WATERSHEDS

DEFINITION OF WATERSHEDS
A watershed, or catchment, is an area that drains to a common point. More specifically, it supplies water by surface or sub-surface flow to a given drainage system or body of water, be it a stream, river, wetland or sea. Each river has its own watershed. Topography is the key element affecting watersheds. The boundary of a watershed is defined by the highest elevations surrounding the river.

WATERSHEDS AS MANAGEMENT AREAS
Watersheds are being considered as a unit of management for many natural resource-related issues including land degradation, water conservation, non-point source pollution, etc. In most instances watershed boundaries do not correspond to administrative boundaries (a notable exception in Jamaica is the parish of Portland where the parish development areas correspond to the watershed management units and Port Antonio urban area). Jamaica has 26 Watershed Management Units (see figure below)
BACKGROUND TO WATERSHED MANAGEMENT IN JAMAICA

Jamaica has been aware of the status of watersheds and the lands in the uphill regions and mountains of the island from as early as the late 1800’s. At that time, it was recommended that forest reserves be created, to protect the catchments of the island’s watersheds. The particular features of Jamaica that necessitate due diligence in the protection of watersheds include the country’s position within an area of earthquake susceptibility and hurricane tracks. The land mass is characterised by steep slopes as more than 50% of the island is over 1600 m above sea level with slopes in excess of 20°. The situation is further exacerbated by susceptible soils and high intensity rainfall events. A large population of small farmers and other persons using natural resources on the upper slopes exert further pressure on an inherently fragile system.

With this background the need for soil conservation has been recognised since the early 1930’s. The 1973 estimate by Sheng of 186 000 small farmers on these marginal areas brought the magnitude of the problem into very sharp focus.

Several initiatives and legislative acts have been implemented over the years to address problems in watersheds that were deemed critical. These include the Christiana and Yallahs Valley Land Authorities of 1951-1961 established under the Land Authorities Law number 25, The Watershed Protection Act of 1963, the Farm Development Scheme, the Integrated Rural Development Project between 1978-1983 and the Hillside Agriculture Development Project of 1987-1997. The projects addressed various components of the watershed problem related to agriculture such as: soil erosion, planting material, deforestation, and soil conservation.

THE ECOSYSTEM APPROACH TO WATERSHEDS

The ecosystem approach views watershed management as the management of a complex ecosystem and that all its components – air, land, water, flora, fauna and humans are interrelated. Key features of the approach are:

- Any of the components of the ecosystem can be understood only in the broader context of the other components.
- An understanding of the ecosystem is best achieved by focusing on the processes and functions within the system, including the ecological, economic and social ones.
- Humans are part of ecosystems and human use of resources, rather than human exclusion, must be factored into management systems.

THE VALUE OF WATERSHEDS AS ECOSYSTEMS

Upstream and downstream areas within watersheds are linked through hydrology. Because water flows downhill, land use in different parts of a watershed are interdependent. For example, water use; patterns of vegetative cover, and soil erosion upstream all have impacts on water availability downstream. These impacts - the extent to which they are harmful or helpful - are highly location-specific.

Clean water, trees and open space contribute to quality of life. Healthy watersheds mean better water quality and quantity downstream. Healthy watersheds provide habitat for the spectrum of biodiversity in any given area.
Healthy watersheds provide flood protection functions. Forests and farmlands help to maintain the natural hydrology and sustain the rural character of the land. In a forest, rain soaks into the ground where it is either taken up by tree roots or continues to move down through the soil and into the groundwater. Impervious cover is any surface in an urban watershed that does not allow water to soak into the ground. Forms of impervious cover include roads, parking lots, buildings, sidewalks, and driveways. When rain falls on impervious cover, rain cannot soak into the ground and becomes storm water. Impervious cover produces 16 times more storm water runoff than forest. If it were to rain 2 inches on a parking lot, 1.9 inches would become storm water runoff. In a forest, only 0.12 inches would become storm water runoff with the remainder soaking into the ground. This reinforces the fact that very often flood events are more devastating in urban river systems.

The converse happens in periods of low rainfall. In areas where impervious cover prevents water from replenishing groundwater supplies, stream flow is low during dry periods. This is because streams often draw from the groundwater supply, but if the supply is diminished, there is less water to fill the stream channel.

**ECONOMIC CONSIDERATIONS**
Spatial interlinkages mediated by the flow of water lead to externalities. An externality is the effect of one party’s actions that impose a cost or benefit on another party, without that cost or benefit being accounted for in the market. Watershed externalities arise because different people own and use different areas within a watershed. In other words, the upstream-downstream hydrological relationships that exist within a watershed boundary cross property and administrative boundaries, often with no regulations or institutions governing the rights and obligations of different stakeholders. (see diagram below)
PROBLEMS IN URBAN WATERSHEDS
Impervious surfaces also influence water quality as they collect many harmful pollutants. When it rains, these pollutants are washed away with the storm water runoff and directed into gullies and rivers through the storm drain system.

