United Nations Disaster Assessment & Coordination (UNDAC)

ZANZIBAR POWER CRISIS

UNDAC Team
ENVIRONMENTAL ASSESSMENT
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Introduction

Overview

This report describes the activities, findings and recommendations of an environmental expert deployed on a United Nations Disaster Assessment and Coordination (UNDAC) team in response to a prolonged power outage crisis on Unguja Island of Zanzibar, Tanzania. This final report is aimed at the national authorities in the affected areas, donors and other stakeholders of the Joint UNEP/OCHA Environment Unit (Joint Environment Unit) to assist them with follow-up actions. Earlier field copies of the report were shared with relevant authorities at the time of the assessment.

Power Outage

On 21 May 2008, Zanzibar experienced a major power outage when the national power grid of Tanzania failed. During the process of restoring power to the Unguja grid, there was a mechanical failure related to porcelain insulators. The subsequent damage caused a total, prolonged power blackout on the island. Since this date, and up to and beyond the time of the mission, the entire island was without power.

At the request of the Revolutionary Government of Zanzibar, an UNDAC team carried out an assessment of the impacts and provided a risk analysis of the power outage. This UNDAC assessment, of which the environmental expert was part, took place 11-19 June 2008[1].

Role of the Joint UNEP/OCHA Environment Unit (Joint Environment Unit)

The Joint Environment Unit is the United Nations mechanism to mobilize and coordinate the international response to environmental emergencies, including natural disasters and crisis with major environmental impacts. In situations such as the Zanzibar power crisis, the Joint Environment Unit supports the identification of acute environmental issues, mobilizes assistance to ensure that they are addressed, and helps to ensure appropriate transition and follow-up to recovery and rehabilitation phases.

Methodology

For the environmental assessment, the expert made use of the Flash Environmental Assessment Tool (FEAT). This new methodology was developed by the Dutch Institute for Health and Environment in collaboration with the Dutch Ministry of Environment, at the request of the Joint Environment Unit. It allows users to identify acute environmental risks following sudden onset natural disasters. The FEAT can also help users to identify medium to longer-term issues, given that these may be evident, and should be identified, immediately following a disaster. The FEAT is still in a prototype phase, and will be finalized late in 2008.

[1] *For details of the UNDAC team mission please see the report, UNDAC MISSION REPORT Zanzibar Power Outage, 10-20 June 2008*

Environmental assessment overview

Overview: activities of the UNDAC team environmental expert

Upon arrival to Zanzibar, the UNDAC team environmental expert, in close cooperation with experts from Zanzibar Water Authorities (ZAWA) and the Ministry of Agriculture (Department of Environment)[2] used the FEAT to identify a list of major infrastructure and industrial installations posing potential impact on human life and health, and/or longer term impacts on the natural environment, as a result of the power outage. Based on this, the following issue areas were identified and became a subsequent focus of the mission:

- Drinking water quality
- Sanitation/waste water
- Municipal waste management
- Industrial installations

Of these, the lack of drinking water and quality of drinking water - including a risk of water-borne diseases - were identified as being of greatest concern to health and the environment.

The next sections provide findings and recommendations in each of these four areas.

General findings on drinking water

One of the main concerns to the population of Ungula is the supply of clean and safe water. Under normal circumstances, almost all urban areas are provided with drinking water from the existing water supply network. An estimated 50% of the rural areas have access to this network. The source for drinking water network is ground water from boreholes and natural springs. In rural areas, water is supplied from individual wells.

The water is distributed from a number of boreholes, each having a pump station that operates on electricity provided by Zanzibar power company network. Water is pumped into a number of overhead tanks from where the water supply flows by gravity. There are 74 pump stations on Unguja.

Within the first week of the crisis, authorities installed 14 generators at key pump stations in the area around Zanzibar Town (Urban West), providing water to approximately 50 percent of the population (ca. 462,590 people) in the town for 12 hrs during day time. According to the Director of ZAWA, the decision on running generators for 12 hrs and not 24 hrs a day was due to high fuel costs. ZAWA established a number of alternative taps along the pipelines to serve people without water supply. At the collection points water is collected in tankers and private containers. Twelve generators and fuel to run them were subsequently provided by UNICEF in cooperation with the Danish International Development Agency (DANIDA). It is estimated that 80% of the population normally served by the network will have service re-established as a result of the installed generators. The additional generators from UNICEF are installed at the following locations:

