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Proposal for an effective legal framework to protect the marine environment from pollution : the case of plastic garbage pollution in the coastal waters of Tanzania

Farida Idrisa
WMU

WORLD MARITIME UNIVERSITY

Malmö, Sweden

PROPOSAL FOR AN EFFECTIVE LEGAL FRAMEWORK TO PROTECT MARINE ENVIRONMENT FROM POLLUTION:

The Case of Plastic Garbage Pollution in the Coastal Waters of Tanzania.

By

FARIDA IDRISA

The United Republic of Tanzania

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DECLARATION

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.


..... (Signature)

Farida Idrisa

16.10.98 (Date)

Supervised by:

Dr. Karl Laubstein

The Rector

World Maritime University (WMU) Malmö, Sweden.

Assessor:

Prof. Fernando Pardo

Associate Professor

General Maritime Administration and Environment Protection.

World Maritime University (WMU) Malmö, Sweden.

Co-assessor:

Prof. Ted Sampson

Visiting Professor, World Maritime University (WMU) Malmö, Sweden.

Adviser to HELMEPA, Athens, Greece.

DEDICATED TO MY LOVELY PARENTS.

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ABSTRACT

Title: **Proposal for an Effective Legal framework to Protect the Marine Environment From Pollution: The Case of Plastic Garbage Pollution in the Coastal Waters of Tanzania.**

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There is an increasing amount of man-made debris that litter the world's oceans and coastal waters, and associated problems which this brings. This debris consists mostly of persistent materials such as plastics, metal, glass and rubber.

This dissertation provides an insight into problems and threats associated with plastic garbage. Apart from its persistence in the environment, plastics float for years and are concentrated into specific location by ocean currents causing permanent and irreversible damage to the marine ecosystem. Thus, sources and impacts of plastics into the marine environment are discussed.

The increase in population, industrialisation, urbanisation and the rising standards of living has resulted in an ever increasing amount of wastes such as plastics in Tanzania. The study discusses existing control measures concerning the use and disposal of plastics in the marine environment in Tanzania. Legislation applicable to waste management and prevention of water pollution are identified and examined.

International pollution control measures of plastic waste into the world's oceans are also identified.

The concluding chapters propose necessary changes in Tanzanian legislation concerning plastic garbage pollution in coastal waters. A number of recommendations are made which might assist both in implementing and enforcing environmental laws regarding waste management and pollution prevention in Tanzania.

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LIST OF ABBREVIATIONS:

CAP	Chapter
CSO	Combined Sewer Overflow.
DCC	Dar Es Salaam City Council.
DES	Dar Es Salaam.
EEZ	Exclusive Economic Zone.
GESAMP	United Nations Group of Experts on the Scientific Aspects of Marine Environment Protection.
GNP	Gross National Product
HELMEPA	Hellenic Marine Environment Protection Association
IMO	International Maritime Organisation.
JICA	Japan International Co-operation Agency.
MARPOL	International Convention for the Prevention of Pollution from Ships 1973, as modified by Protocol of 1978.
MPPRCA	Marine Plastic Pollution Research and Control Act, Public Law 100-200.
MPRSA	Marine Protection, Research, and Sanctuaries Act of 1972.
NEMC	National Environment Management Council.
NOAA	The National Oceanic and Atmospheric Administration.
RCRA	Resource Conservation and Recovery Act of 1976
THA	Tanzania Harbours Authority.
TSCA	Toxic Substances Control Act of 1976.
UNCLOS	United Nations Convention on the Law of the Sea 1982.
UNEP	United Nations Environment Programme.
USCG	United States Coast Guards.
USEPA	United States Environmental Protection Agency.
WACS	Waste Amount and Composition Study.

CHAPTER ONE

"We depend on the oceans for food. Now and in the future. Famine is a horrible thing to witness. Starvation and malnutrition are reality in a world with ever growing population and less land available for cultivation. Protection of the oceans now will ensure their availability as a source of food for future generation"[1]

1. INTRODUCTION

1.1 Geography:

Tanzania lies south of the equator between the great lakes: Victoria, Tanganyika and Nyasa and the Indian Ocean, stretching from the border of Kenya to Mozambique. There are five coastal regions in Tanzania:[2] Dar Es Salaam, Tanga, Coastal, Lindi, and Mtwara. The coastline stretches 800km along the Indian ocean from the Kenyan to the Mozambican border with a 200 nautical miles Exclusive Economic Zone (EEZ). The coast has a very narrow continental shelf varying from approximately 3.2 nautical miles wide to a maximum of 34.5 nautical miles at areas around Mafia, Zanzibar and Pemba Islands. The coastline is characterised by white sweeping sand beaches, rock outcrops and developed fringing coral reefs and is also punctuated by extensive growths of mangroves particurlaly near the mouth of larger rivers.

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[1] Fine C.J (1987) *Ocean in Peril*, Atheneum New York p.4
[2] see Appendix 1.

1.2 Dependence on Coastal Resources:

The livelihood of the coastal population and national economy have been for many decades been largely, dependent on coastal and marine resources. Fish is the major natural resource and in some cases the only source of protein for coastal communities in Tanzania. In addition, fish and fisheries are a source of foreign exchange[3] and generate employment for a number of nationals in the country. Other important resources, goods and services provided by coastal zones are seaweed resources, natural resources, tourism, coastal facilities such as ports, industries and urban centres. Further, the coastal zone houses a bounty of biodiversity most of which is known to us to perform critical life functions and plays a significant role in balancing the extremes of climatic conditions[4].

The following table shows the contribution of fisheries and tourism to the Tanzanian economy.

Table 1. Contribution of Fisheries and Tourism to the Tanzanian Economy

Country	Tanzania
Population (1990) 000's	28,846
GNP/CAP1990 (USD)	110
No of coastal Fisher folk	28000
Fish Production1987-1989 (000tons/yr)	47
Fish Production increase since 1980(%)	24
Value of fish exports 1988 (mill.USD)	60(1990)
Fish Consumption (kg/person/yr)	14.2
No. of Visitors (000's)	487(1988)
Annual Revenue (mill.USD.) from tourism	95(1990)

Source: Linden, O and Lundin, C.G (ed) Integrated Coastal Management in Tanzania, World Bank and SIDA, 1996.

[3] see Table no. 1

[4] Ngoile, M.A.K (1997) (Ed) 'Ocean and Coastal Management': *Integrated Coastal Management in Africa* ,Vol. 37 No. 3 1997 p.271.

1.3 Marine and Coastal Issues:

Urbanisation, coastal development and population growth, especially in coastal urban centres have increased the demand for coastal and marine resources. Poverty, lack of awareness and inadequate management have resulted in over-exploitation of coastal and marine resources, habitat destruction, including shoreline erosion, as well as marine pollution.

Nowadays, pollution of oceans by waste products has become one of the major global concerns, Most of it comes from landbased sources and includes the by-products of industry, runoff from agricultural activities and waste effluents discharged from urban areas. Marine transportation and fisheries activities also contribute to the pollution of oceans. Yet another threat to the environment attracts relatively little public comment, even though it can be just as deadly to marine life, this is the release of garbage into the sea. The greatest danger of all garbage comes from plastics which can float for years and are not biodegradable and can therefore seriously and permanently damage natural marine resources and the marine habitat in general.

1.4 Purpose and Scope.

This study discusses the problems associated with plastic waste effects on the marine environment. Its scope does not extend to cover other types of garbage though the proposed legal framework is intended to affect the management of plastic in particular and management of solid waste in general.

The study is restricted to Dar Es Salaam because it has the highest levels of pollution in the United Republic of Tanzania (Appendix 2). This level of pollution is not only attributable to industrial discharges but also to urban wastes from both planned and unplanned residential areas.

The purpose of this work is:

1. to identify and locate possible sources of plastic releases into the marine environment;

2. to evaluate the significance of each plastic release pathway and its impact on marine environment; and
3. to recommend an appropriate legal framework for controlling or preventing the release of plastics into the coastal waters of Tanzania.

1.5 Research Problem:

The quantity of waste generated in different forms (solids, liquids and gaseous) is growing as a result of the increase in population, industrialisation, urbanisation and the rising standards of living which generate increasing levels of private and industrial waste. Plastics, among other garbage, which can be found in the marine environment come from industrial, social and agricultural activities, primarily through streams, rivers and storms water drains.

It has also become increasingly evident that the problem of disposal of fishing nets and associated gear, other forms of persistent plastic, and other materials, has become serious problem having widespread impacts on marine ecosystems. All varieties and classifications of ocean going vessels, fishing, merchant, naval and pleasure boats are contributing to this problem by disposing plastics and other shipboard-generated waste into the sea. Despite this fact, currently in Tanzania the number of laws aimed at preventing water pollution and providing for waste management do not specifically provide for plastic wastes.

The author therefore commences in chapter two by providing a global overview on solid waste issues and measures taken through international conventions to protect the marine environment from plastics.

Chapter three addresses the possible sources and impact of plastics on the marine environment.

In an attempt to comprehensively cover the topic the inadequacies in the existing national legislation is highlighted. The paper then proceeds to illustrate how

legislation is not only scattered in other laws, but also that it is limited in scope and is poorly enforced most of the time. The reader will be informed of current limitations to enforcement of existing laws and regulations regarding prevention of water pollution as well as inadequacies of provisions (lacuna) to protect the environment from pollution by plastics.

Chapter four examines examples of international efforts and the degree of success in these countries in preventing pollution from plastic garbage.

In chapter five a need is advocated to revise the present system which allows many line ministries to become involved in the matter and through which there is a tendency to handle issues in a disintegrated and inconsistent manner, sometimes leading to duplication of tasks and overlaps in administrations. The author proposes a review of existing legislation pertaining to water pollution and waste management and recommend necessary changes to address the threats that plastics present to the marine environment of Tanzania.

In arriving at the conclusion and recommendations, the author emphasises the need for a proper and effective legal framework that embraces a preventive approach that will remedy the prevailing situation of plastic pollution.

1.6 Hypothesis

The working hypothesis of this paper is:

a) that urbanisation, coastal development, population growth, continuing technological progress, new methods of manufacture, packaging and marketing of consumer products have resulted in an ever-mounting increase of wastes such as plastics which are non- biodegradable that once thrown into the sea they have a very negative and often irreversible impact on the marine ecosystem;

b) that while the collection and disposal of solid wastes from industrial, commercial, domestic and other human activities present to government financial,

management, and technical problems, the existing environmental legislation in Tanzania (i.e. water and waste management legislation) do not provide for the prevention of pollution from plastic garbage.

1.7 Research Methodology:

Both field and library research have been conducted for this study. While field research was done in Dar Es Salaam, library research was confined to the World Maritime University and Internet. During field research, the interview method was used. The following institutions were visited: Dar Es Salaam City Council, National Environment Management Council, Dar Es Salaam Port and Beach hotels; i.e. the Oyster bay, Bahari and Kunduchi hotels.

CHAPTER TWO

"At one time or another we have all come across scenes like this:
Ocean, rivers, lakes and streams have been used as all - purpose dumps
.....wastes that will not degrade litter the river. Plastic and Styrofoam containers may be convenient now, but in the long run seriously destroy the environment" [5]

2. GLOBAL OVERVIEW ON SOLID WASTES

During the past two decades, environmental issues have become a global concern. Advances in scientific understanding of the biosphere and developments in international communications have contributed to this international environmental consciousness.[6] An increasing number of environmental problems, previously within the domain of individual nations demand international solutions. Many cities in developing countries suffer from overcrowding and pollution far worse than that in the industrialised, developed part of the world.[7] For example, metropolitan authorities in developing countries face environmental problems commonly associated with large human settlements, solid waste disposal, sewage treatment, and industrial pollution, as well as the sociocultural impacts of overcrowding and congestion.[8] The bulk of the world's population now lives in coastal areas, and there is a continuing trend towards its concentration in these regions. The health, well being, and very survival of coastal population depend upon the health and well being of coastal systems. Ultimately, sustainable patterns of human activity in coastal areas depend upon a healthy marine environment and vice versa.[9]

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[5] Fine, C.J (1987) *Ocean in Peril*, Atheneum, New York p.4
[6] Lee,J.A (1985) *The Environment Public Health, and Human Ecology: Consideration for Economic development* .World Bank the Johns Hopkins Univer.Press London, p.208
[7] D.B Magraw, 'Global Change and International Law', *Colorado Journal of International Environmental Law & Policy*, Vol. 1 pp.45-49
[8] Lee J.(1985) *The Environment Public Health, and Human Ecology: Considerations for Economic Development*. World Bank. p.153
[9] UNEP(1985): *Global Programme of Action for protection of marine environment From* Land-*based* (12-13 December)p.43

In addition, many cities have grown up so quickly that there is little forethought or time to develop a rational urban plan to accommodate the vast influx of rural poor drawn to the city. As a result of increasing population, industrialisation and urbanisation the quantity of waste generated in different forms, solid, liquid and gaseous is growing, leading to major concerns for its proper disposal.

For hundred of years, the seas have been used as a place to dispose of waste resulting from human activities both on land and at sea.[10] Various methods have been adopted in the global efforts to dispose of waste and include physical and or chemical treatment, incineration (with or without energy extraction), recycling. composting, and landfills.

