ENVIRONMENTAL ASSESSMENT
Flooding in the Gaza Province, Limpopo River Basin, Mozambique

UNEP

JOINT
UNEP / OCHA
ENVIRONMENT UNIT

Mobilizing and coordinating the international response to environmental emergencies

OCHA
Office for the Coordination of Humanitarian Affairs

Cover photo: Flooded area in Mandlakazi, Mozambique © Kaisa Nugin / Konstanze Kampfer

Table of contents

List of Acronyms

CCA	Climate Change Adaptation
CCDM	Coordination Council of Disaster Management
CTGC	Technical Council of Disaster Management
DDT	Dichlorodiphenyltrichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDD	Dichlorodiphenyldichloroethane
DNA	National Directorate of Water, under the Ministry of Public Works and Housing
DRR	Disaster Risk Reduction
FAO	Food and Agriculture Organization of the United Nations
FIPAG	Water Supply Investment and Asset Fund
JEU	Joint UNEP/OCHA Environment Unit
GEF	Global Environment Facility
GoM	Government of Mozambique
INGC-GACOR	Reconstruction Office of the National Institute of Disaster Management
MICOA	Ministry of Coordination of Environmental Affairs
MINAG	Ministry of Agriculture
MoH	Ministry of Health
MSB	Swedish Civil Contingencies Agency
NGO	Non-Governmental Organization
OCHA	United Nations Office for the Coordination of Humanitarian Affairs
SAICM	Strategic Approach to International Chemicals Management
UNCT	United Nations Country Team
UNICEF	United Nations Children's Fund
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
WHO	World Health Organization

The Joint UNEP/OCHA Environment Unit (JEU) assists Member States in preparing for and responding to environmental emergencies by coordinating international efforts and mobilizing partners to aid affected countries requesting assistance. By pairing the environmental expertise of the United Nations Environment Programme (UNEP) and the humanitarian response network coordinated by the United Nations Office for the Coordination of Humanitarian Affairs (OCHA), the JEU ensures an integrated approach in responding to environmental emergencies. The JEU developed the Environmental Emergencies Centre (EEC) (www.eecentre.org), an online tool designed to build the capacity of national responders to environmental emergencies by strengthening their own mechanisms and drawing on external resources and services for guidance and preparedness, including a number of eLearning training modules and workshops.

Executive Summary

Environmental Assessment of Flooding in Gaza province, Limpopo river basin, Mozambique

Heavy rainfall in January 2013 caused severe flooding in Mozambique, specifically in the Gaza province, Maputo city, Zambezia province followed by limited flooding impact in Inhambane, Sofala, Manica and Nampula provinces. The Gaza province, located in southern region of the country, mainly in the Limpopo river basin, was the most affected province. From 12 January, when the Orange Alert was declared by the Government of Mozambique to 19 April 2013, when alert warning were lifted, the balance on damage and loss issued by the Government indicates that almost 420,000 people were affected by floods across Mozambique and a total of 119 people lost their lives, with 17 additional deaths due to the cholera outbreak in Northern provinces[1]. For instance, the Chokwe district in Gaza was under water at least 2 weeks. In mid-February the Resident Coordinator, through the UN Office for the Coordination of Humanitarian Affairs (OCHA) Regional Office for Southern Africa, requested an environmental expert from the Joint UNEP/OCHA Environment Unit (JEU). The objective of the deployment was to **assess the environmental impacts of the flooding and to, based on the findings, develop key recommendations for the UN agencies** for subsequent integration into their recovery plans and projects. The expert was made available by the Swedish Civil Contingencies Agency (MSB), and worked in Mozambique for two weeks (March 14th – 21st). The **assessment was undertaken in Gaza province** located within the Limpopo river basin. Site visits were undertaken to Chibuto, Chokwe, Xai-Xai, Guija and Mandlakazi. Given that field observations were undertaken only in these areas, it cannot be seen as a comprehensive assessment for the whole flooding, but rather as an indicative one.

Key findings

The assessment focused on the damage to the environment caused by the floods. Both the environmental impacts of the flooding itself, as well as the impacts of the corresponding relief activities, were assessed. The main conclusion of the assessment is that **the floods did not lead to major environmental emergencies or accidents**. No secondary risks (from industrial facilities, warehouses or infrastructure) were identified. However, the assessment **highlights several cases where the flooding has exacerbated pre-floods poor environmental practices**. Key findings according to sectors / issues are included below, in order of significance.

Waste, including healthcare waste

Waste management is generally poorly arranged in the area, with waste disposed of in uncontrolled waste dumps, buried or burned. Dumpsites are usually placed in natural lowlands or (sand) extraction areas. Several of the visited dumpsites were located in the close vicinity of houses and agricultural lands (Bairro Novo in Xai-Xai). Materials present could pose a hazard to communities through leaching of hazardous substances to nearby water bodies and agricultural lands. In addition,

[1] Humanitarian Country Team Consolidated Early Recovery Strategy, Mozambique, available on www.reliefweb.com

the waste poses risk to those persons, including children, scavenging on the sites (sharps, infections, chemicals like oil, etc.).

The flood generated mixed waste consisting of construction material from destroyed houses, medicine, chemicals and food (rice). From the onset there was a lack of equipment for handling disaster waste which has hampered the clean-up. There was no indication of flood waste contaminating water resources, but with the general poor waste management practices in the country, it is clear that the **flood waste poses an additional burden on already weak waste management systems**.

Flooding caused some damage to hospitals in Chokwe and Guija. Damaged medicines from both these locations were transported to the Chokwe hospital and incinerated. While the assessment did not conduct a full assessment of healthcare waste management practices, it was found that the simple batch burner in use in Chokwe does not correspond to minimum WHO healthcare waste management standards[2] (Photo 15).

The flooding poses an **opportunity to bring in some elements of good waste management practices to the regions, for example by showcasing recycling and appropriate disposal, or discouraging waste incineration close to communities**.

Chemicals

In the district of Guija **chemicals (DDT[3], Ficam[4]) remaining from an anti-malarial campaign were damaged**. DDT and its break-down products DDE[5] and DDD[5], are persistent, bioaccumulative, and toxic. Ficam products are very toxic to aquatic organisms and may cause long-term adverse effects in the aquatic environment. The quantity and quality of the product should be investigated. It is not clear whether the products still can be used or whether they are to be disposed of.The insecticide Milbitraz TR is used in the province and the impacts related to the chemical solution are described in the section *Water*.

Water

In urban areas drinking water is supplied by the Water Supply Investment and Asset Fund (Fundo de Investimento e Patrimonio do Abastecimento de Agua or FIPAG). According to information provided by the districts authorities no treatment plants were affected by the flood. In rural areas drinking water is taken from boreholes, wells and rivers. River water is also used for irrigation and an irrigation dam is located in Chokwe district.

The **floods caused release of excreta from latrines and subsequent sanitary contamination of water** which needs to be addressed. The sewage system in Chokwe was damaged and overflowed as a result of the flood. In addition, flooding caused dispersal of waste and, with high probability, some dissolution of fertilizers and pesticides from the field. The single **largest noted impact was from the discharge of animal treatment solution** (insecticide Milbitraz TR) from up to four washing basins in Chibuto. Reports of dead fish around three kilometres downstream could possibly relate to this

[2] See, for example, WHO (Pruss et. al.) - Safe management of wastes from health-care activities, available on www.healthcarewaste.org

[3] DDT (dichlorodiphenyltrichloroethane) is an organochlorine insecticide.

[4] Ficam is a brand name of bendiocarb used for vector control. Bendiocarbs are classified as R50 /R53 very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

[5] DDE (dichlorodiphenyldichloroethylene), DDD (dichlorodiphenyldichloroethane)

release, as the chemical is toxic to aquatic life and fish. However, the chemical breaks down rapidly, and would therefore no longer pose a threat. The chemical solution should, however, not be disposed close to water resources.

Dumpsites close to rivers might pose a risk of contamination of the water. If some kind of national / regional water quality monitoring has taken place, the results of these could be assessed in order to evaluate the potential impact of fertilizers, pesticides and possible leachates from dumpsites. There was also some concern about the salinity of irrigation water, caused by salt intrusion from the sea and (possibly) high salt levels in the soil.*Infrastructure*

The dyke at Xai-xai community was damaged by the flood, and must be repaired and maintained.

