Ethnobotany of the Caucasus – Armenia

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Location

Armenia is a South Caucasian republic, bordering with Georgia, Azerbaijan, Turkey, and Iran. It is a landlocked country with a total area of 29,740 km^2, at a distance of about 145 km from the Black Sea, and 175 km from the Caspian Sea. It lies between 38°50' and 41°18' of northern latitude and between 43°27' and 46°37' eastern longitude, and measures 400 km along its main axis (north-west to south-east). Armenia is generally a mountainous country, having its lowest point of 375 m above sea level and culminating at 4095 m with an average altitude of 1850 m. Forty-four percent of the territory of Armenia are high mountainous areas, not suitable for inhabitation. The degree of land use is strongly unproportional. The zones under intensive development make 18.2% of the territory of Armenia with a concentration of 87.7% of total population. On these areas the population density exceeds several times the ecological threshold index (200 person/km^2) reaching here up to 480–558 person/km^2. The poorly developed zones make 38.0% of the territory, where only 12.3% of total population resides with a very low density of 11–20 person/km^2. The zones under intensive development are provided with engineering-transportation infrastructures. In this zone there are the most available public services, more human resources and financial opportunities. At the same time, the poorly developed areas have rich natural

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resources with preserved unique natural ecosystems, beautiful landscapes, clean water and air, and biological resources (Gabrielyan 1986).

Geomorphology

Four main geomorphological regions can be recognized within Armenia. 1. Mountain ridges and valleys in the north-east of the country which bear witness of extensive erosion. 2. Areas covered by lava of relatively recent (upper Pliocene) origin within Asia Minor characterized by gentle slopes with little evidence of erosion but, in which larger rivers have carved out deep gorges and canyons. 3. A series of ridged mountains in the south of Armenia, which constitute the Minor Caucasus system and show intense erosion. 4. The Ararat Valley representing the lowest part of the Ararat depression which is covered with alluvial and proluvial sediments (Aslanyan 1958, Bagdasaryan and Gabrielyan 1962, Gabrielyan 1962, Dumitrashko 1979).

Climate

A wide range of climatic zones have been recorded within Armenia. The country is located centrally in the sub-tropical zone, and thus is dominated by arid to semi-desert conditions. The altitudinal zonation adds diversity resulting from altitudinal clines. In general the climate is best characterised as dry continental, in some areas with an annual rhythm more or less similar to the Mediterranean one. The average temperature varies from 2.7 °C to 14.1 °C. Average annual precipitation is around 600 mm; it varies depending on altitude from 250 to 1000 mm. Most precipitation falls in the spring. Long-lasting snow cover exists in the mountains above 1300 m, where the annual snowfall could attain 2 m. In the northern part of Armenia humidity comes from the Black Sea in the west, in the southern part from the Caspian Sea in the east, the central part is in the rain shadow of mountain ridges the driest area.

Landscape

The mountainous nature of Armenia results in a series of highly diverse landscapes with varying: geological substrate, terrain, climate, soils, and water supply. There are seven distinct landscape types described for Armenia: deserts, semi-deserts, dry steppes, steppes, woodlands, sub-alpine and alpine lands. The great diversity of ecosystems and vegetation types is correlated with the variety of landscapes, ranging from sand deserts and semi-deserts situated at 400 m above sea level to alpine meadows and carpets at 3000 m, from xeric mountain formations to wetland vegetation, or from mesophilous forests to feather grass steppes (Magakyan 1941, Edilyan 1976).

Hydrography

There is only one big river in Armenia – Arax, but the river net is rather dense – 215 rivers longer than 10 km. All Armenian rivers belong to rivers Kura and Arax basins There are many lakes in Armenia. Lake Sevan is the most famous and important for economy and biodiversity conservation.

Vegetation

The first scheme of floristic regions of Armenia was elaborated by Armen Takhtajan (Takhtajan 1954). In our previous work (Tamanjan and Fayvush 2009, Fayvush and Aleksanyan 2016) we proposed some changes for floristic divisions of the republic. According this scheme Armenia is divided on 12 floristic regions. It has to be noticed that, according our analysis, Shirak, Aparan, Yerevan, Darelegis and Meghri floristic regions belong to the Armeno-Iranian, and all other regions – to the Caucasian floristic provinces (Takhtadjan 1978) (Fig. 1).

