



**Dar es Salaam Marine Ecology Conservation  
PROJECT**

CONCEPT PAPER

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# Dar es Salaam Marine Ecology Conservation Project

## 1: Dar es Salaam Regional and City Profile

**Location:** Dar-es-Salaam (DSM) lies in the eastern part of Tanzania mainland, located between latitudes 6027' and 7015' South of equator and between 390 and 39033' east of the Green Witch Meridian line. It lies between 6.34' and 7.10' South on the West Indian Ocean coastline, stretching about 100 km between the Mpiji River to the north and beyond the Mzinga River in the south, enclosing a land of 1,350km<sup>2</sup>. The region is divided into three Municipal Districts, namely Ilala, Kinondoni and Temeke that are subdivided into 72 wards.

**Population:** DSM is the commercial capital and largest urban center in Tanzania. It has an estimated population of 3.5 million people, Ilala 800,000, Kinondoni 1,200,000 and Temeke 1,500,000. Since 1988 the average growth rate has been about 8% per annum. The total number of households is about 547,000 with an average size of 6.4 persons. 70% of the population lives in 40 unplanned settlements.

District	Population
Ilala	800,000
Kinondoni	1,200,000
Temeke	1,500,000
Total	3,500,000

*Source: Dar es Salaam City Council*

**Climate:** DSM region has tropical equatorial climate, a mean annual temperature of 26°C and an average humidity of 96% in the morning and 67% in the afternoon. The annual rainfall averages over 1000mm.

**Morphological characteristics:** The region is characterized by four distinct landforms:

**(a) Shoreline & Beach:** The shoreland immediately abutting the sea, comprising sand dunes and tidal swamps.

**(b) Coastal Plain:** A limestone coastal plain to the west of shoreland extending to the Pugu hills, overlain with clay bound Pleistocene with fairly uniform relief lying between 15 and 35m above sea level and slopes of less than 3%. Whilst extending 10kms to the west of the city, the plain narrows to 2kms at Kawe in the north before widening to 8kms at the Mpiji river, and varies between 8-5kms in width to the southwest where the relief is more irregular gradually merges into the more elevated head waters of Mzinga river. Lakes and ponds are scattered throughout this landform where rich clay soils and zero gradient impede natural drainage.

(c) Inland Alluvial Plains: Rivers originating from the Pugu hills to the east dissect the coastal plain in a series of steep sided Ushaped valleys, culminating in creeks and mangrove swamps before entering the Indian Ocean. Dar es Salaam harbor penetrating almost 10kms inland along the Kizinga and Mzinga creeks forming the principal topographical feature of the region. These valley soils are generally poorly drained silt clays enriched with organic matters.

(d) Upland Plateau: The deeply dissected Pugu hills, which bound the region to the west average 100 to 200m above mean sea level rising some 330m at some point, are characterized by steep weathered slopes and well drained of unconsolidated gravely clay bound soils.

**Water Resources:** The region contains watersheds of 4 major rivers. Mpiji River forms the northern boundary of DSM, Msimbazi River flows to the north of the city centre and Kizinga and Mzinga Rivers flow into the harbour area of the city. There are also smaller water courses such as Nyakasangwe, Tegeta, Mbezi, Sinza, Tabata, Minerva. Apart from a small pumping station at Mtoni on the Kizinga River, all regulated water comes from Ruvu River outside the city boundary. Due to the distance involved, there is high leakage and limited free flow. The region will always rely on external surface sources as groundwater is not only polluted from effluents but contains high degree of salinity. Whilst the primary function of these river systems is for drainage with only a small pumping station in Kizinga River, some streams are occasionally used as last resort water sources by poor families in unplanned settlements who cannot afford to purchase water commercially.

**Industry:** 80% of the nations' industries are located in the DSM region. In 1999 there were 412 industries on the register of the Ministry of Industries and Trade, including some which may have since ceased to operate.