Natural resources and land use

Particularly in Chibuto there are visible signs of erosion on infrastructure such as roads and bridges. Erosion was also noted on mountain slopes and the bases of houses, which destabilizes the structures (Xai-Xai). Sand mining is conducted in several locations, leading to large areas without vegetation cover. Some erosion protection projects have been implemented. There was no reported impact of the floods on these areas. The (re-)construction of housing is expected to create an increased demand for construction material such as wood, sand and metal sheeting and the use of natural resources should be monitored. Thus, (existing) reforestation and nursery programs should be supported as part of resettlement projects requiring wood. Flooding destroyed agricultural crops in several areas of Gaza province. Fertilizers and pesticides released from agricultural land are not expected to have caused significant impact.

Settlements and accommodation centres

A number of accommodation centres were visited, and the impact of these on the environment was assessed. As the centres were connected to existing structures such as schools, there were no significant negative environmental impact from the settlements – such as for example improper latrines, use of virgin land, use of construction materials, and so on. In Mandlakazi the settlement area plans included tree-planting activities. Furthermore, it was planned to make residents responsible for the trees in order to maximize their involvement and ownership. Similarly, the municipality had plans to map floodprone areas and prevent people from resettling in these areas.

Key recommendations

The key recommendations, in order of significance, are given below. Recommendations should be carried out in close collaboration with district, provincial and national authorities and other concerned stakeholders. Actors are encouraged to seek out synergies with existing initiatives and programs when implementing these recommendations. Where reference to international guidance is given, proper care should of course be taken to also ensure proper alignment and adherence with national laws, regulations and practices.

1. **Continue supporting flood affected areas in disaster waste management** (United Nations Development Programme - UNDP, World Health Organization - WHO, Ministry of Coordination of Environmental Affairs - MICOA and Local Authorities)

1.1 Support **disaster waste management activities**: collection, recycling, disposal – giving necessary attention to hazardous waste (UNDP)

1.2 Support initiatives aimed at improving existing dumpsites as part of disaster waste management: **encourage mapping and concentration of dumpsites in suitable areas**, i.e. some distance from communities, agricultural lands and water resources and preferably with barriers like sand banks or fences around them, encourage recycling (UNDP and MICOA)

1.3 Explore opportunities for a national project on **sound healthcare waste management** – which could be funded by the Global Environment Facility (GEF) (UNDP, WHO)

1.4 Use and share the **disaster waste management guidelines** (www.eecentre.org); explore opportunities to organize training on disaster waste management (UNDP, with potential support from JEU and MSB in Mozambique)

2. Promote sound chemicals management (WHO, Food and Agriculture Organization - FAO, UNDP, others as applicable)

2.1 **Identify state and quantity of remaining anti-malarial chemicals** (DDT, Ficam) in Guija district and if these are not usable: ensure proper storage and establish how safe storage/disposal can be undertaken (WHO)

2.2 **Advocate for adherence to chemical safety data sheets guidance** in agriculture (to avoid insecticide-type accidents) and appropriate handling of chemicals (safety equipment like boots and gloves, discourage reuse of chemical containers and bags, etc.) and ensure availability of information in local languages; Sound storage and handling of pesticides and fertilizers (FAO and Ministry of Agriculture - MINAG)

2.3 **Explore opportunities for national project on sound chemicals management**, for example supported by the Strategic Approach to International Chemicals Management (SAICM) (UNDP, WHO, United Nations Environment Programme - UNEP, non-governmental organizations - NGOs, Ministry of Health - MoH and/or others as applicable)

3. Drain stagnant water and monitor water quality (United Nations Children's Fund - UNICEF, WHO and the National Directorate of Water - DNA)

3.1 Drain areas of stagnant water to prevent spreading of malaria (UN and national agencies as applicable)

3.2 Support national efforts to **monitor water quality, with appropriate attention to salinity potential sources of contaminants like dumpsites and agricultural facilities** (UN and national agencies as applicable)

3.3 Restore **infrastructure in order to reduce future disaster risk** (UNDP)

3.4 Identify suitable areas where material for (re-)construction can be sourced safely, without contributing further to erosion and/or disaster risk (UNDP)

3.5 Support restoration project – re-vegetation and use of native plants (UNDP and other relevant agencies)

4. Other

4.1 Assess environmental impacts of resettlement programmes; take natural resources, including risk of deforestation, into account and support reforestation efforts[6] (UNDP and the Reconstruction Office of the National Institute of Disaster Management - INGC-GACOR)

4.2 Sensitize agency (and authority) personnel to key environmental issues and considerations and **build awareness on available support** (such as the **Environmental Emergencies Centre** (**www.eecentre.org**) and associated trainings like "Beyond Response: Increased Preparedness for Environmental Emergencies") for the various sectors (UNCT, with support provided by JEU upon request); if applicable, ensure from now on, that the national contingency plan include key environmental issues such as disaster waste management.

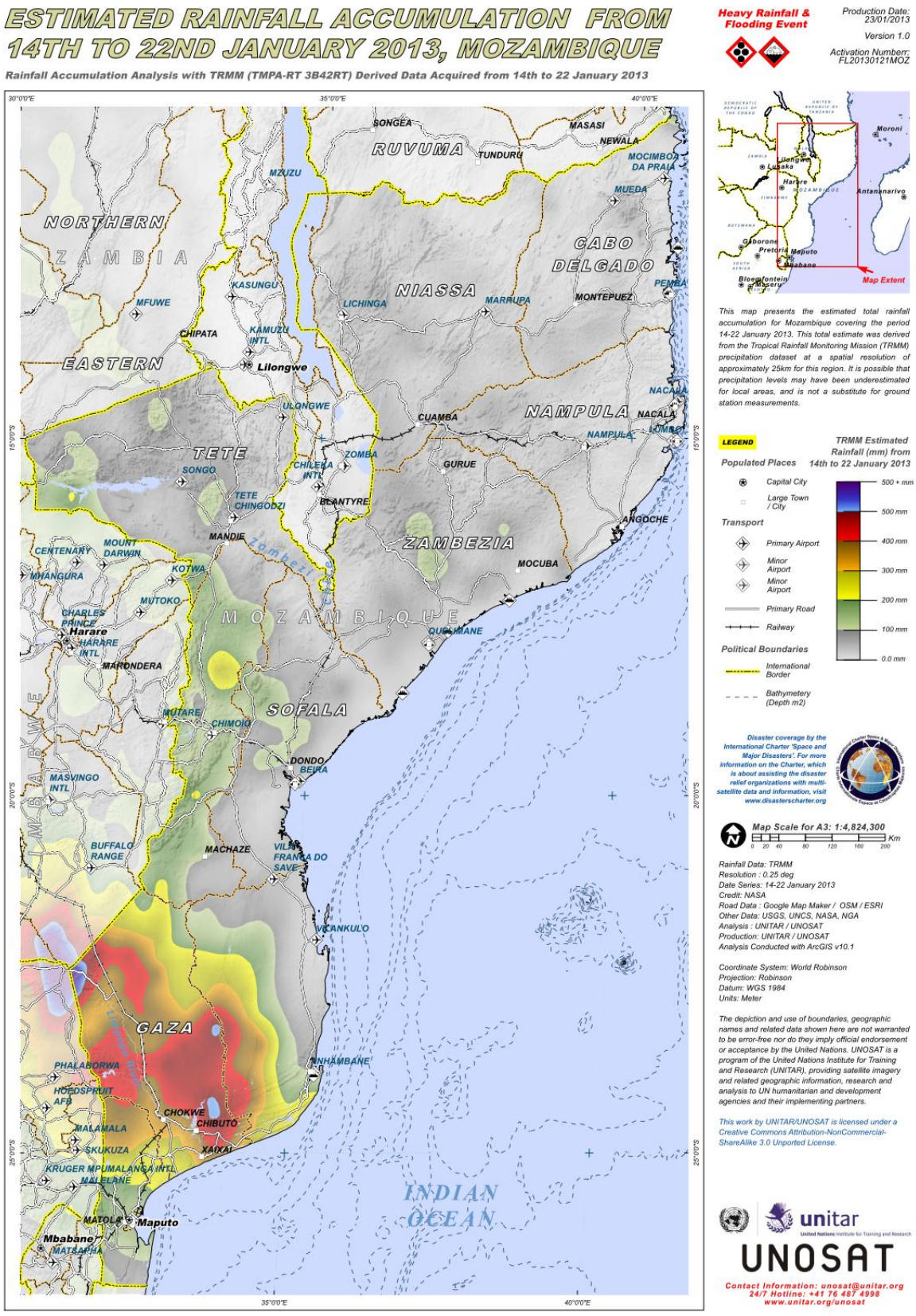
[6] Please refer to, among others, guidance materials available on
- Shelter Cluster Environmental Reference Pages (www.environmentinshelter.org; www.sheltercluster.org/References/Pages/Environment.aspx)
- Fuel network including the IASC matrix on Safe Access to Firewood and Alternative Energy in Humanitarian Settings (www.fuelnetwork.org)
- Checklist-Based Guide to Identifying Critical Environmental Considerations in Emergency Shelter Site Selection, Construction, Management and Decommissioning (ProAct) http://postconflict.unep.ch/humanitarianaction/02_05.html

1. Background

In the beginning of January heavy rains that lasted more than a week caused an increase of hydrometric levels in main river basins in the southern regions (Limpopo, Incomati, Inhanombe and Save) and central part of the country (Zambezi, Pungoe and Buzi). The Government of Mozambique (GoM) declared an institutional orange alert on 12 January 2013 due to the heavy rains. Since then, Government and humanitarian partners scaled up monitoring measures and strengthen preparedness for response in most affected areas and other at high-risk. The southern received a high amount of precipitation (Map 1) and on the 22nd of January 2013, the Disaster Management Coordination Council (CCDM) declared an institutional red alert by recommendation of the Technical Council of Disaster Management (CTGC) for the central and southern part of the country based on the scenarios of the Limpopo, Incomáti, Zambeze, Pungué and Save Rivers.