Nevertheless, present waste disposal practice is largely characterised by misjudged assumptions of the assimilative capacity of the waters receiving wastes. Main reasons for these misjudgments are lack of knowledge or lack of understanding of complex waste ecosystem interactions. The inability to link 'in situ' effects to specific causes promotes thought that wastes disposal is harmless.

It is important to note that waste treatment and disposal like any other human activity inevitably gives rise to some form of pollution. In most developing countries, the common methods of municipal waste disposal are uncontrolled dumping or burning on open ground, and where no collection systems exist, in the city streets. Landfills where they do exist, are often poorly designed and controlled because of insufficient resources and lack of trained staff. Scavenging for reusables from the dumpsites is widespread in some countries. Frequent and heavy rains in the tropics for instance, leach wastes into the soils under landfills or even cause them to overflow onto surrounding surfaces (or with runoff into the sea). Little or no pre-treatment of wastes, causes local people to be directly exposed to wastes and the resulting contaminated water supplies.

Tanzania is not an exception to the waste management problems that face the rest of the world. Waste from industries, households and municipalities is becoming a matter of concern. Most industries do not treat emissions and effluents before

[10] IMO,*Evolution of London Dumping Convention*, 1972

discharges are made. It is not uncommon to see piles of garbage in the streets. In urban areas problems are aggravated by poor management for handling wastes and inadequate implementation of existing physical plans and regulations.

2.1 The need for action:

In many countries, however, concern has begun to grow about the wisdom of using the sea as an uncontrolled rubbish dump. It has been widely felt that something should be done not only to assess the problem but also to control it. It has also been seen that something has to be done at an international level. As one commentator[11] writes ' ...It is time for every one to become involved in preserving our planet. We have polluted the air, the water, and the land. The rapid deterioration of the global environment is already creating political and social problems, and unless immediately arrested, it will affect the quality of life for future generations.'

In 1972 the general interest in the importance of the environment resulted in the holding of the United Nations Conference on the Human Environment in Stockholm, Sweden. The Stockholm conference recommended that Governments should ensure that, " ocean dumping by their nationals anywhere, or by any person in areas under their jurisdiction, is controlled and the Governments continue to work towards the completion of and bringing into force as soon as possible of an over-all instrument for the control of ocean dumping..."In response to this recommendation the London (Dumping) Convention was adopted in 1972, the purpose being to control all sources of marine pollution and prevent pollution of the sea through regulation of dumping into the sea of waste materials. It covers materials transported to the sea for the purpose of dumping.

The 1972 Convention[12]defines dumping as, "any deliberate disposal at sea of material and substances of any kind, form or description from vessels, aircraft, platforms, or other man-made structures, as well as the deliberate disposal of

[11] Worldwatch Institute, (1997) 'A Better World Starts at Home' p.1

[12] London Dumping Convention adopted on 13 Nov 1972 entered into force 30 August 1975

vessels, aircraft, platforms or other man-made structures themselves". This definition was later adopted in the United Nations Convention on the Law of the Sea, 1982 (UNCLOS).

Furthermore, according to a study carried out by the United Nations Group of Experts on the Scientific Aspects of Marine Environment Protection (GESAMP) in 1990, waste dumped into the sea from ships contributes only 10% or less of the pollutants that enter the sea each year. Land-based sources contribute 44%; 33% comes via the atmosphere, or originates from the land, 12% is from maritime transportation and the remaining 1% from offshore production. The Group (supra) classifies wastes considered for disposal at sea by means of a number of technical Annexes and are graded into three categories according to the danger they present to the environment. For example the **black list (annex I)** consists of the materials that are most dangerous to the environment and their dumping is prohibited. These include: organohalogen compounds, mercury and mercury compounds, cadmium and cadmium compounds, **persistent plastics and other persistent synthetic materials**, crude oil and petroleum products, high-level radioactive wastes, materials produced for biological and chemical warfare. And, United Nations Environment Programme (UNEP),[13] urges actions, policies and measures by states within their capacity to introduce appropriate regulatory measures, economic instruments and voluntary agreements to encourage reduction of the generation of wastes. It is on this premise that the author intends to examine the problem of garbage, particularly plastic, as a threat to the environment and to propose a legislative framework to address the problem.

2.2 Plastic A Threat

It has been submitted that the oceans are immense and theoretically capable of diluting all waste inputs to undetectable levels. Biodegradable organic compounds are fairly rapidly decomposed by marine organisms depending on conditions in

[13] Washington Declaration on the Marine Environment From Land-based activities. para.146

given areas.[14] The organic materials are often beneficial since they serve as a food source for marine organisms. The ability of the seas to accept and purify waste is a great natural resource which should not be overlooked. It must not be abused either, because this can result in considerable and permanent damage to marine life. As, these waste loads such as plastics are not uniformly spread over the oceans, rather they are almost invariably concentrated along the fragile coastlines where the potential for damage is the greatest -they pose a particular problem. The fact must be recognised that a major share of the world's marine fisheries is obtained from the coastal waters and estuaries which are essential as breeding grounds for many marine species.[15]

The Washington Declaration on Protection of the Marine Environment from Land - based[16] sources emphasises that litter (used interchangeably in this paper to mean plastics and garbage) threatens marine life through entanglement, suffocation and ingestion and is widely recognised to degrade the visual amenities of marine and coastal areas with negative effects on tourism and general aesthetics. Litter is any persistent manufactured or processed solid material that is discarded (e.g. fishing nets), disposed of, or abandoned in the marine and coastal environment, sometimes called marine debris. Litter in the marine environment can also destroy coastal habitats and in some situations interfere with biological production in the coastal areas.

Litter entering the marine and coastal environment has multiple sources. Sources include poorly managed or illegal waste dumps adjacent to rivers or coastal areas, windblown litter from coastal communities from which they are washed into the sea, resin pellets from industrial feedstocks, and litter that is deliberately channelled to the marine and coastal environment through municipal stormwater systems and rivers. Marine litter is also caused by dumping of garbage into marine and coastal environment by municipal authorities as well as that thrown overboard by

[14] Bishop,1982 *Marine Pollution* p.23
[15] .ibid
[16] IMO The Intergovernmental Conference to Adopt a Global Progrmme of Action for the protection of the Marine Environment from Land- based Activities (4-8 December 1995) agenda item 10 para 140-143 p.55

recreational, fishing and commercial vessels (these sources are discussed at length in the next chapter).

Apparently, the ocean is not large enough so that marine life can avoid encounters with litter/debris. Among the litter garbage plastic accounts for the highest percentage. Plastic's devastating effect on marine mammals was first observed in the late 1970's,[17]when scientists from the National Marine Mammal Laboratory in United States of America concluded that plastic entanglement was killing up to 40,000 seals a year. Annually, this amounted to a four to six percent drop in seal population beginning in 1976. In thirty years, a 50% decline in Northern Fur seals has been reported.

In 1987, a US Federal law was passed restricting the dumping of plastics into the ocean.[18] The Marine Plastic Pollution Research and Control Act went into effect on Dec. 31,1988 making it illegal for any US vessel or land based operation to dispose of plastic at sea. This was made part of an international treaty (MARPOL), where countries representing at least half of the shipping fleet tonnage in the world agreed to ANNEX V, preventing pollution by garbage from ships, and is prohibiting the dumping of plastics any where in the ocean.

Examination of the literature describing marine monitoring studies leaves no doubt that the main component of litter around the coastal waters is plastic. Rees[19] submits that 'this appears as the dominant type of litter no matter what monitoring method is employed.' Other broad trends identified are the high levels of wood, metal, glass and paper encountered and that litter originates from a wide range of countries.

The impacts of marine debris on wildlife, tourism, shipping and human health are well documented and will be discussed in chapter three; however the solution appears to lie in tackling the problem at the source (i.e. employing preventive approach). As mentioned earlier, two main sources of litter on coastal waters do exist: sea borne sources' i.e. industrial and domestics wastes disposed of at sea

[17] Amaral, Our ocean p.2
[18] Amaral, ibid
[19] Rees p .103 Amaral, Our ocean p.2
[19] Amaral, ibid

and litter originating from visitors to the coast, whether it be items such as drink cans from recreation or unauthorised dumping of larger items such as landfill materials.

For land borne litter, e.g. beach clean-ups have been shown to be at best a palliative measure to clean up the coast. The author concurs with other writers[20] that though legislation prohibiting the dropping of litter e.g. on streets and discharge of plastic garbage overboard by ships, is notoriously difficult to enforce, it is nevertheless essential. On the other hand, it is important to actively involve the users of the coast of all types; local residents, fishermen, or tourists, directly in coastal management issues. It is generally recognised that public participation is essential to effective coastal zone management and waste management. Involvement is critical to facilitate understanding of the issues surrounding coastal zone management.[21]

2.3 Environmental issues in Dar Es Salaam

While rapid industrial growth (estimated at 8% per annum) provides numerous economic opportunities to the urban population, environmental conditions in Dar Es Salaam (hereinafter DES) have deteriorated rapidly severely limiting the national economic development and adversely affecting the health and welfare of the city's residents. There are serious environmental problems constraining development of DES. The key development activities with environmental implications and constraints are related to, water supply and distribution, sewerage and sanitation, industrial pollution control, housing and transportation, unplanned development at the urban fringe, and health care. One of the most serious causes of environmental degradation is the growing amount of unmanaged solid wastes generated by the city.

[20] Rees, ibid
[21] Gubbay,(1994) Marine Litter p.7

2.4 Solid Waste Management in Dar Es Salaam:

Unlike other cities in the United Republic of Tanzania, Dar Es Salaam contains the largest urban and industrial complex in the country. It is characterised as having the highest levels of pollution (see appendix 2), heavy fishing pressure, established tourist facilities, and marine reserves. The population of the city in 1996 was 2.26 million which accounts for about 8% of the national population. The city of DES accommodates 80% of the national industrial base, commercial and governmental centre of Tanzania, serving the nation (and several neighbouring land-locked countries) through its natural harbour and communication linkages. The city has an estimated growth rate of 8% per annum, which could be one of the highest in the sub-Saharan Africa[22].

Dar-Es-Salaam port is the principal port of Tanzania serving national traffic and transit cargoes for land locked countries in the East, Central and Southern Africa regions. The port has a rated capacity of handling four million tonnes (4,000,000) of dry cargo per annum, but during the period 1992-96, the average tonnage handled per year was roughly two million (2, 000, 000) tonnes.

The Container Terminal handles an average of 93,600 TEUs per year for an average utilisation of 50% of the containers terminal facility over the five year period 1992-96 per year on average. Table 1 below gives data for the cargo handled and berth utilisation for the five years 1992 - 1996.

Table 2 : Port Utilisation and Cargo Performance 1992 - 1996.

YEAR	G.C.T. Berth Occupancy %	C.T. Berth Occupancy %	TEUs Handled	Total Dry Cargo - Tons	Liquid Bulk - Tons
1992	59.6	47.0	86,655	2,345,792	2,256,474
1993	64.3	61.0	97,793	2,452,983	2,032,489
1994	55.4	48.0	95,887	2,070737	1,905,194
1995	59.9	51.0	94,109	2,084,069	2,350,808
1996	55.0	45.0	93,628	1,663,974	1,871,480
Average	58.8	50.4	93,655	2,123,511	2,063,289

Source: Tanzania Harbours Authority Statistics.

Key: GCT:-General Cargo Terminal;. C.T:- : Container Terminal; TEU Twenty Equivalent Unit.

[22] Ngoile,M.A.K (1997) Ocean & Coastal Management: *Integrated Coastal Management in Africa*,Vol.37, No 3 1997 p.297.

2.4.1 Institutional Capacity and Constraints:

In the city of DES, development is theoretically guided by the 1979 Master plan. However, the actual development of the city has generally failed to follow the long-term Master Plan. There is no institutional mechanism to co-ordinate the parties involved in managing the city's growth, to provide resources for investments, and to take enforcement measures against those developers who do not comply with land use and development standards.

Facing the rapid growth of the city, a severe lack of financial and legal institutional capacity in both the DES city council and the central government has led to rapidly deteriorating environmental conditions in and around the city, reducing opportunities to achieve sustainable socio-economic and environmentally responsible growth, and development of the city.

2.4.1.1 Constraints at Waste Source:

Poor housekeeping habits and the use of inappropriate, crude technology has resulted in excess amounts of waste generated at households and factories. In the past five to ten years opening up of the market economy has resulted in an enormous increase in waste generation per capita. The lack of waste bins, receptacles and lack of awareness and knowledge to reduce waste at source adds to the growing volume of wastes (see appendix 3 and 4).

2.4.1.2 Constraints for Waste Movers:

The main constraints at this level have been identified as lack of authorised or recognised collection points, poor infrastructure, i.e.,. roads and transport capacity, insufficient financial resources, poor transport management and maintenance systems. Furthermore, inadequate capacity of the private contractors, insufficient contract preparation, lack of integration at different management levels, means of collection and lack of transparency on the use of various revenues collected by the City Commission. Similarly, lack of laws enforcement, adherence to laws by the public, insufficient or lack of database and poor exchange of information has contributed to the inadequate monitoring of the solid waste collectors. Again the

attitude of people towards waste also contributes to the problems in waste collection and transportation. People are not used to paying for waste collection and therefore it is rather difficult at the moment to fully finance the waste collection and disposal system.