#### Industrial in Dar Es Salaam

Category	No. of industries
Food and beverage manufacturing, chemicals and cosmetics	162
Metal products	55
Textile mills, garments, leather and plastic products	90
Paper and paper products, printing, publishing and allied industries	33
Wood and wood products	17
Building and construction materials	14
Electrical appliances, battery industries	12
Animal feeds	8
Motor/vehicles assembly and maintenance	10
Glass and Glass products	5
Ginnery and tobacco	3

Mineral	2
Petroleum refineries	1

*Source: Ministry of Industries and Trade. (International Standards: Industrial classification of all economic activities Part II List of major Divisions, Divisions and major groups).*

**Tourism:** The coastal climate is favourable to beach tourism. In DSM there are more than 13 tourist hotels, and new ones are under construction, with a total of 5,000 beds. The main ones include the Sheraton Hotel, New Africa Hotel, Kilimanjaro Hotel (now inoperative), Silversands Hotel, Whitesands Hotel, Jangwani Beach Hotel, Haven of Peace Hotel, Sea Cliff Hotel, Africana Hotel, Kunduchi Beach Hotel, Bahari Beach Hotel, Oysterbay Hotel, Karibu Hotel. According to the Ministry of Natural Resources & Tourism and the Tanzania Tourist Board, the annual average number of tourist is about 201,000 with average annual expenditure of US\$ 190 million.

**Commercial and Industrial activity and the "Informal Sector":** Until the 1980s, the main commercial and industrial areas were mainly those designated by the Urban Master Plan of the City, covering an area of some 170 ha for the Central Business District and over 2000 ha for the industrial areas. By 1992, industrial sites sprawled and doubled in size; small scale commercial, industrial and service units mushroomed throughout the city, in response to high urbanization and rising unemployment in the formal sector, occupying city center pavements, road junctions, transportation terminal sites, as well as locations along arterial road reserves. The informal sector in DSM region is growing rapidly. In 1991, the Ministry of Labour and Youth Development counted more than 210,000 businesses with an average of 1.5 jobs per enterprise (Report on Self-help organization in the informal sector of the DSM, SIDO/GTZ Project, 1995). By definition many informal activities are low-cost, unregistered and escape official statistics; 95% of informal businesses are survival activities. Overall, the informal sector is estimated to generate over 32% of the officially recorded Gross Domestic Product. Earnings per worker are 2.6 times higher the minimum wages in the urban formal sector.

**.Agriculture:** Of the total area of DSM of 1,350km<sup>2</sup>, an area of 430km<sup>2</sup> (or 32%) is taken up by urban development, 20km<sup>2</sup> is forest land and 900km<sup>2</sup> (or 67%) is rural only part of it in agricultural use. Agriculture is however the main activity within the region. Satellite image pictures suggest that as much as 23% of the area of the region is used for agriculture production.

**Fishing:** The total population of fishermen is disputed; estimates range from 3,000 - 50,000. This vast difference is explained by the small number of licensed fishermen relative to the much larger number of non- registered fishermen. Despite the number of rivers crossing the city and the few fresh water lakes and ponds, inland fisheries are limited. Offshore fisheries are extensively exploited by

small-scale fishermen trawling and netting the coastal waters landing on average some 50,000 kg annually, marketed for more than TSh. 3.0 million.

The fishermen are divided into three groups: Wealthy fishermen owning fleet of boats with engines on board, nets and gear. They employ hired labour. This group comprises rich fishermen with resources to buy dynamite and use it in their fishing techniques together with trawling and small mesh nets. Small-boat owners fishing in shallow water near their villages for their livelihood and family consumption. Poor fishermen (the largest group) mostly employed boat owners as labourers.

Fish species caught in marine waters of DSM

COMMON NAME	REPRESENTATIVE SPECIES	LOCAL NAME
Rays	Rhinoptera javanica	Taa
Flat fish	Psettodes	Goyogoyo
Sardine	Sardinella gibbosa	Dagaa
Thread fish	Polynemus spp.	Kupe
Cat fish	Arius spp.	Hongore
Half beaks	Hemiramphus spp.	Chuchunge
Mackerel	Rastrellinger kanagurta	Vibua
Parrot fish	Leptoscarus spp	Pono
Rabbit fish	Siganus spp.	Tasi
Scavenger	Lethrinus spp	Changu
King fish	Scomberomorus commerson	Nguru
Tuna	Auxis thazard	Sehewa
Jacks	Seriola rivoliana	Kolekole
Rockcod	Epinephelus spp	Chewa
Silver Biddes	Gerres spp	Chaa
Mulletts	Mugil cephalus	Mkizi
Milk fish	Chanos chanos	Mwatiko
Cobia	Rachycentron canadum	Songoro
Sword fish	Xiphias gladius	Samsuli
Queen fish	Scomberdes	Pandu