Armenia is situated between two very distinct phyto-geographical domains: the Boreal and Ancient Mediterranean Subkingdoms and at the junction of two floristic provinces - Caucasian and Armeno-Iranian (Takhtajan 1978). The peculiarity of each, enhanced by vertical zonation, is the cause of the great variety of the country's vascular flora and vegetation. The location of the country in the intersection of these phyto-geographical provinces, diversity of climatic conditions and active geological processes have resulted in formation of diverse ecosystems and rich biodiversity with high level of endemism (Fayvush et al. 2013). As a result, within the small territory of the country there are about 3800 species of vascular plants (including 142 local endemic species), 428 species of soil and water algae, 399 species of mosses, 4207 species of fungi, 464 species of lichens (Fayvush 2007). The territory of Armenia is notable for intensive speciation processes and it is not accidental that the researchers of flora of the country often identify new species for the science. Only over the last 10 years more than 50 new species for the science and Armenia have been described, which needed protection.

The diversity of landscapes and orography is an important determinant of Armenia's diverse vegetation. The lower mountain belt (480–1200 m) is covered by semi-desert (or phryganoid) formations, gypsophilous or halophilous vegetation. There are salt marsh areas as well as the South Caucasian sand desert. The middle and upper mountain belts (1200–2200 m) are characterized by various kinds of steppe and forest vegetation, meadow-steppes, shrub steppes and thorny cushion (Tragacanth) vegetation. The altitudinal span of the forest belt varies from 500 to 1500 (−2000) m depending of the region, and may be approaching to 2400 m when open park-like tree stands are included. The subalpine and alpine belts (2200–4000 m) are covered by meadows and carpets.

