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WASTEWATER POLLUTION ON CORAL REEFS

Science-to-Policy Brief on Managing Wastewater to Support Coral Reef Health and Resilience

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Science-to-Policy Brief on Managing Wastewater
to Support Coral Reef Health and Resilience

Healthy coral reef in Misool, Raja Ampat, Indonesia.

About

The overall purpose of this brief is to provide policy and management recommendations for addressing and reducing the impacts of wastewater on coral reefs, based on current scientific knowledge. In doing so, the brief will contribute to achieving the related global, national and regional goals and targets, including the Sustainable Development Goals (SDGs).

The brief promotes integrated planning and management, awareness-raising, capacity-building and other efforts to improve monitoring of wastewater loading and its impacts, among key stakeholder groups.

It is primarily aimed at national and state policymakers. The supporting scientific basis (available as a White Paper) provides further rationale for recommendations and more detailed information for government officials with technical roles, as well as regional environmental organizations and conservation organizations.

Acknowledgements

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Local fishermen in Papua New Guinea.

For years, oceans have been used as dumping grounds for many types of waste, including sewage, industrial waste, chemicals and litter. More than 80 percent of marine pollution originates from land-based wastewater and sediment and nutrients delivered via waterways. In South-East Asia alone, 600,000 tonnes of nitrogen are discharged from major rivers into the ocean each year, and it is expected that by 2030, these nitrogen inputs will increase globally by at least 14 percent. More recently, policy changes in many countries have reflected the opinion that oceans do not have an infinite capacity to absorb society's waste. However, marine pollution remains a major problem that threatens marine life, and consequently, the provision of marine ecosystem services.

Sources of land- and marine-based pollution in coastal ecosystems are wide-ranging. The focus of this science-to-policy brief is on wastewater pollution impacting coral reefs, including from point sources (single identifiable sources) that discharge directly into coral reef environments, and indirect or diffuse sources such as urban, rural and industrial activities on land that discharge into the ocean via waterways. Accidental pollution, such as oil or chemical spills, is not considered here.

More than **80%** of marine pollution originates from land-based wastewater and sediment and nutrients delivered via waterways.

Sediment dredged from a waterway is dumped into the ocean in Florida, United States. Most of the sediment goes right out into the water, resulting in a turbidity plume that may harm coral reefs.

A GLOBAL PRIORITY

The Manila Declaration[1] adopted in 2012 identifies wastewater as a priority source category of land-based pollution in the marine environment. As such, governments have stressed the need to significantly reduce water pollution and improve water quality and wastewater treatment.

Coral reefs are vulnerable to wastewater pollution, which consequently threatens the health and well-being of hundreds of millions of people who depend on coral reef ecosystem services for nutrition, livelihoods and a safe living environment. However, awareness and data on how wastewater pollution impacts coral reefs remain limited in most reef regions. Many countries, including several Small Island Developing States (SIDS), did not achieve the 2015 sanitation target of the Millennium Development Goals.[2]

The 2030 Agenda for Sustainable Development now provides a holistic and comprehensive framework through which wastewater and its impacts on coral reefs can be addressed. SDG 14 – *Conserve and sustainably use the oceans, seas and marine resources for sustainable development* – is directly relevant to coral reefs; target 14.1 specifically addresses marine pollution and targets 6.3 and 11.6 specifically address wastewater:

Target 6.3: By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.

Target 11.6: By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.

Target 14.1: By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution.

With the 2030 Agenda in mind, in 2016 the UN Environment Assembly adopted Resolution 2/12 on sustainable coral reefs management, which encourages governments to formulate, adopt and implement integrated, ecosystem-based and comprehensive approaches to managing coral reefs sustainably. The resolution calls on countries to undertake the priority actions to achieve Aichi Target 10 in COP 12 Decision XII/23, one of which is: implementation of watershed management policies that include reforestation; erosion control; runoff reduction; sustainable agriculture and mining; reduction of pesticides, herbicides, fertilizer, chemicals, hormones and other agrochemical use; and wastewater management and treatment.

Coral reefs are vulnerable to wastewater pollution, which consequently **threatens the health and well-being of hundreds of millions of people** who depend on coral reef ecosystem services for nutrition, livelihoods and a safe living environment.

1. http://bit.ly/ManilaDeclaration

2. http://www.un.org/millenniumgoals/

Small-scale fishermen in Indonesia.