Source: *An Aquamarine Profile of DSM region by NEMC, 1995.*

**Quarrying:** Sand, stone, limestone and clay are extracted in key locations for building and construction purposes. Salt is mined in the shore for domestic consumption. Approved sand quarrying areas include Mbagala, Chamazi, Pande, Twangomna, Majohe Makonge, Kitunda, Mpiji, Pugu and Bunju, with other more urban areas where mining is carried out unofficially such as Kawe, Mbezi beach, Tegeta Mtongani, Boko & Tabata. Stone is mainly extracted from Kunduchi, Mjimwema, Boko, Bunju and Kigamboni quarries, supplemented by small scale family operations in disused quarries scattered throughout the urban area, especially in Msasani, Oysterbay & Masaki. Limestone is quarried from Wazo /

Kunduchi outcrops for the Tanzania Portland Cement Company Ltd. at Wazo Hill cement factory. Clay is extracted from upper Msimbazi river valley for the manufacturing of bricks.

**Estimated income:** The average annual contribution of DSM region to the national GDP is reported at 33% and the per capita income at about TSh. 197,000 (National Accounts of Tanzania 1976-1994), both higher compared to other regions. The current average wage in DSM is 250 US\$. The liberalisation of the economy, intended to stimulate private sector development and markets for goods and services, has contributed to rapid growth of informal sector activities that increasingly absorb working population released from the previously protected public and parastatal sectors. It is estimated that in the informal sector earnings per worker are 2.6 times higher minimum wages.

**Health facilities:** In this region health facilities are located in various parts of the area comprising both informal and formal health establishments. Despite improvements in medical practice, the informal sector still plays an important role in the community. The formal sector is run by various institutions including the Government, voluntary agencies, parastatal and other private organisations. There are in the region 429 health units that include 36 hospitals, 13 health centres and 380 dispensaries.

**Distribution of hospitals, health centres and dispensaries in DSM region, 1997**

Facilities	Number of hospitals				
	Government	Voluntary agency	Parastatal	Private	Total
Hospitals	3	1	2	30	36
Health centres	4	2	2	5	13
Dispensaries	52	65	61	202	380

*Source: An Environmental Health Profile for DSM region by NEMC 1998*

**General Environmental Sector Problems**

**Urbanization:** Urbanisation is the most dynamic factor underlying most of the immediate causes of environmental degradation. Rapid urban population growth imposes heavy demands on the already densely inhabited housing areas, most of which are unplanned and lack organised sanitary and wastewater infrastructure systems. Urban population growth in DSM is currently around 8% per year outpacing the limited capacities of municipal authorities to supply adequate infrastructure facilities. **It is estimated that 70% of the population live in over 40 unplanned communities covering an area of 10,000 ha.** Uncontrolled disposal of wastewater and solid wastes is a common problem affecting water sources and living conditions in all unplanned settlements, particularly in settlements such as Manzese and Vingunguti. Outbreaks of water-borne diseases are frequent during the rainy seasons.

**Domestic wastewater:** DSM has no operative sewage collection infrastructure. The sewerage system is old and degenerated. It covers an area of 130km of sewer and consists of 11 networks supported by 17 pumping stations, including the City Center, parts of Sinza, Ubungo and Vingunguti. It was built in the late 1950's and its attempted rehabilitation in the period 1980–1988 has been unsuccessful. Sewage from the areas supposed to be served is discharged into oxidation ponds and directed to the ocean untreated. Poor managing of these ponds result in overflowing and spreading of sewer to the surroundings. Only 4 of the 8 oxidation ponds are considered to be operating (University of Dar-es-Salaam, Kurasini, Mikocheni and Vingunguti). Only 15% of the households are connected to the system. 80% of the households in the rest of DSM use on-site pit latrines and septic tanks. High water table in various parts of the city during the short and long rains further compounds the poor sanitary conditions with many pits overflowing into the drainage system emptied manually, often by the families themselves and occasionally by private companies at a cost.