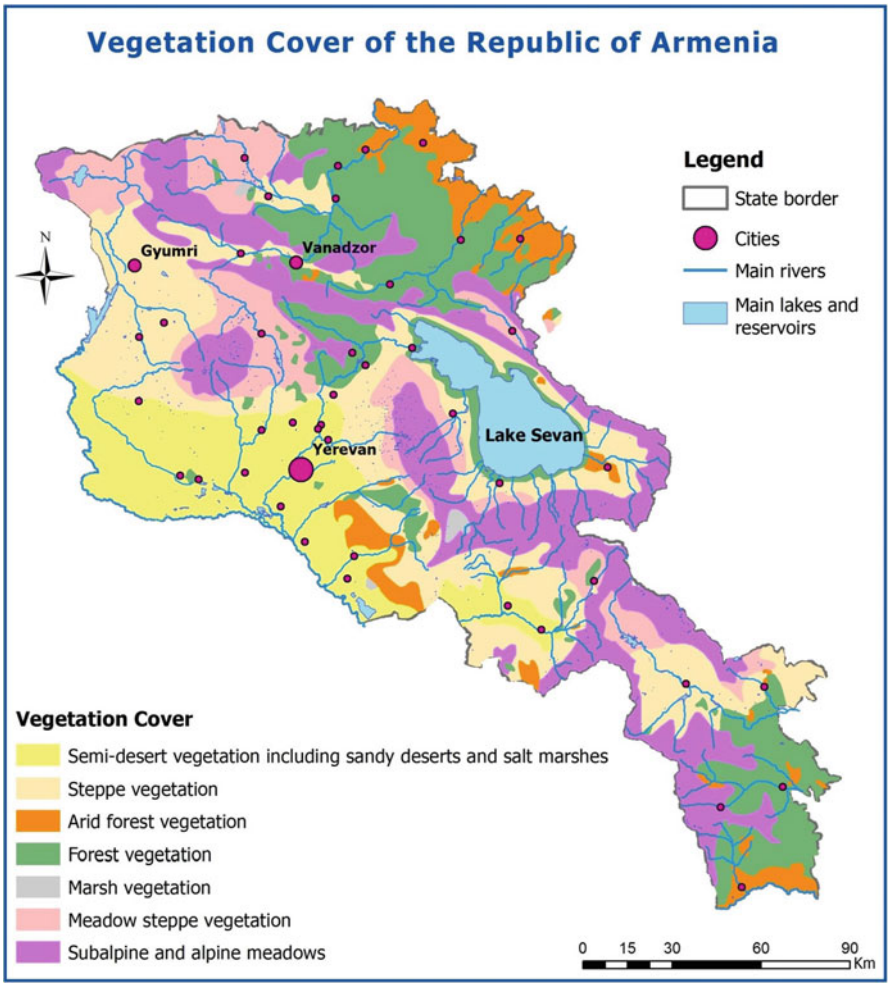

Fig. 1 Floristic regions of Armenia (Map G. Fayvush)

Semi-Deserts and Deserts

The semi-desert and desert vegetation of Armenia is very rich in endemic and rare species. The active speciation processes is one of the peculiarities of semi-desert flora of Armenia. Over the last five years with intensified processes of soil erosion and desertification the expansion of semi-desert zone up by profile by about 50 m has been observed, in particular the species *Artemisia fragrans* Willd., *Capparis herbacea* Willd. and *Rhamnus pallasii* Fisch. & C.A. Mey. have been registered 200–300 m above the previous altitudinal limits of their distribution (Fig. 2).

Fig. 2 *Salsola* semi desert, Armenia (Photo G. Fayvush)

Fig. 3 Steppe, Armania (Photo G. Fayvush)

Steppes and Meadow-Steppes

They represent the richest vegetation in terms of species with the largest number of endemic species of Armenia. Over the last five years the reduction of the lower part of steppe belt has been observed due to the expansion of semi-desert vegetation. Penetration of typical steppe species into meadow-steppe zone is taking place with reduction of its altitudinal limits (Fig. 3).

Arid Open Woodlands

Arid open woodlands are one of the oldest types of vegetation represented both by coniferous (juniper woodlands) and deciduous species (*Pistacia mutica* Fisch. &

Fig. 4 Arid open forest, Armenia (Photo G. Fayvush)

C.A. Mey., *Acer ibericum* M. Bieb., *Celtis glabrata* Spreng., *Pyrus salicifolia* Pall., *Amygdalus fenzliana* (Fritsch) Lipsky, *Punica granatum* L. and others) and shibliak (*Paliurus spina-christi* Mill. domination) Aleksanyan (2012). Over the recent years the expansion of the areas covered by this ecosystem has been observed first of all at the expense of penetration of typical species of open woodlands and shibliak, mainly *Paliurus spina-christi* and *Rhamnus pallasii*, as well as due to reducing density of forest cover at the lower timberline (Fig. 4).

Forests

The forest biodiversity of Armenia is represented by valuable species of trees (125 species), shrubs (111), small shrubs (30), semi-shrubs (48) and woody lianas (9). In general, forest communities in Armenia are distributed on foothills and in the lower and middle mountainous belts at the mountainous slopes with inclination of 20–25°. The lower timberline in Northern Armenia (Tavush Region) is on the altitude of 500 m, the upper timberline reaches up to 2300–2400 m, though separate trees occur above the upper timberline on higher altitudes. The oak and beech forests are of the highest productivity, and are located on the altitude of 1300–2000 m above sea level (Makhatadze 1957).

It is known that the forests with high biodiversity are more resilient to main threats, for example, climate change or pests and diseases. In the result of various natural and antropogenic impacts the natural seed regeneration of the main valuable forest species such as oak and beech is not satisfactory. The stands dominated by *Pinus kochiana* Klotzsch ex K.Koch, *Taxus baccata* L., *Corylus colurna* C.K. Schneid. and other rare tree species have reduced; at present they occur in the form of patches and sporadic trees. The steppe-meadow vegetation types are often replacing valuable forests. The instability of forest ecosystems has an impact on productivity of agricultural crops as well as diversity of species composition of hay-making areas and pastures (Figs. 5, 6, 7, 8, and 9).

