WORKSTREAM 5: ECOSYSTEMS AND DROUGHT

Lead Organizations:

IUCN

IWMI International Water Management Institute

The Nature Conservancy

When a drought occurs, existing pressures on ecosystems from natural water supplies are amplified, particularly in areas where the environment has little water allocation. Ecosystem health is closely linked to drought, as it is significantly influenced by land management outcomes which determine land cover, productivity, and carbon stocks. These aspects, in turn, have a direct impact on water stocks and play a pivotal role in shaping the occurrence of drought. While species and ecosystems have evolved with and adapted to local water cycle and hydrologic conditions that include flood and/or drought events (Junk and Wantzen, 2007), changes to the frequency, intensity, and duration of these events under climate change can have significant impacts, direct and indirect, on biodiversity. Drought can alter the ecological balance of natural systems and harm fish, wildlife, and plant species, as well as the services that these ecosystems provide to human communities. Vulnerable ecosystems may be pushed beyond the threshold at which it can recover.

Maintenance of water flows is the single, most important element for building drought resilience in dryland ecosystems. The water nutrient cycling in healthy drylands should be characterized by irregular inputs (including inter-seasonal, interannual and multi-year fluctuations in rainfall and precipitation), and regular outputs, which includes regular ground water recharge, as well as consistent surface and subsurface stream flows and water availability.

In terrestrial ecosystems, reduced soil moisture limits the photosynthesis of vegetation leading to wilting or die-back and reduced carbon and nutrient cycling. The impacts can disrupt entire food webs, limiting much-needed nutrition to animals, affecting survival of young offspring and juveniles, and altering adults' breeding cycles. There are also increases in wildfires, which can consume vast swaths of land, destroying natural habitats that often are very slow to recover.

The soil hydraulic properties including texture and minerology are both a cause and consequence of drought – especially due to land management decisions. Soil Organic Matter (SOM) and soil texture affect the capacity of soil to store and release water by influencing the aggregation of soil particles.

Soil erosion is caused by land degradation and runs off into our rivers and lakes during subsequent rainfall events, reducing water quality and affecting freshwater ecosystems. Migration, temporary loss or, sometimes, permanent extinction of some local species may result only in them to be replaced in many instances by non-native, invasive species.

Loss of land cover – as a result of loss of tree and vegetation cover – results in a typical change in atmospheric processes that result in local and regional climate anomalies. Land degradation processes including soil compaction limit and even halt the water cycling processes, which affect percolation and storage of water within the soil but also affect aquifer recharge, which is particularly important for maintaining water supply in the long-term.

In freshwater environments, drops in the water levels and flows speeds of rivers, lakes, ponds, wetlands, and aquifers change their biological, physical and chemical conditions. Reductions in gas exchanges, increased concentration in pollutants. and contraction in available habitats leading to fragmentation of the ecological connective of rivers are just some of the impacts that result. The combination of elevated nutrient concentrations, water temperatures, and sunlight, alongside low river flows, can result in algal blooms which shade out and outcompete submerged aquatic plants. Natural triggers such as sudden floods that would normally prompt migration or spawning in rivers and wetlands are often missed during unusually prolonged droughts, affecting animal lifecycles over coming seasons or years.

While the impacts of drought to terrestrial and freshwater ecosystems are significant, it is important to understand the ways that healthy ecosystems can also mitigate drought. Ecosystems provide a number of services that support the natural water cycle and are critical during weather extremes, including drought. These include infiltrating and storing water that can be made available over time, such as into shallow or deeper aquifers, in wetlands or in soil, and regulating temperatures, which can reduce some impacts of drought on waterways and reduce water loss to evapotranspiration. Protecting and restoring natural ecosystems helps maintain their resilience and ability to deliver on these services. Management of working lands, such as through maintaining or restoring soil health or employing other regenerative agriculture or grazing practices, can also play an important role in determining the resilience of a landscape system under drought.

A LOOK BACK ON THE PAST 10 YEARS

The term ecological drought has been employed relatively recently to capture this emphasis on how drought impacts ecosystems.