**Industrial wastes:** The rapid growth of informal sector activities, particularly workshops and repair establishments, generate industrial wastes in settlement areas and near rivers adjacent to coastal areas. Industrial development and more so small and medium size workshops are not subject to proper Environmental Impact Assessment due to institutional inadequacies relative to the sheer scale, pace of undetected nature of informal sector activities. Car washing activities are often sited near streams (e.g. Msimbazi river along Jangwani, near Kilimanjaro Hotel etc) discharging dirty water covered with layers of oil. At the ports ships handle large quantities of oil with frequent oil leakage from Tazama Pipeline. Oil spills also occur during operational transfer of oil from tankers into receiving facilities. Within the city industries are concentrated mainly in the Mikocheni light industrial area, Nyerere road industrial area, Changombe industrial area, Morogoro Road industrial area, Mandela express industrial area and Mbezi along Ali Hassan Mwinyi road. Many industries discharge untreated effluents directly or through storm water drainage, river creeks and streams or estuary drainage into the sea.

- ?? Msimbazi river has been found to be heavily polluted due to effluents from industries along Nyerere road industrial area (e.g. Vingunguti abattoir), Morogoro road (e.g. Tanzania-China Friendship Textile mill), Mandela road (e.g. Tradeco Ltd), Tanzania Breweries Ltd. Dar es Salaam plant, leachate from Vingutinguti crude dump.
- ?? Karibu Textile Mill discharges its effluent to the Mzinga River.
- ?? Leachate from closed Kabuma crude dump (in Temeke) flowed into the ocean (now closed).

The extent of industrial pollutants has not been quantified to provide further information.

**Solid wastes:** It is estimated that about 2,220 tons/day of solid wastes are generated in the city of DSM. Currently only 23% of the generated quantity is collected and disposed of to the Vingunguti crude dumpsite. Smoke, dust and intolerable smell is released to the nearby residential areas creating vermin and mosquito breeding, whilst lack of hazardous wastes separation contaminates ground water resources. Solid wastes are burnt and dumped in streets and open space (Changanikeni, Makumbusho, Mpakani road, etc) that further degrade living and health conditions. It is estimated that 64 million m<sup>3</sup> of municipal wastes a year are disposed of into open channels that percolate into the ground or flow in rivers (Kishimba M. A, and Mkenda A., The Impact of Structural Adjustment Programs and Urban Pollution and Sanitation: Empirical Evidence from Tanzania Major Cities, and Njau G. J. and Mugurusi E. K., Towards Sustainable Environment in DSM: AMREF, 1995).

#### Production of solid wastes in the region

Source	Quantity (tons/day)	Quantity (tons/day)
	1995	2000
Domestic	870	1020
Market	200	335
Industrial	100	240
Institutional	80	120
Commercial	50	130
Street cleaning	40	130
Car wrecks	30	50
Harzadous wastes	30	110
Hospital wastes	25	75
Construction wastes	5	15
Total	1430	2,220

Source: for year 1995: Kishimba M A, Mkenda a & Njau D J Sustainable Environment in Tanzania for year 2000: Dump Management at Vingunguti Dump.

Soil conditions and the high water table in the city intensify the vulnerability of the environment to poor waste disposal practices. Systems for collecting domestic, institutional, commercial and industrial solid wastes are operating inefficiently, if at all. The city centre garbage collection service is now privatised, run by private companies as well as Community- Based Organisations and industries and other commercial enterprises. The Kabuma dumpsite close to the Indian Ocean was used until 1988. There have been problem in identifying suitable alternative site(s) for final solid waste disposal following the closure of other sites such as Tabata, Mbagala Kilungule, Kabuma and Kunduchi as a result of protests from residents. Since 1992 a new crude dump at Vingunguti has been used. This dump is located at residential area bounded by Msimbazi River and the residential area. The City Council has earmarked other places for disposing of solid wastes in Kunduchi Mtongani quarries in Kinondoni, Mbagala behind Saint Antony Secondary School in Temeke and Pugu Kajiungeni at old Aduco in Ilala. Scavengers search and collect refuse for re-use, some collect and cook food



within the dump, build houses adjacent to the dump and even in the dump itself. Solid waste flows into Msimbazi River and finally into the ocean. As stated in FAO/UNEP Marine Pollution in East Africa Region:

*“In Tanzania a few kilometers stretch of Dar-es-Salaam coast is polluted with sewage and industrial wastes. Faecal lumps and floating solids litter areas around the harbour.....a foul odour due to severe Oxygen depletion of the waters pervades the coastline. The natural flora and fauna within the polluted areas have been smothered”* (page 5 para. 88)