Fig. 5 Dry open forest, Armenia (Photo G. Fayvush)

Fig. 6 *Juniperus* open forest, Armenia (Photo G. Fayvush)

Sub-Alpine and Alpine Meadows

These are ecosystems typical for upland zones of Armenia. Over the last years probably due to the change and redistribution of pasture use as well as climatic changes some successional changes have been observed such as shift of sub-alpine species to alpine zone (in Syunik, Mount Aragats), whereas the alpine carpets with domination of *Taraxacum stevenii* DC, *Campanula tridentata* Schreb. and *Pedicularis crassirostris* Bunge are gradually replaced by alpine meadows with domination of grasses. Almost everywhere the expansion of expansive species not suitable as fodder is observed, especially of the species *Tripleurospermum transcaucasicum* (Manden.) Pobed (Figs. 10, 11, 12, 13, and 14) (Baloyan 1992).

Fig. 7 Mixed broadleaved forest, Armenia (Photo G. Fayvush)

Fig. 8 Mixed broadleaved forest in fall, Lake Parslich, Armenia (Photo G. Fayvush)

Wetland Vegetation

These are extremely diverse ecosystems including lakes, rivers, streamlets and marsh areas, which vary dependent on environmental conditions and elevations. Over the last centuries the changes due to economic activities have resulted in extinction of some wetland species (for example, termination of rice cultivation in the Ararat valley caused extinction of the species of genus *Sagittaria*). Over the last years the following processes have cause serious threats: construction of small

Fig. 9 Mixed broadleaved oak forest, Armenia (Photo G. Fayvush)

Fig. 10 Subalpine meadows, Aragats, Armenia (Photo G. Fayvush)

Fig. 11 Subalpine meadows, Armenia (Photo G. Fayvush)

Fig. 12 Alpine meadows with *Campanula tridentata*, Armenia (Photo G. Fayvush)

hydropower plants on rivers with scarce water resources, which results in ecosystem alteration; fluctuation of water level in Lake Sevan, which results in redistribution of water plants in the lake; as well as changes of hydrological regime of rivers and lakes (for example, Lori Plateau) (Barsegyan 1990).

Fig. 13 Aragats range, Armenia (Photo G. Fayvush)

Plant Use in Armenia

The well-being of Armenia's population is greatly dependent on availability of biological resources, which are strategic resources for the country, equally to underground resources. The biodiversity has been used during the centuries and being actively used in Armenia in various aspects of social life including its use as food, fuel, construction material, medicines and for other purposes.

Food. Since ancient times the Armenian nation has been maintaining its existence through hunting, fishing and use of various wild plants with transferring those traditions to generations. The flora of Armenia is very rich in useful species among which the following groups of used plants are of unique importance:

(a) Edible plants. There are about 200 species. They are used both in fresh and processed (cooked, pickles and others) forms making up to 10–15% of the consumed food. Among the most used species are the species of sickleweed (*Falcaria*), horse fennel (*Hippomarathrum*), asparagus (*Asparagus*), chervil (*Chaerophyllum*) and of other genera.
(b) Wild fruits and berries. There are about 120 species making close to 40% of the dendroflora of Armenia. The most valuable species include walnut (*Juglans*), hazel (*Corylus*), pear (*Pyrus*), apple (*Malus*), cornel cherry (*Cornus*), strawberry,

Fig. 14 Nival zone, lake Aragats, Armenia (Photo G. Fayvush)

blackberry (*Rubus*), raspberry (*Ribes*) and numerous other species. Wild fruits and berries are widely used also for canned food production as well as for getting economically valuable and high-yielding varieties of fruits and berries through their use as resistant wildlings.

(c) Honey plants. There are about 350 species widely distributed in all landscape zones. The honey plants belong to the following groups: a) fruit trees (apricot, plum, peach, cherry, sour cherry, apple and pear); b) forest tree species (maple, oak, sea-buckthorn, Jerusalem thorn, lime-tree and others); c) meadow herbs (*Nepeta, Stachys, Anchusa, Rapistrum, Thymus, Medicago, Salvia* and others).

