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Ecosystem Accounting in Armenia: Setting the Scene



Leibniz Institute of Ecological Urban and Regional Development

June 2024 – May 2026

The project is being implemented by the Biodiversity Conservation Center (BCC Armenia), in collaboration with the Leibniz Institute of Ecological Urban and Regional Development (IOER), with the participation of experts from leading scientific organizations in Armenia.



Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection



Federal Agency for Nature Conservation



Umwelt Bundesamt

This project is funded by the German Federal Environment Ministry's Advisory Assistance Program (AAP) for environmental protection in the countries of Central and Eastern Europe, the Caucasus and Central Asia and other countries neighboring the European Union. It is supervised by the Federal Agency for Nature Conservation (BfN) and the German Environment Agency (UBA).

The aim of the project is to create a Prototype of national ecosystem accounting in Armenia in accordance with UN recommendations (SEEA-EA)

Ecosystem accounting is a system for collecting and organizing data on habitats, landscapes, and ecosystem services, which is essential for:

- understanding the material and non-material contributions of nature to human well-being;
 - tracking changes in ecosystems and their services;
- making informed decisions for the conservation and sustainable use of ecosystems and their services.

The project focuses on terrestrial ecosystems and covers two sections of ecosystem accounts in physical terms: ecosystem extent and ecosystem services.

Monetary valuations are not considered in the project.

This publication presents a brief overview of the results of the project's first phase. The maps and quantitative estimates were developed through GIS-based modeling of ecosystem services and spatial GIS analysis of ecosystems, using vegetation and landscape maps of Armenia, global databases, and land cover datasets. Detailed results are available on the project website (<https://biodiversity-armenia.am/>), and the project's digital maps can be accessed via the project's GIS platform (<https://bccarmenia.nextgis.com/resource/113/display?panel=layers>).

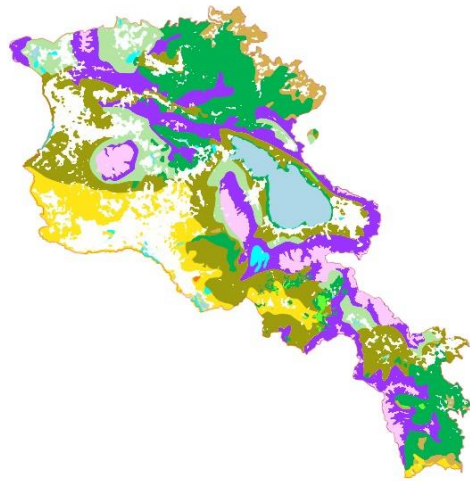
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Ecosystem Extent

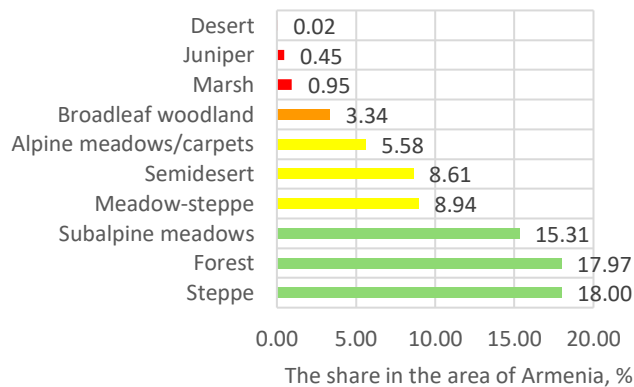
<https://biodiversity-armenia.am/extent/>

Ecosystem extent has been assessed for ESRI natural land cover classes, natural landscapes, and vegetation types across Armenia as a whole, as well as by marzes (provinces) and major watersheds. The area of ecosystems and their changes from 2017 to 2023 have been estimated, ecosystems have been ranked by rarity, and rarity maps have been produced. Below are examples of accounting for types of natural vegetation.

