

**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

**Country:** Mozambique

**Deliverable:** 2.2.b. Minute of the on-site visit



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

### **Minute of the on-site visit**

May 2024

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



Commissioned by UN Environment, CTCN, Adaptation Fund



#### 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 provides an overview of the first field visits to gather field data from the 9 farms pre-selected by the Agencia: Tete (3), Manica (2), Sofala (1), Zambezia (3). This report provides an overview of the context of the local farmers (which will be the baseline) and assesses the feasibility of the selection of the farm based on the needs and expectations of energy, water, animal food and waste, which will directly impact the size of the Water-Energy-Food system that will be designed. This on-site visit enabled the consortium to provide a ranking of the farms for which the fit-for-purpose system will be designed.

Table 1 shows an overview of the inputs, final product and the interest in why including these processes at the farm level. The table was used to explain to the farmers in the sites visited to understand the objective of the project.

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

Process	Inputs	Final Product	Interest
Bio composting	<ul style="list-style-type: none"><li>Organic and animal excreta materials</li><li>Water</li></ul>	<ul style="list-style-type: none"><li>Organic fertilizer</li></ul>	<ul style="list-style-type: none"><li>Reduce dependence on chemical fertilizing</li><li>Improve of yields</li><li>Improve soil at the farm level</li></ul>
Biodigester	<ul style="list-style-type: none"><li>Fresh organic material</li><li>Animal excreta (ruminant)</li><li>Water</li></ul>	<ul style="list-style-type: none"><li>Biogas (Metane)</li></ul>	<ul style="list-style-type: none"><li>Reduce CO<sub>2</sub> emissions</li><li>Reduce household expenses on charcoal or gas consumption</li><li>Green energy</li></ul>
Aquaculture <sup>1</sup>	<ul style="list-style-type: none"><li>Water</li><li>Baby fish (Alevin)</li><li>Fish food</li></ul>	<ul style="list-style-type: none"><li>Added Value fish</li></ul>	<ul style="list-style-type: none"><li>Diversifying the diet</li><li>Increase income through commercialization</li><li>New products in the local and regional market</li></ul>

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<sup>1</sup> 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.

Horticulture	<ul style="list-style-type: none"> <li>• Water</li> <li>• Seeds</li> <li>• Fertilizer</li> <li>• Pesticides</li> </ul>	<ul style="list-style-type: none"> <li>• Added value crops</li> </ul>	<ul style="list-style-type: none"> <li>• Diversify diet</li> <li>• Increase income through commercialization</li> <li>• New products in the market</li> </ul>
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**2. Methodology**

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

**2.1 Field mission to collect data from the preselected farms**

During 17-24 April 2024, a 10-day mission took place to assess conditions on the pre-selected farms by the Agencia. These visits verified the existence of suitable conditions and identified possible risks or barriers to the project to be implemented. The consortium created a template to assess the technical conditions: 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 that allows to compare of the farms visited. The core of this 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
<b>Resources/Conditions</b>	
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 expand the activities
Potential to share knowledge	Conditions to engage in knowledge-sharing activities (close to university/easy access/ visibility/ close to other farmers)
<b>Existing technologies</b>	
Solar pumping	The farm is equipped with the technology (currently working or not)
Drip irrigation	
Fish pond/ Aquaculture	
Biodigester	
Biofertilizer	
<b>Farmer’s experience with the topics</b>	
Horticulture	The farmer has proven hands-on experience (present or past) with the topic
Aquaculture	

Biogas	
Bio fertilizing	
<b>Farmer's profile</b>	
Professionalism	Level of commitment and dedication to farm activities, degree of care and thoroughness in farm management
Entrepreneurship	Ability to identify and/or create, and capitalize on agricultural business opportunities
Appropriateness of technology	Ownership of new technology

### 3. Results

The mission was carried out by a group consisting of representatives from HUB, Practica and ADVZ to assess the needs of the future users. A total of 9 farms were visited in the Zambezi Valley. Visiting the provinces of Tete, Manica, Sofala and Zambezia. Figure 1 shows a map of the farms visited by the consulting team during the fieldwork.