From 12 January, when the Orange Alert was declared by the GoM, to 19 April 2013, when the alert warnings were lifted, the balance on damage and loss issued by the Government indicates that almost 420,000 people were affected by floods across Mozambique and a total of 119 people lost their lives, with 17 additional deaths due to the cholera outbreak in Northern provinces[7]. The most affected areas in the southern region are the Gaza province with over 150 000 people affected and Maputo city followed by Zambezia in the central region. In the other provinces, Manica, Sofala, Inhambane, Nampula and Cabo Delgado the flooding impact was limited.

[7] Humanitarian Country Team Consolidated Early Recovery Strategy, available on www.reliefweb.com



Map 1. Precipitation 14- 22nd of January2013, UNOSAT. www.unitar.org/unosat/maps/MOZ

1.1 Mission objective

The Mozambican Government requested Humanitarian Agencies of the UN present in country to assist with post-flooding recovery activities. In mid-February, the Resident Coordinator in collaboration with the UNDP-led early recovery cluster requested the support from UNEP/OCHA Joint Environment Unit (JEU) to this end. The request was for an environmental expert to assist with assessments. The expert was seconded to the JEU by MSB. In country, the environmental expert worked directly with the Early Recovery cluster.

The expert's task was to assess overall physical damage and losses to the environment caused by the floods in the affected areas of the Limpopo river basin (Annex 1. Terms of Reference). Limpopo river basin extends over the four countries Botswana, South Africa, Zimbabwe and Mozambique.

The environmental assessment included the development of recommendations for UN agencies to integrate into their (early) recovery planning - linking to long-term sustainable recovery.

1.2 Methodology

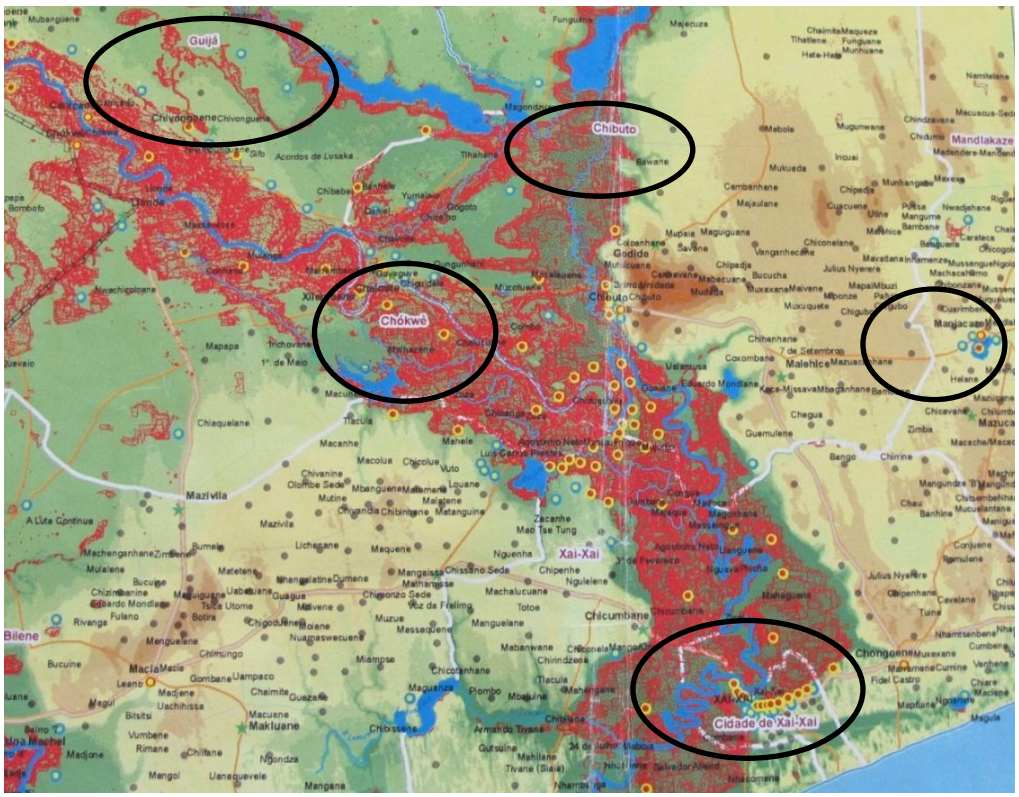
The assessment was carried out primarily through field observations. Prior to site visits, a review was made of preceding work and information available. Updated information on the situation was obtained at meetings of the Technical Council of Disaster Management (CTGC) as well as the Humanitarian Country Team (HCT). The detailed field mission agenda was designed and coordinated with the Early Recovery Cluster. The field assessment was conducted using a number of tools, including the Flash Environmental Assessment Tool (FEAT) and the Disaster Waste Management Guidelines (DWMG). The Hazard Identification Tool (HIT)[8] was used to identify and prioritize area points of interest, namely the presence of industrial facilities potentially posing secondary risks. The structure of the report is in conformity with prior documentation of field visits done by the Early Recovery Cluster.

Field visits were carried out between March 14 – 21, 2013, by the following persons:

- Kaisa Nugin, Environmental expert seconded from MSB
- Konstanze Kampfer, DRR Analysis Officer, MSB country team
- Jamisse Elidio, Provincial Advisor on DRR & CCA , UNDP

The geographical scope of the assessment was the Gaza province. The following sites within the province were visited: Chibuto, Chokwe, Xai-Xai, Guija and Mandlakazi (also refer to map in Annex III).

[8] All tools issued by the JEU are accessible through the Environmental Emergencies Centre website www.eecentre.org.



Map 2. Flooded area, Gaza province (Source WFP) with site visits indicated.

2. Findings

This section describes the environmental impacts of the flooding; starting with a summary of the general observations in Gaza province according to sector, and subsequently describing the various environmental impacts noted in the five sites visited (1. Xai-Xai; 2. Mandlakazi; 3. Chokwe; 4. Chibuo and; 5. Guija).

2.1 General

Agriculture

Many people in the Gaza province are dependent on agriculture for their livelihood. The flood destroyed their crops and also the possibility of sowing new crops as fields were still inundated (Photo 1).

Photo 1. Inundated fields Xai-Xai. Photo: Kaisa Nugin/Konstanze Kampfer

Information given by the provincial director of agriculture was that Mozambique, compared to other surrounding countries, uses lesser quantities of pesticides and fertilizer. The primary reason is that these chemicals are too expensive for small scale farmers. Natural means of keeping the crops free from vermin are used when farming plants such as tobacco. In larger scale production (e.g. rice) managed by companies pesticides and fertilizer are used. The province has a storage facility for pesticides that could be used in the event of serious plague. Information provided indicates that the recurring floods have not had a significant negative impact on soil fertility.

Waste management

Waste disposal is primarily carried out through dumping, burning or burial. Insufficient or open burning of waste poses health risks and causes air pollution. There are some identified and official dump sites, frequently coinciding with topographical lowlands - either natural or man-made, for example due to sand mining activities. There is no developed system for treatment and /or recycling of electronic, chemical or other hazardous waste. Health care waste is buried or incinerated within the hospital areas.

The assessment shows that there is an opportunity to use disaster waste management activities for improving the existing overall waste management system (separation, collection, management and disposal) in order to improve current practices and reduce future risks.

Water resources

In the urban areas drinking water is supplied by The Water Supply Investment and Asset Fund, (Fundo de Investimento e Patrimonio do Abastecimento de Agua or FIPAG). According to information given in the districts no treatment plants had been affected by the flood. In the rural areas drinking water is taken from boreholes, wells and the river. There are systems for collecting water for irrigation, including the use of water from the Limpopo river, which has a high level of salinity. In Chokwe district there is a constructed dam for irrigation in Macarretane (barragem).