Despite an increasing recognition that ecosystem functions can be diminished following drought events, land degradation is not a forthright discussion in the drought context. To date, human influences on land management and the concomitant results remain largely unconsidered and therefore go unplanned for in local, national, and global strategies and policies. Building resilience and coping mechanisms for drought must therefore strongly rely on the knowledge of how human activities impact the land and how this is linked to drought. These must then be included in the responses including drought policies and plans.

MAIN CHALLENGES

Owing to multiple causal dimensions, drought has varied contextual definitions, some of which describe the process while others its impacts. Multiple definitions have therefore emerged in the drought discourse, which presents a significant obstacle when investigating, assessing, monitoring and addressing drought.

Land management has a direct bearing on land cover, land productivity and carbon stocks, which are directly linked to water stocks, ecosystem health and therefore the occurrence of drought. Desertification, defined as land degradation in arid, semi-arid and dry-sub humid areas and results from the interaction of human and environmental processes, including drought. When these links are ignored, the opportunities to account for land restoration actions to reduce drought impacts are lost, which further exposes society and ecosystems to drought. Drought impacts usually result in the loss of ecosystem services and negatively impact on livelihoods, especially for populations that are dependent on natural resources.

Many national drought policies typically rely on the disaster risk reduction (DRR) frameworks, which share a common approach, that is … “largely invest in the immediate impacts following an disaster event, and only after that is when you will have investment to support preparedness, provide hazard information, mitigate existing risks and engage disaster risk governance structures to build community resilience (UNGA, 2015)”... While this will always be a necessary approach in alleviating human suffering and building back crucial infrastructure, the unrushed nature of drought does not fully lend itself to DRR approaches.

Drought affects societies by inducing a complex web of chain reactions that impact multiple economic sectors including livestock, crops, water, public health, energy, transportation, and biodiversity just to name a few. It therefore follows that in addressing drought, one must fundamentally lean on interdisciplinary approaches that engage a wide range of expertise including climatology, meteorology, hydrology, ecology, agronomy, economics, sociology, and anthropology.

POTENTIAL SOLUTIONS

Nature-based solutions have significant potential to reduce the impacts of drought to ecosystems and to mitigate the severity of drought to human communities, agriculture and domestic water supply. In general, NbS can reduce natural disaster risks by addressing one or a combination of the three components of risk by:

- Preventing or mitigating the incidence and severity of *hazards*
- Reducing people's and/or assets' direct *exposure* to hazards
- Reducing people's and communities' *vulnerability*, and bolstering adaptive capacities

Some of the most promising categories/types of NBS include:

- Improving Watershed Health. Forest and Land cover. Reduced Erosion. Riparian Buffers.
- Enhancing environmental storage/Water Supply. Increasing Aquifer recharge, wetlands, beaver ponds. Discuss reducing extremes and capturing water during wet periods, Ag Resilience/Food Security. Regenerative/Soil Health Practices.
- Building system resilience – Strengthening the function of socioecological systems, nature-positive outcomes, benefits for communities, protecting biodiversity

These issues could be further elaborated through different workstream questions including:

- What is the envisioned goal, objectives and outcomes of NbS drought approaches?
- What metrics do we require for NbS drought? How can we integrate these into drought assessment, planning, monitoring, and reporting?
- How do we incorporate ecosystems and biodiversity to improve the economic assessment of drought? What knowledge under economic analysis is needed for decision-making and for drought planning?
- How can adopt NbS approaches for local, national, and regional drought planning.
- How do we engage institutions including local indigenous people groups.
- How do we finance ecosystem approaches for drought? What role does the private sector have to play?
- How do we integrate ecosystem-based approaches into planning for multiple types of potential disasters that are likely to increase in frequency and severity in many places around the world (drought, famine, fire, flood, landslides, etc.)?
- How do we ensure NbS consider issues of equity and gender, and consider the tradeoffs as well as the benefits / co-benefits?