**Agricultural wastes:** About 900 sq. km. of DSM are reserved for agriculture. Agriculture is still a major activity within the city. Application of agro-chemicals, disposal and run-off of wastes is uncontrolled. Contamination of soils, water sources and valuable resources is widespread. The national inventory on obsolete pesticides and unwanted chemicals conducted by NEMC 1997 revealed the presence of piles of stock of obsolete pesticides of about 127,000 kg. and 123,000 kg. of veterinary wastes in various water catchment areas or close to water bodies kept in leaked containers and stores. Soil erosion sediments reach the Ocean either directly or through seepage and runoffs or indirectly through the creeks and rivers. The level of concentration of these chemicals and the load of suspended materials in the rivers and estuaries has not yet been evaluated

**Vehicle Traffic:** Smoke emitted from cars pollutes the air. A study conducted in 1996 by NEMC through the Commission for Energy, Environment, Science and Technology (CEEST), revealed high levels of SO<sub>2</sub> and Suspended Particulate Matters in some selected locations within Dar es Salaam. There is effective monitoring of air quality; industrial development, importation of vehicles, population growth and construction are likely to increase the problem.

**Oil spills:** In DSM there is one oil refinery situated in Kigamboni near Dar es Salaam harbour. This plant receives 750,000 metric tons/ year of crude oil discharged from tankers into offshore coupling pipeline located to the west of inner Makutumba Island. Apart from wastes produced in the refining process the refinery also pollutes the marine environment by sporadic oil spills which have resulted in chronic pollution of the harbour area and the coastline. Oil from tankers, waste oil discharged from garages, thermal power plants and few industries are disposed without any treatment or control underground or into drains, rivers and creeks. There no statistical data as the pollution load due to oil spillage.

**Coastal erosion:** The DSM beach stretches from Mpiji River to the north for about 100 km and in the south to the Mzinga River and up to Mpakani village. The width of beaches varies from 0 in the creek areas, such as Gezaulole, Police Mess etc., to over 200m in other area, such as Mbweni, Ndege beach, Ununio, Kunduchi, Bunyuni and other areas. The northern coast of DSM between

Msasani bay and Mbweni is an area of sensitive sand beach ridges of tourist attraction. Erosion is common in areas under development pressure (tourist hotels, institutions, residential villas and fishing villages also caused by variation in the supply of sediment load to the coastal system by rivers, quarrying of coraline limestone, sand and beach rocks.

**Floods:** A number of low-lying areas along the coast are currently subject to occasional or regular marine inundation at high tides. Soils characterized by mangrove swamps with poorly drained clay exhibiting high shrink-swell properties. These areas are unsuited to urban development even if engineered barriers are constructed for shore protection. Highly mobile of sand dunes coupled with intense recreational use, under limited management, result in beach erosion, which threatens property and physical structures. Sea level rise in large parts of the coastline to the north and south of the city is a potential environmental hazard. The City is dissected by a number of rivers close to sea level which are easily flooded during both short and long rains. The typical alluvial accumulation of silt and clay materials makes for poor drainage posing the same development constraints as those found in coastal swamps.

**Fishing practices:** Reefs break waves are breeding areas for most marine flora and fauna. Dynamiting smashes the coral reefs and destroys the habitat of fish and other reef dwelling organisms. The rubble of smashed coral is subject to wave erosion and pollutes the marine environment. Application of dynamite for fishing causes considerable adverse effects to marine and coastal environment. Dynamite fishing cause explosion and fire and produce toxic substances in ocean and air. Exposure to these substances affects fishermen, damages fish and bottom flora and fauna. Apart from fire and explosion effects, dynamite fishing leads to overfishing and destroys fish breeding grounds. The Aquamarine Profile of DSM region produced by NEMC 1995 indicates the main hot spots of dynamite fishing are Mwakatumbe islands, Msasani bay, Sinda islands, Kimbiji, Pemba mnazi, Kunduchi and Mbweni-Ununuo villages.

### **Environmental Impacts**

**Water Resources:** A water quality survey conducted in 1988 identified extensive surface water pollution as:

- ?? High conductivity suggested substantial dissolved and suspended solid loads.
- ?? Low dissolved oxygen indicated high biological and /or oxygen demands.
- ?? High bacteriological / pollution with evidence of pathogens with human excreta.
- ?? High kjeldahl nitrogen and low orthophosphate counts suggested extensive eutrophication, as ammonia released from the decay of fresh sewage as well as all soluble phosphates was being absorbed in the algae.

