NUTRIENTS:
A BACKGROUNDER FOR THE GPA ONLINE DIALOGUE

Throughout the world, excess nutrients from agricultural runoff and municipal or private sewage over fertilize ocean and coastal areas, leading to the creation of numerous 'dead zones' where virtually no life can exist. The number of known 'dead zones' has doubled since 1990 and is increasing as a result of accelerating urbanization and intensified agricultural-related activities. The discharge of nutrients into coastal waters is a major cause of eutrophication, especially in areas of limited water circulation. The main nutrients are nitrogen and phosphorus compounds, they enter coastal waters from point and non-point sources. Eutrophication may cause algal blooms, changes in the aquatic community structure, decreased biological diversity, fish deaths and oxygen depletion events. The presence of nutrients in the water column enhances the growth of plants, and in some cases may cause algae to overgrow the corals or seagrasses that were previously present. Habitat degradation, in turn, causes decreased fisheries production and loss of recreational and tourism potential. Nutrient levels are high over wide parts of the Mediterranean and the North Sea and eutrophication is a particular problem in the Gulf of Lyon and the northern areas of the Adriatic. Eutrophication can result from a number of causes, including: point sources of nutrients in areas with large population density or tourism; sewage; waste from aquaculture production and effluence from ships; and nonpoint sources such as runoff from agricultural areas and urban storm water. The effects of the enhanced mobilization of nutrients are enhanced productivity but these can also result in changes in species diversity, excessive algal growth, a reduction in dissolved oxygen and associated fish kills and, it is suspected, the increased prevalence of toxic algal blooms.

Levels of nutrients in the environment show a substantial regional variation. Biological communities, adapted to available levels, may elicit both negative and positive impacts of nutrient addition. Many of the impacts nutrients have on coastal and marine environments are due to an over-enrichment with nutrients. Riverine fluxes have increased three/fold in some regions, and atmospheric deposition has increased an order of magnitude in many parts of the world. Increased levels of nutrients are favouring opportunistic growth of certain algae and plants, in particular toxic algae blooms such as the *"red tides"* which are caused by enhanced nutrient levels. These may impact on the quality of seafood for human consumption, thus having an enormous economic impact. The decay of the large masses of algae themselves may cause the depletion of oxygen, resulting in the disappearance and mass mortality of many other aquatic species. High nutrient levels also have been associated with the bleaching of corals, also influencing biodiversity.

Addressing the impact of nutrients and sewage on marine environments are two out of the nine pollution source categories identified by the GPA. More generally, the objective of the GPA is to support States in: identifying marine areas where nutrient inputs are causing or are likely to cause pollution; reducing nutrient inputs and the number of marine areas where eutrophication is evident; and protection and restoration areas of natural denitrification. The World Summit on Sustainable Development specifically identified the need to advance the implementation of the GPA in relation to nutrients, particularly during the period 2002-2006. The UNEP/GPA Secretariat has identified the agricultural sector as a key priority for reducing land–based sources of marine pollution. More specifically, the Secretariat has highlighted the need to minimize the release of nutrients by the use of best environmental practice in agriculture and aquaculture operations, as well as the implementation of appropriate agricultural techniques, including balanced fertilization and ecological agriculture, to minimize nutrient losses from agricultural activities.

The 2nd Intergovernmental Review meeting (IGR-2), in Beijing from 16-20 October 2006, will explore the necessity of proposing action at the international, regional and national policy level to address Nutrients, with a particular reference to Nutrients as a pollution source category impacting the coastal zones and the marine environment, and the benefits that can be gained from this action. This background note provides a brief overview of the core nutrient-related issues, and introduces several

questions for discussion on how IGR-2 can strengthen global, regional and national commitment to address the marine pollution as a result of nutrient over treatment.

