ECOSYSTEM SERVICES: NO SUCH THING AS A FREE LUNCH!

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What are ecosystem services? The sun, wind, rivers, rain, aquifers, wetlands, soils, forests, and snow-covered mountain peaks are important providers of ecosystem services. These services supply us with many benefits, but we seem to have forgotten that there is a cost associated with keeping them.

When we need cash, where do we get it? Perhaps we go to the bank or ATM to make a withdrawal. Nature and the ecosystems we live within have been used as societal cash machines for as long as humans have been on the planet. When we want a hot shower, we simply turn on the tap and let the water heater start working.

Nature's ATM is always there to provide us with both the water and the electricity to heat it. What happens to our bank accounts when we only make withdraws? How do we keep money flowing? How and when do we replenish it?

In other words, there is no such thing as a free lunch.

Every time we turn on the heat, wash clothes, make a cup of coffee, drive to work, or build a shelf, we experience the value of ecosystem services in our everyday lives. The ecosystem has been providing humans with services since before recorded history. As hunter-gatherers, we were heavily dependent upon ecosystems to supply us with food, fuel, medicine, and shelter. We had to interact with our ecosystems to withdraw the life-sustaining elements that are so convenient to obtain today.

In more modern times, we can simply go to the store to buy our food or go to the gas station to fill our fuel tanks. We no longer interact directly with the ecosystems to receive the benefits that sustain us. Farmers grow our food in bulk, chemical engineers refine our fuels and create additives to keep our engines running clean, dam operators manage flood waters and use the stored water to generate electricity, loggers harvest trees and mills process the logs into lumber. We only utilize the final packaged products at the grocery store, the switch that turns on the lights, or the lumber to build our homes.

However, these conveniently packaged ecosystem services come at a cost. Sometimes we pay for these costs, sometimes they are subsidized, and sometimes they are even ignored. For example, let us look in-depth at the cost of hydropower. Dams were built to store large amounts of water. They then pass that water through penstocks and gates to turn massive turbines to produce electricity. It might seem rather harmless to store water and later release it to create life-enriching resources.

From a landowner perspective, or that of a fish, dam infrastructure poses significant risks and challenges to the surrounding environments and hinders what was once unobstructed access. In some cases, fish are blocked from upstream migration routes to complete life cycles.

In other cases, water slows down and warms in temperature, which changes species and habitat compositions. For some areas, riverbanks are exposed to altered hydrologic regimes and can erode faster, or once fertile valleys are inundated by stored water. Dams ultimately impact thousands of acres of productive floodplains, bottomlands, and habitats by permanently raising water elevations. When Grand Coulee Dam was built, the surrounding ecosystem paid a heavy price with increased irrigation capacity, electricity generation, and recreational opportunities.

Clean water from a watershed, lake, stream, or aquifer is necessary for all lifeforms, commercial agriculture, and material processing.

Raw materials such as lumber, fuel, and fodder are a provision of ecosystem services.

Reproduction of the world's vegetation is regulated mostly by invertebrate and bird pollinators.

Influencing the structure of soil and recycling of nutrients is a supporting role of ecosystem services.

Several Tribes in the United States and Canada lost access to over 37 percent of the Columbia River's entire salmon population. In 1941, when the dam closed its gates, salmon were lost to the Upper Columbia River Basin. So were ocean nutrients to our interior forests from salmon carcasses.

Even though efforts are now in place to restore salmon runs above Grand Coulee Dam, those costs and associated challenges are significant. The current situation consisting of slow-moving warm water reservoirs is no substitute for fast moving clean, cold water for salmon and other native fish migrating to their natal streams.

Most of the impacts to ecosystems go unmitigated and the costs borne by those resources continue to subsidize those services derived from it. In this case, it is electricity production and irrigation water to the Columbia Basin Reclamation Project (i.e. CBRP converted approximately 1.3 million acres of shrub-steppe habitat into irrigated farmland). With the loss of approximately 1.3 million acres of prime habitat, sharp-tailed grouse, prairie grouse, pigmy rabbits, and black-tailed jackrabbits have virtually disappeared from the interior Columbia Basin.

Yes, cheap power and accessible water supplies have increased industries and businesses throughout the Columbia Basin, plus farming and crop access to markets have increased dramatically with irrigation. But at what cost? Growing crops on sand is not likely the most efficient use of land and water.

In addition to dams, the functions of wetlands and floodplains in our society is another example of the impacts on ecosystem services. Since the industrial revolution, humans have been disconnecting floodplains from rivers to create farmland and homes in the fertile valleys. Wetlands have been filled in because they are "dirty" or "smelly" and they grow mosquitoes and other bugs that humans do not necessarily enjoy. However, we do not often consider the ecosystem services these floodplains and wetlands provide.

Floodplains provide flood relief. Without them, dikes and dams were built to protect downstream areas from flood waters. Because those high flows no longer have access to floodplains, surging rivers now transfer flows and hydraulic energy to other areas that result in damages and costly repairs to infrastructure. For example, bridges, dikes, or homes may be destroyed by those high flows; especially in areas where we removed, disconnected, or hardened the floodplains.

Floodwaters used to occupy these areas as a method of hydraulic energy dissipation and storage. Floodplains and wetlands also provide for aquifer recharge. We tap into these services for our water supplies. How does a River continue to flow after the rains have stopped and the snow has melted? Aquifers and hyporheic flows from underneath the river recharge and keep water cool and flowing. Ultimately, the services from the ecosystems we reside in provide us with a multitude of valuable benefits and opportune-ties.

Additionally, the monetary value of mitigating these services can be expansive. Grand Coulee Dam cost $300 million to build and the third power plant $700 million. Today that cost would be over $7.5 billion.

The 2019 flooding on the Mississippi River cost almost $6.2 billion in damages across eleven states. The 1927 Mississippi River flood damages would cost us more than $160 billion today. If land use conversions continue at the current pace, we will face between 2 to 4.5 trillion dollars in losses to ecosystem services.

A 1997 study published in Nature estimated ecosystem services worldwide were valued at about $33 trillion per year, about $6 trillion more than the world GDP.

Of course, not all alterations to the ecosystem have negative effects. For example, after the CBRP, duck hunting in the Columbia Basin was greatly improved, there are

Nature's ecosystems regulate sediment retention, flood control, and natural irrigation.

Nature regulates the introduction and spread of genetic diversity in plants and animals.

Ecosystem services generate human cultural activities such as outdoor education, scientific discovery, and recreation.

Climate moderation and wildlife habitat refugia are valuable benefits from ecosystem services.

more wetlands and wetland habitats than ever before (it was a steppe desert, after all), as well as more shoreline for boating, fishing, skiing, and homes.

However, it is also an important part of our shared responsibility as human consumers to recognize what ecosystem services are, how they enhance our lives, and affect certain opportunities. It is equally incumbent upon us to recognize the costs borne by our natural world for providing these services. In addition, we must also accept the cost to us as recipients of ecosystem services.

Our planet and its ecosystems provide us with services and wealth needed for survival and a high-quality life. When we use our stovetop, switch on a light, or refill our gas tank, we should consider all that nature and its ecosystems are doing for us to enjoy these conveniences.

When considering ecosystem services and how they impact our lives, we must ask ourselves, is there such a thing as a free lunch?

Ecosystem services add aesthetic and spiritual values to human life.