of pastcampaigng per crop	(ton/ha)	
Labour	Workers (all)	Number	
	Young workers	Number	
	women	Number	
	Payment workers	MZN per day	
Market	Distance of the closer main market & location	Underground	Name for outputs, inputs and equipment available
	Available products/services (inputs)	Seeds	
		Fertiliser	
		Chemicals	
		Others	
		Advice/extensionism services	
	Available products/services (equipment)	Pumps	
		Pipes	
		Irrigation materials	
		Solar panels	
		Generator	
		Services	
Main crops value chain			