WASTEWATER IMPACTS ON CORAL REEFS

Many wastewater pollutants, including agricultural fertilizers, pesticides and organochlorine compounds, domestic and municipal waste, trace metals and petroleum products are known to have adverse effects on coral reefs, even in small volumes. Understanding their impact is therefore important for informing policy and management.

Agricultural run-off threatens approximately 25 percent of the global reef area, with further increases projected by 2035. Rangeland grazing and logging (extensive clearing) are the main contributors of sediment load, whereas intensive cropping (e.g. sugar cane) and horticulture are the main contributors of nutrients and herbicides. Most of these pollutants are delivered through waterways during high-flow periods, and flood plumes often carry elevated concentrations of several pollutants, simultaneously exposing near-shore reef systems to toxic combinations of chemical stressors. Livestock operations can also constitute significant point sources of agricultural wastewater pollution.

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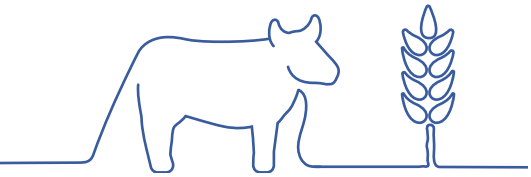
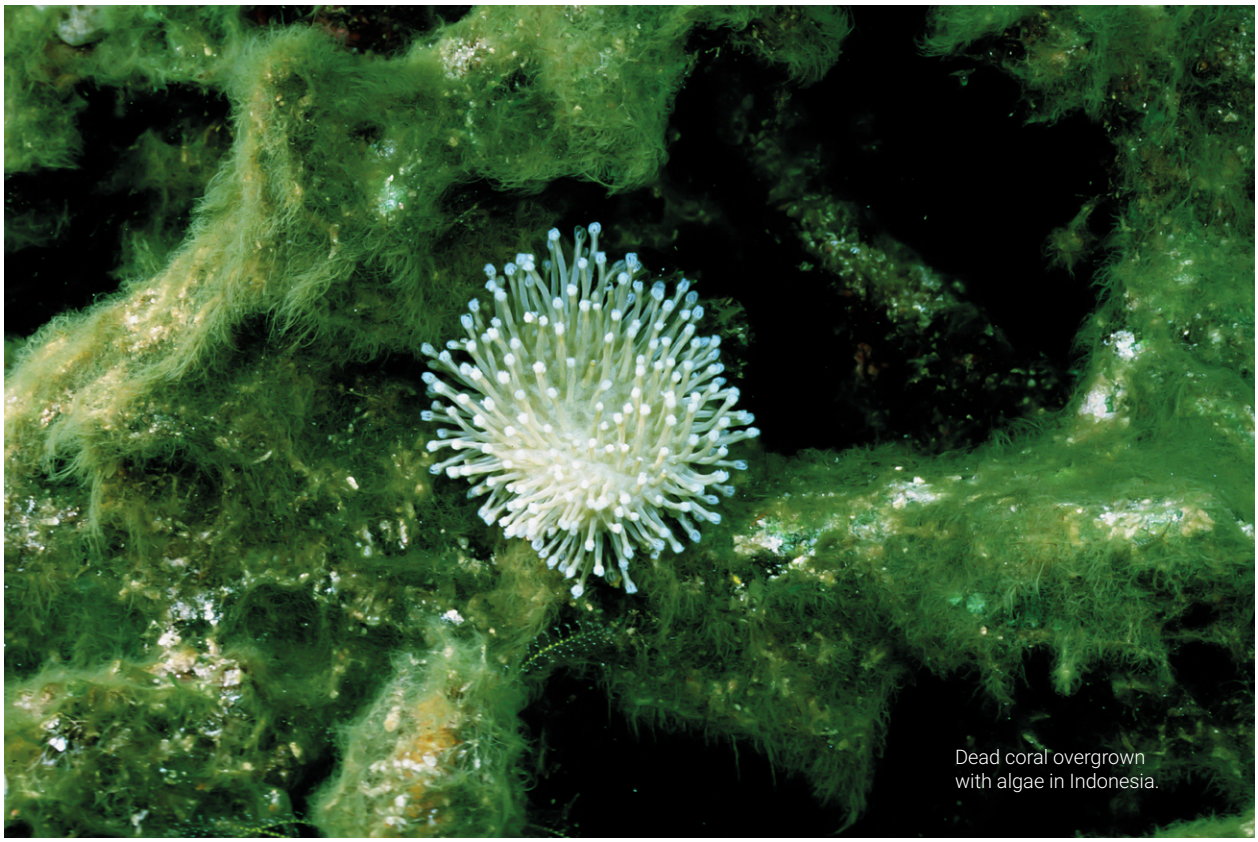


Rising sediment and nutrient loads have been linked to declines in coral cover in reef systems around the world. The release of excess nutrients into coastal waters causes eutrophication, resulting in macroalgal proliferation, algal blooms and the creation of hypoxic 'dead zones', which can kill large numbers of organisms, such as fish. Furthermore, sediment input stresses coral reefs by reducing light penetration in water and smothering reef organisms.