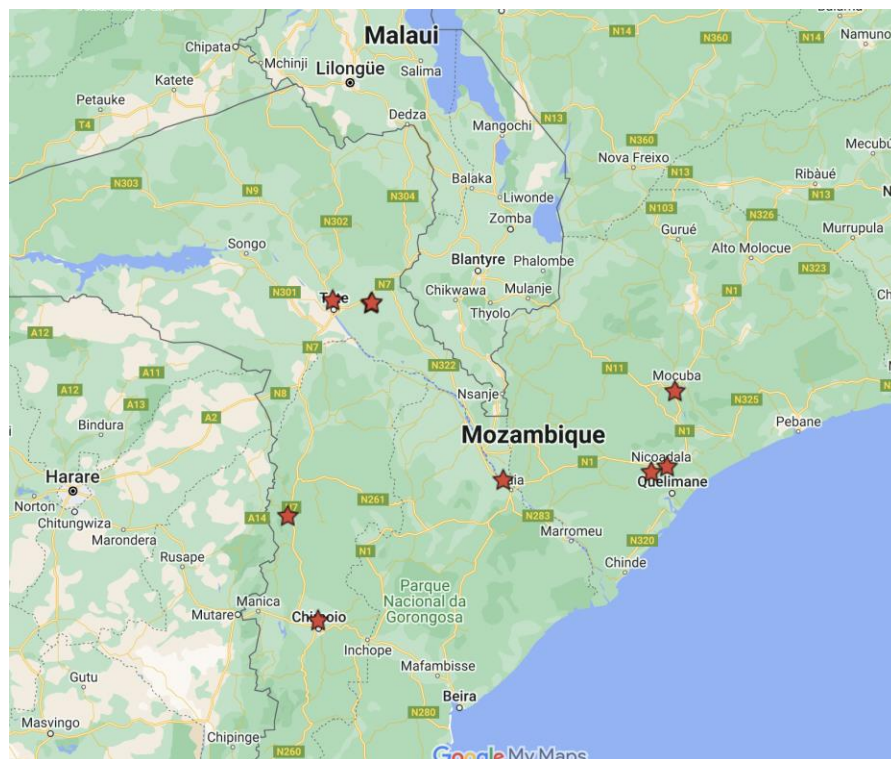


Figure 1. Map with the visited sites<sup>2</sup>.

#### 3.1 Overview description of the farms visited

A short summary of information from each farmer is presented in Table 2; more detail can be found in Deliverables 2.2.a and 2.2.c.

<sup>2</sup> Link to access the online map:

<https://www.google.com/maps/d/u/0/viewer?mid=17qFa6sboH86MplVo8t4p9StUI6eNWjA&ll=19.02485000000003%2C33.453340000000004&z=9>

Pictures of each farm can be found in the following link:

[https://www.dropbox.com/scl/fo/ulylsh0o36r4vsd6ncoda/AFQItmzDK\\_zuKRpGtir4bWo?rlkey=z8h8wua7e3rhks03aln13b9my&dl=0](https://www.dropbox.com/scl/fo/ulylsh0o36r4vsd6ncoda/AFQItmzDK_zuKRpGtir4bWo?rlkey=z8h8wua7e3rhks03aln13b9my&dl=0)

ID	Province	Name	Resources/ Conditions	Existing technologies <sup>3</sup>	Experience	Profile
1	Tete	Joaquim Ximica	Three existing boreholes, two functioning. Possibility to expand the irrigated area looks compromised due to the lack of water resources. Access to animal excreta.	Existing solar irrigation pump, water storage tanks, drip line and sprinkler, and vermicompost beds. Several technologies are non-functional or abandoned for multiple reasons	Experience in irrigated horticulture under the shadow nets. Experience with pork and chickens. Not using the excrement of pork and chickens to create bio compost.	Farm seems to have received continuous support from different projects in the past, but most of the investment remains unused. There is a lack of professionalism and appropriateness of the technologies. Lack of investment in maintenance and/or expansion of the cultivated area.
2		Joao Vinte	One borehole and a surface water source. Water quality is good for irrigating crops. Possibility to expand the irrigated land Access to animal excreta	Existing solar irrigation pump (not yet functioning), water storage tank, shadow net, and sprinkler. No access to fish pond, bio fertilizing, and biogas	Only experience in irrigating the crops with sprinkler.	Crops look in good shape, farmer takes his activities serious and is willing to invest time and money on his farm to upgrade it towards increasing the irrigated area.
3		Paulo Borges	Already two boreholes drilled with enough water to irrigate the existing shade nets. Possibility to expand the irrigated area. Access to animal excreta	Existing solar pumping, water storage tanks, shadow net, drip lines and sprinklers.	Knowledge on horticulture for commercial purposes. Currently has a contract to supply fresh lettuce to a mining company. Previous knowledge on aquaculture, understand the	He has been investing in the development of the farm, by acquiring more equipment, testing different crops and taking into account the market trends. There is a clear plan from the farmer to expand the activities, acquire more clients and have secure investments for the coming years. Openness from the farmer to expand the business to where there is demand.