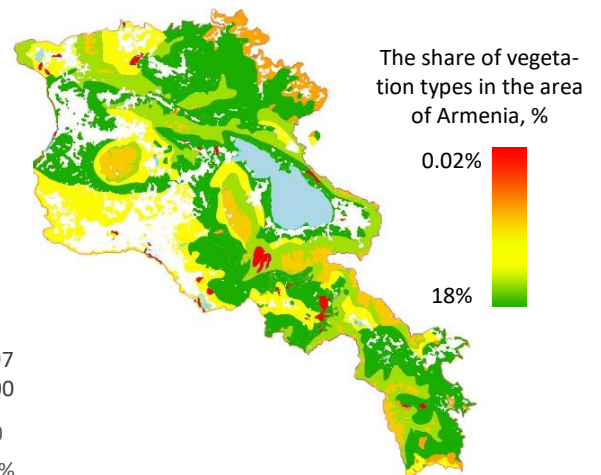


- Alpine meadows/carpets
- Juniper
- Subalpine meadows
- Broadleaf woodland
- Meadow-steppe
- Semidesert
- Steppe
- Desert
- Forest
- Marsh

Map of current natural vegetation digitized within the framework of the project. Areas shown in white represent built-up areas and croplands, which were excluded from the analysis of natural ecosystem extent.

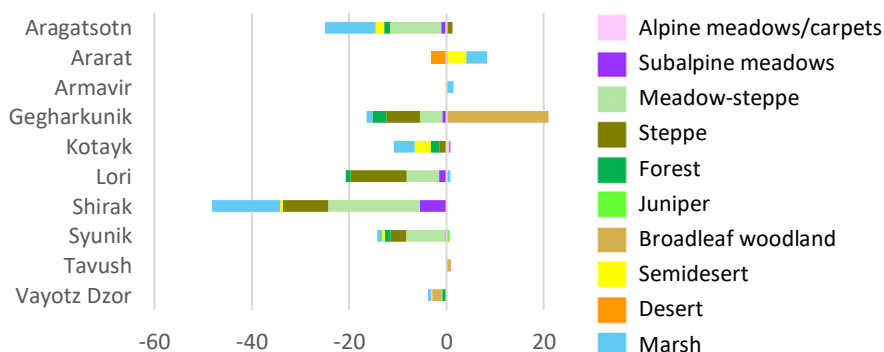
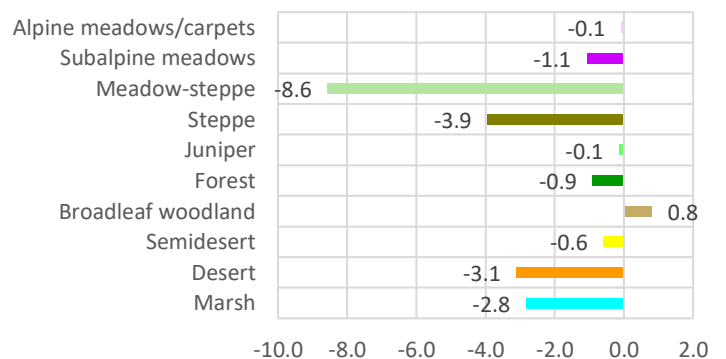


Rarity ranking of vegetation/ecosystem types



Map of rarity of vegetation/ecosystem types

Changes in the area of different vegetation/ecosystem types from 2017 to 2023, % relative to 2017



Changes in the area of different vegetation types by marzes from 2017 to 2023, % relative to 2017

Ecosystem Services

<https://biodiversity-armenia.am/services/>

As of now, we have assessed and mapped five regulating ecosystem services:

1. **Seasonal redistribution of water flow** (InVEST Seasonal Water Yield)
2. **Prevention of soil water erosion and sediment wash-off into waters** (InVEST Sediment Delivery Ratio)
3. **Flood risk mitigation** (InVEST Urban Flood Risk Mitigation)
4. **Cooling effect of terrestrial ecosystems** (InVEST Urban Cooling)
5. **Carbon storage in terrestrial ecosystems**