Energy distribution

In Mozambique there is one hydropower dam, the Cahora Bassa, situated in the Tete province in western Mozambique. The electricity generated is sold to the company ESKOM and distributed via South Africa. The transmission lines and pylons of the distribution net from Cahorra Bassa to South Africa were damaged due to the rise in level of the Limpopo River, temporarily reducing the export of electricity to South Africa [9].

Protected areas

The Limpopo reserve is located within the Gaza province and forms a part of the great Limpopo transfrontier park which consists of the connecting reserves Kruger National Park in South Africa and Gonarezhou National Park in Zimbabwe. During the assessment, no impacts on the Limpopo reserve were reported, even though the provinces it is located in were flooded. However, negative impacts on livelihood and resources in the area adjacent to the reserve could lead to use of park resources, such as trees for fuel.

2.2 District Xai-Xai

Accommodation centres

Accommodation centres visited were located in school areas or areas used by organisations such as Organização da Mulher Moçambicana (OMM). The accommodation centres had been closed shortly prior to the visit and the purpose of the visit was to examine potential impacts. Waste was normally collected from the schools and it had been collected from the accommodation centres in large containers. As the centres were connected to existing structures such as schools, basic infrastructure such as toilets was already present. However, the number of units was based on a lower total amount of people (students) in the area and was under-dimensioned for function as an accommodation centre. The assessment showed that the use of existing buildings and areas had decreased the environmental impact of resettlements (compared to utilization of virgin areas). At the same time it was noted that normal functions and activities such as education had been hindered during this time.

Waste management

Waste is collected and transported to the official engineered dump site *Bairro Novo* established 2001. The dumpsite is a gorge that is filled up with waste and the site has no constructed liner or barriers. At the bottom of the dumpsite (gorge) there was a broken fence facing the lowlands. People and children from the area often come here to look for reusable things. Downstream from the dumpsite, at a distance of approximately 1 km, fields of rice, corn, sweet potato, beans and

[9] http://www.hcb.co.mz/

banana are located. Photo 2 shows the dumpsite/gorge and behind-lying lowlands with fields still under water. The absence of a solid physical barrier implies that rain and water percolate through the waste on its way through the gorge towards the lowlands.

Photo 2. Official dumpsite Bairro Novo with lowlands and fields in the background. Photo: Kaisa Nugin/ Konstanze Kampfer

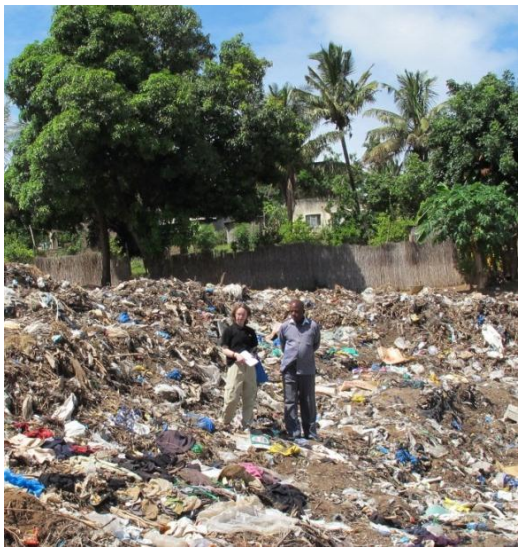


Photo 3. Official dumpsite Bairro Novo with house in the background. Photo: Kaisa Nugin/ Konstanze Kampfer

On both sides of the dump site houses were located close to the gorge, see photo 3. According to information given by Sergio Narciso Rojas, people found it positive that the gorge was filled up, as they were afraid the land was unstable. The households get drinking water from FIPAG so there were no wells for drinking water in use in the direct vicinity of the dumpsite. However, the location of the dumpsite poses risk of contamination of downstream areas used for cultivation. Furthermore, the dumpsite might be geotechnically unstable and create a false sense of security, in particular to communities scavenging on the site. As it is open to the public, safety issues should be considered.Beside the official dumpsite there are unregulated dumpsites. One is a dumpsite close to Bairro B and the market place Xiquema se photos 4 and 5 below. Waste was being burned uncontrolled in the area.

Photo 4. Unregulated dumpsite close to the market Xiquema. Photo: Kaisa Nugin/ Konstanze Kampfer.

Photo 5. People dwelling and fishing close to the market and dumpsite Xiquema. Photo: Kaisa Nugin/ Konstanze Kampfer.

Photo 6. People selling fish at Xiquema market. Photo: Kaisa Nugin/ Konstanze Kampfer.

The dumpsite poses a risk of contamination of the water and soil in the area and downstream. As the dumpsite is located in the open without barriers, waste has been spread during the flood. This waste poses a risk for human health for communities living nearby.

Many families regularly burn their waste or bury it in the backyard. Open burning of waste creates air pollution and poses health risks. Waste was also put in the drainage system, which spreads it further and/or obstructs the water flow.

Resettlement area

The resettlement called Marien Ngouabi B is located on higher grounds on the slope of a hill. The plots allocated were 20x20 meter and the area was planned for a total of 710 plots or 284 000m^2. Wood for construction of houses was expected to be transported from the Massingir area. An extensive transportation of wood from Massingir could cause secondary impacts such as deforestation and erosion.

Infrastructure such as roads and drinking water supplies were already under construction. Cement slabs for latrines were produced in the area. There was one tent set up for education and one tent for health services.

The plots had been cleared of lower vegetation but there were trees left. Wood (branches and whole trees) were used for cooking.

Photo 7. Resettlement area called Marien Ngouabi B, Xai-Xai. Photo: Kaisa Nugin / Konstanze Kampfer.

Clearance of vegetation could cause erosion. Development of water and sanitation systems should correspond to the future population to mitigate environmental impact. If not collected, waste from the area could cause environmental contamination.

Erosion

There were visible signs of erosion on the mountain slopes as well as on the roads. In the hillside residential areas Bairro 3 and Ndambine 2000 roads had been eroded and were now topographically lower than the surrounding garden plots where vegetation bound the soil. Stone houses on the slopes had lost some of their structure due to erosion. Along the paved roads erosion was visible due to runoff. Former and current sand mining areas had left large areas without vegetative cover. The municipality wanted to create a green garden for the children in the area.

Photo 8. Sand mining. Photo: Kaisa Nugin/ Konstanze Kampfer

Photo 9. Example of erosion protection. Photos Kaisa Nugin/ Konstanze Kampfer

In 2011, a Dutch project constructed concrete blocks for erosion protection (Photo 9).

Chemicals

Information received from the municipality was that there were no larger storages of chemicals in Xai-Xai province that had been affected, indicating that only small amounts of chemicals might have been lost and dispersed as result of the flooding. No specific storage was identified as damaged and no survey of specific chemicals stored or released during the floods was carried out.

Infrastructure

The dyke was functioning at the time of the year 2000 flood but during this flood event it broke in five different locations. No continuous maintenance work of the dyke had been carried out.

Recommendations for Xai-Xai district

Recommendations should be carried out in cooperation with national authorities as well as national laws and regulations.

- ✓ Develop and implement restoration plans for active sand mining areas.
- ✓ Plant vegetation to create green areas in the resettlement area and to prevent erosion.
- ✓ Construct drainage system for the resettlement area to prevent erosion
- ✓ Develop collection of waste from the resettlement area. Encourage people to organize waste management and support recycling – allowing an opportunity to support livelihoods.
- ✓ Develop and implement separate waste collection systems including systems for electronic, and chemical waste. Treatment or management can be done centrally or in collaboration with neighbouring districts.
- ✓ Support sound healthcare waste management practices at all health facilities.
- ✓ Repair the dyke and implement maintenance strategies.
- ✓ Repair the fence that constricts the engineered dumpsite Bairro Novo or construct alternative barrier or protection e.g. a sand bank.
- ✓ The location of the dumpsite upstream from fields and close to housing is unsuitable. In the medium and long term perspective the engineered dumpsite should be reconstructed or replaced by a new dumpsite.

2.3 District Mandlakazi

The geological composition of Mandlakazi district is calcareous bedrock which prevents water from infiltrating the soil – subsequently, these areas were still flooded.

Photo 10. Flooded area in Mandlakazi. Photo: Kaisa Nugin / Konstanze Kampfer

Waste management

Waste is mainly buried or burned. In Mandlakazi an old sand mining site is used as dumpsite to fill up the excavated area. During the heavy rains the area was filled with water (Photo 12). The dumpsite poses a risk of contamination of the water and soil in the area and downstream. The practice of open burning of waste creates air pollution and poses health risks.