2.4.1.3 Constraints at Waste Destination:

Lack of environmentally and publicly accepted waste disposal sites and poor access to the dump sites have been identified as the main constraints. Because of a lack of financial resources there is only one official existing waste disposal site for DES city, which is the Vinguguti site, operated by Dar Es salaam City Council (DCC). It is located about 10 km from the city centre and is a convenient site only in terms of transportation of waste to it. The Vinguguti disposal site has many associated environmental problems such as public nuisance, odour, smoke, dust, vibration, and traffic congestion due to the currently crude nature of the dumping operations, and from being too close to a densely populated residential area. The reserve capacity of the Vinguguti disposal site is very limited and it is located within the Msimbazi river flood plain. Evidently large quantities of wastes, especially litter, are carried through it to the sea.

At present, the solid waste management system of the city only collects about 8% of the total waste generation amounting to 1772 tons per day (see appendix 3 and 4). This low rate is mainly due to insufficient and decrepit equipment. Uncollected garbage is mostly stockpiled on the vacant lands. The average waste generation rate per capita, per day, has increased by 1.85 times from 377 gram/capita/day to 698 gram/capita/day, between 1989 and 1996. As of now, the total waste generation in the city has essentially tripled.

2.4.1.4 Constraints on Refuse Recycling/Composting:

The existing constraints on garbage recycling and composting include the lack of public awareness on their benefits and inadequate technical know- how on recycling including a lack of knowledge on the market potential for recycled products. Other

problems of garbage recycling encompass the inadequate legal framework and enforcement mechanism to encourage this mode of solid waste management.

The present waste generation rates and composition of wastes in DES derived from the field study are presented in the tables below.

Table 3: Waste Generation Rates in Dar Es Salaam 1996.

Type of waste	sub-category	Unit	WAGR
Household Waste		g/cap/d	698
Commercial Waste	Restaurant	g/restaurant/d	37,450
	Others	g/shop/d	906
	Guest House	g/guest house/d	405
	Hotel	g/hotel/d	744
Institutional Waste		g/worker/d	172
Market Waste	Retail shops	g/Shop/d	3,120
	Wholesale shops	g/shop/d	5,360
Streetsweeping Waste		g/km/d	40,390

KEY: WAGR - Waste generation ; G/CAP/D - Gallon/capita/day.

Table 4: Waste Composition in 1996.

	Components	Households	Commercial Restaurant	Institution	Market	Street	Others
Physical Composition	Kitchen	32.0%	93%	9.2%	19.6%	23.0%	0.8%
	Paper	3.1%	1.9%	71.5%	13.2%	17.5%	51.6%
	Textile	1.2%	1.2%	2.6%	0.5%	1.3%	2.5%
	Plastic	12.2%	2.0%	6.1%	30.7%	16.4%	28.4%
	Glass and wood	25.3%	0.8%	0.9%	27.2%	9.0%	1.5%
	Leather &Rubber	0.9%	0.0%	0.0%	0.0%	2.4%	0.5%
	Metal	2.0%	0.5%	4.0%	0.1%	2.5%	5.3%
	Glass & Ceramic	3.5%	0.6%	3.3%	0.3%	1.0%	0.0%
	Stone	0.4%	0.0%	0.7%	0.2%	0.9%	0.5%
	Others	19.4%	0.0%	1.7%	8.2%	26.0%	8.9%
	Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

source: JICA,(1996) Study on the Solid Waste Management for Dar Es Salaam City in the United Republic of Tanzania.

From the above table one may argue that paper is leading in percentage figure on waste generated, and question why they should not be given a priority. The answer

relates to the point made earlier, namely the greater potential threat of plastic to the marine environment. Plastic goods are probably the most widely used products in many homes in Tanzania. In any activity in the home, plastic is involved in one way or another. For lower and middle class people in Tanzania, plastics are the best household material and kitchen utensils, as plastic packaging and components are usually cheaper than conventional materials.

When examining the large quantities of kitchen waste, most consists of leftovers foods that are biodegradable. The glass and the wood generated is largely reusable, being reprocessed into bottles jars, used to make security glass barriers on top of concrete walls around premises. In the case of wood, these items are used for firewood and carpentry/construction.

According to a special Report on Plastic factories in Tanzania, there are currently over forty (40) plastic industries in Tanzania. The largest factories include Cotex, Simba plastics, Raffia Bags, ILP, Amboni plastics, Tegry Plastics, Banco and Souza Pasl. They manufacture a range of products including, crates, pvc pipes, pp bags, pe bags, household products, buckets, tanks and many other items. Related industries include Bora and OK Plastic which manufacture EVA beach sandals and slippers, Ply Foam and Banco. Three quarters of these manufacturers are situated in DES. It is also estimated that the factories combined manufacturing capacity is about 5,000 metric tonnes per month. It is important to note that among the forty factories only three of them have recycling plant. These are limited to recycling internal rejects because of the difficulties involved in sorting and grading used plastics. Bearing in mind that the tables above do not include industrial waste, it is fair to say that there is an additional threat from industry and waste generated by these factories. Lack of recycling facilities, erratic and inconsistent power supplies,- (fluctuations and stoppages) normally lead to exorbitant waste in these factories because of the nature of materials and machines used.

Furthermore, a recent report from National Management Council (NEMC) says that at least 35 tonnes of plastic waste is generated each day in Dar Es Salaam city.

According to the NEMC experts, the plastic waste produced daily constitute two percent of the 1772 tonnes of the solid waste generated in the city each day. "What is alarming is that at this rate 13,000 tonnes of plastic waste is produced in Dar Es Salaam per annum. More and more plastic waste is generated and could reach 10 percent of all solid waste produced as is the case in the industrialised countries.[23]"

What all this indicates is that effective solid waste management and proper marine environmental protection is required following an integrated approach. The potential threat by plastic garbage is now recognised world wide, necessary measures have been taken i.e. international conventions prohibit discharge of plastics and urge countries to practice proper waste management. The following chapter therefore discusses the impact of plastic garbage on the marine environment and the inadequacy of the existing Tanzanian legislation to address the problem.

[23] Ubwani, Z (1998) 'Plastic Waste Pollutes Dar City' *Daily News*, Monday,31 August 1998 p.1(Top page) See also appendix 3 and 4.

CHAPTER THREE

"For many years it was believed that the oceans were so vast that no amount of waste which humans could generate could have other than negligible impact on them. It is now readily evident that this is not the case. Beaches pollution caused by wastes and petroleum materials washed on shores are now widespread. Unfortunately we do not know what the long term effects of them may be. We may be permanently despoiling our essential natural resources"[24]

For a scientific examination of marine pollution by plastics or any other sort of pollution value judgments of have to be reached. In what way is the pollution bad, how bad is it?. The answer to the question lies in considering implications for human health, food resources, commercial interests, amenities, wildlife conservation and the ecosystem in general. It is also important to consider what is being done, or should be done, to reduce or remove the damaging or undesirable effects of these additions to the marine environment. Does Tanzania have control measures to address the pollution from plastic waste? This chapter intends to discuss impact of plastics on the marine environment and existing legislation to address the same.

3. THE IMPACT OF PLASTICS ON THE MARINE ENVIRONMENT:

Garbage comes in many forms and is made up of many different materials. The plastic component of garbage has potential for causing the great harm in Tanzanian waters. Not only is plastic used for a wide range of products but it is also virtually indestructible.[25] This means that when it gets into the sea it can stay there for many decades or longer. As Amaral[26] contends:

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[24] Bishop, P.L (1983) *Marine Pollution and its Control*. Mc Graw Hill Book Company. New York. p.34

[25] Sampson, T (1997) 'Garbage : More than nuisance', *Intergrated Ocean Management case Studies*.lecture notes.

[26] Amaral, K (1997) Plastics in Our Oceans , Sea Education Association p.1

"Before the days of plastics, when fishermen dumped their trash overboard or lost a net, it consisted of natural materials--metal, cloth or paper that would either sink to the bottom or biodegrade quickly. But plastic remains floating on the surface, the same place where many genuine food sources lie--and can remain so for 400 years. Plastic is durable and strong.. precisely the qualities that make it so dangerous if it reaches the ocean."

A recent study reported in the "Environmental Technology Journal" underlines some of the potential problems of plastic debris accumulating in the sea. Plastics enter the coastal waters from industrial, social and agriculture activities primarily through streams, rivers and storm water drains of these, domestic wastes usually constitute is the dominant contributing source.[27]

Some of the plastics entering the ocean are lighter than seawater and initially will float, but eventually become coated with sand particles, shell debris and other objects will ultimately sink to the ocean floor. Their ultimate fate is consolidation in sediments, where they may last for centuries or longer. According to the study reported in the Journal, "There appears to be an increasing flux of materials with time and an increased a real coverage of the benthos.[28]" Among the impacts such material can have is acting as surrogate hard bottoms which attract seaside organisms, altering the makeup of communities of organisms on the seabed.

Furthermore, it is estimated that merchant shipping contributes a great deal of the garbage that is currently floating around the world's oceans. The United States National Academy of Sciences calculated that shipping garbage in 1975 amounted to 5.6 million tonnes world wide.

Another estimate in 1982 calculated that the world's merchant marine disposed of 639,000 plastic containers a year, together with 426,000 made of glass and nearly 7 million of metal. The same study showed that a crew of 46, during a 44 day period dumped 320 cardboard boxes, 370 plastic beer can holders, 165 crisp packets, 19 plastic bags and 2 plastic drums, 245 bottles, 5 glasses, 29 fluorescent tubes, 2 bulbs, 5,176 cans and two metal drum. And this is categorised as "domestic waste"[29]

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[27] Goldberg, E.D (1997). Plasticizing the seafloor:an overview. Environmental Technology 18: 195-202

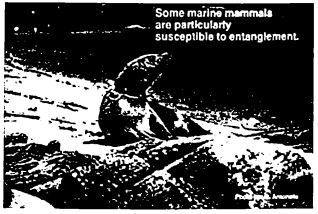
[28] Golberg,E.D (1997) Plasticizing the floor: overview. Environmental Technology 18: 195-202

[29] Sampson, T (1997) Garbage: More than nuisance Case study on Garbage in the Urban Coastal Environment p. 1

The Environmental Protection Agency (EPA)[30] Harbour studies Program states that significant land-based plastic pellet sources exist, and the plastic industry is the main source of the releases into the environment. Pellets released by the plastic industry flow into the aquatic environment by two routes:

(1) Combined Sewer Overflow (CSO) and storm water discharges- spilled pellets may be carried by rainwater into storm-water drains, which in turn transport the water into the municipal waste treatment systems. The pellets may be the discharged into aquatic environment through storm water discharges or where the sewage and storm sewers are combined, through CSO discharges.

(2) Direct spills into the aquatic environment- According to the Greenpeace international report[31] the world's merchant fleets dispose of large amount of debris into oceans contribute much more tonnage than the fishing fleets. For example plastic wastes of pellets may be spilled directly into waters, during cargo handling operations at ports or during cargo transport at sea. The following table on the next page lists the sources and type of solid waste from shipping world-wide. The picture below shows one of the impact of plastics on the marine environment.



This curious playful seal often plays with fragments of plastic netting or straps,catching their neck in the webbing.Photo:NOAA(1998) Marine Entanglement Research Program

[30] EPA (1992). Plastic Pellets in the aquatic environment sources and recommendations. Final Report. US Environmental Protection Agency (EPA) 842-B-92-010

[31] IMO (1985) Environmental Hazards caused by the Loss or Disposal at Sea of Fishing nets and other marine debris. Greenpeace International 23-27 September 1985.

Table 5. Sources and types of solid wastes from shipping.

Types of commercial vessels	Primary types of solid waste
Freighters, passenger-cargo vessels	Garbage:solid wastes from food and food preparation Rubbish:cartons,boxes,paper,cans,glass,plastics Cargo dunnage:wood,cardboard,etc used to protect cargo from condensation, chafage, crushing etc. Cargo sweepings:leakage from cargo containers
Ore carrier	Garbage Rubbish Cargo residues:ore remaining after discharge of cargo
Oil tankers	Garbage Rubbish Cargo tank sludge and scale congealed oil, dirty ballast sediment, oil-saturated rust
Fishing boats	Garbage Rubbish Fish offal Worn-out nets, seines,lines,etc
Ferryboats, container vessels tugboats, towboats	Garbage Refuse

SOURCE: Adopted from Hopper and Myrick,1971

Just as the type of rubbish dumped by ships varies so does its impact and some of the harmless sounding items can be the most damaging[32] . These are:

3.1 Fishing gears:

In fishing areas, damaged or abandoned nets probably are the greatest threat to marine life. The types of gear which cause the greatest problems are gill (or drift) nets and trawl nets, all of which are made from synthetic fibres, Gill nets are suspended from buoys and ropes to entangle fish and other creatures. The net can be up to 50km in length. It has been estimated that the total length of all gill nets used in Pacific is 170,000 km, or more than four times the distance around the earth's equator.[33] Trawl nets are bag shaped and are towed behind the vessel with bottom of the sea.