Soil erosion leads to siltation of rivers which can reduce the capacity of reservoirs and dams and lead to increased utility bills. Urban sprawl due to development causes decreasing acreage of agricultural land.

Improper disposal of solid waste causes numerous problems such as blocked drains, gullies and rivers. This garbage is often seen on beaches or being transported by currents across coastal waters.

Illicit discharges are illegal discharges of pollutants into storm drainage systems and streams. These discharges may be either industrial or domestic in source. Septic systems have the potential to pollute groundwater and rivers if they are located improperly or if they fail. Even properly functioning septic systems can be a substantial source of nutrient loads in some settings. Bacteria from septic systems can threaten our water supply or close beaches and shellfish beds. Nutrients can cause algal blooms. Pesticides, oil and grease can be harmful or deadly to aquatic life. Muddy water can block sunlight from reaching plants, clog waterways, and physically harm animals. Heavy metals, such as zinc, copper, and lead, can be toxic to organisms. Some heavy metals accumulate in organisms, causing them to be unsafe for human consumption.

THE INTEGRATED APPROACH TO WATERSHEDS
The integrated approach to watersheds simultaneously considers all elements of the natural and socio-economic systems. That is, drainage basins, surface water, groundwater, upstream and downstream activities, land use and land practices, economic activity and social development; governance and institutional capacity. The College of Engineers of Peru define watershed management in this context as ‘the application of principles and methods for the rational and integrated use of the natural resources of the watershed – essentially water, soil vegetation and wildlife – aimed at achieving optimal and sustained production of those resources with minimum damage to the environment for the benefit of the inhabitants of the watershed and the communities linked to it’.

Watershed management is simultaneously a technical and social undertaking. From a technical perspective, it involves reducing soil erosion, promoting vegetative cover, and harnessing rainwater resources. From a socio-economic perspective, it involves coordinating the actions of numerous land users in a watershed who may have multiple, conflicting objectives. In the 1980s watershed management was treated largely as a technical problem, but lack of attention to socio-economic complications undermined numerous projects because people refused to go along with technical plans that conflicted with their diverse interests. Today, watershed professionals pay more attention to the socio-economic aspects of watershed management.

MITIGATIVE MEASURES TO ADDRESS WATERSHED PROBLEMS
Watershed Planning
Watershed planning is a cost effective way of minimizing the effects of floods, it helps to protect public infrastructure such as bridges, utilities and roads. Planning also prescribes
zones for various categories of activities and recommends best practices for the conducting of these activities. Thus in planning the idea is not to conserve all areas adjacent to or near rivers, but to keep facilities that may pose threats as water pollution hazards include landfills, sewage treatment plants, and hazardous waste generators a designated distance away from streams, rivers, and other water bodies to avoid contamination. Land, water and natural vegetation may have multiple, conflicting uses and reconciling them can be extremely challenging.

**Land Conservation**
Land conservation efforts protect critical lands in the watershed based on their ability to protect habitat and water quality. Technologies to support soil and land conservation must be actively pursued and supported.

**Public Education**
Public education and awareness programmes increase public understanding and awareness about watersheds, promote better stewardship of private lands, and develop funding to sustain watershed management efforts.

**Local Governance**
In recent years, developing countries throughout the world have embarked on campaigns of decentralization of governance over natural resources to local communities. The rationale for decentralization is that local communities that critically depend on natural resources can best choose what is in their best interests and to regulate control over them. This viewpoint stems in large part from the continuing degradation of natural resources under state control, and the growing theoretical and empirical literature that illustrates the capacity of non-private and non-state groups to manage common pool resources effectively.

Participatory watershed management is one embodiment of this decentralization process. One of the advantages of the watershed approach is its capacity to integrate different kinds of natural resources at a landscape and community level.

Managing watershed externalities requires cooperation among the various stakeholders and therefore the need to develop mechanisms to promote collective action. Arrangements for such cooperation already exist in Jamaica in the form of Local Watershed and Forestry Management Committees or Water Users Associations. These local level organizations need to be supported and strengthened. In other locations, new mechanisms may need to be developed, ideally by building on existing institutional arrangements (social norms and laws), to develop systems of sharing the responsibilities and benefits associated with watershed management.

**Land Tenure**
The most critical laws, policies and customs with respect to watershed management are the tenurial rights over land, water and other natural resources. Land tenure, the formal and informal systems of property rights over land, is an important variable affecting watershed management practices. Certainty of tenure and unambiguous rights provide incentives for stakeholders, especially farmers, to invest in improving the management of land and water in a watershed. When land tenure is insecure, on the other hand, incentives to manage natural resources are diminished.
REFERENCES


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