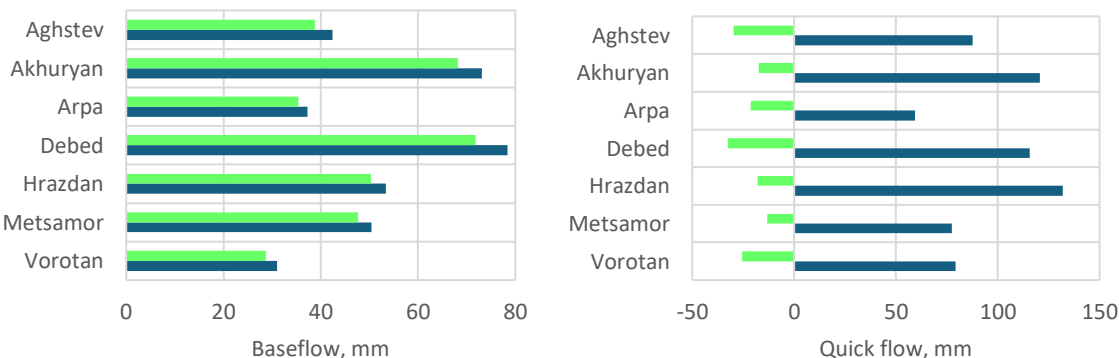
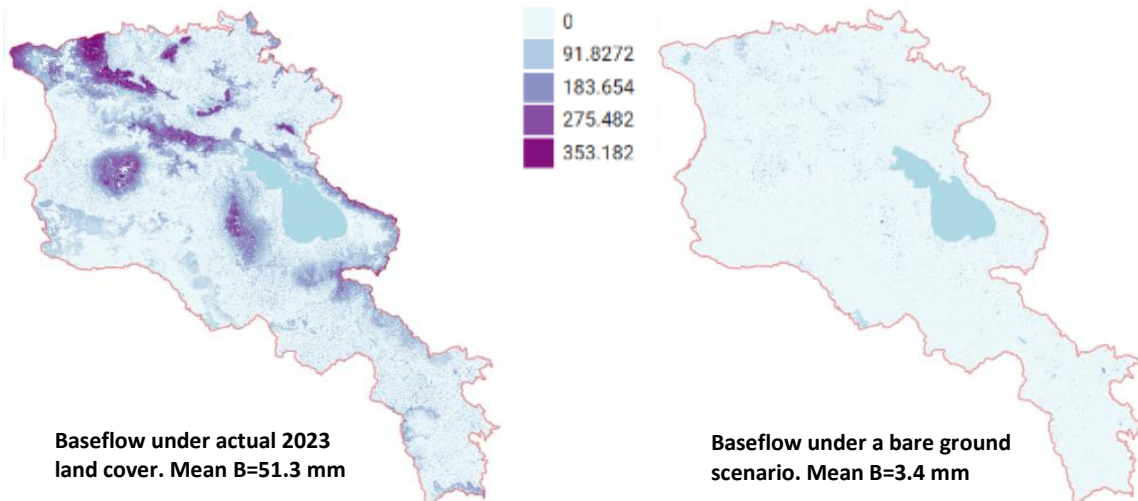
By the end of the project, four additional services are planned to be assessed and mapped: non-timber production (medicinal, culinary, and melliferous plants); forage production on natural pastures and hay-fields; pollination of agricultural crops by wild pollinators; and natural conditions for recreation.

The ecosystem service assessments include the following data: maps of ecosystem services; statistical indicators for Armenia as a whole, by marzes and watersheds; supply-demand balance of ecosystem services; and changes in indicators from 2017 to 2023.

The assessments of the four regulating services have highlighted the crucial role of terrestrial ecosystems for the well-being of the population and the economy of Armenia:

- water retention and provision of **93% of baseflow**, which remains within a watershed for several months or years — ensuring water availability in summer and during droughts, which is critically important for Armenia;
- reduction of spring and early summer flood risk by increasing **runoff retention by 11%** and decreasing **quick flow by 24%** compared to bare ground;
- prevention of more than **90% of erosion** and **over 95% of sediment wash-off** into streams and water bodies;
- microclimate cooling in summer due to water evaporation from tree vegetation;
- the total carbon stock in soils and tree biomass amounts to 173 MtC, with 91% stored in soils.

Below are examples for the ecosystem services of seasonal water flow redistribution and carbon storage.

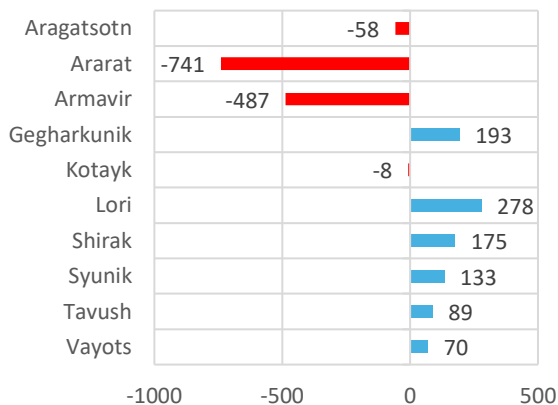


Baseflow and quick flow in main watersheds under actual 2023 land cover (blue), and the contribution of terrestrial ecosystems to these indicators (green), increasing baseflow and reducing quick flow