[32] Sampson, T (1997) Garbage: More than nuisance ,op cit p.1
[33] Sampson, T (1997)Garbage: More than nuisance p.1

Both types of nets can be a danger to marine life, but gill nets can be a particular problem because of their size and because they are virtually invisible in water and because of their non discriminate fishing of both target and non target species. They have infact been banned in some countries[34]. Even if they break free the nets will continue fishing until they eventually fold up and sink to the seabed.

Large sea creatures, such as whales, dolphins and seals can be endangered by becoming entangled with drifting nets. This may happen during normal fishing operations, the whole gear or parts of gear is lost and continue to fish as "ghost nets" catching not only mammals but also fish. The consequences arising from these unintentional catches are biologically an extra mortality rate added to the natural mortality of the species and to the mortality caused by fisheries. A study of northern fur seals in Alaska showed that entanglement is a major cause of death and that the seal population has declined by more than half in the last thirty years.[35]

In addition, such nets often entrap seabirds and of course fish and mammals, making it difficult, if not impossible, for them to move or to eat[36] (see appendix 4). In coastal areas, traps used to catch lobsters and crabs are often lost or damaged yet they will continue to attract prey until eventually the trap rots away. Since they are increasingly being made of plastic this could take centuries. Furthermore, accumulation of debris on the sea bottom in the long run, can hamper bottom trawling and other fishing operations, and drifting debris and discarded nets lying close to the surface become harzard to safe navigation.[37]

3.2 Ropes and Strap Bands:

Ropes are frequently made of plastics these days, as are straps bands used to secure boxes and other items ashore and on ships. They are popular because they

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[34] ibid
[35] ibid
[36] Gregory, M.R (1978) Accumulation and distribution of virgin plastic granules on beaches. N.Z.J Mar. Freshwat. Res. 12, 399
[37] IMO (1985) Unintentional Entanglements in Fishing nets and debris ,Fishery Resources and Environment Division at FAO 23-27 Sept. 1985.

do not corrode, are cheap compared with steel and are very strong. This is bad news for any mammal or other sea creature which happens to get its head trapped in one.

Material of this type can also be a problem to shipping and pleasure craft. Nylon or plastic ropes can entangle propellers and block water intakes (see appendix 4). Bishop[38]has this to say on the negative impact of plastic in shipping:

> "In addition to fouling of beaches, economic loss can result from fouling of trawling nets and ship's propellers and from clogging of water intake pipes. Large floating debris can be a navigational harzard."

3.3 Plastic Bags:

The 1987 Texas coast clean-up operation already referred to recovered nearly 32,000 plastic bags, the biggest category of rubbish. Plastic bags can entrap fish and other creatures, but are also sometimes eaten by creatures with equally fatal results. To a sea turtle, a floating plastic bag looks like a ocean jellyfish.[39] One baby sperm whale that died of infection of the abdominal cavity lining in 1984 was found to have a 30- gallon plastic garbage can liner in its stomach.[40]

3.4 Beer Can Rings:

The plastic rings used for the six packs of beer may seem harmless. But to many smaller sea creatures such as fish, turtles and seals they can be deadly.[41] The rings float in the water and can become stuck round the body of a fish or the throat of a mammal (see appendix 4 and page 22). This can lead to severe discomfort or slow strangulation as the animal grows.[42]

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[38] Bishop P. (1983) *Marine Pollution And its Control* Mc Graw- Hill Book Company Tokyo p.272
[39] Amaral op cit p.4
[40] Sampson, T (1997) 'Garbage: More than nuisance' lecture p.2
[41] ibid
[42] Sampson,T(1997) Garbage: More than nuisance p.3

3.5 Pellets:

Plastics are a product of the petrochemical industry and begin as small pellets which are then melted down and moulded to the required shape. They are frequently carried in bulk and are also used in packaging. Because they are so small, cheap and common, they frequently get thrown away as rubbish. Unfortunately, they can be mistaken for food; seabird for example, often think they are fish eggs.[43] Sea turtles are also partial to plastic pellets, which when eaten then clog their intestines and because they are indigestible and accumulate until the creature dies. [44] Cases have been recorded of turtles ingesting so much plastic rubbish that they have become too buoyant to dive for food.[45]

There are several factors according to the EPA[46] that affect the vulnerability of seabird populations to the presence of pellets:

- Frequency of Regurgitation- Birds with a limited ability to regurgitate are most likely to be affected by pellet ingestion.
- Pellet colour - Seabirds are more likely to ingest pellets that are light-coloured (e.g. white, tan, brown, yellow)than those of the other colour. This colour preference has been attributed to the pellet's similarity to common food sources, such as fishegg, crustaceans,and the like.[47]
- Prey type - Pellets pose the greatest threat to plankton- feeding species, such as shearwaters, petrels, prions, phalaropes, and auklets.
- Proximity to pellet sources - Logically, the closer that a seabird is to release point, the more likely it is to encounter and ingest pellets.

Finally, plastic pellets in the environment may contain chemicals that are toxic to seabirds. These toxic substances may be additives that were intentionally mixed into the resin to achieve specific properties, or contaminants that were absorbed by the pellets from the environment. On the other hand, marine turtles ingest many

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[43] Ryan(1988) 'Effect of Plastic ingestion on seabird feeding: evidence from chickens'. *Maritime Pollution Bulletin* 19, 125-128

[44] Sampson,T(1997) Garbage: More than nuisance p.2

[45] Day R.H (1990a) The quantitative distribution and characteristics of marine debris in the North Pacific ocean 1984, In Proceedings of the 2nd Intern. confer. on Marine Dbris(2-7 April 1989)

[46] EPA (1990)Final Report- Plastic Pellets in the Aquatic Environment p.4

[47] Day et tal (1990b) op cit p.248

items of floating debris, including plastic pellets (e.g. unfoamed polystyrene beads) Evidence suggests that, plastic material passes through the digestive tracts and are voided naturally and may have potential serious problems in sea turtles, such as lost nutrition, reduced absorption of nutrients, and adsorption of plasticizers.

3.6 Tanzanian Legislation for the protection of environment from Plastics:

Historically in Tanzania, environmental management has predominantly been ministerial based, a situation which has facilitated the growth of disparate regulatory institutions some with overlapping roles. Thus, enforcement of environmental related legislation has been generally ineffective, partially because of difficulties in implementing the inherent cross-sectoral conflicts of such legislation.

Matters pertaining to pollution control and management lie with the different ministries, and different institutions and legislative Acts. Environmental management responsibilities are lodged in ministries addressing different sectors such as water, lands, agriculture and natural resources, industry, and mining. Each ministry sector devises its own strategies and structures for the management and protection of its sector.

Furthermore, the existing legislation does not cover all aspects of environment concern. For example air pollution and hazardous waste management are unregulated. Standards on environmental quality and waste disposal are not well stipulated. There is no specific legislation in Tanzania concerning pollution from plastics. Thus the following section will examine legislation on water and waste management in general.

3.6.1 Water Pollution legislation:

The Waterworks Ordinances, (Cap 281), Urban Water Supply Act, No 7 of 1981 and *Water Utilisation and Control Act of 1974* (as amended) address water pollution issues. Water pollution can be a result of wastes from industry households, public facilities and other activities such as mining, when effluents are discharged directly into rivers and streams, into the lakes and into the ocean, or may be discharged on

land finally, finding their way into the water by runoff or underground water movement. *The Waterworks Ordinance* specifies that pollution of water supplies in certain instances are offences under the Ordinance punishable by penalty.

The Urban Water Supply Act gives the National Urban Water Authority power to make rules regarding surface or ground water pollution and specifies that it is an offence to pollute water supplies.

The Water Utilisation and Control Act: The purpose of this Act is to control and protect water resources. The legislation defines water as all water flowing over the ground surface or contained or flowing in or from a spring or stream or natural lake, swamp or beneath a water course. The Act puts in place a regime of water rights to govern access to water use and includes pollution control norms. Furthermore, this Act puts in place a requirement for a consent for discharge of effluents. Under section 15A(1) of the Act, no person may discharge an effluent from any commercial, industrial or other trade waste systems into receiving waters without a duly granted permit by a Water Officer. The Act also contains two schedules which set standards for receiving waters and effluent quality.

The Act establishes temporary standards for receiving waters and effluent discharges

Section 55(2) of the *Local Government (urban Authorities) 1983* states the responsibilities of urban authorities. This includes prevention of the pollution of water in any river, stream, water course, well or other water supply in the area. For this purpose the authority may prohibits, regulates or controls the use of water supply.

The above legislation does not however, stipulate what kinds of wastes, whether solid or liquid, could cause pollution to water supplies. Nor does this legislation stipulate (however, temporary standards are established in the schedules to the *Water Utilisation and Control Act)* the environmental standards to be met.

It has to be noted that water pollution control efforts should aim towards the integrated environmentally sound management of water resources and the safe disposal of liquid and solid wastes. This should include the establishment of

protected areas for sources of water supply, the safe disposal of refuse, the control of water associated diseases and the sanitary disposal of excreta and sewage, using appropriate system to treat wastewaters.

These laws might have been adequate to control water quality before pollution from current industries and activities become a major environmental problem. However now they lack adequate definition of standards to be an effective control against pollution, in that they do not stipulate specific requirements of environment quality and waste disposal. Penalties provided do not correspond with the severity of the offences envisaged.

For example, section 28 *Townships Ordinance* stipulates that any person in any way fouling or obstructing or causing or to be fouled or obstructed any supply or means of supply of water for man or beast shall be guilty of an offence against the rules and also will be liable to a fine of forty shillings for each day that such fouling or obstruction continues after notice has been given to him to cease such fouling or obstruction.

Coastal waters such as those of Dar Es Salaam, contains highly diverse ecosystems and most biologically productive habitats. Uses of coastal spaces are multiple and include settlement, food production, exploitation of oil, gas, minerals and other living resources, tourism, recreation and transport. Coastal zone boundaries are defined by political, administrative, and ecological considerations. Therefore, they demand an appropriate policy and legal framework to regulate access and use, to promote environmental sustainable technology and practices, to make environmental impact assessments mandatory, and to establish liability and compensation. The water pollution prevention legislation in Tanzania has failed in this respect.

Fisheries Act of 1970: The Act is under control of the Minister of Natural Resources and the Director of Fisheries. It provides for the development, protection and conservation of marine products, namely finfish, shellfish, marine algae and

invertebrate including turtles and dugongs. The Act is implemented by the Fisheries Division which is responsible for issuing licences to vessels, fishermen, exporter dealers, and (with ministerial approval) the granting of licences to foreign operators. The Act also deals with the use of explosives, poisons and water pollution. The following are salient points pertaining to prevention of water pollution.

The Minister is empowered under Part IV, Regulation 7(1) of the Act, to make regulation which in his opinion are necessary or expedient for the purpose of protecting, conserving, developing, regulating or controlling the capture, collection, gathering, manufacture, storage or marketing of fish, fish products, aquatic flora or products of aquatic flora. He is required to make regulations for preventing the obstruction and pollution of territorial waters.

According to Section 27, of the Act prohibits throwing overboard certain substances: "No person shall throw overboard ballast, coal ashes, stones or other prejudicial or deleterious substances in any lake, river, harbour, or road stead, or any other water where fishing is carried on."

Section 28 prohibits effluents and other deleterious substances: no person shall cause or knowingly permit to flow or pass into or put or knowingly permit to be put in any water lime, chemical substances or drugs, poisonous matter, dead or decaying fish or remnants thereof mill, rubbish or saw dust, or any deleterious substance or thing to such an extent as to be injurious to fish or to the spawning grounds, spawn or food of fish.

The Minister may by order declare any substance to be deleterious for the purpose of this regulation.

Section 29 provides for exemption from certain prohibition

"Notwithstanding anything contained in these Regulations, a person shall not be guilty of an offence against any of the provisions of s.25, 26, 27 or 28 by reason only of any act done in the exercise of legal right, or in continuance of any process or methods which he has been lawfully employing from before the commencement of these Regulation, if he proves to the satisfaction of the court that he had available means to render any substances, matter or thing used by him harmless to fish or to

the spawning grounds, spawn or food of fish." Since the term 'legal right' under the regulations is not defined in many occasions bring confusions in interpretation leading to abuse of good intention of the provision.

3.6.2 Waste Management Legislation:

The Townships Ordinance (CAP 101 Supp.59): Section 2 defines a street to include any street, road, highway, path, lane sanitary lane, sandy lane thoroughfare or public space to which the public has access and includes a bridge over which a roadway runs.

The duties of the Township Authority according to Section 4(1), is to cause time to time, inspections of the Township with a view to ascertaining what nuisances exist and to call for abatement.

By virtue of Section 23, the occupier of buildings or premises is required to provide and maintain a receptacle, for ashes and other non liquid domestic refuse, of sufficient size and fitted with a good and efficient lid to be kept permanently in the same premise.

