

Monitoring Requirements

A review of literature suggests there are no clear-cut phases or stages associated with monitoring of environmental stress. Nevertheless, information requirements for that process may be extensive and demanding. Monitoring environmental stress means in practice monitoring each medium of the environment for the presence of principal threats inherent to that medium and for effects of these threats on that medium in terms of extent, severity and dynamics of progression. Additional data may be needed to support analyses and assessments of particularly severe instances of environmental degradation, the "hotspots" of environmental stress, and also to establish legal liability in case of man-made pollution. Specific user requirements may be as follows.

Air

Concern here is with gaseous emissions, as a source of environmental stress, and the levels of air (and environmental) pollution, as the effect. Emissions of particular concern are: 1) dioxins and heavy metals output from industrial smelters and waste incinerators; 2) smoke and aerosol output from forest fires and volcanic eruptions; 3) GHG output from industrial plants and transportation; 4) ozone output from transportation and industry and its deposition in the troposphere, and 5) acidifying substances (mainly sulphur dioxide and nitrogen oxide) output from the burning of fossil fuels. The EO technology has a role to play at least in three areas: 1) detection and identification of emitters and toxic air pollutants³⁵, especially in urban areas; 2) supply of maps of atmospheric load of particulate matter, especially over urban areas, and; 3) assessment of environmental degradation and of its impact on trans-boundary and regional security. The relevant parameters where EO data is required are: regional and trans-continental transport paths and loads; particle characterization, and; spatial distribution and local concentration by volume.

Water

The total freshwater resource of a country is the water held in dynamic storage in rivers, lakes, reservoirs and aquifers. It includes water flowing into these states from neighboring countries. Trans-boundary flows make a significant contribution to the total freshwater resources of many states. Increasing population, industrialization, the intensification of agriculture (irrigation, land reclamation), impoundment (building reservoirs, dams), not to mention over-exploitation and pollution, have all significantly increased pressure on inland waters worldwide and more conflicts are developing between various users and uses. Tensions arise especially where resources are limited.³⁶ Droughts add to the problem. The role for EO technology is basically two-fold: monitoring of water use patterns by multiple parties and providing assessments of impacts of shortages/scarcity on security. The EO data needed includes the following parameters: 1) total availability volume and recharge rates; 2) levels of abstraction surface and ground water; 3) surrounding land use, especially percentage of irrigated lands; 4) surface water quality and levels of pollution (water color, films), and; 5) flow regulation works and impoundment works affecting trans-boundary flows.

Soils

Soil is necessary for the growth of crops of food, fiber and timber, and it is an essential component of all terrestrial ecosystems. Degraded soils are no longer capable of supporting cultivation, resulting in land abandonment and migration. Soil loss is thus not only a direct threat to sustainable development but it has wider strategic implications for food security and trans-border refugee movements. Today soils are subject to increasing pressures worldwide. Among the most severe soil degradation threats are: 1) erosion, both by water and wind;³⁷ 2) pollution by heavy metals, pesticides and other organic contaminants, nitrates and phosphates, and artificial radionuclides; 3) desertification and deforestation. Other important threats

³⁵ Not only trace gases but also aerosols and volatile organic compounds.

³⁶ See, for example, "Pakistan-India Water Talks Fail to Resolve Kashmir Dam Row." An *AFP News Service Story* (February 7, 2003), pp. 1-3, and, "Conflict Looms Over India's Colossal River Plan." A *New Scientist News Service Story* (February 27, 2003), pp. 1-3.

³⁷ This is a major and accelerating cause of soil loss today. Reduction in vegetative cover through inappropriate farming practices, unsustainable forestry, fires and overgrazing have all significantly contributed to this end as has inappropriate water management practices.