Wood. The wood of oak, beech and hornbeam is highly valued. Construction wood makes 8–11% of the annually logged total volume of wood. For example, the wood harvested in 2012 made 39 542.4 m^3, out of which the construction wood made 3586.9 m^3.

Medicines. Medicinal plants make about 10% of the species composition of the flora of Armenia. Since long ago numerous representatives belonging to buckthorn (*Rhamnus*), hawthorn (*Crataegus*), juniper (*Juniperus*), dog-rose (*Rosa*), St. John's wort (*Hypericum*), barberry (*Berberis*) and other genera have been widely used in folk medicine. It has been proven, that the useful properties of wild medicinal plants growing in mountainous regions are obviously higher, due to which their collection

is increasing every year. About 15 species are used for production of refreshing and medicinal teas, which are of high demand both in Armenia and other countries.

Plants of economic significance. There are more than 2000 species of fodder plants. The most valuable are the species belonging to the genera sainfoin (*Onobrychis*), clover (*Trifolium*), medick (*Medicago*) and foxtail (*Alopecurus*).

The ether-bearing plants are represented by about 150 species, out of which the most valuable are the species of thyme (*Thymus*), helichrysum (*Helichrysum*), wormwood (*Artemisia*) and other genera.

On the territory of Armenia there are about 120 species of dye plants, out of which the species of the genera euphorbia (*Euphorbia*), buckthorn (*Rhamnus*), elder (*Sambucus*), madder (*Rubia*) and others have been traditionally used since early times.

Numerous plants with vitamin, tannin and rubber producing properties also have economic significance.

Genetic diversity of wild plants. The wild relatives of a large number of cultivated plants (cereals, fruity trees and others) identified in Armenia is a specific source of genetic material. Thanks to rich diversity of wild relatives of cultivated plants Armenia has been rendered by N.I.Vavilov as one of the rich centers of origin of cultivated plants. At present the territory of Armenia belongs to the Southwest Asian center of origin of cultivated plants (soft and hard wheat, pea, lentil and grape). The rich genetic pool of wild relatives of cultivated plants is used for getting new varieties of plants resistant to drought and cold as well as having high adaptability.

The Southwest Asian center of origin is first of all distinguished by diversity of wheat species and ecotypes. Three out of four species of wild wheat known in the world grow in Armenia: *Triticum boeoticum* Boiss., *T.urartu* Thum. ex Gandil. and *T. araraticum* Jakubz. The last two species have been first identified in Armenia. The species *T. araraticum* grows in semidesert and mountainous-steppe conditions; it is considered a predecessor of the cultivated species *T. timofeevii* Zhuk. The species *T. boeoticum* is considered a direct predecessor of the cultivated species *T. monococcum*. The species *T.urartu* grows on tertiary red clay soils and basalts on the altitudes of 1300–1400 m above sea level as a component of semiarid vegetation; it is a donor for the polyploid wheat. In Armenia there are 9 species of goat grass with rich intraspecies diversity. The diploid self-pollinated species *Aegilops tauschii* Cosson (*A. squarrosa* L.) is of special value for breeding purposes. The mentioned species of goat grass occurs in semidesert and steppe zones on the altitudes of 500–1650 m above sea level. The other 8 species of *Aegilops* are considered to have the genes ensuring resistance to drought, diseases and pests and other properties. Among wild cereals of Armenia there are also two (with 36 varieties) species of rye (*Secale*) and eight species of wild barley (*Hordeum*).

In Armenia there are numerous wild species of cultivated leguminous plants as well as wild relatives of vegetables (280 species), oil-bearing and medicinal plants and spicy herbs.

Among fruit and berry species on the territory of Armenia there are wild relatives of apple, pear, rowan, hawthorn, plum, cherry, pistachio, pomegranate, almond, grape, raspberry, currant and other species.