Section 25 stipulates that the no person shall throw or deposit, or cause to be thrown or deposited in or upon any street or other public place any accumulation of dust, refuse, garbage, decaying animal, vegetable or noxious matter.

Moreover, Section 27 provides that the occupier of any plot or portion of a plot, or in the case of unoccupied plots, the owner thereof, shall not in any street or open place throw or lay down any dirt, rubbish, stone or building materials or cause or allow any offensive matter to run from house pantry dung heap or alike.

Fines for environmental offences are inadequate, inconsistent and out of proportion with the damage done to the environment. Further, there is no duty established to restore or repair the damaged environment or make good the damage. This state of affairs does not augur well for deterrence and rectification of environmental harm.

Section 8(1) provides where no penalty is expressly imposed by any rule, any person contravening any of the provisions of the rules, or failing to comply with any order or direction lawfully given thereunder, or obstructing or molesting any person

exercising powers conferred by the rules, will be liable to a fine not exceeding four hundred shillings.

Under *The Local Government(Urban Authorities) Act of 1982 By-Laws (Made under s. 56 &13)* domestic refuse is defined as normal household waste produced on any residential building used wholly as a private dwelling. Where any trade is carried in any residential bullding or any part thereof, the whole of the waste arising therefrom is considered to be trade refuse.

According to these By-Laws, premises include lands, buildings, vehicles, railway carriages or other conveyances and tent vans, structures of any kind, streams, lakes seashore, drains, or places open, covered or enclosed, whether maintained or not under statutory authority, and any ship, boat, or canoe or other vessel lying in the sea, river, harbour or other water, or exadverso of any place within the limits of the city which is not used as a residential dwelling. Service means the collection and disposal of trade and domestic refuse. Street is defined to include any street, road, highway, path, lake, sanitary, lane, sandlane, through fare or public space to which the public has access, and includes bridges over which roadway runs.

By Law 6 provides that if the council so directs, the occupier of any residential dwelling or premises will deposit all refuse arising from a residence or premises at a place directed by the council at the time and in the manner specified. Any person depositing refuse other than in accordance with the direction of the city council shall be guilty of an offence liable on conviction to a fine not exceeding five thousands shillings (equivalent to USD.8).

On the other hand, both *Tanzania Harbours Authority* and *Merchant Shipping Act* are silent on the responsibility for containment, collection and disposal of wastes.

Economists emphasise that it is necessary to value those environmental functions and services which are generally unpriced in order to correct decisions which treat natural environments as if they were free goods. Plastic waste seems to be nuisance on one hand but can cause unmeasurable damage at along run due to its durability in the marine environment. The existing legal provisions lack incentive to

reduce discharges of wastes. They do not provide for a feasible means of removing the pollutants from the source.

The provisions do not state a requirement for separating wastes bearing in mind hazardous, non-biodegradable and toxic wastes The objective of any law or regulation is to govern the conduct of individual(s) and a successful law is one which can be easily comprehended. The duplication of laws or unclear definitions of main terms in the legislation brings confusion and absurdity.

According to Agenda 21 of the 1992 Earth summit in Rio de Janeiro, protecting the marine environment requires an anticipatory rather than a reactive approach, and should involve the adoption of precautionary measures, environmental impact assessments, clean production techniques, waste audits and minimisation improved sewage treatment quality criteria for classified substances and comprehensive approach towards addressing damaging impacts from air, land and water. This is not the case in the above Tanzanian legislation.

The adequate disposal of wastes gives rise to several environmental problems that contribute toward unsustainable patterns of development. On the other hand, sound waste management legislation provides exceptional opportunities for enhancing the environment and supporting development. For example, recycling metal, paper, plastics and organic waste can lessen the demand for energy, raw materials ad fertilisers. Pollution control and prevention depend on the integration of economic and regulatory mechanisms backed by adequate monitoring and surveillance. Reading between the lines the Tanzania provisions for prevention pollution from solid wastes (which include plastic waste) it can be said that they do not provide opportunities for creating and enhancing management in collection and disposal (whether the need for recycling or land fills or any other kind of treatment) of the same.

A sound strategy of waste prevention calls for minimisation and reutilisation as the foundation of a solid waste management programme. Waste minimisation can be

achieved through modification of industrial processes and through changes in the design and use of products. This represents another deficiency in Tanzanian provisions. Sources of plastics as discussed in the previous sections industry and domestics requires effective and strict regulations which carter for management systems and monitoring programmes. In general, the existing provisions rely on reactive rather than proactive and 'after the fact' rather than 'before-the fact' strategies for protecting the environment. The result is a legal regime which lacks a vision for the future, coming into play only after the environment has already been damaged.

This chapter has analysed present Tanzania legislation pertaining to waste management and prevention of water pollution. It has been observed that there is vacuum in these laws to address pollution from plastic wastes. The following chapter provide example of countries which have taken control measures both legal and administrative to deal with plastic waste pollution.

"There is ample evidence to suggest that in most instances it is more effective to prevent pollution and natural resource degradation, than to compensate for damages caused. Often the damages are irreversible, or if reversible only at unacceptable costs. Moreover, there is frequently no way to calculate damages accurately, particularly in regard to the natural environment, to provide adequate compensation, nor to apportion liability if many sources contribute. From both an equitable and cost effective approach, the emphasis should be on pollution prevention."[48]

4. INTERNATIONAL EXAMPLES OF EFFECTIVE LEGISLATION AGAINST PLASTIC GARBAGE POLLUTION:

The preventive approach to marine pollution is an important theme in this paper. In the author's view like others,[49] it is more effective to prevent pollution than to remedy its effects or to assign liability for damage. The focus of this chapter is on how to prevent pollution from solid wastes such as plastics. There are a number of ways that can accomplish the task. Experience in many countries has shown that effective waste management relies on a combination of measures such as:-

- Development of legislation setting acceptable standards for waste handling facilities, and requiring monitoring of waste operations.
- Development of procedures and facilities to enforce the legislation, to monitor waste generation, and to undertake practical disposal operations.
- Co-operation and support of all parties involved such as governmental organisations port authorities, the public and industries

Establishment of safe waste handling, treatment and disposal facilities, and safe management of existing facilities using implementation and enforcement

[48] Edith, B.W (ed.) (1992) *Environmental Change and International Law: New Challenges and Dimensions*. United Nations University Press. p.18
[49] Edith,B.W(ed.) (1992) *Enironmental Change and International Law: New Challenges and Dimensions*. United Nations University Press. pp. 17,

programmes which are within the limits of available resources and skills, or those likely to be available.

This chapter examines, Singapore and the United States of America's legal framework, efforts and success in waste management strategies to protect the environment. The author cites numerous laws and regulations designed to protect the environment from solid wastes such as plastics. Specifically, the chapter addresses the issues of compliance and enforcement and points to the need to ensure that regulations and laws are enforced.

4.1 Legal Framework In Singapore:

Following independence in 1959, achieving economic progress was the main priority of the government of Singapore. The main thrust was to attract foreign investment in industries and to establish the country as a regional financial centre. The early industries were mainly pollution- and labour intensive manufacturing industries and such industries inevitably resulted in the degradation of the environment.

To address the emergence of environmental problems consequent to industrialisation, statutes and regulations were passed and enforcement mechanisms established to combat pollution in the early 1970's. The Anti Pollution Unit was set up in April, 1970 under the supervision of the Prime Minister's Office. The ministry of Environment (hereinafter referred to as Ministry) was formed two years later. In 1986, the Anti- pollution Unit merged with the Water Pollution Section (part of the Sewerage Department) to form the present Pollution Control Department.

The Singapore government's basic anti-pollution strategy is to locate industries in proper industrial parks. Industries are encouraged to use the cleanest technology possible. Where necessary, industries are required to install pollution control equipment to clean their emissions. Regular inspections are conducted to ensure that such equipment is properly operated and maintained. Of the major programs embarked upon by the Ministry, two were particularly crucial to the success of pollution control in Singapore. These were the provision of a comprehensive

sewerage system to collect and treat domestic and industrial wastewater, and the establishment of an efficient solid waste management system which today comprises a daily collection services, supported by transfer stations, incineration plants and sanitary landfills.

Therefore, the Ministry handles all environmental and public health matters. Its main functions include the control and monitoring of air and water pollution, planning, developing and operating sewerage, drainage, and solid waste disposal facilities, and providing environmental public health services. Other measures are also taken to improve the environment, including providing sewerage and drainage facilities, re-location of petty traders into proper premises with pollution control facilities, control and monitoring of air quality, proper collection and disposal of refuse, control of infectious diseases, and cleaning up of polluted rivers and water courses.

The Environmental Public Health Act consolidated the law relating to environmental health. Generally it is concerned with the maintenance of a healthy environment and regulates the disposal of solid waste. Under the Act, the Commissioner of Public Health is empowered to cause public streets to be cleaned and to impose a duty on owners of premises abutting a private street to keep the street clean. Section 8 of the Act also empowers the Commissioner to undertake the collection and removal of rubbish and refuse. The Act makes it an offence to litter or deposit refuse in any public place. This is in line with the anti-littering policy in Singapore and carries a minimum fine of USD 2000 (two thousand dollars). This policy is enforced vigorously to maintain Singapore's reputation as a "clean and green" city. In 1988 the number of prosecutions for littering initiated by statutory boards was 3,651.[50]

The authority responsible for the disposal of domestic, trade and industrial refuse and solid waste is the Environment-Engineering Division. This department plans and develops refuse disposal facilities, including the control of dumping

[50] Chen C.J et al (1991) *Environmental Law of Singapore*. Allen & Gledhill. Singapore. p.12

(separation/segregation of wastes, e.g. plastics which are hard to dispose of) at dumping grounds and the operation of refuse incineration plants

Section 23 of the Act empowers the Commissioner of Public Health to order an owner (e.g. industry) to construct, establish, maintain, operate any disposal facility for the disposal or treatment of refuse or waste if the Commissioner considers it necessary. The term "disposal facility" includes any refuse disposal ground, any place used for the deposit of refuse or waste, any incinerator, and any plant machinery or apparatus used for the processing or treatment of refuse or waste.
The Act also makes it compulsory for all disposal of refuse and industrial waste to be carried out only at an authorised disposal facility or public disposal facility. The Act requires a plant operator to provide proper facilities or efficient methods for storage of industrial waste before it is disposed of, so as not to create a nuisance or cause any pollution or risk, harm or injury to persons or animals.

Where toxic or persistent industrial waste or residue is to be disposed of at any public facility, the written permission of the Commissioner of Public Health first must be obtained. The term "toxic industrial waste" is defined to mean any industrial waste that, owing to its nature, composition, or quantity, constitutes a danger to human health or the environment or that contains or may produce pathogens or transmittable disease. A plant operator may be required to alter his methods of operation, to install anti pollution devices or equipment, and to make any necessary action to minimise pollution where the commissioner is of the opinion that a particular trade or industrial factory is producing a high quantity of toxic industrial waste.

4.1.1 Implementation of Environmental Laws in Singapore:

The Ministry of Environment is the main governmental body that administers environmental legislation. The work of the Ministry is carried out by its three main

divisions: the Environmental Engineering Division; the Environmental and Public Health Division; and the Finance and Administration Division.[51]

The Commissioner of Public Health and the Director of the Environmental Engineering Division appoint officers and delegate powers to these officers under respective acts and regulations. In certain cases, the Commissioner of Public Health is empowered to appoint a public officer or officers of statutory boards to exercise the powers under acts or regulations. For example, town councils are authorised to exercise the powers of the commissioner of Public Health under *the Environmental Public Health Act* and its regulations, subject to such conditions as the Commissioner may specify.[52]

There are three basic means of pollution control in Singapore: social control; legal control; and administrative control. The Ministry uses a combination of mass media and interpersonal communication strategies to increase public awareness and concern about environmental health and protection. It has launched environmental education programmes focusing on littering, keeping rivers clean, prevention of mosquito breeding, toilet cleanliness and food hygiene. In June, 1988, a permanent exhibition entitled "Towards A clean Environment" was opened to instill a greater public awareness about environment protection. The largely successful antilittering campaigns have been conducted since 1968, and the latest nation-wide campaign was launched in March 1988. The ten- year Clean - Up Program for Singapore River and Kallang Basin was completed in 1987, and the Clean Rivers Education Program was launched in October, 1987 to educate the public on massive efforts to clean up rivers and the public's role in keeping the watercourses clean.[53]

Legal control through active legislation remains the most active means of controlling pollution. Legislation providing mandatory measures, coupled with strict enforcement against a breach of such measures, is seen as the most effective way to achieve governmental policy objectives. Administrative control in Singapore is

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[51] Chen,C.J et al (1991) *Environmental Law of Singapore*. Allen & Gredhill Singapore pp.11,12

[52] ibid

[53] Chen, C.J (1991) *Environmental Law of Singapore*. Allen &Gledhill. Singapore.p32

exercised in various ways. The Ministry of Environment regulates existing and potential pollution problems through its system of granting or withholding permits and approvals for plans and projects.[54]

4.2 Legal Framework In the United states of America.

Several legal authorities, such as international conventions and Federal laws and regulations, have been developed for controlling the release of plastic materials into the aquatic environment. This reviews some of the legal authorities for controlling the disposal of plastic wastes from vessels into navigable waters (water-based sources) and disposal of plastic debris from land-based sources, such as industry and sanitary and storm-sewer systems.