Accommodation centre

Initially the local school had been used as accommodation centre. To be able to resume normal school activities a separate house had been constructed on the school area. Since January, a total of 35 people slept in the house. During daytime these people spent time either in the new resettlement site or elsewhere.

Resettlement area

The resettlement area was planned to host a population of 1750 families and the plots were 30 x 40 meters large. The houses will be constructed using local materials such as straw (caniso), cement, nails, trunks, wire and a metal sheeting. A sample house is shown in Photo 11. Materials would be taken from areas such as Makaka and Chalala.

Photo 11. Example of a reconstruction house resettlement area Mandlakazi. Photo Kaisa Nugin/ Konstanze Kampfer.

In the resettlement area one manual well for drinking water had been installed to a depth of 34 metres. More wells are needed to serve the future population. Resettlement development plans provides a buffer area of 40-50 metres around wells in order to protect the water from sanitary contamination. There were plans to install water storage tanks for water supply and electricity by ESKOM/IDM. The municipality also planned to plant trees along the new road and wanted to make the closest resident responsible for the tree which could be a good example of how to involve the community in managing measures taken.

Development of water and sanitation systems should correspond to the future population in order to mitigate environmental impact. If not collected, waste could cause environmental contamination. Clearance of vegetation in connection with infrastructural development may cause erosion.

Erosion

Erosion damaged the roads in the area. On the old sand mining site / the dumpsite had left the road with no support causing erosion to destroy the roadway.

Photo 12. Mandlakazi. The road and the old sandmining site/ dumpsite now filled with water and covered with green algae. Photo: Kaisa Nugin/ Konstanze Kampfer.

Other

The area where rocks are mined for construction purposes was still flooded. The population in the area consists mainly of women and children as the men were elsewhere for example working in the mines in South Africa. To reduce future risk the municipality wanted to map the flood prone area and classify relevant parts as unsuitable as residential area – ultimately not allowing people to live there permanently. People with stone houses in the area could keep them and stay in them during dry season but not live in the area permanently.

Recommendations for Mandlakazi district

- ✓ Construct systems for water and sanitation in the resettlement area
- ✓ Assure that the water resource and capacity in the area is sufficient to supply the future population.
- ✓ Develop and implement erosion protection and drainage in resettlement area and along roads.
- ✓ Identify suitable areas for initially temporary and later permanent dumpsites.
- ✓ Develop waste collection systems including for the resettlement area.
- ✓ Develop and implement separate collection and treatment systems including for electronic, chemicals and other hazardous waste.
- ✓ Establish separate collection and treatment systems for healthcare risk waste at every health facility.
- ✓ Measures to protect the groundwater from leachate from the existing dumpsite to the groundwater should be taken.

2.4 District Chokwe

Resettlement area

Photo 13. Chiaquelane resettlement area. Photo: Kaisa Nugin / Konstanze Kampfer.

No canalization system for drinking water was established and water was delivered in tanks to the resettlement area. As for construction material, clay is not found in the area and wood is a probable alternative for the construction of new houses. Wood was transported and delivered to the area

and used for cooking and for construction/marking of plots. There were small tents for latrines. Chiaquelane was used for resettlement during earlier flood events (2000/2001). When combining with the old village and prior resettlement Chiaquelane will ultimately develop into a larger urban area.

Photo.14. Chiaquelane resettlement area. Photo: Kaisa Nugin / Konstanze Kampfer.

Infrastructural development with clearance of vegetation could cause erosion. Development of water and sanitation systems must correspond to the future population in order to prevent and mitigate environmental impact. If not collected, resettlement area waste could cause environmental contamination.

Waste management

Waste is either burned or buried. There is no designated dumpsite. Disaster waste was being burnt approximately four km from the city. There are no systems for separate collection and treatment of hazardous waste. Health care waste and industrial waste due to the flood is described under the sections of health and industrial facilities below. Waste poses a risk of contamination of the water and soil in the area and downstream. Open burning of waste creates air pollution and poses health risks.

Industrial facilities

The following industrial facilities were visited:

- MozFoods/ MIA/ Mozseeds, rice production, factory and seeds.
- Pesciculture /Fishfarming ponds

The storage of the company Mozfoods had been flooded. When cleaning up after the flood the personnel had used protective equipment such as masks and gloves. During the visit people wore rubber boots and a white mask for covering the mouth (observed in the storage).

According to information provided by the director of production, Alessandro Saucedo, the storage contains seeds (rice), fertilizer and pesticides. A total of 140 ton of seeds had been damaged in the floods and had to be destroyed / burned. In the rice factory three silos had been affected and 2,000 tons of rice had been damaged and had to be destroyed/ burned. Some fertilizer paper and plastic bags had been damaged. Pesticides were stored in plastic containers which had remained intact, i.e. the pesticides had not been damaged.

Information about the fertilizer and pesticide products used were given from the company in form of an inventory list from 2011. Examples of fertilizers include: *Ominical* calcium nitrate, *Ominical* Magnesium, Omni K, Urea, Zinc sulphate. Examples of pesticides include: Atracin, Endosulfan,Glyosato36%, Propanil 36 %.

Pesticides and fertilizer are harmful if not handled and disposed of correctly. Proper equipment must be available like:
- protective eyewear and clothing, respiratory protection and chemical resistant gloves
- containers should be available for handling/disposal of leakage and spills.

The director of production noted that the floods were unlikely to have impact on topsoil quality.

Fishfarming (pesciculture) was conducted in constructed ponds. The ponds had been flooded and partly damaged. No information about treatments or chemicals used in the fishfarming was obtained during the field visit. In theory, chemicals and antibiotics used in fishfarming could cause environmental contamination. Dispersal of cultivated fish could theoretically affect the native population, but such impact would likely be minimal.

Health / Chokwe hospital

The hospital handles health care waste locally though incineration. The hospital had a machine that disintegrated the waste prior to incineration but before the flood it was not functioning properly and now it is totally destroyed. In Chokwe there were two small concrete constructions in order to burn waste see photo 15.

Photo 15. Incinerator in Chokwe Hospital.
Photo: Kaisa Nugin/ Konstanze Kampfer.

Human remains from surgery or other operations in the hospital were put in a concrete construction and closed by a lid. According to given information the tank had no bottom. According to information received, the disaster waste from the hospital had been difficult to clean up with people hurting themselves in the process.

The hospital's storage of medicine had been damaged and an estimated quantity of 1 ton of medicine had to be burnt. Information given in Guija district was that damaged medicine from Guija had been transported to Chokwe hospital for destruction. In order to be able to burn the complete amount a hole in the ground was excavated for open burning of the medicine.

The sewage system was damaged and temporary toilets were put up in the backyard. The hospital also had sanitary problems due to the fact that the cooling system of the morgue was not functioning.

The hospital had two x-ray machines before the flood. The stationary one still functioned but the mobile one (Siemens multi mobile 10) was out of order after the flood and the hospital planned to repair it. It is not clear whether the hospital used hazardous developer liquid or whether it used electronic x-ray devices. Either way, the radiologic equipment must be dismantled and handled by knowledgeable personnel. If equipment is not handled and disposed of in a correct manner it could pose a threat to human health and environment.

Sanitation

In urban areas the sewage water is lead through vegetation before it reaches the river. No chemicals are used for treating the sewage water. The suburban and rural areas do not have a sewage system. The sewage system had been damaged and overflowed during the flood.

Recommendations for Chokwe district

All recommendations should be carried out in cooperation with national authorities as well as national laws and regulations.

- ✓ Supply communities with basic equipment for cleaning up the disaster waste.
- ✓ Damaged fertilizers must be handled and disposed of properly. Fertilizer bags must not be reused for other purposes as this poses risks to the environment and human health.
- ✓ Repair the sewage system in Chokwe including the health facility in order to prevent spreading of disease. Look into feasibility and opportunity for upgrading the (currently) uncontrolled treatment of the sewage before it reaches the river
- ✓ Identify suitable locations for dumpsites for waste: both for temporary or permanent use.
- ✓ Construct and organize a system for waste collection including the resettlement area.
- ✓ Develop and implement separate collection and treatment systems for electronic, chemical and other hazardous waste.
- ✓ Support sound healthcare waste management in adherence with WHO guidelines:

2.5 District Chibuto

Waste management

Waste is collected and transported to a public dumpsite. The dumpsite is also an active sand mining area. People burn, bury or leave their waste on the street or at the dumpsite. According to information provided, healthcare waste was not deposited in the dumpsite. Waste poses risk of contamination of the water and soil in the area and downstream. Open burning of waste creates air pollution and poses health risks.