<sup>3</sup> All farmers have received support from the ADVZ in the form of a mechanized borehole, a submersible solar pump, an elevated water tank, shadow net and a set of sprinklers. None of the farmers has access to biogas production technologies.

					conditions and the environment of the business.	
4	Manica	Zacarias/ Catandica Sede	Water diversion from a stream by gravity with a pipe. Water quality is good for irrigating crops There is area available to expand the irrigated land. Access to animal excreta	Existing solar pumping, shadow net, drip lines and sprinklers.	Farmer has knowledge on aquaculture, and has 2 ponds on a different farm. He currently produces for his own family consumption.	Farmer has already received a lot of support in terms on investment from different partners/projects. However, this does not reflect on the professionalism of the activities at the farm. Farmer's main activity is Litchi production (on a different location). Horticulture and livestock production is not his main income activity.
5		Domingos Tomas	Water quality is good and available (lake). The lake has never gotten dry. Shallow aquifer. Agricultural area available to expand the irrigated activities. Access to animal excreta	Several diesel pumps, and gravity and sprinkler irrigation. High potential for pumping and irrigation efficiency improvement	Farmer has knowledge on horticulture, aquaculture	The farm is in good shape, there is a professional approach towards the activities that are taking place there. The farmer takes the business seriously and is currently commercializing through different channels, mainly local markets. Farmer is open to try new technologies and has already innovated at the farm.
6	Sofala	Joaquim Xatala	Water quality is good for horticulture production. Shallow aquifer. Agricultural area available for expanding irrigated agriculture. Access to animal excreta	Petrol pump an solar pump with microsprinkler and drip irrigation, water storage tanks. Vermicompost beds. Several technologies are non-functional or abandoned for multiple reasons	Farmer has knowledge on horticulture production, aquaculture and biofertilizing (vermicompost)	The farmer has received support from different projects and has tested different technologies, but there is a lack of own investment to secure the long term sustainability of the technologies in the field. Farmer's professionalism, entrepreneurship and levels of appropriation of technology are low.

7	Zambezia	Ricardo Cesar	Shallow aquifer and surface water source. Water available is of good quality to irrigate horticulture. Possibility to expand the irrigated area No access to animal excreta	Existing solar pump and petrol pump, water storage tank, sprinkler. Farmer made the investment on a rustic fish pond, results were not as expected, the fish were not growing, and food was expensive.	Horticulture already happening in the area	Farmer has received support from different projects and has managed to capitalize on the investments. The shadow nets under production have a professional approach and there farmer is following an entrepreneurship approach by investing on his own fish ponds.
8		Jeremias Hilario	Salty shallow aquifer. Two existing boreholes but none of them can be used to irrigate horticulture. Farm has flooding issues, spends up to 4 months per year without being used due to high water levels. No access to animal excreta	Existing solar pump (not functioning yet), shadow net. Other investment: tractors, rice cultivator	Basic knowledge on horticulture production. No knowledge on aquaculture, biogas, bio composting.	Main focus of the farm is on rice seed production (+100 Ha). Horticulture and/or animal production is not an interesting business for the farm.
9		Roque Baia	Already existing borehole to irrigate the farm. Close to the campus of different education institutions, easy accessibility for knowledge sharing with farmers as well. Access to animal excreta	Existing solar pump, water storage tank, shadow new and drip lines for irrigation. The farm looks in very good shape.	Strong technical knowledge on agricultural technologies. The manager has an agriculture degree and seems committed to the success of the farm.	Currently conducting different tests to assess what is the best way to reduce evapotranspiration, and to produce bio compost.

### 3.2 Visits to CITT and Biogas pilot

During the fieldwork in Manica province, a Centro de investigação e transferência de tecnologias para o desenvolvimento comunitário (CITT) was visited to learn about the production of vermicompost and aquaculture tanks. CITT is a public institution focused on research, technology transfer and innovation for communities. This institution is supervised by the Minister who oversees the area of science-by- technology, higher and professional education (CTCN NDE).

In 2020, CITT developed a technical package for vermicompost production that includes the production beds, 5 kg of red worm and a manual<sup>4</sup>. The manual presents an introduction to what is vermicompost and what are the raw materials required to start producing it. A clear step by step explanation with pictures is provided on the production and process and finalized with an overview of the different uses of the final product. As for the production, a ratio of 50% organic matter and 50% of excreta is mixed and watered every week to produce the humus after 2 months.



Figure 2. Final product (Humus) of the vermicomposting process.



Figure 3. Home-made 200L biodigester.