### **Pollution load to surface water resources (kg/day)**

Type	Industrial Effluent	Pit latrines	Septic tanks	Without facilities	Total
BOD	28,330	15282	3275	9897	56784
COD	29,904	16131	3457	10447	49776
Suspended solids	47,216	25470	5458	16495	78429
Dissolved solids	83,940	45280	9830	29325	13892
Total N	4,145	2236	479	1448	6859
Total P	787	425	91	275	1302

Source: *Managing sustainable growth and development of DSM by SDP*

A survey of groundwater quality from a number of boreholes drilled in 1980 concluded that its high salinity excluded it from being considered as a potable resource. The salinity probably resulting from the leaching of the predominantly saline sand / clay geology of the region rather than saline intrusion. The majority of groundwater resources within the built up area are also contaminated as a result of poor sanitary arrangements, with more than 118,822 tons of polluted water discharged to the ground daily. Projected 1991 pollution loads from land sources included 68tons BOD, 7tons COD, 147tons Suspended Solids, and 219tons Dissolved Solids, 21tons of total Nitrogen and 33tons of total Phosphorus; which result in high nutrients and suspended solids loads, as well as occurrences of pathogens at places where fresh excreta are released. The high levels of nitrogen and phosphorus result in algae and seaweed blooms, the decay of which combined with accumulated suspended matter on the foreshore could give rise to the pungent odours occasionally experienced at low tide in the vicinity of the Salender bridge and along ocean road.

#### **Pollution load to groundwater resources (kg/day), 1991 Projections**

Type	No facility	Pit latrines	Septic tanks	Sewer Domestic	Losses industry	Total
BOD	1100	15282	7641	1221	1899	27
COD	1161	16131	8068	1289	11994	29
Suspended solids	1833	6116	3832	2035	3148	18
Dissolved solids	3258	97857	61128	3618	5596	196
Total N	120	4829	3018	3618	5596	10
Total P	23	915	572	34	52	2

Source: *Managing sustainable growth and development of DSM by SDP*

Shallow and deep wells are used to provide variable qualities for washing rather than drinking water. More than 18,000 people relying on groundwater from 144 shallow wells in 52 periurban villages. Many industrialists also supplement the city supply with their own deep wells. There are 51 such wells recorded within the city boundaries. The results of a survey in 1988 on quality of coastal waters (Managing sustainable growth and development of DSM by SDP) suggesting that:

- ?? The conductivity to be rather low for ocean water, indicating the presence of fresh water dilution.
- ?? Whilst both BOD and COD were low, the most probable number of F-Coli was high at 30,000/100ml, as was the MPN of total Coli counted at 600,000/100ml suggesting serious bacteriological pollution.
- ?? The relatively high-suspended solids could result from pollution.
- ?? Low Ammonia Nitrogen but high Kjeldahl nitrogen evidenced eutrophications as did low orthophosphate levels.

In 1999, NEMC conducted a rapid assessment of Msimbazi river around Vingunguti Dumpsite (Report on Situation around Vingunguti Crude Dump by NEMC, 1999). It was observed that at very place people utilizes river water for domestic and agricultural purposes including fishing, feeding animals, washing clothes, irrigating vegetables etc. while the river water is not safe for human consumption or other uses. The results for the analysis of the river water showed that the latter is contaminated from all sorts of pollutants including toxic ones. Also, vegetables were found to be contaminated by heavy metals.

Readings of pollutant loads in discharge stabilization ponds and sea outfalls, off the ocean road have show high turbidity but rapid dilution of discharges from short distance source and therefore limited potential impacts on coral growth and mangrove forests. Pollution loads discharged at DSM harbour and the Msimbazi creek, generally from longer distance sources, reveal higher pollution loads (Managing sustainable growth and development of DSM by SDP).

Wastewater polluted loads affect sequentially the surface and ground water resources used in the settlements, the nearby rivers and merge into the runoff reaching the coastal area and later entering into the marine environment. Cumulative health and environmental hazards emerge as a result of the combined impacts on living conditions and the quality of natural resources from diverse point sources. Marine pollution is typically the ultimate recipient of domestic pollutants in "brown" and "black" wastewater discharged either directly to the sea or indirectly through additional loads from agricultural runoff, sediment and silt and oil wastes from industrial effluents.