Most petroleum hydrocarbon pollution (including biologically highly toxic and persistent polycyclic aromatic hydrocarbons) in the near-shore marine environment is delivered by heavy manufacturing, ports and shipping, primarily through operational losses, but also in the event of accidents.



Dead coral overgrown with algae in Indonesia.

Before and after image of coral bleaching (left) and later dying (right) at Lizard Island, Australia, taken in 2016. Coral exposed to the impacts of waste dumped into the sea is less able to survive a coral bleaching event.

CUMULATIVE PRESSURES: WASTEWATER, CLIMATE CHANGE AND OCEAN ACIDIFICATION

Coral reefs are increasingly threatened by multiple stresses, including wastewater, climate change and ocean acidification. The cumulative impacts of extreme events caused by climate change, such as coral bleaching, floods and tropical cyclones, and the chronic impacts of poor water quality, are major drivers of reef degradation.

For example, coral exposed to excess nutrients, turbidity, sedimentation, pathogens or chemical pollutants is more susceptible to thermal stress and less able to survive a coral bleaching event. Furthermore, chronic wastewater stress prevents reef communities from recovering after a bleaching event. The interaction of ocean acidification and localized, high-nutrient loading also accelerates coral reef loss.

Minimizing the land-based pollution reaching coral reefs is a critical resilience strategy in the face of global climate change and is amenable to policy decisions and management actions at the local and national level.

Minimizing the land-based pollution reaching coral reefs is a **critical resilience strategy** in the face of global climate change.

KEY MESSAGES

- Coral reefs are socially and economically important ecosystems that hundreds of millions of people worldwide depend on for food security, livelihoods and shoreline protection.

- Wastewater contains a range of pollutants that harm coral reefs, including sediment, nutrients, pesticides, trace metals, hydrocarbons, organochlorines and various emerging pollutants, such as pharmaceuticals and microplastics.

- Sources of wastewater pollution on coral reefs include urban areas and other coastal development, e.g. tourism and industry, as well as animal husbandry, agriculture and logging.

- Nutrients and sediment can have very significant and widespread negative impacts on coral reefs; other pollutants may be significant on a localized scale.

- Wastewater pollution reduces the climate change resilience of coral reefs and makes them more sensitive to ocean warming and acidification.

- In general, point-source sewage and industrial discharges are easier to manage than indirect and diffuse wastewater streams, as there are technologies that can be applied at the source (such as sewage treatment and on-site treatment technologies).

- Indirect and diffuse wastewater pollution requires broader, often cross-sectoral policy and management responses, spanning catchment as well as reef.

- Major obstacles to managing wastewater discharges into coral reef environments include:

    - poor enforcement of existing legislation and, in some instances, a lack of appropriate legislation or water quality standards;

    - limited funding for installing or upgrading wastewater treatment systems;

    - some remaining technological barriers, e.g. in relation to low-cost, small-footprint treatment systems; and

    - poor monitoring of the effectiveness of treatment and other wastewater reduction measures, including their suitability from a marine-ecological perspective.

- A root cause of wastewater pollution is the limited understanding of its environmental significance, among both the general public and decision makers.

- Monitoring is important for determining key sources of pollution and targeted management. It requires consideration of sources and loading, as well as impacts on the coral reef ecosystem and the people dependent on it, and economic sectors.

Coral reef in Keruo, Raja Ampat, Indonesia. Dive into the scenery with Google Street View.

POLICY AND MANAGEMENT RECOMMENDATIONS

Wastewater pollution on coral reefs is a major cause for concern. It must be addressed through an ecosystem-based, source-to-sea approach, covering catchments and urban areas as well as marine areas. It requires a range of regulatory and voluntary efforts across public and private sectors and within communities. Key recommendations in this regard include the following:

Raise awareness among key stakeholder groups

1. Raise awareness among key stakeholder groups on the negative environmental, social and economic impacts of wastewater pollution on coral reefs, the opportunities for using wastewater as a resource and other approaches for reducing wastewater pollution. These groups include all levels of government, companies in sectors that generate wastewater or that are vulnerable to its impacts on coral reefs and the general public.