Agriculture

The agricultural sector is the single largest consumer of ground and surface water and is a major contributor to the enhanced introduction of nutrients, particularly through the application of fertilisers. In areas where agricultural development has been rapid, and in addition, where coastal areas have seen increased population growth, together with changes in adjacent land use, marine and coastal areas have been put under increasing the pressure. On average, more than 90 kilogrammes of fertiliser are used per hectare of cropland per year, although the total amount varies considerably. While fertiliser use has declined in some parts of the developed world, use in the developing world has increased significantly, particularly in Asia. Large amounts of these fertilisers are lost from agricultural systems and enter river or groundwater systems, large amounts then enter coastal waters where eutrophication, such as algal blooms and reduced oxygen levels, often result. Nitrogen fertilisers may also contribute to the increase of nitrogen-compounds in the atmosphere, possibly fuelling eutrophication episodes such as algal blooms even away from coastlines. A major source of nitrogen is the run-off from agricultural practices; these then are transported through rivers or groundwater aquifers, or flow directly into coastal waters. Unsustainable animal farming in coastal areas (husbandry, aquaculture) can add up to a locally significant level. Regionally varying practices can result in a high variance around the globe of nitrogen releases to the seas and ultimately the oceans.

Sewage

Historically, it was commonly believed that the introduction of organic carbons and nutrients to the marine environment via sewage was acceptable as it resulted in increased biological production. Such views clearly did not foresee the growth and concentration of populations in coastal areas, which occurred in the latter half of the 20th Century, with the resultant overloading of coastal waters. Today pollution from domestic sewage is one of the most serious forms of coastal contamination, and affects every region of the world. Another major source of rising nutrient levels mainly at the local or regional level, is the discharge of untreated domestic wastewater, especially near urban agglomerations, but also in attractive tourist regions. This input can add significantly to the total nutrient loads reaching the coastal and marine environment. In Chile for example, it is estimated 82 percent of all domestic sewage finishes up in the sea, transported there by 27 river basins. In the Mediterranean over 50% of wastewater, or over 3.2 billion cubic metres per year, are discharged untreated. Africa's rich coastal and marine areas are also under threat from pollution, an estimated 38 per cent of coastal ecosystems, such as mangrove swamps and coral reefs, are under threat from developments such as ports and the growth of coastal settlements and their sewage discharges. In Lagos one of the largest costal mega-cities in the world, water resources for domestic, industrial and commercial use are becoming scarce as a result of pollution of water bodies by wastewater, which contains heavy metals, bacteria etc. In recent years wastewater has been rediscovered as a resource and many, usually poor, farmers depend on wastewater from urban areas to grow crops and raise fish, hence utilising the dissolved nitrogen and phosphate nutrients. In many developing countries untreated or partially untreated wastewater is also used to irrigate the cities green spaces. Especially with regards to urban and peri-urban agriculture urban wastewater can generate considerable value, despite some health and environmental risk associated with the use of wastewater.

Looking Forward to IGR-2

While the link between sewage and excess nutrients in the coastal and marine environment has been extensively explored, the relationship between agriculture and the marine environment requires further consideration, particularly in regard to the further implementation of the Global Programme of Action.

A number of measures exist to mitigate the impacts of nitrogen including reduction at the source (e.g. reducing fertilizer use in agriculture), re-use of nutrient containing domestic waste and wastewater (e.g. ecological sanitation, which aims at ‘closing the loop’ by re-using the nutrient rich urine and faeces from household sanitation services in agriculture practices), recycling of nutrient containing products (e.g. food recycling, combustion) and restoration of impacted areas. In particular the conservation or rehabilitation of wetland areas may be effective; as these are the natural de-nitrification depositories before nutrient loaded waters reach the coast. In recent years a number of countries have adopted action plans and strategies to regulate the impact of the agricultural sector on the aquatic environment, but the results have been mixed. A new understanding is now emerging of the dynamics of the problem and the kind of approach and control measures that can be effective. In

particular, focussing on an outcome based approach rather than on arbitrary goals of nutrient reduction seems to offer some promise. However, this presents scientific and technological challenges that will not be easy to overcome. Sewage problems occur mainly in developing countries and at present, conventional water supply and sanitation systems are costly. There are, however, an increasing number of alternatives, ranging from technically sophisticated, large-scale, costly systems to simple, small-scale and inexpensive ones. Overall, despite considerable efforts in the area of sewage, control of pollution from sewage continues to be a major problem, particularly in developing countries and is continually getting worse. In developed regions, municipal sources are fairly well managed, but nutrient over-enrichment from agricultural runoff is emerging as a serious problem. It is now clear that, while there has been continuous action to deal with this problem, it is not yet having the desired effect. According to Thomas Goreau, of the Global Coral Reef Alliance, there is enormous resistance to serious efforts to control nutrients and as a result reefs and fisheries are being destroyed, and the establishment of marine protected areas is failing. Goreau argues that the most effective solution is to get rid of the masses of algae that smothering reefs and destroy coastal fisheries habitats by eliminating land-based nutrient sources that feed them.