4.2.1 Water -Based sources of Plastics:

The United States is a signatory to Annex V of the Protocol of 1978 Relating to the International Convention for the Prevention of Pollution from Ships (MARPOL Protocol of 1973/78)(hereinafter referred to as MARPOL Annex V). Under the terms of the Convention, MARPOL Annex V became effective on December 31, 1988. The Convention prohibits the disposal of all plastic wastes generated during normal shipboard operations.

MARPOL Annex V cannot be used as a mechanism for controlling land based releases of pellets into the environment because the treaty applies only to releases at sea and is not applicable to land-based sources. In addition, MARPOL Annex V applies only to vessels of signatory nations; vessels from non signatory nations are not bound by the treaty's restrictions.

The US Marine Plastic Pollution Research and Control Act, Public Law 100-220 (MPPRCA) implements the provisions of MARPOL Annex V by amending the Act to Prevent Pollution From Ship as amended in 1961. MPPRCA also implements several other pieces of legislation introduced in the Congress in 1986 and 1987.

The MPPRCA specifically prohibits the disposal of plastics at sea by U.S registered vessels in any waters, and foreign- registered vessels in navigable water (i.e. bays,

[54] ibid:

sounds, other inland waterways, and coastal waters) and the exclusive economic zone (waters to 200 miles offshore) of the United States. The law assigns the responsibility of developing regulations for implementing the MPPRCA, implementing and enforcing the regulations, and establishing civil penalties for violations to be administered by the United States Coast Guards (USCG).

Several requirements of the MPPRCA that are applicable to plastic releases include

- Public Outreach- The National Oceanic and Atmospheric Administration (NOAA) and EPA are required to develop and conduct public outreach programs for educating the public about the problems associated with the disposal of plastic and other debris into the aquatic environment.
- Waste- Reception Facilities- All ports and terminals that receive ocean-going vessels of 400 gross tons or > 500,000 lb. of commercial fishing products in a calendar year must have adequate waste-handling and waste -reception facilities for collecting shipboard wastes. Pellets spilled on loading docks, ships' decks, and in cargo holds may be considered shipboard wastes.
- Waste Management Plan- All U.S vessels must develop and implement shipboard waste management plans that address the provisions of MARPOL Annex V. The USCG is authorised to prosecute any vessel, foreign or domestic, that disposes of plastics within 200 miles of the U.S. coast.

Another Federal law that may apply to water-based releases of pellets into the environment is the Marine Protection, *Research, and Sanctuaries Act of 1972* (MPRSA) referred to as the *Ocean Dumping Act.* Under the MPRSA, no U.S vessel may transport any material, including plastic, for the purpose of dumping the material into the ocean unless the vessel has a permit to dump from EPA; EPA does not grant permits for the dumping of plastics into the ocean and regulations implementing the MPRSA also prohibit such dumping.

In addition to Federal laws and international treaties to which the United States is a signatory, states and local governments may regulate the disposal of wastes from vessels in waters under their jurisdiction.[55] As Bean[56] suggests that, state and local

[55] USEPA (1992) *Plastic pellets in the aquatic environment sources and recommendations.* Final Report US Environment Protection Agency (EPA) 842-B-92-010p.6

[56] Bean (1987) *Protection of environment from plastics.* New York Havard University p.120

strategies should focus on shore-based or dockside controls, including at sea waste storage requirements and provisions for adequate waste disposal facilities at ports.

4.2.2 Land -Based Sources of plastics:

The discharge of plastics from outfalls or other land-based point sources into coastal or inland waters is subject to regulations under section 402 of the Clean Water Act. Prior to November 16, 1990, permit guidelines for the plastics industries controlled only the pH of the effluent and did not limit the discharge of solid or suspended particles. On November 16, 1990, Environment Protection Agency (EPA) published the final revisions NPDES regulations for storm-water discharges. Section 122 of Title defines materials considered to be significant in storm water discharges and plastic pellets are specifically named as significant materials. Therefore, pellets can be subject to regulation under the NPDES permit guidelines[57].

The new storm water discharge regulations requires selected industries to obtain a NPDES permit for all storm sewers that carry storm water from industrial sites into public waterways. Applicable industrial discharges include storm water runoff from industrial plant yards, immediate access roads and railroads sidings, drainage ponds, material handling sites, refuse sites, wastewater sites, equipment handling/main-tenance areas, residual treatment areas, and loading and unloading areas.[58]

Other Federal laws that apply to land-based releases of pellets into the environment include:

- The *Toxic Substances Control Act* (TSCA) of 1976- Under TSCA, EPA has the authority to require the testing of new and existing chemical substances entering the environment, and, subsequently, the authority to regulate these substances.
- *Resource Conservation and Recovery Act of 1976*: This Act defines hazardous waste as "solid waste...which because of its...physical or chemical characteristics

[57] USEPA (1991) Plastic pellets on the aquatic environment sources and recommendations. Final Report. US Environmental Protection Agency (EPA) 842-B-92 180 p8
[58] Bain and Moment,(1991) 'Pellets and Environment' p.23

may pose a substantial present or potential hazard to the environment when improperly treated, stored, transported, or disposed of." Based on this definition, Bean considers, plastic trash (e.g. pellets in the solid waste stream) to be hazardous. Because the focus of the EPA 's RCRA program focuses on chemical toxicity and generators that produce this type of waste in the course of manufacturing other products, EPA does not regulate pollution by plastic trash under the authority of RCRA.

4.2.3 Environmental Protection Enforcement

As a result of growing public concern for environmental protection, and mounting pollution costs imposed on the public, federal and state environmental enforcement efforts are intensifying. More self-monitoring and reporting obligations are being imposed on the regulated community, and the use of "citizen suit provisions" to supplement governmental enforcement efforts is being encouraged.[59]

In the United States of America administrative agencies play a critical role in the development and enforcement of US environmental laws. The agency (EPA) translates congressional policy on environment into regulations: The agency gathers data and conducts research and, on the basis of this information promulgates drafts regulations that translate Congress policy into regulatory programs with discrete obligations and prohibitions. These regulations are published in the Federal Register with a preamble explaining how the agency derived these rules from Congress's authorising statute. The public is invited to comment on the draft regulations. After consideration of public comments, the agency publishes the regulations in final form, again with a preamble describing and responding to public comments. Unless successfully challenged in court, or overturned by congress, these regulations then become law.[60]

[59] Stever D. W (1991) *Environmental Law of the United States of America*. Sidney &Austin New York, USA. p.35
[60] ibid. p.35

Historically, penalties under US environmental statutes have had three primary goals: i) deterrence. ii) fair and equitable treatment of the regulated community iii) swift resolution of environmental problems.

In EPA's view, effective deterrence is achieved only when the penalty places the violator in a worse position than he would have been if he had complied. Thus, penalty attempt to ensure that, at a minimum, the violator gains no economic benefit from the violation. This objective is accomplished by determining the economic benefit achieved by the violator's non compliance, for which EPA provides the BEN formula (Benefit of Environment Non compliance). To place the violator in a worse position than if he had complied, EPA adds a second component to the penalty formula that consists of a calculation based on the seriousness of the violation. Together, the first two components of the formula are called the preliminary deterrence.[61]

The second goal of EPA's fair and equitable treatment of the regulated community, requires that the preliminary deterrence amount be reduced or increased to account for differences between individual cases. The equity adjustment component of the policy considers such factors as the degree of negligence or wilfulness, the history of non compliance, the liability to pay, and the degree of co-operation. EPA's initial penalty target is the preliminary deterrence amount after adjustment based on equitable consideration.

The ability to pay component takes a hard look at the violator's financial conditions. The policy contemplates that the violator will utilise the following resources to pay penalties: i) cash on hand ii)Asset sales, iii) commercial borrowing iv)stock sales and retained earnings v)withheld dividends and deferred future investments. In evaluating the violator's ability to pay, EPA enforcement officers are instructed to review tax returns, balance sheets, income statements, statement of changes in financial position, statement of operation retained earning statement, loan

[61] Stevers D.W (1991) *Environmental Law of the United States of America*. Sidney & Austin New York p. 15

applications, financial agreement, annual report, and information available from business services.

To advance its third goal, swift resolution of environmental problems civil penalty policy is pursued in two approaches. First, the penalty policy provides discretion to reduce penalties in exchange for prompt settlement and remedial action, provided they do result in a net economic benefit of non compliance to the violator. Second, the policy provides discretion to increase penalties for delaying compliance.

In the late 1980's USEPA saw a need to heighten the regulated community's awareness of compliance obligations. Since 1985, statutory required enforcement programs have been initiated under the *Emergency Planning and Community Right to Know Act* and the *Resources Conservation and Recovery Act*. Citizen groups are using the *Clean Water Act's* "citizen suit provisions" more aggressively as they become more familiar with the enforcement tool. *The Clean Water Act's* citizen suit provision authorises private citizens to bring lawsuits in federal court to enjoin violations and recover penalties. In these citizens suits, the plaintiff's burden of proof is relative easy to carry because the Act obligates dischargers to monitor and report their discharges violations, and their discharge violation reports are available to the public. Thus, the defendant creates the evidence of its own violations. The citizen suit provision also enables the plaintiff to recover its litigation costs, which encourages citizen groups to pursue *Clean Water Act* violators on a systematic basis.

The chapter has discussed the legal framework to protect marine environment from plastic wastes both in Singapore and United States of America. Among factors which has led to effective legal framework include ability to develop affective legislation coupled with strict enforcement against the breach of those legislation. It is also observed that public involvement is important in achieving governmental environment objectives. The next chapter proposes what should be done in Tanzania to address environmental issues related to waste management with special reference to plastics and pollution prevention.

CHAPTER FIVE

"Environmental law involves the creation of offences. For what that law protects often is not directly people, their health and property but the ecology or ecosystems - the world in which we live."[62]

5. NECESSARY CHANGES IN TANZANIAN LEGISLATION CONCERNING PLASTIC GARBAGE POLLUTION IN COASTAL WATERS:

In chapter three of this paper, the author examined the effectiveness of provisions dealing with waste management and water pollution prevention. Deficiencies were pointed out, one being the lack of provisions for prevention of environment pollution from plastics. With plastic waste being a central subject of this paper, this chapter proposes a legal framework to address its environmental aspects. The proposed legislative framework aimes to affect management of plastics in particular, and the management of solid waste in general.

5.1 The Role of the Legal Framework in Preventing Pollution:

It is has been emphasised in this paper that it is much more effective to prevent pollution than remedy its effects or to assign liability for damage. This can be accomplished by preventive approach through legal control, administrative control and social control. However it is important to point out that legal control through active legislation seem to be most effective means of controlling pollution. Legislation providing mandatory measures coupled with strict enforcement against a breach of such measures, is the effective way to achieve governmental environmental objectives as elaborated in the example countries cited in previous chapter.

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[62] Smith, T.T (1989) *Understanding US and European Environmental Law: A Practitioner's Guide.* Graham & Trotman/ Martinus Nijhoff. London.

5.2 Regulating Pollution

These laws should pursue a strategy of regulating pollutants at the points where they are discharged into receiving waters or into public areas. These laws should contain the following components:

i) a permit program addressing direct discharges to receiving waters, along with pre treatment standards for discharges from plastic industries;

ii) a program to further limit effluents where the nation-wide standards are not at present sufficient to achieve acceptable water quality; and

iii) a program to regulate "non point" source discharges.

In addition, the law should establish a system for public access to environmental information.

5.3 Amendment and Consolidation:

The author proposes Amendment to the legislation which deal with solid wastes and prevention of water pollution. In order to make an effective implementation of these laws: *The Water Ordinance, Cap 281, Urban Water Supply Act, No 7 of 1981* and *Water Utilisation and Control Act No 42 of 1974 (as amended)* should be consolidated into one law (it could be called Water Pollution Control Act) because all of them are catering problem of the same nature. There is also a vital need to amend *the Fisheries Act* in order to make an offence on the unsafe disposal of fishing gears.(drift nets)

In reforming 'Water legislation' each kind of waste, solid or liquid, needs be given separate treatment, i.e. should be clearly defined. The law should be able to define activities which are environmentally hazardous and subject their activities to government authorisation through permits, certification and license. For example, proper use and type of fishing gears. Plastic waste should be identified as a dangerous / harmful substance considering its long negative effects on the marine environment. The law should further provide for a mechanism for ultimate disposal of wastes and by products.

A provision in the law should provide for a general upgrading/enhancing of penalties under relevant laws dealing with prevention of pollution of marine environment from solid waste.

5.4 Amendment and Harmonisation:

The Dar Es Salaam City Council (DCC) By Laws define premises to include any ship, boat or canoe or other vessel lying in any sea, river harbour or other water. The DCC is required to direct occupiers of the premises where to deposit refuse/garbage and that the DCC is responsible for collecting and disposing of that garbage. The occupiers of premises are supposed to pay a collection charges in a specified period under the By Laws. Penalties may be imposed or civil suit may follow for breach of the rules or failure to pay the charges. In this respect the author proposes amendment and harmonisation of the *Merchant Shipping Act* and the *Tanzania Harbours Authority Act* which are silent on the management of garbage from ships. In amending these laws all kinds of waste should be categorically defined along with relevant direction for treatment.