Main Threats to Ecosystems and Important Components of Plant Diversity

The second decade after independence of Armenia (1990) was characterized by a trend of overcoming various types of crises (energetic, socio-economic, psychological) with certain improvement of the economic and social situation in the country. Recently the intensity of the negative impact on biodiversity and territorial indicators of impacted ecosystems was changed, which is briefly presented below. It should be mentioned that the loss of biodiversity and changes of ecosystem services in many cases are not a result of the impact of just one factor, but of a complex impact. In the early post-soviet period this was connected with the hard socio-economic conditions, energetic crisis and poverty of wide classes of population in the country. Over the recent years the negative impact on biodiversity and increased rates of ecosystem degradation have been conditioned by certain intensification of economic and social activities, which is expressed in overuse of biological resources, exploitation of mines, privatization of lands, expansion of areas under construction, visible activation of agriculture and tourism development. Basically almost all threats of the hierarchical classification of threats suggested by IUCN have some impact on biodiversity of Armenia (Solomon et al. 2013).

Loss of Habitats

Mining: The underground resources of Armenia are the most used elements of the environment. By approximate estimation in Armenia there are 613 mines with the possibility to extract 60 types of minerals. Nowadays the mining industry is declared by the RA Government as a priority sector of economy. It is intensively developing. The Government of Armenia has issued several hundred mining licenses without having a long-term program on sustainable use of resources, appropriate tax legislation and legislation on environmental protection as well as comprehensive assessments of environmental and social implications. Nowadays the mining industry continues to have catastrophic consequences. Thousands of hectares of the territory of Armenia are covered by open mines and tailings ponds.

Construction (urban development, road construction, reservoir construction): Due to reduction of the total volume of construction works during 2010–2011 at present the risk of their impact on ecosystems is not high. In recent years the expansion of existing inhabited areas and establishment of new settlements (in the form of summer-house communities) have been slower and almost without occupation of new territories. The works on the road network are mainly aimed at widening and renovation of existing roads. The works on establishment of new reservoirs are still not active.

Agriculture: After the independence in Armenia the land privatization process has seriously changed the character and status of agriculture in the country. At present the main land users for agricultural production in the country are the farms, which manage more than 82% of arable lands, 75% of perennial stands and 50% of hay-making areas.

Today the absolutely major proportion (more than 98%) of the gross product from agriculture is provided by the private sector. In the sphere of agriculture, the most serious problems connected with the environment are the losses of water due to ineffective irrigation as well as salination of soils, erosion and pollution by agricultural wastes. For the natural ecosystems being used as pastures the biggest threat is the unproportional distribution of the pasture load, when the distant pastures suffer from under-grazing, which results in change of ecosystems, in particular replacement of alpine carpets with alpine meadows as well as active penetration of sub-alpine weeds to alpine ecosystems. At present the majority of the community adjacent pasture areas are overused and degraded in various forms varying from changes in plant cover to erosion, which is also the result of land-slides and mudflows.

Logging: In recent years in Armenia just 1.7 thousand ha of forests has been logged – the figure, which is far from the reality. By the official data the volume of illegal loggings in the country has reduced twice. However, the long-term negative changes of the ecological status are observed in the areas, which have been subject to intensive loggings. Considering the fact that the forests in Armenia cover mountainous slopes and have protection significance as well as that the wood demand exceeds several times the forest productivity rate and cannot be fully met by the country resources, it is necessary to rank the environmental significance of forests higher than their socio-economic significance. In this regard, the state forest management system should be considered a subsidized, partially self-financed and non-profit sector requiring continuous investments aimed at forest protection and rehabilitation.

Hydropower production: In Armenia the construction of small hydropower plants (SHPP) is considered a leading direction in development of the renewable energy sector. Construction of SHPPs is done according to the SHPP development scheme approved by the RA Government in 2009. By the scheme it is planned to construct 115 SHPPs. In parallel to implementation of the scheme on development of small hydropower plants, in Armenia the problems have occurred related to overuse of water resources and to river ecosystems, biodiversity, specially protected areas, landscapes, social status of population and life quality.

Recreation and tourism: The impact of recreation and tourism on ecosystems is mainly connected with recreational trampling of plant cover. On the other hand, underuse of forests for recreation has indirect contribution to the increase of harvested volumes of wood. At the same time development of recreation and ecotourism is much more beneficial and advantageous from economic and environmental perspective, but respective approaches for organization of the mentioned activities are still missing in Armenia.

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