RIVER BASIN BASICS

Watershed

Buba River, Guinea-Bissau

Land and water are ecologically linked in a natural system called a catchment, drainage basin, or watershed. From the smallest droplet to the mightiest river, water works to shape the land, taking with it sediment and dissolved materials that drain to watercourses and, in most cases, eventually to the sea. So, too, is the river a product of the land it inhabits – the type of rock and soil, the shape of the land, the amount of rainfall and type of vegetation are some of the factors that determine the river's shape, size and flow.

We all belong to a watershed (literally, an area of land that catches all the rain and directs it to a stream, river or lake). A watershed also includes all the humans, plants and animals who live in it, and all the things we have added to it such as buildings and roads. Everything we do affects our watershed – from washing clothes and growing food to mining, commercial farming, and building roads or dams. The reverse is also true: our watershed affects everything we do, by determining what kinds of plants we can grow, the number and kinds of animals that live there, and how many people and livestock can be sustainably supported by the land.

One important truth about watersheds is that we all live downstream from someone, and upstream from someone else. Anything dumped on the ground in the watershed can end up in its rivers, lakes or wetlands. And anything released to the air can come down again, nearby or thousands of miles away. A watershed's water may be made undrinkable by activities many kilometres away. To understand the water quality of a stream, one must look at the entire area it drains.

We are all connected through watersheds. Watersheds do not respect political boundaries, and in fact can encompass several cultural, national and economic boundaries. What

happens in one country’s part of the watershed will impact water quality, quantity, or people who depend on it in the countries downstream.

A watershed is a web of life. The life it supports is interconnected, meaning every creature and plant depends on other creatures and plants in the watershed for sustenance. If the whole watershed is like our bodies, then rivers are like our veins – coursing with life and crucial to sustaining it.

Physical Features

Because water runs downhill, a watershed usually starts at the top of a hill, mountain or ridge.Most of a watershed consists of slopes and the river valley. Water eventually makes its way to a major stream or river, and eventually it joins that of other watersheds and makes its way to seas and oceans. It may also spend some time underground along the way.

Slopes influence a watershed’s drainage pattern. Very steep slopes make it difficult for rainwater to seep into the ground. This causes water to run off and increases erosion. Plant cover is more difficult to establish and infiltration of surface water is reduced on steep slopes.

A watershed's floodplain is the flat area that starts at river's edge and continues to the beginning of surrounding highlands. Floodplains are a particularly rich zone for biodiversity and agricultural soils. In many parts of the world, annual flooding of the floodplain is welcomed, as it renews the soil's fertility for farming. Damming has been especially harmful to floodplains.

The watershed’s exposure to the sun affects temperature, evaporation, and transpiration (water used by plants) – which in turn affect how we use the land and what will grow there. Soil moisture is more rapidly lost by evaporation and transpiration on steep slopes facing the sun. Slopes exposed to the sun usually support different plants than those facing away from the sun. Orientation with regard to the prevailing winds has similar effects.

Watersheds come in all sizes, and large ones contain many smaller ones. A typical watershed is a network of smaller rivers or streams called tributaries, which link to each other, and eventually into a bigger river. Streams can be one of three types, depending on how often they carry water:

- **Ephemeral streams** are small, temporary paths which occur only during a rainstorm or after a flood. The channels are not defined and vary from storm to storm.
- **Intermittent streams** generally flow only during the wet season.

- **Perennial streams** flow year–round, their channel is usually well–defined and they may have several smaller tributaries which join them.

The physical, chemical and biological makeup of a stream relates to surrounding physical features of the watershed. Analysis of these features aids understanding of stream–watershed relationships and predicts effects of human influences on different stream types.

Climate

Land and water are closely linked through the water cycle. Energy from the sun drives this and other natural cycles in the river basin. Climate – the type of weather a region has over a long period of time – determines how much water comes to the watershed through seasonal cycles. The seasonal pattern of precipitation and temperature variation control streamflow and water production. Although the amount of precipitation can vary from year to year, the earth has a finite amount of water which cannot be increased.

Some precipitation infiltrates the soil and percolates through permeable rock into groundwater storage called aquifers. Natural groundwater discharge is a major source of water for many streams.

Pumping water from an aquifer for industrial, irrigation, or domestic use reduces the aquifer's volume. Unless withdrawals are modified or groundwater recharge is increased, the aquifer will eventually be depleted. A drained aquifer can collapse from the settling of overlying lands. Collapsed underground aquifers no longer have as much capacity to accept and hold water, because the soil settles and condenses, resulting in less volume to hold water. Recharge is difficult, volume is less, and yields are considerably reduced. Springs once fed from the water table also dry up.

Climate affects water loss from a watershed as well as providing water. In hot, dry, or windy weather, evaporation loss from bare soil and from water surfaces is high. The same climatic influences that increase evaporation also increase transpiration from plants. Transpiration draws on soil moisture from a greater depth than evaporation because plant roots may reach deeper into the available moisture supply. Transpiration is greatest during the growing season and least during colder weather, when most plants are relatively dormant.