Nutrient enrichment of water and its environmental consequences has often been seen as a local, sometimes a regional problem. However, the ubiquitous presence and increasing incidences of reported algae blooms, dead zones, etc. make it an issue of global importance. Addressing agricultural policies and associated legislation is the key to many nutrient-related solutions for environmental management. The 2nd Intergovernmental Review Meeting of the GPA (IGR-2), which will take place in Beijing from 16-20 October 2006, will aim to strengthen the implementation of the GPA, including defining the programme of work for the UNEP/GPA Coordination Office for the period 2007-2011. The need to strengthen the institutional capacity to manage problems related to agricultural non-point sources of pollution has long been recognized as a critical factor in sustaining the use of coastal and marine waters in many regions. Similarly it is necessary to control and monitor the sources of nutrient enrichment and to reverse the adverse effects of eutrophication through improving the effectiveness of nutrient reduction in sewage treatment plants and to control the runoff from non-point sources by improving management practices in agriculture. In addition, practices that promote long-term benefits and cause the least damage to interrelated ecosystems should also be encouraged. IGR-2 provides an important opportunity to advance international cooperation on nutrients. The draft guidance document for the implementation of the GPA 2007-2011 identifies the need for international organizations to support State's efforts to address nutrient over-treatment by determining its effect on coastal ecosystems, defining desirable and achievable outcomes for rehabilitation efforts, reducing nutrient sources, enhancing nutrients sinks, strategically targeting those efforts within watersheds, and predicting and observing responses in an adaptive management framework.

Key Questions for Discussion

Given the increasing concern over the continuously rising levels of nutrients and the environmental consequences in coastal waters and the marine environment world wide, participants to the online dialogue may wish to consider the following questions:

- How could the Programme of Work for the GPA be strengthened to address a global policy framework for Nutrients?
- Which global and regional organisations and mechanisms could be strengthened to address the problem of nutrients?
- What types of international cooperation and partnerships could be established to address the problems of nutrients?
- What regional best practice regarding nutrient management, at the policy or project level, can be shared with delegates at IGR-2?

Links

UN Atlas of the Oceans:

Nutrients
http://www.oceansatlas.org/servlet/CDSServlet?status=ND0yNjA3JjY9ZW4mMzM9KiYzNz1rb3M~
Eutrophication
http://www.oceansatlas.org/servlet/CDSServlet?status=ND0xOTE3MiY2PWVuJjMzPSomMzc9a29z
Rural Land Use
http://www.oceansatlas.org/servlet/CDSServlet?status=ND0xOTIyMSY2PWVuJjMzPSomMzc9a29z
Land Use Change
http://www.oceansatlas.org/servlet/CDSServlet?status=ND0xODAwNCY2PWVuJjMzPSomMzc9a29z
Agriculture
http://www.oceansatlas.org/servlet/CDSServlet?status=ND0xOTY3MiY2PWVuJjMzPSomMzc9a29z

UNEP/GPA:

The State of the Marine Environment, Trends and Prospects
http://www.gpa.unep.org/document_lib/en/pdf/global_soe.pdf
Clearing House Nodes – Nutrients
http://www.fao.org/gpa/nutrients/nutintro.htm
Clearing House Nodes – Sewage
http://www.sanicon.net/gpa/index.php3
Demonstration action of the Strategic Action Plan on Municipal Wastewater
http://www.gpa.unep.org/bin/php/programs/sap/regional/index.php

Food and Agricultural; Organisation – United Nations:

Water Resources, Development and Management Service
http://www.fao.org/landandwater/aglw/index.stm
Control of Water Pollution from Agriculture
http://www.fao.org/docrep/W2598E/W2598E00.htm#Contents

New Agriculturist:

Wastewater, a resource for agriculture?
http://www.new-agri.co.uk/04-5/focuson/focuson3.html