Erosion

The district of Chibuto is highly affected by erosion, which is closely linked to Infrastructure development. The increasing numbers of houses with roofs of metal sheeting leads to more erosion than the traditional roof constructions with straw where the water falls in drops and not in concentrated flows. Increasing areas of hard surfaces put higher demands on effective drainage

systems to handle runoff. The paved road between Chibuto- Chissane has a supplementary drainage system which caused heavy erosion at the drainage outlets points (Photo 16).

Photo 16. Drainage system for the road Chibuto-Chissane. Photo Jamisse Elidio.

A metal bridge constructed two years ago connects the populated area with the fields. The bridge support structures had been affected by erosion and people and cattle had to ascend/ descend a slope on one side of the bridge.

Photo 17. Erosion damage of a metal bridge. Photos Kaisa Nugin/ Konstanze Kampfer.

Chemicals

According to information provided there are no larger storages of pesticides or fertilizer in the area. Insecticides are used for treatment (cleaning) of larger animals. The animals, cattle, passes through basins filled with an insecticide solution (Photo 18). During the flood solution from three or four basins had been washed out. The effluent was suspected to have caused the death of fish that were observed 2-3 km downstream in the river. Information provided at the SAIDE was that the product used is Milbitraz TR.

Photo 18. Washing basin for animals, Chibuto. Photo: Kaisa Nugin/ Konstanze Kampfer.

General information of the use of insecticides in the province was received from the provincial director of agriculture, Ernesto Paulo. The volume of the basins vary but the constructions may contain up to 10 000 to 15 000 litres. The solution is reused and generally animals are washed once a week or every 15 days. The complete volume of water solution in the basin is changed once a year. The product Milbitraz TR is highly toxic to aquatic life (fish). Disposal of solution must be done downstream of water resources and wells and on a distance of 100 meters. The product decomposes in water and has no longterm effects.

Other

The sand in the area contains minerals/ metals and there are plans to start mining in the future. Mining -if not managed properly - can cause environmental damage depending on extraction method.

Recommendations for Chibuto district

All recommendations should be carried out in cooperation with national authorities as well as national laws and regulations.

- ✓ Follow safety instructions for the usage, storage and the disposal of the product (Milbitraz TR) in order to protect water resources and aquatic life.
- ✓ Development of mining industry should consider environmental impacts in order to prevent future damage.
- ✓ Inventory of infrastructural erosion damage due to erosion, incorporation of reconstruction activities in development plans.
- ✓ Implement erosion protection/drainage systems in reconstruction and development of infrastructure projects.
- ✓ Identify suitable locations for dumpsites.
- ✓ Organize a system for waste collection including for the resettlement area.

- ✓ Develop and implement separate collection and treatment systems for electronic, chemical and healthcare waste.

2.6 District Guija

Waste management

Waste is buried or burned. There was as a lack of proper equipment for cleaning up the waste after the flood. There is no collection of waste or appointed areas for dumpsites. Waste is buried in unsuitable locations which has the potential to contaminate soil and groundwater. Open burning of waste creates air pollution and poses health risks.

Chemicals

Storage of products to prevent mosquitos and malaria had been affected by the floods. Products DDT and Ficam were in the storages. Ficam is a trade name for bendiocarb products used for vector control. The products had not been dispersed but the stored chemicals had been damaged. The information was given that it was the last remaining chemicals from an anti-malarial campaign from the last year so apparently there is not a large quantity left. A team had looked into it but the district was awaiting further instructions on how to handle the damaged products. If present in large quantities, proper disposal is an important issue as DDT and its break-down products DDE and DDD, are persistent, bioacculumative, and toxic. Ficam/ Bendiocarb products are very toxic to aquatic organisms and may cause long-term adverse effects in the aquatic environment.[10]

Health

The storage of medicine at the hospital had been damaged. The damaged medicine was transported to Chokwe for destruction by incineration. Other hospital waste is buried in the hospital area. The hospital does not have any radiological equipment and it relies on Chokwe hospital for this kind of examinations. Hospital waste can cause sanitary and health problems as well as negative environmental impact if not handled properly.

Resettlement

There are three resettlement locations in the area:

- 7 de abril
- Tomanine
- Chinaquanine.

The residential areas existed before the floods and are all located in elevated areas. The resettlement Chinhaquanine is planned for 700 families. The areas for resettlement were chosen in connection to existing infrastructure, namely by the northbound road offering commercial opportunities. Development of water and sanitation systems should correspond to the future population in order to mitigate negative environmental impact. Infrastructural development and/or clearance of vegetation may cause erosion. Waste can cause health and environmental problems if not collected from resettlement area.

[10] Bendiocarbs are classified as R50 /R53 very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Infrastructure

During the floods all access roads to Guija were blocked and the only means to enter or exit were by helicopter or boat. The asphalt on the paved road had been carried away by the water. A bridge in the district was damaged due to the water flows. The railway in the area was damaged but under reconstruction.

Natural resources

Choice of materials for reconstruction was not yet decided upon but could be sand, wood and metal sheeting. In the area of Guija there is no reed (caniço) which is often used for the construction of dwellings. Extraction of natural resources may lead to deforestation and erosion.

Other

The governmental infrastructure and facilities for school and hospital are located in the lower areas. It is expected that all functions and habitants will gradually be relocated to reduce risks due to floods. The district has been running a nursery project with UNDP and MICOA (Ministry of Coordination of Environmental Affairs) and different trees had been planted such as Acacia, Moringueiras and Eucalyptus. In total 59 000 plants have been produced.

Recommendations for Guija district

All recommendations should be carried out in cooperation with national authorities and in accordance with national laws and regulations.

- ✓ Quantify the remaining chemicals from anti-malarial campaign, DDT and Ficam, and assure restricted and safe storage of the chemicals. Follow-up implementation of the recommendations and instructions given of the examining team to assure safe and proper disposal of the chemicals.
- ✓ Organize waste collection systems in living areas including the resettlement area.
- ✓ Identify suitable locations for dumpsites and develop adequate waste treatment including for electronic and chemical waste.
- ✓ Specifically establish management systems for healthcare waste. Systems could be elaborated in cooperation with other districts such as Chokwe.
- ✓ Continue the nursery programme.
- ✓ Reconstruct damaged infrastructure.

3. Recommendations

Short- and mid-term detailed recommendations are given in Table 1. All recommendations should be carried out in close cooperation with national, regional and district authorities as well as in accordance with national laws and regulations.

4. Sources and additional information

Environmental Emergencies Centre, www.eecentre.org

- *Flash Environmental Assessment Tool (FEAT)*
- *Disaster Waste Management Guidelines (DWMG)*
- *Beyond Response: Increased Preparedness for Environmental Emergencies*
- *Other guidelines, trainings and materials*

Joint UNEP/OCHA Environment Unit, www.unocha.org/unep

WHO Healthcare Waste Management guidelines, www.healthcarewaste.org

Reliefweb, Mozambique profile, http://reliefweb.int/country/moz

Shelter Cluster Environmental Reference Pages

- *www.environmentinshelter.org*
- *www.sheltercluster.org/References/Pages/Environment.aspx*

Fuel network including the IASC matrix on Safe Access to Firewood and Alternative Energy in Humanitarian Settings

- *www.fuelnetwork.org*

Checklist-Based Guide to Identifying Critical Environmental Considerations in Emergency Shelter Site Selection, Construction, Management and Decommissioning (ProAct)

- *http://postconflict.unep.ch/humanitarianaction/02_05.html*

Draft assessments carried out by UNDP / Early recovery cluster
Information provided at CTGC meetings
Situation reports , UNCT

Table 1. Recommendations, areas of expertise. As environmental issues are crosscutting and have effect in the short- and long-term the table is one way of arranging the recommendations. Linking areas of expertise are presented in parenthesis after the recommendation. Measures should be implemented in close collaboration with ongoing projects and organisations.

AREAS OF EXPERTISE	TERM	RECOMMENDATIONS
Waste management In compliance with **national laws and regulations** on waste management. For recommendations refer to: *Disaster waste management guidelines* available at www.eecentre.org. WHO for health care waste guidelines: www.healthcarewaste.org	**Short term**	▪ Support the process of cleaning up disaster waste. ▪ Encourage people in the affected area to organize waste collection and treatment systems. Supply communites with basic equipment ▪ Establish waste collection in resettlement areas. (Resettlement) ▪ Existing dumpsites which are open to the public should be designed and maintained considering safety and health risks. – Investigate geotechnical stability and risk of human injury. ▪ To create livelihood opportunities, organize recycling of materials. Consider health and safety issues and provide proper equipment. (Natural resources) ▪ Hazardous waste must be handled separately and disposed of in closed and confined areas to prevent contamination and health risks. ▪ Support the establishment of sound health care waste management practices in compliance with national laws and regulations.