The amended law should provide for the provision of separation of garbage as stipulated in the Guidelines for the Implementation of Annex V of MARPOL Convention. It is provided[63] in the guidelines that, to reduce or to avoid the need for sorting after collection, it is recommended that three or more categories of distinctively marked garbage receptacles be provided to receive garbage as it is generated. These separate receptacles(e.g. cans, bags, bins) are to receive 1) plastic and plastics mixed with non plastic garbage, 2) food wastes and 3) other garbage which can be disposed of at sea. Hence, these Acts should be amended to make use of reception facilities compulsory.

[63] *International Convention for the Prevention of Pollution from ships*, 1973: Guidelines for implementation of Annex V , Guideline 4.3 Collection

5.5 Penalties:

The legislation resulting from the amendment should, at all levels, be mandatory to government agencies, the private sector and the community at large In building an integrated and co-ordinated administration of pollution prevention programs.

The Penalties (stringent) should be brought up to the current economic value of the affected environments.

Here below, examples are given of the various legislation from different public sectors:

5.5.1 The Role and Functions of Tanzania Harbours Authority (THA):

The role and function of Tanzania Harbours Authority in protection of coastal waters constitutes an integral part of the general environmental law of the state. It is inevitable that the responsibilities of the THA will have impact on, and be affected by, the responsibilities of other government institutions concerned with maritime transport and environmental protection.

Accordingly, legislation on the role of the THA in pollution prevention should indicate clearly the relationship of the THA with other government institutions. It should also indicate procedures and arrangements for the co-ordination of the respective activities of the various bodies and institutions of the government.

Similarly, the port has to take into account the regulations or written procedures established by appropriate government institutions regarding the disposal of waste manual which have been deposited at the port , whether such disposal is to be made at sea or land.

THA should specify measures to be taken by existing industries which are currently polluting the environment due to the lack of treatment plants and provide for mechanisms for co-ordinating the activities of different sectors.

5.5.2 Environmental Court/ Tribunal:

Generally, courts do not resort to rules of interpretation to resolve the meaning of statutory language that is comprehensible to a reasonable person. However, when interpreting statutes, it is the legislative intent manifested in that statute that is paramount. Therefore, judges should be acquainted with environmental issues and laws. There is also a need to establish an environmental court or tribunal to hear cases brought by the public of an environmental nature.

5.6 Integration of Strategic Principles in Legislation:

The Tanzanian Environmental Policy is still in draft and will become the basis for all other environmental legislation. As a conceptual framework in amending the legislation, there is need to incorporate the following principles for the protection of environment.

These principles are:

a) precaution principle,

b) the polluter pays principle,

c) common charge principle and

d) the co-operation principle.

From the legal point of view, these principles primarily are strategic principles, i.e. guiding principles of a general kind and merely reflected by the provisions of environmental statutes which justify them. They have in part the function of a norm and are directly applied by the authorities.

5.6.1 The Principle of Precaution:

This principle concerns the content and intensity of environmental protection. It means that the environmental policy is not limited to the elimination or reduction of pollution already existing or imminent (protection against dangers as opposed to mere risk, but ensures that pollution is combated in its incipiency (it is much more cost effective to prevent pollution than to remedy its effects) and that natural

resources are used on a sustained yield basis[64]. The principle has several different aspects, such as minimising pollution to the extent possible, reduction of waste materials, prohibition of significant deterioration of the environment, reduction of known but highly improbable risk, screening of new products, and consideration of environmental concerns in physical planning.

5.6.2 The Polluter Pays Principle:

This principle concerns the distribution of financial burdens of environmental protection measures and the selection of such measures. It means that cost incurred in preventing, eliminating, or offsetting adverse effects on the environment must be borne by the polluter. The polluter can transfer these costs via market mechanisms to the consumers product[65].i.e. by increasing the price of a commodity. It is believed that a distribution of charges and incomes that conforms with the principles of market economy and contribute to the prudent utilisation of natural resources is thereby achieved. This principle requires concretisation by statutes and regulations.

5.6.3 The Common Charge Principle:

This principle when applied means that the public collectively bears environmental protection costs. The state grants tax advantages for pollution control investment and research and development on pollution control technology e.g. sewage treatment and waste disposal.

5.6.4 The Co-operation Principle:

This is a procedural principle that concerns the making of public decisions on environmental protection measures, calling for close co-operation between regulators, polluters and affected citizens, as well as between the state and local executive and administrations. The assumption underlying the principle is that

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[64] Smith T.T (1989) Understanding US and European Environmental Law: A Practitioner's Guide p.13 see also Clark R.B (1992) (3rd Ed.) Marine Pollution. Clarendon Press. Oxford p.149

[65] Weiss E.D (1992) *Environmental Change and International Law: New Challenges and Dimensions.* United Nations. University Press. p.16

solving problems emerging in the formulation and implementation of environmental issues through discussion and persuasion is necessary and desirable in environmental management and protection.

5.7 Effective Implementation and Enforcement of Legislation:

According to Agenda 21, improving solid waste management requires changes in technical, social, financial, planning, legislative and institutional practices at community, local, national, regional and global levels. Implementing such changes requires considerable efforts in building up sufficient capacity within the relevant institutions and organisations

Thus, it should be noted that in order to create and maintain an effective legislative framework, there should be rules in the first place which are known to all those affected by them i.e. the administrators and the public at large. The rules should be understandable, consistent as announced and should be directed to the relevant existing administration.

As discussed in the previous chapters, in Tanzania the responsibilities for many relevant pieces of legislation are scattered in different ministries and authorities. This complication together with the existing administrative gap between local and central government, contribute to a failure in the implementation of environmental legislation concerned with environment.

The author advocates the need to revise the present system of allowing so many ministries handle issues in a fragmented and inconsistent manner. This sometimes leads to duplication of tasks and overlaps in administrative responsibilities. There is also an urgent need to bridge the gaps which exist between central and the local government. This can be achieved by:

- Clearly identifying divisions of responsibility between the central and the local governments.
- Clarifying who should monitor the implementation of the legislation.

- Establishing environmental liaison units in all departments in relevant central government ministries; e.g. Ministry of Industry and Fisheries and Natural Resources to ensure effective co-ordination and exchange of information between government institutions in implementing policies, plans and resource conservation. This could be accomplished by establishing notification procedures by sectors of intent to pass subsidiary legislation under specific environmentally related Act and notification to undertake projects and activities which will affect other sectors.

5.7.1 Local Authority:

The Dar Es Salaam City Council (DCC) has a major role to play in effectively implementing legislation relating to waste management. The DCC has a responsibility over handling, collection and disposal of waste within the city. Being the level of government closest to the people, they can play a vital role in educating the public on the ill effect of the plastic waste in our environment, thus providing a means to reduce the problem at its source and to effect proper disposal.

This could be achieved by developing programs through local officials (authorised officers from DCC) to consult citizens and community businesses and industries to gather information and build a consensus for action. This consensus could help them reshape industrial policies, regulations and people's behaviour/attitude towards the environment in general, and the proper handling of wastes in particular.

5.7.2 Public Involvement:

It should be always remembered that the quality of the marine environment and its enhancement is free to be enjoyed by all. It is a 'public good', 'non exclusive' in nature, meaning that everyone, including those who have not paid, will benefit from an improvement in its quality.

Again, public participation in environmental matters and problem solving depends on the public understanding of environmental problems. At present, in Tanzania

there is an inadequate level of environmental education, public awareness and only a few trained personnel exist to campaign for the protection of the environment. To improve this situation the government should seek to:

- make environmental education on solid waste available to people of all ages, that is through formal and non formal education focusing on littering and keeping rivers and water courses clean including conducting of anti littering campaigns.
- ensuring that environment concepts and issues of waste management are included in education programmes starting with primary schools.
- make special training available to the decision makers on the impact of the solid wastes with special reference to plastics in the marine environment.
- involve school children in local and regional studies on environment and sustainable use of natural resources.
- disseminate the provisions of the law relating to solid waste management and water pollution prevention to the public, plastic industries, local fishermen, beach hotels, and ships calling at Dar Es Salaam port; this should be in a simple language made available through radio programs, press, placards, television, health centres and booklets;
- maintain effective reception facilities at the port, with the government making arrangement to involve landlocked countries which make use of the port.

5.7.3 Administrative Measures

The Ministries concerned, i.e. the Ministries of Industry, Transport, and Communication should regulate existing potential pollution problems.

This means the ability of an administrative authority to demand reparations from whomever has contravened the regulations and to restore, as far as possible, the situation to what existed before the illegal transaction took place. The authority concerned may exact the necessary costs involved from the contravenor,

The administrative sanctions can be administered by the authority responsible for the regulation that is contravened. Criminal sanctions can be administered only by the court after a process of law has been followed.

5.7.3.1 Administrative Enforcement:

The most important administrative sanctions with respect to these environmental acts are

i) withdrawal of licences and

ii) closure.

5.7.3.2 Withdrawal of Licence and Closure:

The license can be taken from a license holder who has not abided by the regulation. Failure to observe the acts and regulations concerned the law should provide for the sanction of closure of a business.

This chapter has recommended necessary changes to the existing legislation concerning pollution from plastic garbage. This changes include amendment, consolidation and harmonisation.The chapter also highlights measures to be taken for an effective implementation and enforcement of the said legislation i.e. public involvement and proper solid waste management. The next and final chapter is conclusion and recommendations which might assist to address the problem of plastic garbage in particular and waste management in general.

CHAPTER SIX

"With good management - strict safeguards and conservation measures that will protect the oceans from pollution-the harm can be controlled. The responsibility for ocean conservation is everyone's responsibility."[66]

6. CONCLUSION AND RECOMMENDATIONS

6.1 Summary:

This work has reflected upon a number of issues associated with solid waste management, particularly plastics. The work has dealt with threats and sources of plastics releases into marine environment.

It has been observed that plastic threatens marine life through entanglement, suffocation and ingestion, and is widely recognised to degrade the visual amenities of marine and coastal areas with negative effects on tourism and general aesthetics. Plastics in the marine environment also destroy coastal habitats and in some situations interfere with biological reproduction in coastal areas.

Plastics entering the marine and coastal environment have multiple sources. These sources include poorly managed or illegal waste dumps adjacent to rivers and coastal areas, windblown plastics from coastal communities, and resin pellets from industrial feedstock, all of which are channelled to the marine and coastal environment through municipal stormwater systems and rivers. Marine litter (plastics) is also caused by dumping of garbage into the marine and coastal environment by municipal authorities as well as recreational, commercial and fishing vessels.

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[66] Fine, C.J (1987) *Ocean in Peril Atheneum*. New York p.4

It has been argued that, while international action[67] has been taken to prevent the discharge of plastics and other persistent wastes from vessels, approximately 80% of these persistent wastes originate from land. In this regard, the paper has focused on pollution of coastal waters of Tanzania from land based sources and shipping with Dar Es Salaam as a case study.

The author strongly believes that the existing pollution of the coastal waters of Tanzania is a result of poor institutional arrangements and weak legislation governing both resource management and conservation and pollution prevention. As far as plastic waste is concerned, the work has examined the shortcomings, strengths, and weaknesses of water and waste management and thereafter made proposals for appropriate legislative framework.

Environmental protection and resources conservation of a nation is a process of reflecting the interest for the environment and natural resources by incorporating appropriate provisions into national development processes and laws. This is done by incorporating strategic principles in the laws. Such principles are: the polluter pays principle, a precautionary principle, the common charge principle and co-operation as covered in chapter five.

Similarly, the government has a major role to play as a co-ordinator between different sectoral interests: the public and the business enterprises in the country.

Therefore, in recognising the threats of plastic waste in the marine environment the author wishes to make the following recommendations to both the government and plastic industries.

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[67] *Convention on the prevention of marine pollution by dumpind of wastes and other matters* 1972 Annex I; UNEP Washington Declaration on Protection of marine environment from land based activities; MARPOL 73/78

6.2 Recommendations to the Government:

In the development of control strategies for any pollution, a number of factors must be taken into account in addition to the level of scientific and technological capabilities within a country. These factors should include the social, political and cultural circumstances of the country.