- **Urban West**: Kianga No 4, Mfenesini No 12 (ca. 26,500 people)
- **South Region**: Makunduchi Cave, Machui Spring No 1&2, Jendele, Bambi & Mpapa (ca. 33,461 people)
- **North Region:** Kiashange, Kandwi, Donge Kipange, Donge Mbiji, Upenja (ca. 81,910 people)

[2] The Department of Environment is housed within the Ministry of Agriculture

Chlorine is added to the water at only two pump stations. According to the site manager, the water at Saateni, the main pump station in Zanzibar town, is analysed 1-2 times/month during normal operations. However, due to the lack of 24 hour/day supply of electricity and a lack of funds for analysis, no monitoring of the water quality was being done at the time of the mission.

During the assessment several pumping stations were visited. One of these can be seen in the photo below. It was observed that the pump stations were operated at low standards. For example, many of the wells were not fenced, and some well-heads were not closed, meaning that contaminants can enter the aquifer and the supply system.

A pump station operating on a generator provided by UNICEF/Danida

According to ZAWA, previously abandoned wells were reactivated during the crisis so that local populations could access water supplies. However, the UNDAC team observed surface water from streams being collected without any knowledge on the part of the users of the water quality.

Conclusions on drinking water:

The lack of safe and clean water poses direct risks to the health of the population of Ungula even under normal situations. However, the power outage increased these risks in several ways. In particular, the fact that water stands still in the network for 12 hours/day (i.e. the system is not flushing), combined with an estimated 35% leakage through faults in the network system (i.e. meaning there are holes in the pipes), leads to a high risk that contaminants can enter the system and that diseases can be spread through the network. Furthermore, as described in more detail below, problems with solid waste management mean that wells that have recently come into use as a result of the crisis, may also pose risks. The situation is exacerbated by poor sanitation standards at the public collection points, in particular those with open well-heads through which contaminants can enter.

Short-term recommendations for drinking water:

- **To provide clean and safe water, pumping stations should meet operational standards to be developed and provided by ZAWA. The UNDAC team environmental expert proposed elements of such standards to ZAWA, using World Bank guidance a basis.**
- **In order to reduce the risk of water-borne diseases, the pump stations should operate 24 hours/day. This will maintain water pressure in the pipes, keeping them flushed and reduce infiltration of contaminants and water-born diseases into the system.**
- **ZAWA could provide chlorine to households including information on treatment of the water and water containers used for collection of water before being used in the household. Donors could consider providing support for this, if needed.**
- **Pre-crisis water sampling and analyse programme should be re-implemented by ZAWA.**
- **ZAWA should inform the public on a regular basis the areas being provided with water and alternative sources.**
- **Generators at pump stations should be installed according to "Environmental guidelines for instalment of temporary generators," being prepared by the Zanzibar Environmental Department.**
- **Once power has been re-established and water supply is back to pre-crises levels, the network should be flushed before it is used for drinking.**

Medium-longer term recommendations for water quality:

- **A water quality monitoring programme should be instated to reduce the risk of water-borne diseases. This programme should include water sources (wells and springs), the network and end-user distribution sites.**
- **As a preparedness measure for any future power outages, key pump stations should be equipped with backup generators for power supply by ZAWA. Donors may wish to consider support if needed.**
- **In areas with low pump capacity, mechanical wind power or solar cells should be included in the future planning. This will reduce the effects of any future power outage and lower energy consumption.**

General findings on sanitation and waste water

There is one site that posed particular sanitation risks as a result of the power outage. On Unguja, waste water flows by gravity except at an area known as Kikwajuni flats. Due its location, waste water at Kikwajuni flats cannot be removed by gravity and a waste water pump station is in place. However, this pump station was not operating due to the power outage, causing wastewater backups. These backups in turn can enter the water distribution network, or create localized health risks. At the time of the mission, the waste water was only being pre-treated in a septic tank before being discharged into the sea.

Conclusions:
On a short-term basis the backups of waste water at the Kikwajuni flats pump station could increase the risk of water-borne diseases

Medium-longer term recommendation:

- **Install a 15 KW generator at Kikwajuni flats pump station in order to prevent backups in the system potentially increasing the risk of contaminants to enter into the drinking water pipeline system.**
- **Installation of waste water treatment facilities should be considered.**

General findings on Municipal waste management

As noted above, there are clear links between sanitation/solid waste management issues, the power outage, and environmental and health risks. In particular, various wells have recently come into use as a result of the crisis that may be at risk as a result of poor sanitation/solid waste management practices.