Cover photo: Flooded area in Mandlakazi, Mozambique © Kaisa Nugin / Konstanze Kampfer

Waste management	**Medium to long-term**	▪ Further develop waste collections system for different types of waste such as electronic waste, chemical waste and other hazardous waste. For healthcare waste see healthcare section. (Hazardous material) ▪ Develop systems for recycling/ reuse. Consider health and safety issues and provide proper equipment. (Natural resources) ▪ Identify suitable locations for waste management / dumpsites. Dumpsites should be located on a safe distance and downstream of wells and water resources. (WASH, Natural resources)) ▪ Construct new dumpsite so leachate from the waste is prevented to infiltrate the soil and contaminate groundwater. (WASH, Natural resources) ▪ Closure of existing dumpsites should include cover to prevent water from infiltrate the waste and avoid contamination. (WASH, Natural resources) ▪ Information about the locations of waste management (former and active) must be documented and future use restricted in order to prevent risks of health problems, damage on constructions and/or environmental pollution. ▪ Incorporate waste management in contingency plans and assure that proper personal equipment is available. Identity future areas for waste management during disaster events. ▪ Education and information about waste and proper disposal in order to prevent negative impact on health and environment. Information campaigns can be carried out in public places, local meeting points and in cooperation with health centres and schools. (Education) ▪ Future developments of industrial facilities/ activities, such as mining, chemical production must assure that the waste management system is suitable to prevent environmental and health issues. (Physical infrastructure /Risk)

Hazardous materials **Usage, storage and disposal of chemicals and hazardous materials must be** In compliance with **national laws and regulations**. For information refer to : Chemical products: Safety data sheets and information from the supplier. Persistent organic pollutants, Stockholm convention: www.pops.int Emergency response guidebook: http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/ergmenu.aspx	**Short term**	▪ Identify quantities of remaining and damaged chemicals from anti-malarial campaign in Guija district and support proper disposal in accordance with recommendations given from the investigating team and in compliance with national laws and regulations. ▪ Usage and storage and disposal of the product Milbitraz TR should be done in a safe way and preferably at a safe distance from water resources. Solution of the product should be disposed of at least 100 metres away from boreholes and water courses. (WASH, Natural resources)
	Medium to long-term	▪ Improve the storage facilities for medicine and chemicals to reduce risk and damage in future events eg. floods. (Physical infrastructure/ Risk) ▪ Information about products must be properly saved and available in local language/s - necessary in order to insure proper usage, storage as well as disposal. ▪ Chemicals used contra malaria/ mosquitos. -Assure that proper equipment and information about the usage and storage of chemicals are available and implemented. (Health) ▪ Include existing chemical storages in contingency plans and assure proper response equipment for chemical accidents is available.

Water and sanitation (WASH) In compliance with **national laws and regulations** eg drinking water and water extraction.	**Short term**	▪ Support project and work in water and sanitation to assure clean drinking water. ▪ Drain areas of stagnant water to prevent spreading of malaria. (Health)
	Medium to long-term	▪ Sustain and improve system for collecting water (dams, rain harvesting) and for irrigation to assure cultivation during the dry season. (Agriculture) ▪ Map water resources and the capacity. (Natural resources) ▪ Support anti-malarial projects such as distribution of mosquito nets, draining of areas of stagnant water (Health)
Physical Infrastructure / Risk In compliance with **national laws and regulations** e.g building codes, development plans and authorization/legal permission.	**Short term**	▪ Restore and reconstruct infrastructure specifically dykes after the flood to reduce future risks.
	Medium to long-term	▪ Develop maintenance plans for dykes and drains to assure future function. ▪ Make an inventory of damaged infrastructure and include a reconstruction programs in a longer development plan. ▪ Revise infrastructural protection measures constantly in order to adapt to climate change. ▪ If larger infrastructural measures towards reducing risk such as dam construction or other make sure that feasibility studies include environmental aspects by an environmental impact assessment. (Natural resources, Waste management)

Education In compliance with **national laws and regulations** regarding he educational system.	**Short term**	▪ School facilities should contain proper facilities for sanitation and waste collection in order to create good examples. (WASH, Waste management)
	Medium to long-term	▪ Include environmental knowledge and awareness in the education.
Natural resources / Erosion In compliance with **national laws and regulations**.	**Short term**	▪ Support recycling and reuse of material. (Waste management) ▪ Identify suitable areas where material for (re-) construction can be sourced and extracted to minimize impacts on the environment. ▪ Develop restoration plans -replanting programs with the same tree/ vegetation or other native trees/ vegetation. ▪ - Restrict the depth or area for extracting sand if necessary to prevent geotechnical hazards or other negative impacts. ▪ Implement restoration measures continuously as the activities progresses. ▪ Avoid using materials that can create future environmental and health problems. (Resettlement) ▪ Make an inventory of infrastructure damaged due to erosion. (Physical infrastructure/ Risk) ▪ Study infrastructure impact on erosion. ▪ Construct drainage systems to prevent erosion due to increased runoff. (WASH) ▪ Preserve existing vegetation. (Resettlement)

Natural resources / Erosion	**Medium to long-term**	▪ Support sustainable use of natural resources in the area in order to support livelihoods and mitigate future risk or negative impacts. ▪ Important resources such as water for drinking and areas for livelihood such as fishing should be identified and protected in order to mitigate future negative impacts. (WASH) ▪ Support (re-) vegetation programs. Programs should use native plants/trees. (Resettlement areas) ▪ Investigate infrastructures impact on watercourses and erosion in order to mitigate negative impact. (Physical infrastructure) ▪ Improve erosion protection by vegetation and better drainage system. (WASH, Resettlement areas)
Resettlement Areas In compliance with **national laws and regulations** e.g building codes and development plans. Shelter Cluster Environmental Reference Pages. www.environmentinshelter.org www.sheltercluster.org/References/Pages/Environment.aspx Fuel network including the IASC matrix on Safe Access to Firewood and Alternative Energy in Humanitarian Settings.	**Short term**	▪ Develop suitable systems for water and sanitation. (WASH) ▪ Develop system for collecting waste from the resettlement areas. (Waste management) ▪ Protect and preserve the existing vegetation and construct drainage system to prevent future erosion in the area. (Natural resources/ Erosion, WASH) ▪ Plan for green areas where water can infiltrate or accumulate during periods of intense precipitation. ▪ Identify risks regarding the new settlement area that must be considered in the construction of houses or planning of the area. (Physical infrastructure/Risk) ▪ Assess environmental impacts of resettlement programmes; take natural resources, including risk of deforestation, into account. (Physical infrastructure/Risk)
	Medium to long-term	▪ Monitor the development of the area for opportunities of early interventions and response to problems arising. E g development of drainage systems or erosion protection.

www.fuelnetwork.org Checklist-Based Guide to Identifying Critical Environmental Considerations in Emergency Shelter Site Selection, Construction, Management and Decommissioning (ProAct): http://postconflict.unep.ch/humanitarianaction/02_05.html		▪ Support (re-) vegetation programs with native plants/trees and edible plants and fruit trees. The community should manage plants and trees.
Agriculture In compliance with **national laws and regulations** regarding agriculture.	**Short term**	▪ Pesticides and fertilizers must be used, stored and disposed of properly to prevent health and environmental risks. Necessary equipment must be available. (Waste management, Hazardous material)
	Medium to long-term	▪ Sustain and improve system for collecting water (dams, rainwater harvesting) and for irrigation to assure cultivation during the dry season. The irrigation water must not have too high content of salt in order not to damage the quality of the soil. (WASH) ▪ Support sustainable use of agricultural land. Vegetated areas prevent erosion and provide organic material and nutrients to the soil. (Natural resources/ Erosion)

Photos 19- 21 . De Montfort incinerator that remained after the earthquake 2010 in Port au Prince, Haiti. The incinerator and chimney made of brick. Below the incinerator is space for the remaining ashes and when this is filled the incinerator need to be moved or replaced. Photos MSB.

Photos 22-24. Example of oil fuel incinerator, Haiti 2010. This incinerator use oil but LPG and biogas could also be used as fuel. Below the incinerator is space for the remaining ashes and when this is filled the incinerator need to be moved or replaced. The shed also offers protected storage space. Photos MSB.

