The coastal environment

Agricultural pollution

Assessing its impact on coastal resources in the Caribbean

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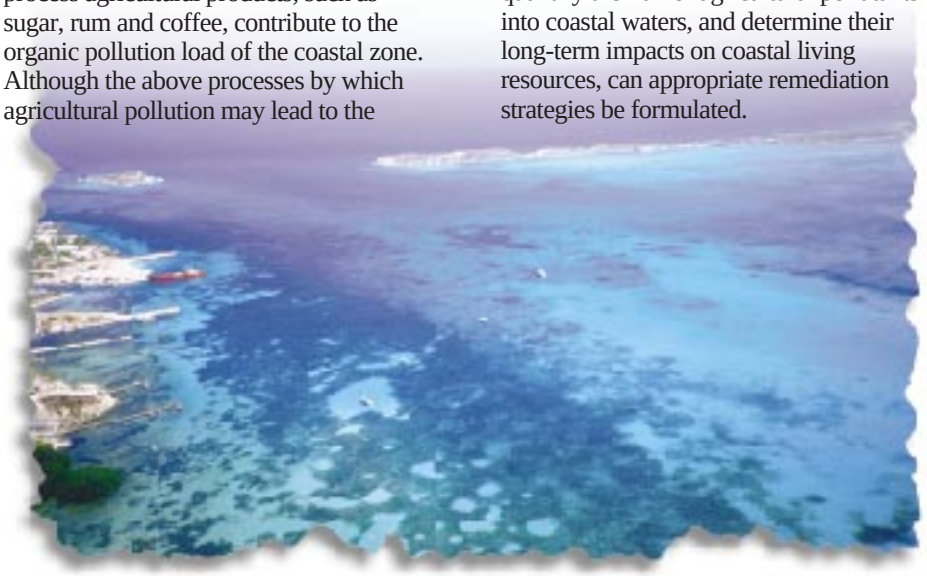
Agriculture is central to the economy of the Caribbean, being the largest employer in many small island states. Several recent studies in the Caribbean have attributed the degradation of coastal living resources (such as fish and coral reefs) to the effects of agricultural pollution. The Living Planet Report, published in October 1998 by the World Wide Fund for Nature, showed that worldwide between 20 and 40 per cent of marine resources, measured using a Marine Ecosystems Index, had been destroyed since 1970. The principal causes of this destruction are the result of human activity. A report published by the United Nations Environment Programme in 1994 stated that land-based sources were the single most important impediment to the use and sustainable development of the coastal zone and its resources in the Caribbean. There is very little data on the concentration of agricultural pollutants, such as nutrients and pesticides, in fresh and nearshore coastal water. However, the increased use of agrochemicals, particularly to boost the yield of export crops, has been recognised as a growing source of aquatic pollution.

With funding from the UK DFID (Department for International Development) Land Water Interface Programme, a group of scientists from the BGS undertook a review of information on the pollution of coastal waters by sediments and agrochemicals around small island states of the Caribbean. On the basis of this review, a field study may be funded to investigate the impacts of such pollution on coastal living resources.

There are four ways in which agricultural practices can lead to the degradation of coastal living resources, particularly through their impacts on coral reefs. Poor farming practices on steep slopes result in high rates of soil erosion, especially in tropical environments with very intense rainfall events, leading to siltation which has deleterious impacts on coral reefs. Fertilisers applied to crops increase nutrient (nitrogen and phosphorus) loads delivered by surface runoff and groundwater flow to nearshore coastal waters. The marine environment in which coral ecosystems flourish are nutrient-poor; algae which are part of this ecosystem become increasingly dominant in nutrient-rich water, which can lead to a loss in coral cover and reduction in ecosystem biodiversity. Pesticides applied to agricultural crops have direct toxic effects on coastal and marine biota. Finally, industries which process agricultural products, such as sugar, rum and coffee, contribute to the organic pollution load of the coastal zone. Although the above processes by which agricultural pollution may lead to the destruction of marine resources have been documented, few studies have made a direct link between cause (a pollutant) and effect (reduced fish catches or loss in species diversity).

The coasts of the Caribbean vary in their geology, hydrogeology, geomorphology, climate and oceanography. Each of these factors has an important bearing on the retentive capacity of the coastal zone and the vulnerability of coastal living resources to land-based sources of pollution. On volcanic islands with non-transmissive rocks (such as St. Lucia) discharge is confined to surface streams and rivers. Conversely, on islands with extensive limestone outcrops (such as western Barbados), much is derived from dispersed groundwater issues. Coastal geomorphology controls the retentive capacity of the coastal zone as well as determining the distribution of coastal habitats. Sheltered intertidal shores and creeks, including those with mangroves, favour the accumulation of sediments and provide sinks for phosphorus and pesticides which are strongly bound to organic matter and clays.

To date, budgets for storage and transfer of phosphorus from their source in agricultural areas, through transport via streams and semi-estuarine pools, to sinks in mangroves or marine sediments, have not been quantified. Likewise, no data are available concerning the transport and fate of pesticides from sources to sinks in the coastal zone, although this is considered to be strongly linked to the fate of organic matter and suspended sediments. Only by conducting integrated studies which quantify the flux of agricultural pollutants into coastal waters, and determine their long-term impacts on coastal living resources, can appropriate remediation strategies be formulated.



Coastal zone, Turks and Caicos Islands, Caribbean. Photo courtesy of Peter Mumby.