**Sea water quality:** Measurements made in 1993 of heavy metals and petroleum hydrocarbons content of marine water along the coast of DSM City and rivers entering the Indian Ocean are presented below.

**Concentration of heavy metals and petroleum hydrocarbons along the Coast, 1993**

Metal	Area				
	Africana Hotel beach	Kawe beach (Mbezi river)	Kawe/ Msasani Mlalakuwa river	Msimbazi bay Msimbazi river	Ferry (part area)
Zinc		Present		Present	Present
Iron	Present		Present	Present	Present
Manganese				Present	Present
Oil				Present	Present

*Source: Msafiri M.J Marine Pollution Studies along Dar es Salaam, NEMC, 1993*

There was high concentration of Zinc in Kawe beach area and Msimbazi bay where rivers Mbezi and Msimbazi enter the ocean. This is attributed to the disposal of industrial wastewater into or near the rivers by industries located up-stream.

It was also found that at the Africana Hotel Beach, Mlalakuwa and Msimbazi rivers and the DSM Port area, iron concentration was high. High concentration is caused by the wastes from tourist hotels along the beach, construction sites, workshops, garages and industries located upstream along the rivers. High concentration values are also found in Msimbazi bay (mouth of Msimbazi river) and the Port areas due to the discharge of industrial wastes up-stream along Msimbazi river adding to the wastes from anchored vessels, ships and boat repair activities in the Port area. October 1999 NEMC conducted an industrial monitoring program for selected categories of 13 industrial sectors within the city. The analysis of pollutant concentration in the discharged wastewater to the receiving bodies showed that:

- ?? Oxygen depletion in receiving water (rivers and storm water drainage)
- ?? Suspended solids
- ?? Presence of toxic substances (heavy metals)
- ?? High organic loads from on-site wastewater septic disposal tanks.

**The Fisheries Sector:** Fishing is very important in DSM for employment, family food supply and for animal feed. Fishing methods include freshwater fishing, marine fishing, dynamite fishing and beach seine. *Freshwater fishing* is mainly for household consumption. Few lakes and ponds are used for inland fisheries resources in Mikocheni, Kawe, Kimara, Tegeta, Boko, Mtoni and Pugu. Existing lakes include Luhanga, Makurumula, Msimbazi River and Tandale. No data is available for the actual catch. *Marine fisheries* employ more than 3000 men in villages such as Mbweni, Ununio, Kunduchi, Mtongani, Kawe, Kimbiji, Gezaulole, Mjimwema etc. Fish catch in 1995 was about 5,000 MT. The main types of fishnets are gillnets, shark nets, sieve nets, hand lines and traps. *Beach seine* is practised mostly by small-scale fishermen with canoes or small boats who fish in shallow waters. The demand for fish in the city of DSM exceeds local supply. Fish is imported from Lake Victoria, Mtera Dam, Ifakara, Lake Tanganyika and Nyumba ya Mungu, while local fish is also exported. Fish handling methods are very poor. At landing stations fish are thrown on sand at the beach where they are gutted and de-scaled, the offal is left on the beach and decompose hence becomes a source of pollution. Due to shortage of fresh water at these stations, fish are washed with seawater, catches pile on the sand under high temperatures, increasing the decomposition rate. Effects to fish due to pollution in marine are expected. Through food chain process transferring of toxic pollutants to consumers is highly possible. Although various surveys have been carried out to determine the quality and quantity of fish resources, the impacts on fisheries from land based pollutants and their costs have not been studied within the framework of a cost-benefit analysis.

**Mangroves:** There are 2,266 ha of mangrove forests distributed throughout the coastal area. They serve as a nursery for many species and provide physical habitat for numerous fish, crustacean and many varieties of important species and they are a threatened resource. They are cut and used by local people for construction, export, firewood, charcoal making, boat building and salt making and release land for rice farms. Most of the mangrove tree cutting is unregulated and is carried out without permits although mangrove forests are gazetted as forest reserves.