It is estimated that about 216 tones/day of waste is generated on Zanzibar, and only 25% of this is collected and transported to the municipal landfill in Jumbi. The remaining 75% is either eaten by animals, burnt, dumped illegally, blown away by the wind, swept away by the rain into storm water drains or stay as accumulated heaps in parts of town.

The municipal landfill in Jumbi, about 12 km east of the Zanzibar Town, was visited during the Mission. The landfill includes an area of about 20,000 m² (~170 m * 150 m) in an old stone quarry. It is operated as an open waste dump centre inside the residential area of Jumbi village. The dumpsite is clearly poorly managed, without, for example, bottom-linings and top cover. The dumpsite is not fenced and the public (including children) have free access.

At the same time, many of the houses around the dumpsite relay on drinking water from private wells, moreso following the power outage. These wells are likely at risk as a result of the poorly-managed dump site. Indeed, one of the wells close to the dump sits was reported to be closed/sealed by the local authorities due to the poor water quality. At present the hydrogeology in the close vicinity to the dump site is not mapped in any detail.

The Municipal Council of Zanzibar is responsible for solid waste management services in all 20 wards and 45 shehia`s (a shehia is the smallest local administrative unit). A proposal for upgrading this disposal site at Jumbi has been put forward to responsible authorities. The following measures are envisioned as part of this proposal:

- Levelling and compacting waste
- Improving the access road to and from the disposal area
- Procuring a front end loader for daily site operation
- Constructing of entrance gate and small building for site supervisor.
- Fencing of the area

The Municipal landfill in Jumbi located about 12 km east of the Zanzibar Town

According to the local authorities, no management of the landfill takes place at present due to lack of funds for repairing the front-end loader. This means that immediate risks to water quality may persist as long as wells in the vicinity of the landfill are used. Once the front-end loader is in place the site is to be rehabilitated including dividing it into sections and sections not in use to be covered by soil. Based on a feasibility study on solid waste undertaken in 2005 , the following components need to be addressed:

- Additional procurement of collection and transportation equipment (for primary and secondary collection)
- Removal of illegal dump sites in low income areas
- Improvement and extension of additional collection points including storage containers
- Construction of a proper new sanitary land fill (At New site Kisakasaka)
- Composting of organic waste

Conclusions:

The absence of a bottom-lining and top cover at the waste dump site increases the risk of water-borne disease due to washing out of contaminants to the groundwater and wells now being used by residents as a result of the power outage. The fact that the dumpsite is situated in an old quarry means leakage water is close to the groundwater table. It should also be noted that the lack of top cover contributes to bad odour and increases the risk of spreading of air borne diseases to the neighbouring communities. The air borne contaminants could further contribute to respiratory diseases, with children at particular risk.

Short-term recommendations:

- A management plan for the Jumbi landfill must be put in place, using as a starting point the recommendations made in 2005.
- The landfill should be fenced to prevent public access to the site.

- The groundwater quality in private wells around the site should be monitored.
- Donors may wish to consider providing support to the above activities, as required.

Medium-longer term recommendations:

Implementation of a Municipal Waste Master Plan should be considered in the longer term.

General findings on industrial installations

Zanzibar is characterised by very few, small scale industries. During the Mission two areas with industrial installations were assessed. These are noted in Table 1. No immediate, direct impacts on human health related to the power outage were observed. However, the assessment identified several issues that may pose high risks to humans in the event of a sudden onset natural disaster, as well as issues that are likely to pose longer-term impacts on human health and on life support systems that the authorities could consider addressing. For example, the oil storage facility visited, is operated with poor safety standards posing a high fire risk. Furthermore, no preparedness measures were installed to cope with a leak. If affected by e.g. a hurricane or flooding, it could lead to widespread pollution, especially to the coastal marine environment. Moreover, due to the power outage, higher-than-normal quantities of fuel were being put through the facilities, creating additional risk.

Site specific findings and recommendations are made in detail below.

Site specific environmental assessments and recommendations of industrial installations

Using the FEAT as a basis, the UNDAC team environmental expert developed a list of priority sites to visit for further field assessments. Table 1 summarizes the sites identified and assessed by the UNDAC Team. Detailed descriptions are provided below.