Soils and Geology

Soil is a basic watershed resource that, except over a long period of time, is non–renewable. It may take more than a century to produce a single centimeter of soil and thousands of years to produce enough soil to support a high–yield, high–quality forest, grassland or agricultural crop. Careful management and protection of soil is necessary to

preserve its function and productivity. Because soil carries plant nutrients and holds water, it is a key element in a watershed's health.

Soil is a thin layer of the earth's crust composed of mineral particles and organic matter. It occurs as the result of wind and water erosion, gravity rockfall from hills and mountains, rock minerals in rain water, heating expansion and cooling contraction in summer, and the chemical action of lichens and other plants.

Soils can be divided into two types based on how they are formed.

- **Residual soils** are formed from underlying "parent" rock formations which break up, erode and are mixed in with surface plant cover. They support the local surface plant cover and are usually found at higher elevations in the catchment.
- **Transported soils** are soils which are moved by gravity, wind or water to a different location. These soils are usually found on the valley floor and floodplain. Transported soils make the best soil for farming in the catchment, as they are usually higher in decayed organic matter.

Climate strongly affects soil formation. Rainfall causes leaching – the movement of dissolved particles through soil by the water. Rainfall also transports soils, through the erosive power of runoff. Soil plays a major role in determining which plants will establish a protective vegetative cover in the catchment.

Plants also modify and develop the soil. Plant roots create soil spaces, which help increase a soil's ability to store water. Rotting leaves from plants add organic matter to soil, which also increases water–holding capacity. Plant debris also slows surface runoff and protects the soil surface from rainfall–caused erosion. Soil depths and moisture–holding capacities are usually lower on steep slopes, and plant growth rates are often slower.

Vegetative Cover

Plant cover benefits a river basin in a number of ways. The canopy intercepts rain and reduces the force with which it strikes the ground, thereby reducing erosion. The canopy also reduces wind velocity and therefore wind–caused soil loss. Grasses, shrubs and trees make up the major plant cover types in a catchment, and all are important to catchment management.

When leaves and twigs fall, they decompose and are eventually incorporated into the soil. Before decomposing, this litter protects the soil surface from rain and evaporation, improves infiltration of water and slows down surface runoff.

Stems and roots lead water into the ground. Roots open up soil spaces for water retention and drainage, add organic materials to the soil and remove chemicals from the water. Roots

take water and minerals from the soil to the rest of the plant. These minerals are again consumed or fall back into the soil through leaves and dead plants. In some cases, through this process plants can remove what would become water pollutants.

Kissimee River, Florida

An indigenous forest usually includes, in addition to trees in various stages of growth, an understory of shrubs and a low ground cover of forbs (small herbaceous plants) and grasses. While all plants in a forest have some effect on water, trees are the most important in many ecosystems. Trees play a major role in catchments in the following ways:

- intricate, wide–spreading root systems help hold soil together and prevent erosion;
- deep roots can extract water from a low water table;
- the canopy protects people, animals and crops from sun, wind and rain;
- forests help filter the air;
- trees store carbon, which might otherwise be released into the atmosphere and increase global warming.

Therefore, removing native trees from catchments can have some of the greatest impacts on its ecological health.

People in the Watershed

People can have a great impact on the health of a watershed, as described above. Not only do we use more water than other creatures, but we make major changes to river basins

individually and collectively – some of which are beneficial, and some of which can do serious harm. In general, we have modified watersheds so much that many no longer perform many of the useful functions that protect and support our communities. The following scenario describes a typical series of events undertaken by a community, with the unintended result that their watershed can no longer handle flood waters the way it once did:

- Deforestation reduces the soil's ability to hold as much water, greatly increasing runoff into local streams and rivers.
- Increased siltation from deforested slopes changes the shape of river bed and banks, which can lead to changes in the flood regime.
- Farmers and city planners drain wetlands, thus removing the watershed's natural sponges which absorb run–off and rain.
- Urbanization leads to paved roads, more buildings and less open space. The result is a dramatic increase in runoff, since rooftops and paved roads prevent water from infiltrating.
- As land pressures increase, more people build permanent structures in the river's floodplain, thus increasing pressure to try to stop floods with dams.
- Finally, a dam is built for flood control and other uses, and the watershed is permanently changed. The floodplain no longer serves the ecological function it once did for the community, and more people move into the most flood–prone lands, believing they will be protected from all floods. The dam reduces the frequency of floods, but does not prevent the biggest, most damaging floods from occurring. The result: more expensive damages from floods than ever before.

It takes a lot of actions by a lot of people to do this much damage, but unfortunately it is all too common. The good news is that humans can also be great caretakers of their watersheds – but it takes understanding of some basic issues and the will to make a difference. Individual actions add up to real change.

Source : http://www.internationalrivers.org/river-basin-basics