A homemade biodigester system was also visited in Manica province to understand the existing technologies. This is made by a 200 litres tank and homemade filters that allow for the sulfuric acid to be evaporated. The inputs required for the prototype are food waste and water from a dog (which could be replaced by ruminant excreta due to its high fibre levels). A 200-litre tank can produce up to 0.9m<sup>3</sup> per day. There are no expected dangers of using this type of prototype. There have been efforts to distribute the homemade technology, but it has not been taken up properly by the farmers.

<sup>4</sup> [https://citt.gov.mz/wp-content/uploads/2023/11/manual\\_vermicomposto\\_2023.pdf](https://citt.gov.mz/wp-content/uploads/2023/11/manual_vermicomposto_2023.pdf)

#### 4. Conclusions

The following table presents the consolidated comparison of the nine farmers based on the indicators that influence the feasibility of the project. As presented in section 2, these are the availability of resources, technology, experience with the technologies, and farmer's profile. It can be concluded that in terms of resources and conditions, most of them have good quality water available for irrigating crops (except Jeremias Hilario), and that there are possibility to expand agricultural activities.

In terms of technologies, there is an average score of 2-3, which means that most of the farmers have been exposed to at least half of the technologies presented in the technical assistance, with the majority of them already having solar pumping, solar irrigation and bio composting. Few already have ponds for fish production, and none of them have access to any biogas production technology.

In terms of practical experience, biogas production is lacking in all of them; the second one that is missing is aquaculture, followed by composting.

Finally, the farmer's profile has been evaluated in terms of professionalism, entrepreneurship and level of appropriation of technologies. Observing a trend in which farmers either score well in this subject (having at least one point for each of them), or their score was limited to zero.

Having a clear impact on the conditions in which the farm was found by the consulting team.

Farmers number 3, 5 and 9 are the ones that scored the most points and are suggested to be discussed among CTCN, the consortium, and the project proponents to select a suitable farm.

Table 3. Final score of the assessment.

ID	Name	Resources/ Conditions	Technology	Practical Experience	Farmer's profile	Final Score
1	Joaquim Ximiqua	3	3	2	0	8
2	Joao Vinte	3	4	2	3	12
3	Paulo Borges	3	2	3	6	14
4	Zacarias/Catandica Sede	3	3	2	4	12
5	Domingos Tomas	3	5	2	5	15
6	Joaquim Xatala	3	1	2	0	6
7	Ricardo Cesar	3	2	2	3	10
8	Jeremias Hilario	1	3	1	2	7
9	Roque Baia	4	2	3	5	14

## 5. Annexes

### 5.1 Overall scoring of the visited farms

	Tete			Manica		Sofala	Zambezia		
	Joaquim Ximiqua	Joao Vinte	Paulo Borges	Zacarias/ Catandica Sede	Domingos Tomas	Joaquim Xatala	Ricardo Cesar	Jeremias Hilario	Roque Baia
	1	2	3	4	5	6	7	8	9
<b>Resources/ Conditions--&gt; Yes (1)/ No (0)</b>									
Water availability	1	1	1	1	1	1	1	0	1
Livestock	1	1	1	1	1	1	1	0	1
Area to expand	1	1	1	1	1	1	1	1	1
Potential to share knowledge			0						1
Subtotal	3	3	3	3	3	3	3	1	4
<b>Technology--&gt;Yes(0)/No (1)--&gt; Infrastructure</b>									
Solar pumping					1				
Drip irrigation		1			1				
Fish Pond /Aquaculture	1	1	1	1	1			1	1
Biodigester	1	1	1	1	1	1	1	1	1
Biofertilizer	1	1		1	1		1	1	
Subtotal	3	4	2	3	5	1	2	3	2
<b>Practical Experience --&gt;Yes(1)/No(0)--&gt; Know-how</b>									
Horticulture	1	1	1	1	1	1	1	1	1
Aquaculture			1	1	1		1		1
Biogas									
Biofertilizing	1	1	1			1			1
Subtotal	2	2	3	2	2	2	2	1	3
<b>Farmer's profile --&gt;No(0)/Maybe(1)/Yes(2)</b>									
Professionalism	0	1	2	1	2	0	1	1	2
Entrepreneurship	0	1	2	2	2	0	1	1	1
Appropriation of technology	0	1	2	1	1	0	1		2
Subtotal	0	3	6	4	5	0	3	2	5
<b>Total Score</b>	<b>8</b>	<b>12</b>	<b>14</b>	<b>12</b>	<b>15</b>	<b>6</b>	<b>10</b>	<b>7</b>	<b>14</b>