Annex I - Terms of reference

TERMS OF REFERENCE
Environmental Expert
OCHA Environmental Emergencies Section (Joint UNEP/OCHA)

Background

UNEP/OCHA Environmental Emergencies Section

The UNEP/OCHA Environmental Emergencies Section (EES) responds to environmental emergencies by coordinating international efforts and mobilizing partners to assist affected countries requesting assistance. By pairing the environmental expertise of UNEP and the humanitarian response network coordinated by OCHA, the EES ensures an integrated approach in responding to environmental emergencies. The EES also works on environmental emergency preparedness; to raise awareness among communities, disaster responders, governments, and industries on the impacts of environmental emergencies and the presence of hazardous materials that may be released during a disaster. The position as Environmental Expert relates to a request to assess the environmental impact of heavy flooding in Mozambique 2013.

Flooding in Mozambique

Heavy and persistent rains in January have led to massive flooding in southern Mozambique. To date, 114 people have died due to floods in Mozambique, which have cumulatively affected 240,832 people and temporarily displaced 186,238 persons, according to the Government's National Emergency Operations Centre (CENOE). Hundreds of houses were destroyed and crops and infrastructure were severely damaged. The Ministry of Agriculture's preliminary assessment indicates about 191,315 ha have been affected by floods, including 166,278 ha of cultivated land destroyed.

The magnitude and extent of damage has also raised environmental concerns, and care needs to be taken in providing clean water, sanitation and hygiene to the affected population. Unplanned resettlement camps and pressure on the vegetation for reconstruction could lead to soil erosion and future landslides.

Objective

The Environmental Expert is requested to take part in a damage and needs assessment (hereafter assessment); ensuring that the environmental impacts of the floods are assessed and identify immediate response needs, medium to longterm human recovery needs of the affected communities, and recommend appropriate means of restoring lives as well as reducing their level of vulnerability to future disasters. The process is Government led and supported by the civil society organizations, UN Agencies, World Bank, bilateral and multilateral agencies, INGOs and private sector. It is planned to take place during the month of March, 2013 in the affected areas. The assessment sample will target the Limpopo basin.

Activities

The Environmental Expert is expected to undertake a 3-week mission to Mozambique. Ahead of the mission the Expert is expected to conduct a desktop review of available background materials provided by the national counterparts and HCT WG (situation reports, background country documents, etc). The detailed mission agenda (days for field assessment / desktop work) will be developed together with the HCT / ER cluster. The Expert is expected to undertake the following activities:

Assessment of overall physical damage and losses to the environment caused by the floods in the affected areas:

  - Overall impact of disaster on environment
  - Impact on natural environment (lakes, wetlands, rivers, etc.)
  - Impact on manmade environment related infrastructure (sewage treatment, water supply systems, etc.)

- Development of recommendations for adaptation / mitigation measures to reduce impact to the environment and water sector from flooding as part of the strategic early recovery framework, and linking to long-term sustainable recovery
- Review and analyse inputs from other sectors as it pertains to environmental issues and sustainable recovery; develop recommendations and promote the integration of appropriate actions into the overall humanitarian response strategy;
- Communicate rapidly and regularly key findings to the clusters / HCT emphasizing the possible need for additional specialized expertise (e.g. related to dams, slope stability, waste management, specific chemical hazards) and/or additional equipment as required;
- Identify, where applicable, pre-existing contributing environmental factors to the disasters (e.g. deforestation, poor urban planning, lack of prevention and preparedness);
- Any other task relating to environmental issues that she/he might be requested by the HCT WG Chair or the ER Cluster to perform.

Duration
The expert is expected to spend 14-21 days in Mozambique.

Budget
The costs related to the mission (travel Sweden-Mozambique-Sweden as well as daily subsistence allowance) of the Environmental Emergency Expert will be borne by MSB. In-country travel costs (Mozambique) will be borne either by the host national counterpart and/or the United Nations.

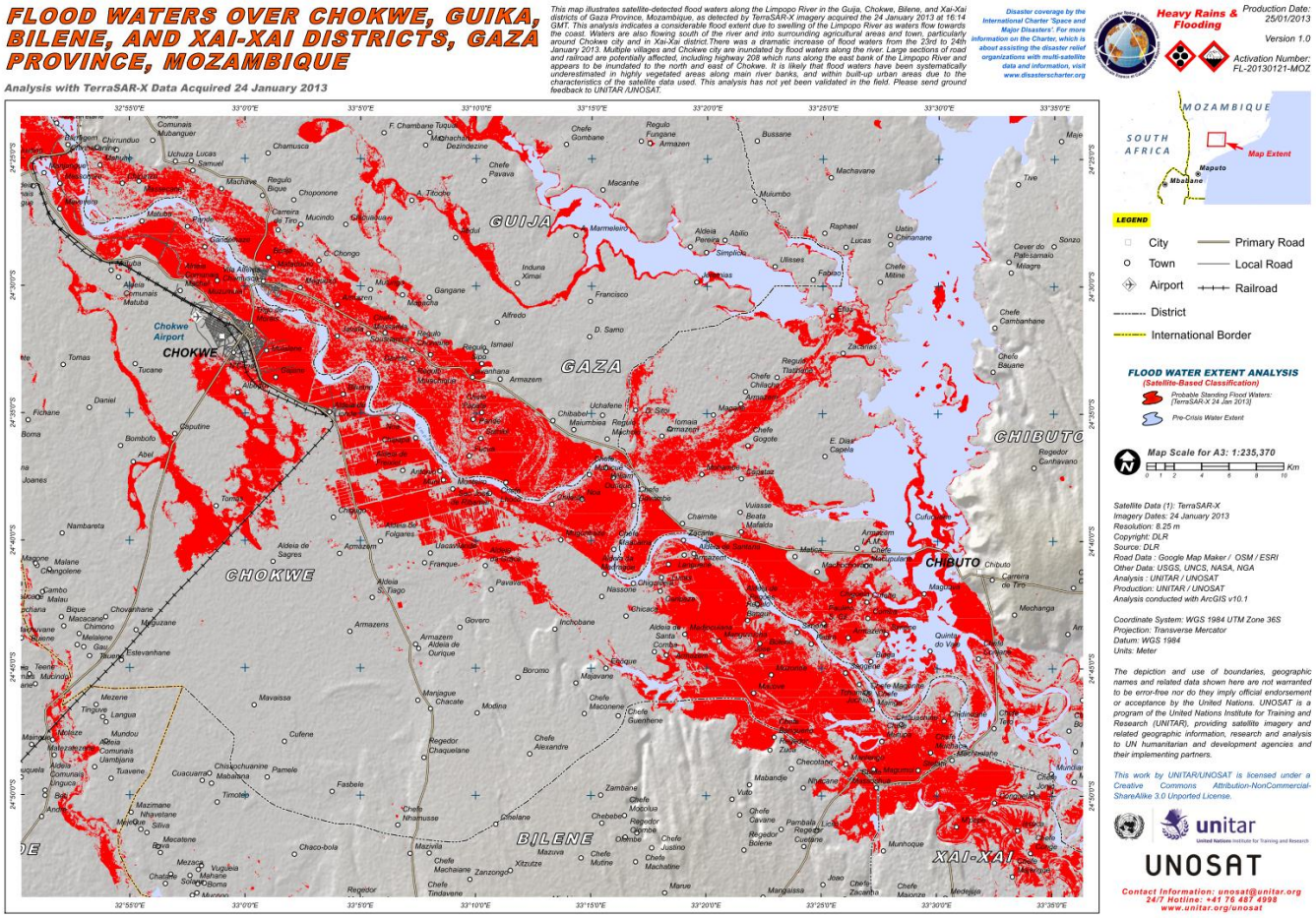
Report:
The results will be documented in a report with following outline;

- Background
- Impacts / observations
- Recommendations

Annex II - Organisations and people met

Location	Organisation	Name
Xai-Xai		
	Provincial director of agriculture	Ernesto Paulo
	INGC, Provincial delegate of Xai-Xai	Alfonso Maxaieie
	INGC	Virginia Malauene
	The technical council in the municipality in Xai-Xai	Fransisco Machembe Sergio Narciso Rojas, Department of Water, Energy, Health, Women and Social service, Carlos Chiehavele, Department of urban services,
	Citizen of Bairro B, flood affected area	Virgilio
Mandlakazi		
	President of the municipal council of Mandlakazi	Maria Helena J. Correia Langa.
Chibuto		
	The permanent secretary of the district	
	President of the municipality	Francisco Soares Manjate
	Counsellor of agriculture	Carlos Celestina Cossa
	Counsellor of water and sanitation	
	SAIDE Chibuto	
Guija		
	The permanent secretary,	Angelina Manhique.
	Director of Health, Women and Social service	Antonio Domingos Assede
	Director of infastructure and planning	

Annex III - Map showing flood water over Chokwe, Guija, Bilene and Xai-Xai districts, Gaza province Mozambique



Map 3. Flood water 24 January 2013, UNOSAT. www.unitar.org/unosat/maps/MOZ