Table 1. Summary of site visits

Site #	Name & location	Key potential risks	Date of visit
1	Oil storage facilities	Oil spill, fire, long term impact to the marine environment	14. June 2008
2	AMANI Industrial Park	Air emission, hazards waste	16. June 2008

Site descriptions and recommendations

Site 01: Oil storage facilities

Findings:
The oil storage facilities are located in the northern part of Zanzibar Town along the coast. The facility consists of four individual companies:

- CAPCO – Diesel and petrol, visit by the UNDAC Team
- BP – British Petrol. Delivery of fuel to the Airport
- UP – United Petrol. Delivery of fuel for ships
- ZP – Zanzibar Petrol. Diesel and petrol

The CAPCO Oil Company is a privately owned oil company located in the southern part of the oil complex. The facility consists of 4 above-ground storage tanks.

The tanks are placed on a concrete foundation directly on the ground (see photo below). The four tanks are placed inside a concrete wall (bunding). The (functioning) pump station is placed on a concrete plate with bunding. The filling station is placed on a concrete plate surrounded by a drainage system.

Delivery of fuel is by ship. Once the ship has anchored up in the bay the oil is pumped from the ship to the tanks by a flexible delivery hose. No oil-pier exists and the oil-hose is submerged on top of the seabed. After delivery, the oil storage tank is drained manually by opening the valve in the bottom of the tank (see photo below). Drainage water for the tanks is drained directly into the ground and/or via an open drainage system into the bay without treatment.

According the site manager of GAPCO, GAPCO and BP share the same delivery hose. The hose is pressure tested every second year. The two other companies have there own delivery hose and the status of these are not known, however according to the site manager of GAPCO leaks from these has occurred on land and the beach between the facilities and the bay show clear evidence of light oil contamination.

Tank farm at GAPCO Oil Company. The valve and pip on the left is used to drain seawater from the tank.

During the site, visit oily water from the facilities was observed draining into the bay.

Conclusions:

The installations were observed to be of very low environmental standard. The present delivery process of oil poses a risk of ongoing release of free oil directly into the bay, with a negative effect on the marine environment. This, in turn, could likely affect the food chain and ultimately human health, over the longer-term. The wall surrounding the tanks will only give limited protection with respect to spreading of oil in case of a major leak from one or several tanks mainly due to the open drainage system around each tank draining directly into the bay and secondly due to no bottom lining in the tank farm to prevent oil to enter into the ground and eventually into the bay via the groundwater having the same negative effect to the environment as above.

Even without a major leak or accident at the facilities the present standard and procedures is a constant source of releasing oil in drainage water into the marine environment.

Recommendations:

- **A thorough environmental audit of the facility should be preformed by the Zanzibar Environmental Department.**
- **To prevent a major oil spill entering into the ground and the bay, all tank farms should be bunded. Bunding should be to 120% of the capacity of the tanks.**
- **All drainage systems should be connected to oil separators and a proper waste water treatment plant to facilitate the whole oil storage facility should be implemented.**

Site 02: AMANI Industrial Park

Findings:

The AMANI Industrial Park is a privately-owned complex. At present the complex includes 8 factories and a number of management companies. Activities include:

Super Sine: Production of audio and video cassettes from granulates. High ration of recycling of plastic takes place, however small amount of waste especially electromagnetic waste is burned in open fires on site. The small incinerator for burning of waste is presently not functioning.

Safari Company: Production of plastic household items from granulates. High ration of recycling of plastic takes place, however small amount of plastic waste is being burned in open fire on site. The small incinerator for burning of waste is presently not functioning (same incinerator as for Super Sine).

Savannah Int.: Import of second-hand clothes for repacking and selling domestic (20%) and abroad (80%).

Mobile phone company: Technical headquarters on Zanzibar, no production.

ZaRec: Production of compost from organic waste. Working on very low capacity for the time being due to no requirements of the product.

Textile Industry: Production of uniforms.

Zanzibar Color industry: Production of uniforms for the public and private sector.

Mobile company: Technical headquarters on Zanzibar, no production.

Management companies: Offices without any production. Only generate a small amount of Municipal waste.

Conclusions:

Except for the lack of waste management on the site and the burning of small amounts of waste, the compound appears well-managed and the present activities is not considered to pose any major risk to the surrounding environment. Nevertheless some more minor recommendations are made:

Recommendations:

- Stop burning of waste, in particular electronic waste, which can release heavy metals during combustion and create localized health risks. Recycling options could be explored.
- Setup a proper central waste management system for the whole compound