## 5.2 Agenda for fieldwork

### Proposta de Programa de Trabalho -WEF Mozambique-V3

Dia	Hora	Local	Actividade	Proposta de Participantes
<b>Dia 01</b>				
17 Abril	8:00 – 15:00	Distrito de Moatize	Visita e interação com produtores do distrito de Moatize <ul style="list-style-type: none"> <li>▪ CENAR Moatize</li> <li>▪ Mateus Vinte</li> <li>▪ Arlindo Enoque</li> </ul>	<b>Agencia do Zambeze:</b> Luís Dias e Salvador Janeiro <b>Practica:</b> Aldo Zamarroni & Stephan Abric <b>HUB:</b> Júlia Barreto
17 Abril	15:00-17:00	Distrito de Moatize	Encontro de apresentação do projeto e concertação entre Agência do Zambeze, Practica e HUB	<b>Agencia do Zambeze:</b> Nelson António, Albertina Uamusse, Alcides Nhamatate, Luís Dias e Salvador Janeiro <b>Practica:</b> Aldo Zamarroni & Stephan Abric <b>HUB:</b> Júlia Barreto
<b>Dia 02</b>				
18 Abril 2024	06:00 – 17:00	Distrito de Barué	Deslocação da Cidade de Tete a Catandica Visita e interação com produtores do distrito de Barué <ul style="list-style-type: none"> <li>▪ Zacarias Manuel</li> <li>▪ Ananias Chicumba</li> <li>▪ João Saugente</li> </ul> Deslocação de Catandica a Cidade de Chimoio	<b>Agencia do Zambeze:</b> Luís Dias e Salvador Janeiro <b>Practica:</b> Aldo Zamarroni & Stephan Abric <b>HUB:</b> Júlia Barreto
<b>Dia 03</b>				

19 Abril 2024	07:00 – 16:00	Distritos de Nhamatan da e Vanduzi	Deslocação da Cidade de Chimoio a Nhamatanda Visita e interação com produtor do distrito de Nhamatanda <ul style="list-style-type: none"> <li>▪ António Francisco</li> </ul> Deslocação de Nhamatanda a Vanduzi Visita e interação com produtor do distrito de Vanduzi <ul style="list-style-type: none"> <li>▪ Domingos Tomás</li> </ul>	<b>Agencia do Zambeze:</b> Luís Dias e Salvador Janeiro <b>Practica:</b> Aldo Zamarroni & Stephan Abric <b>HUB:</b> Júlia Barreto
<b>Dia 04</b>				
20 Abril 2024	07:00 – 14:00	Distrito de Caia	Deslocação da Cidade de Chimoio a Caia	<b>Agencia do Zambeze:</b> Luís Dias e Salvador Janeiro <b>Practica:</b> Aldo Zamarroni & Stephan Abric <b>HUB:</b> Júlia Barreto
<b>Dia 05</b>				
21 Abril	07:00 – 16:00	Distrito de Caia	Visita e interação com produtor do distrito de Caia <ul style="list-style-type: none"> <li>▪ Titos Daniel</li> </ul> Deslocação de Caia a Quelimane	<b>Agencia do Zambeze:</b> Luís Dias e Salvador Janeiro <b>Practica:</b> Aldo Zamarroni & Stephan Abric <b>HUB:</b> Júlia Barreto
<b>Dia 06</b>				
22 Abril	07:00 – 16:00	Distrito de Nicoadala	Visita e interação com produtores do distrito de Nicoadala <ul style="list-style-type: none"> <li>▪ Ricardo Manuel</li> <li>▪ Cenar Nicoadala</li> </ul> Deslocação de Nicoadala a Mocuba	<b>Agencia do Zambeze:</b> Luís Dias e Salvador Janeiro <b>Practica:</b> Aldo Zamarroni & Stephan Abric <b>HUB:</b> Júlia Barreto
<b>Dia 07</b>				

23 Abril	08:00 – 14:00 14:00-16:00	Distrito de Mocuba	<p>Visita e interação com produtor do distrito de Mocuba</p> <ul style="list-style-type: none"> <li>▪ Cenar Mocuba</li> <li>▪ Encontro de Balanço da missão entre a Agência do Zambeze, Practica e HUB</li> </ul>	<p><b>Agencia do Zambeze:</b> Luís Dias e Salvador Janeiro</p> <p><b>Practica:</b> Aldo Zamarroni &amp; Stephan Abric</p> <p><b>HUB:</b> Júlia Barreto</p>
<b>Dia 08</b>				
24 Abril	09:00 – 12:00	Diferentes Locais	Regresso dos integrantes às suas origens	<p><b>Agencia do Zambeze:</b> Luís Dias e Salvador Janeiro</p> <p><b>Practica:</b> Aldo Zamarroni &amp; Stephan Abric</p> <p><b>HUB:</b> Júlia Barreto</p>