VULNERABILITY OF GROUNDWATER RESOURCES

Groundwater systems are affected by climate variability. Direct influences are due to changes in the distribution of global precipitation, of evapotranspiration patterns, of snowmelt regimes and sea level rise. Human activities such as groundwater development and land use change can further influence groundwater systems indirectly. Climate change and human activity affect groundwater properties like fluxes, levels and quality. Groundwater-dependent ecosystems (GDEs) are communities of plants, animals and other organisms whose extent and life processes are dependent on these groundwater properties.

Smooth functioning of ecosystems is necessary for the sustained provision of services. Ecosystem services can be of direct or indirect benefit to humans and are classified as provisional, cultural, supporting, and regulating services. The use of these services as part of a broader climate change adaptation strategy is referred to as ecosystem-based adaptation.

ECOSYSTEM-BASED ADAPTATION MEASURES FOR GROUNDWATER MANAGEMENT

The implementation of ecosystem-based adaptation measures can be based on either a certain ecosystem service, on part of an ecosystem or on several ecosystems. In many cases, ecosystem-based adaptation cannot replace the need for built infrastructure, but instead could provide a critical complement, multiplying the benefits received from healthy, functioning ecosystems.

FRAMEWORK FOR THE IMPLEMENTATION OF ECOSYSTEM-BASED ADAPTATION IN GROUNDWATER MANAGEMENT

To successfully implement and increase the effectiveness of ecosystem-based adaptation measures for groundwater management, it is important to understand and recognize the vulnerabilities and interdependencies between groundwater, ecosystems and services. The following steps describe the process required to create a framework for ecosystem adaptation strategies, based on the ecosystem of interest.

Integrated vulnerability assessment

1. Establishing present status and recent trends
   a. Validation and quantification of ecosystem services
   b. Validation and quantification of groundwater resources

2. Identify groundwater vulnerability and ecosystem resilience
   a. Indicate main drivers affecting groundwater dynamics and ecosystem services
   b. Determine ecosystem adaptive capacity to multiple pressures

Implementation of ecosystem-based adaptation

3. Draft ecosystem-based adaptation plan
   a. Formulate project design for adaptation strategy
   b. Measure and monitor impact of intervention
   c. Evaluation of effectiveness of adaptation strategy