Establish and adopt ecosystem-based regulations and standards

2. Prioritize prevention of wastewater pollution through zero-discharge policies, where possible, and by promoting recycling and reuse of wastewater.

3. Adopt discharge and ambient water quality standards and management guidelines, taking into consideration the sensitivity of coral reefs, e.g. by drawing on standards specific to coral reefs, such as the Great Barrier Reef water quality guidelines[3] and the Association of Southeast Asian Nations (ASEAN) marine water quality guidelines.[4]

4. Establish or update sectoral regulations to reduce and safely manage wastewater discharges and minimize storm-water discharge (including from urban and coastal areas, agriculture, industry and forestry), in order to minimize the volume of key pollutants such as sediment, nutrients, hydrocarbons, trace metals, chemicals, hormones and pesticides entering the marine environment, e.g. by drawing on UN Environment's *Good Practices for Regulating Wastewater Treatment: Legislation, Policies and Standards.*[5]

3. http://www.gbrmpa.gov.au/managing-the-reef/how-the-reefs-managed/water-quality--in-the-great-barrier-reef/water-quality-guidelines-for-the-great-barrier-reef

4. http://environment.asean.org/wp-content/uploads/2015/07/ASEAN-MarineWaterQualityManagementGuidelinesandMonitoringManual.pdf

5. https://sustainabledevelopment.un.org/partnership/?p=7426

5. Promote the land disposal of secondary treated effluent (which has been shown to attain the same 'treatment level' as tertiary treatment systems, while nourishing the soil). If reuse of sewage effluent is not possible, incentivize the establishment of tertiary sewage treatment. Where this is financially or practically unfeasible, ensure that secondary treated effluent is discharged offshore and in deep water, so as not to harm coral reefs, coastal ecosystems and people.

6. Ensure transboundary cooperation in addressing wastewater, including regional agreements and targets, and common or harmonized national policies, e.g. using Regional Seas mechanisms.

Use a combination of public, private and community models for wastewater management

7. Support the creation and voluntary adoption of sectoral codes of practice, such as zero-discharge policies or standards for wastewater reduction, treatment and monitoring that also consider coral reef vulnerability to wastewater pollution.

8. Enable construction and operation of wastewater treatment infrastructure through public–private partnerships and support the development of wastewater treatment services based on cooperatives, e.g. where human settlement is dispersed.

9. Establish nutrient-use efficiency targets for the agricultural sector (as described by the Global Partnership on Nutrient Management),[6] taking into consideration downstream impacts on coral reefs, and incentivize efforts to achieve these.

Use ecosystem management approaches to moderate wastewater impacts on coral reefs

10. Pursue landscape restoration in reef catchments, such as restoring floodplains, reforestation or afforestation, through spatially extensive and long-term efforts.

11. Plan and implement coral reef management using resilience principles. Prioritize wastewater reduction and management in the catchments of reefs that are relative climate change refugia.[7] Use resilience assessments to strategically define reef management interventions through marine spatial planning and land-use planning processes.

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6. https://sustainabledevelopment.un.org/partnership/?p=7426

7. https://environmentlive.unep.org/theme/index/19

Ensure policy and management decision-making is supported by sound data

12. Use risk assessments and cost–benefit analyses that also consider the downstream impacts of wastewater pollution on coral reefs when developing policy and management interventions. Periodically evaluate the impacts of measures taken to support an adaptive approach.

13. Establish monitoring of wastewater loading and the impacts on coral reefs to inform policy and management decisions, and to help evaluate policy and management responses. Since coral reefs are under pressure from many different stresses, it is important to prioritize monitoring of the pollutant source, along with the state of the coral reef ecosystem. Where possible, it is strongly encouraged to combine monitoring with modelling of the delivery of pollutants and of specific bioindicators.

14. Ensure monitoring and reporting on nationally and internationally established targets, including reporting on wastewater pollution on coral reefs and efforts to address this under SDG 6.3 and 11.6, as well as SDG 14.1.

Preventing wastewater pollution on coral reefs requires a range of **regulatory and voluntary efforts** across public and private sectors and within communities.

River plume in Palau. Rising sediment and nutrient loads have been linked to declines in coral cover in reef systems around the world.

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