### Distribution of Mangroves by district

District	Location	Area (ha)
Temeke	Mbezi river	570.3
	Mbuyuni	476.7
	Shugu/Mtandika	270.8
	Ras Dege	245.0
	Mbwa maji	29.6
	Mjimwema	80.9
	Mtoni	378.4
Kinondoni	Kunduchi Creek	68.7
	Ras Kiromoni	20.2
	Mbweni area	100.6
Ilala	Msimbazi river	25.3

*Source: An aquamarine profile of Dar es Salaam region, March 1995 by NEMC*

#### **Marine ecosystem (coral reefs, sea grasses and other marine life):**

Untreated municipal and industrial wastewater discharges, runoff and sediments from rivers ultimately reach the coastal and marine environment. The degradation of the marine environment is often "out of sight" and responsibility is evaded on the assumption that the "sink" capacity of the environment will absorb the impact. Coastal area predominant in Coraline Islands, including Mbudya Island, Bongoyo Island, Sinda Island, Fungu Yasini Island, Pangavini Island and Makatumbe Island. These islands in addition to their diversity provide protection to the DSM coastline. Degradation from land based pollutants has diverse ecological and productivity impacts that are not valued in cost-benefit terms due to conceptual and measurement difficulties. It is now increasingly recognized that at least part of the most important indirect impacts on the marine environment, other than the direct impacts on fisheries, can be estimated through the foregone tourism and recreation opportunities. Coastal lagoons, mud flats and shallow mud-silt bottoms in protected bays and estuaries associated with coral reefs form a good habitat for sea grass and fish species. Degradation of habitats creates direct production changes and indirect losses to the "existence or non-use" benefits from marine resource quality. Apart from land-based pollutants, bad fishing practices such as use of bottom traps, beach seines and explosive fishing techniques, cause considerable damage to fish, bottom flora and fauna and coral reefs and sea grasses.

**Tourism:** Tourism is one of the strongest linkages of coastal ecology to measurable productivity aspects of coastal resources. Degradation of the quality of the coastal environment is reflected in reduced environmental quality and its productivity for sustainable tourism. Unlike biodiversity changes that need deep research to determine, tourism impacts from environmental degradation can be measured in terms of reduced revenues or loss of potential revenues. Equally, increasing intensity of tourist related development is often itself a cause of beach quality changes and a source of wastewater affecting the coastal environment. In

DSM not only present tourism opportunities are limited due to the discharge of wastewater, but also the tourism development that exists (for example Oyster Bay area, Africana and Kunduchi hotel area) is unplanned, without appropriate infrastructure, suffering from lack of coastal management capacities.

## **2. The Project**

**(a) Name of the project:**

Dar es Salaam Marine Ecology Conservation Project

**(b) Name of the Proposing Organization:**

World Care-Tanzania

**(c) Name of Contact person**

Mr. Rweyemamu Mutagaywa

**(d) Contact address:**

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**(e) Project area:**

Dar es Salaam coastal areas

**(f) Project area:**

Dar es Salaam coastal areas

**(g) Project duration:**

The project duration will be three (3) years

**(h) Objective of the project:**

Conservation and restoration of marine ecology in Dar es Salaam coastal areas  
-Indian Ocean



**(i) Project activities:-**

- i. Promotion of community awareness in sustainable management of coastal and marine ecology.
- ii. Promotion of appropriate technology in conservation and restoration of marine ecology including reef ball and mangrove development

**(j) Project components**

- i. Awareness
- ii. Reef ball section
- iii. Mangrove section

**(k) Evaluation mechanism:**

During implementation, there will be the project proceeding reports at regular basis ranging from monthly report to annual report. The proceeding reports will not only review activities undertaken but also reviewing utilization of project resources

**(l) Resources utilization**

All the project expenditures will be audited with qualified auditors with its report being included in evaluation report.

**(m) Community participation:**

The project will be implemented with consideration of community involvement and participation. The project will be implemented with methodology of PRA (Participatory Rural Appraisal). This means the community will be required to participate by all means according to their ability.

**(n) Sustainability**

By means of PRA methodology, the community will have the opportunity to formulate strategic plan and responsibilities during and after the project. Training of Trainers (TOT) will enable the community to acquire skills for future use. However, the project will facilitate and encourage an establishment of Community Based Organization (CBOs) as well as working groups for sustainability of this project.

**(o) Project Management & staff: -To be discussed**

**(p) Project inputs and requirements, budget: To be discussed**