However, it is also necessary to reconcile the interests of competing groups and make decisions that will benefit the state as a whole. These competing group include fishermen, industrialists, environmentalists and consumers. In this respect the following recommendations are intended to address plastics and other wastes.

a) Regulatory Measures

- Introduction of appropriate measures could include regulatory measures and/or economic instruments and to encourage reduction of the generation of solid wastes. Regulatory measures are one of the effective ways of achieving the minimum proposed standards of prevention, reduction and control of environmental degradation. Therefore there is a need to review the solid waste management and water pollution prevention legislation as elaborated in chapter five.
- Tanzania Harbours Authority regulations should be reviewed and amended to enhance the powers of the port to prevent marine pollution in the conduct and operation of vessels while in port. Regulations, such as requirements to be met during the stay of vessels in port should make provision for adequate reception facilities.
- Tanzania should consider ratifying relevant international conventions (eg MARPOL) relating to protection from pollution of the marine environment.
- National legislation and regulations pertaining to the protection and development of the marine and coastal environment (coastal zone management) should be reviewed and when necessary, expanded, updated or strengthened, as well as effective implementation and enforcement of applicable laws.

b) Effective Waste Management

- Installation of garbage containers/bins for citizens in public areas would address the needs of appropriate collection and/or recycling and encouraging the use of them.
- Increasing local planning and management capacity is needed to avoid location of waste- dump sites near coastlines or waterways and to avoid litter reaching the marine and coastal environment
- Improving domestic waste processes will go a long way towards reducing the pollution of the coastal and marine environment.

  In terms of corrective measures, it is recommended that the following actions be taken:

  a) careful selection, and monitoring of dumpsites and the construction of a storm water collection system;

  b) massive education awareness campaign to sensitise the population regarding the ill effects of improper garbage disposal. This could be done through mass media, television, radio, poster, presentations, seminars and the like.

- Resident groups should be assisted and encouraged to undertake community cleanups, including beaches and other recreational areas.
- Developing and facilitating business participation in cleaner production programmes should be considered to minimise waste.
- Introduction of financial incentives is needed to provide incentives for private waste collectors to separate waste and other recyclables from waste stream.
- Setting of fees and charges are needed to encourage responsible waste management
- Garbage collection costs need to be maintained at a competitive level, e.g., at a level which encourages residents and businesses to reuse products as often as possible.

c) Wastes From Ships

- Establishment and ensuring the proper operation of solid waste management facilities on shore would provide for wastes from all sources, including shipping and harbour wastes.
- The environmental hazards caused by loss or disposal at sea of fishing nets and debris can only be mitigated by reducing and eliminating the practice of at sea disposal. The author recommends that there be established a programme whereby all vessels retain on board non degradable plastic waste, including obsolete fishing gear, generated at sea. The programme should ensure that vessels carry the retained materials to nearest ports.

d) Education Campaigns

Awareness and education campaigns should be initiated for the general public, industries, and municipal authorities, as well as recreational, fishing and commercial vessels, on the need to reduce waste generation and the need for environmentally sound disposal and reuse. In this regard a balanced approach is the key. This requires an integrated approach to resource management that selectively utilises **source reduction** by producing less waste in the first place and using less packaging for products.

Source reduction saves money, conserves raw material and energy resource while prolonging the municipal waste management facilities. Promotional material and education programmes for schools and communities should be provided.

e) Harmonisation of Existing Organisational Arrangements.

Effective government administration depends on the existence of a clear agency mandate and line of accountability of staff with capability to implement policies, design programmes and evaluate performance. Thus the current administrative practices need to be modified, where appropriate, with a view to reducing the duplication of roles and introducing innovative and integrated management approaches between local governments and central government.

f) Protection of natural resources

- Priority scientific and technological research on environmental and natural resource protection issues, should be supported
- Development of criteria and indicators for environmental quality standards and guidelines for the sustainable use and management of natural resources is needed.

6.3 Recommendations to the Plastic Industry:

The following recommendations for preventing and controlling plastic wastes releases are organised according to five general areas: industry management, education and training, equipment and facilities, routine operations, maintenance and housekeeping. This section mostly refer to pellets i.e plastic at production level.

6.3.1 Industry Management

- Good communication is needed between internal industry management and management of related industries which will help to identify and eliminate the plastic waste/pellet release pathways.
- Developing educational materials, advertising in trade journals, conducting presentations at professional meetings, sending mailings, and producing videotapes for distribution throughout the industry are needed to effect desired changes.
- Incorporation of environmental issues within the company/industry policies must be pursued.

6.3.3 Education and Training:

The least expensive and most effective way to control the release of pellets into the environment is through education. Many industry officials believe that pellets releases are primarily a result of improper employees attitudes. This indicates that employee education is critical to the success of any corrective measures:

- Educating the key officials and company managers regarding the fate and effects of plastic pellets and the economic disadvantages of pellet loss is crucial. Some of the company officials are not aware of the environmental impacts of pellets, and educating them would be an effective way to bring this to their awareness. Emphasis on the economic benefits of recovering and recycling lost pellets, and the economic disadvantages of their loss (loss of feedstock, loss of recycling revenues and regulatory penalties) should be addressed.
- Education of company employees is needed regarding the environmental hazards of pellets and employee responsibility to institute corrective measures. If employees feel involved or responsible they may provide simple and useful solutions for eliminating pellet release pathways. This can be accomplished through conducting awareness programs to educate personnel on the need to prevent pellet loss. This could include posting educational material throughout the facilities, particularly in areas where pellets are frequently spilled. Initiating a system of rewards for creative solutions for pellet containment and exemplary performance in preventing pellet loss in environment should also be pursued.

6.3.4 Equipment and Facilities:

Recommendations for controlling pellet releases to the environment by improving existing equipment and facilities:

- A containment system to capture storm- water runoff from pellet- handling facilities should be installed. The design of these systems must take into account worst case storm water conditions.

6.3.5 Routine Operations:

Whenever pellets are handled there is the potential for pellet spillage and implementing a few simple practices would decrease the potential for spillage during routine operations: Proper handling, storage, and disposal of plastic waste and providing incentives to the employees should be emphasised.

6.3.6 Maintenance and Housekeeping

- Improving daily and routine housekeeping and spill response procedures both inside and outside of the industry would be useful. Insisting on prompt spill cleanup and making spill cleanup the responsibility of each employee should be made a priority.

6.4 Ensuring success in waste management:

In order to ensure success in waste management the government should do the following:

- Conduct an initial waste review.
- Assess compliance with formulated legislation e.g. duty of care on the handling, storage and disposal of the waste
- Identify sources of all waste produced
- Recommend methods of measuring waste produced
- Assess costs of current disposal methods including storage and transport
- Consider methods of separating special wastes
- Goals should be set with definite objectives. These goals should be based on the solid waste management hierarchy known as "the five R's": opportunities to reduce, reuse , recycle waste(whenever possible), recover, and residual disposal (e.g landfill)
- Waste minimisation schemes which take into account the environmental impact of different waste streams, legal implications and financial constraints should be considered.
- Set achievable targets for waste reduction and;
- assign and communicate responsibilities; this would include the training of relevant staff as well as providing information about procedures to local government officials, and especially municipal officials.

6.5 Conclusion

The introduction of sythetic materials, " plastic" is one of the most important technological advancements for modern society. The superior qualities of these

materials make them an almost universal substitute for natural materials. However, it is these qualities, light-weight, strength, durability, and low cost, which make plastics so prevalant and potentially damaging in the marine environment. This debris is recognised as chronic pollution[68] because of its significant long-term impact on marine environment. Plastic degrades coastal areas and injures or kills many marine animals, fish and birds (see appendix 4). It also interferes with vessel operations and safety by entangling propulsion and steering system and may damage machinery by blocking sea water intakes. All this tells how bad plastic can be. To address this problem an effective preventive approach is required. The preventive approach can be accomplished by effective legislation and proper waste management.

In concluding, it has to be noted that there are no short cuts in the environmental protection process. The role of the government does not end with the formulation of laws, the main challenge actually, is to implement those laws effectively. It should be borne in mind that, taking a preventive approaches a timely endeavour, can eliminate or at least, minimise, the destruction of the fragile ecosystem. Since the ocean belong all of us; to protect all creatures that dwell therein is everyone's responsibility.

> As Fine writes, "we generally take care of things that belong to us, knowing that if we are careless or reckless or misuse something, it wont last. Well, we should have that same sense of personal responsibility towards the oceans and the creatures that live there."[69]

[68] Sullivan, J.O (1998) Chronic Pollution. Lecture. World Maritime University. Malmö Sweden.
[69] Fine (1987) *Ocean in Peril*. Atheneum New York. p.4

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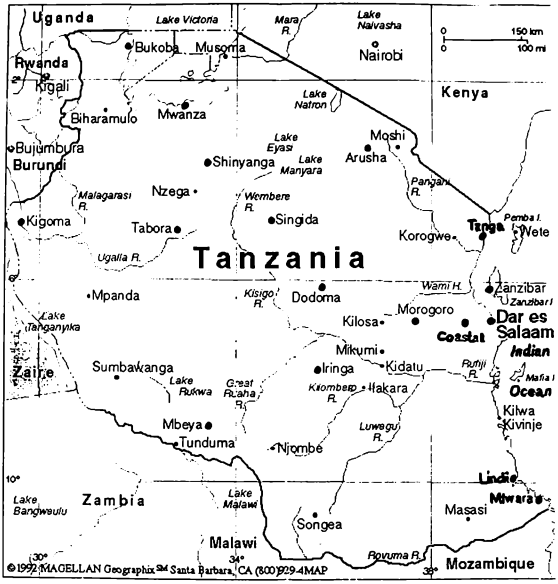
Appendix 1.

Map of Tanzania



KEY:

- Region (Coastal regions: Tanga, Dar Es Salaam, Coastal, Lindi, and Mtwara.
- Small city

Source: Tanzania http://www.pathfinder.com/travel/maps/TANZANF.html

Appendix.2

Destructive Impacts on the Marine Environment of Coastal areas of Tanzania:

IMPACT	Tanga	Dar es Salaam	Lindi	Mtwara
Urban Pollution	x	xxx	xx	-
Industrial Pollution	xx	xxx		
Explosive Fishing	xxx	xxx	xx	xx
Beach seining	x	xx	xx	x
Fishing pressure Heavy Moderate	x	x	x	- x
Mangrove cutting	x	x	xxx	x
Salt works	xx	x	xxx	x
Shell collecting	x	xx	xx	xx
Tourism	LI	xx	-	LI

Key:

LI: Light

X : Medium

XX: Heavy

XXX:: Extensive

Source: UNEP (1989) Coastal and Marine Environmental Problems of the United Republic of Tanzania. UNEP.Level of Pollution in Coastal areas of Tanzania. (Regional Seas Reports and Studies) UNEP NO, 106, 1989.

Appendix.3

PLASTIC WASTE POLLUTES DAR CITY

By Correspondent Zephania Ubwani

At least 35 tonnes of plastic waste is generated each day in Dar Es Salaam city, posing a pollution hazard to the city residents. According to an environmental experts, the plastic waste produced daily constitutes two percent of the 1,772 tonnes of solid waste generated in the city each day. "What is alarming is that at this rate 13,000 tonnes of plastic waste is produced in Dar Es Salaam per annum," said Mr Bernad Bakobi, an expert with the National Environment Management Council (NEMC).

He said as more and more plastic products, notably packages are used by consumers, more and more plastic waste is generated and could reach 10 per cent of all solid waste as is the case in the industrialised countries. The non-biodegradable plastics not only posed pollution hazard but often caused damage to and difficulties in operating municipal waste incinerators, he explained.

A study by the Japanese International Co-operation Agency (JICA) on solid waste management in Dar Es Salaam indicated that less than 13 per cent of solid waste was collected by the city authorities for safe disposal.

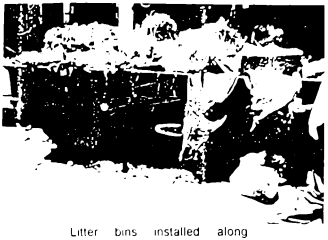
The waste is mostly the hazardous nitrates of domestic origin. Most of the domestic waste which accounts for 60 per cent of all solid wastes generated is disposed of through equally polluting, burning or burying.

Mr Bakobi, who is NEMC's director of research and environmental education, suggested recycling as one of the simplest ways individuals can prevent pollution of such wastes. "This helps to avoid both the pollution associated with the creation of a new product and the pollution caused when the product is thrown out," he said in an interview last week.Recycling was also another way of re-using materials, he said, adding that poor solid waste management in the city has seen recyclable materials like plastics, scrap metals and bottles being thrown away.

source: Ubwani,Z 'Plastic Waste Pollutes Day City' *Daily News*, Monday, 31 August 1998 p. 1 (Front page)

Appendix. 4 Pictures Showing Plastic Garbage and Its Impact on Marine Environment.

A harmless looking plastic ring was enough to trap this seal almost killed it. Photo HELMEPA (1997)

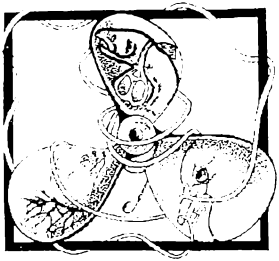


Litter bins installed along Msimbazi Road in Dar Es Salaam: most of this garbage remains uncollected and litter averywhere Photo Author (1998)

Pelican strangled by a piece of monofilament fishing line. Photo HELMEPA (1997)

An all common in Dar Es Salaam Beaches-Garbages are thrown into the sea. In other places however, the rubbish just accumulates.Photo Author (1998).

Discarded plastic in residential areas in Dar Es Salaam. Photo:Author (1998)



Plastic can also endanger human life- here a monofilament fishing line has become wrapped around a propeller causing the engine to break.Photo:NOAA(1998) Marine Entanglement Research Program