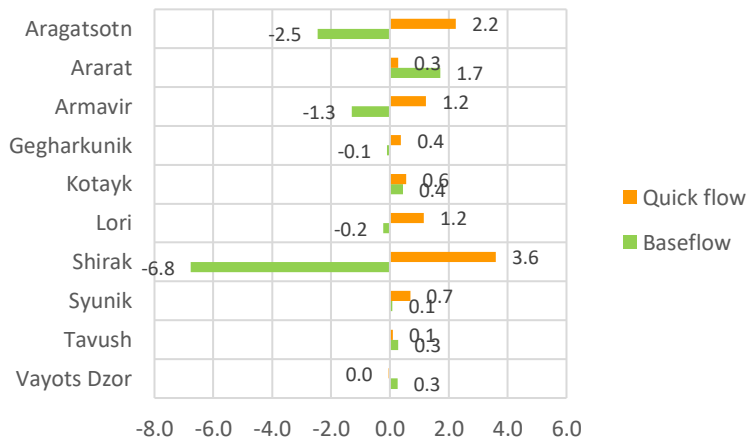


The comparison of supplied and used services, based on ARMSTAT water consumption statistics, shows marzes with a surplus (blue) or deficit (red) of water flow.



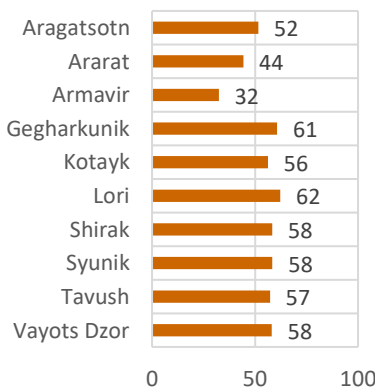
The difference between baseflow and agricultural water consumption in provinces, mln m³

The reduction in baseflow (green) and the increase in quick flow (orange) in most marzes from 2017 to 2023 indicate a weakening of this service, albeit a minor one. This is most noticeable in areas where grasslands and forests were replaced by croplands and built-up areas.

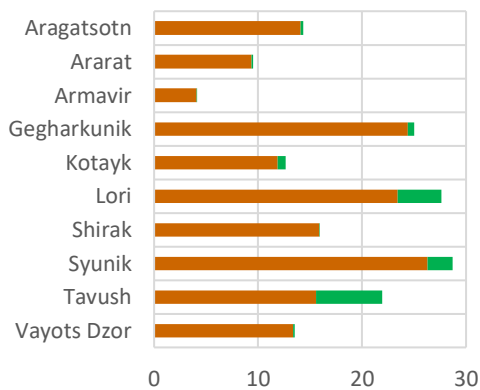


Changes in baseflow and quick flow in provinces, % relative to 2017

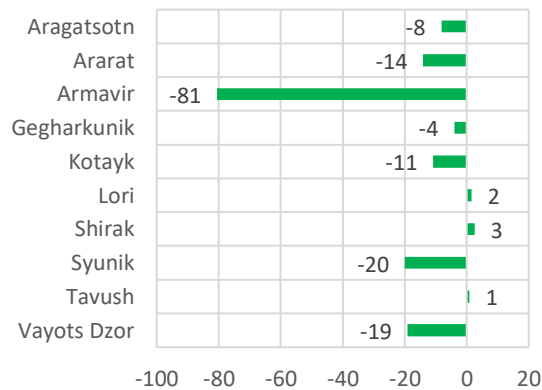
The average soil carbon content across provinces, according to [World Soils 250m Organic Carbon Stocks](#) data, ranges from 62 to 32 tC/ha. The carbon stock in woody biomass was estimated based on the average value of 48 tC/ha, as reported by the FAO report [State of the World's Forests, 2011](#). The total carbon stock amounts to 173 MtC. Due to the relatively small forest area in Armenia, the main carbon stock (91.4%) is stored in soils. Changes in carbon stock were assessed based on changes in the area of tree land cover class, using ESRI data. According to ESRI data, most marzes experienced a decrease in carbon stock within tree biomass. The most significant relative decline was observed in Armavir province.



Carbon content in the 30 cm soil layer (t/ha)



Total carbon stock in soil and forest biomass (Mt)



Changes in carbon stock in tree biomass in marzes from 2017 to 2023, % relative to 2017

This booklet presents preliminary results of testing methodologies for accounting ecosystem extent and ecosystem services. In the future, if a decision is made to apply these methodologies, they should be calibrated and verified using measurements conducted in Armenia.

