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Keynote

**Wetlands in Armenia – their values and threats and their contribution
to sustainable development and poverty alleviation**

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In the imaginary “list of Ramsar records” the United Kingdom is the record holder with the highest number of Ramsar sites (159), Canada holds the largest Ramsar territories (total 13,051,501 ha), Botswana holds the largest single Ramsar site Okavango Delta System (6,864,200 ha), and Armenia’s Ramsar sites are amongst those covering the largest area of the country’s surface: one sixth (4,922 km² of 29,743 km²).

Diversity of Wetlands in Armenia

The Armenian Database of Wetlands of International, National and Local Importance includes 24 inland wetland types according to the Ramsar Classification System. Of **rivers** only 4 are >100 km long (Arax, Debed, Hrazdan, Vorotan). Most rivers have strongly pronounced seasonal water flow fluctuations; many of them are seasonal. Few rivers form small deltas. Among the **lakes** and **ponds** with a surface >1 ha, Lake Sevan is the largest freshwater lake of the Caucasus, Asia Minor and Middle Asia regions. Lake Arpi (Shirak Marz) is the second largest lake of Armenia. Both lakes are designated in the Ramsar List of Wetlands of International Importance. In the mountains of Geghama, Zangezur, and Aragats a large number of small lakes (<1 ha) exist, mainly fed by snowmelt. The larger lakes are fed by well-developed tributary river systems. Lake Ayghr is fed exclusively by groundwater.

Other wetland types exist in the form of **sloping fens**, **wet** and **bog meadows**, **river pools** overgrown with vegetation, **seasonal saline marshes**, and **mires** and **peatlands**. They can be grouped into three altitudinal groups with different vegetation and peat deposits: 1) saline and freshwater marshes at low altitudes up to 1,400 m without peat deposits; 2) freshwater mires, ponds and river pools situated at altitudes between 1,400-2,400 m with well-developed peat layers; and 3) high mountain ephemeral and suspended marshes (>2,200 m) with abundance of mosses and thin peat layers. The surface of sloping fens estimated at 200 ha, bogged meadows - 5,000 ha, peat forming ponds - 800 ha, ephemeral and suspended marshes - 200 ha. The relict Sarnakunq sphagnum mire in the valley of river Vorotan is of special interest for its type and species community. Peatlands are situated on river floodplains, lacustrine depressions, and wet mountain slopes with a total surface of 3,000 ha between the altitudes 1400-2200 m. Peatlands are seriously damaged by peat extractions; many of them have been reclaimed for agriculture or inundated by reservoirs.

One can easily recognize *freshwater springs* by the surrounding juicy vegetation and *geothermal springs* - by outlets fringed with ochre colored stones. The temperature of springs is close to constant over the year and varied from 4°C in Alpine springs to 22-55°C in thermae. Freshwater springs are situated everyway on the slopes of mountains. Geothermal springs appear on the slopes of Geghama and Vardenis ridges. The water, both fresh and mineral is of highest quality. The peculiarity of Ararat Valley is outcrops of underground waters, whether natural or artificial.

The only known *subterranean* hydrological system is situated in Cave Magil. *Alpine wetlands* include small lakes, upstream rivers, springs, fens, wet or bogged meadows, marshes. Besides, some high mountains in Armenia have *snowfields* of considerable sizes, which exist till mid-August and then appear again at the end of September. Such snowfields observe at the altitudes higher than 3500 m.

Of “man-made” wetlands the most important are water storage *reservoirs*. Reservoirs have been constructed mainly for irrigation, but also for generation of electrical energy. Two reservoirs have special purposes: Mantash Reservoir as storage of drinking water, and Kechut Reservoir as storage of water for diversion of runoff of River Arpa into Lake Sevan. The largest Akhuryan reservoir (525 million m³, Shirak Marz) is situated on the border with Turkey. More 29 reservoirs have useful volume over 1 million m³. Reservoirs have rugged bottom topography and large depths.

The total quantity of *fishponds* is still unknown but increases from year to year. Their size varies from a few square meters to hundreds hectares. Most fish-farming ponds have been created in Ararat valley in cavities of former sand excavations. However, the most spectacular Armash Fish Farm (total 1,700 ha) was created on the former saline marsh area. Depending on relief and source of nourishment two main types one can distinguish: 'lacustrine' shape and 'riverine' shape. 'Lacustrine' fishponds are wide and shallow without pronounced current; 'riverine' fishponds are narrow and deep with pronounced current. The main commercial species in the 'lacustrine' fishponds are sturgeons (*Accipenser*) and *Cyprinidae*. In the 'riverine' fishponds main commercial species are trouts (*Salmo*).

The history of *canal* construction goes far back to pre-Christian epoch. The age of the oldest operating Acanates Canal is around 2,500 years and Shamiram canal in the southwestern outskirts of Yerevan – 2,200 years. Irrigated lands, canals and drainage channels have been constructed mainly in Ararat valley and eastern part of Sevan basin (drainage of former Lake Gilli). Canals play important role for irrigated agriculture but also support aquatic and wetland biodiversity.

Wetland Products

A total quantity 2.5 km³ of surface *water* is available in Armenia each year for agriculture, industry and domestic water supply. *The sources of mineral waters* of *Ararat, Arzni, Bjni, Buzhakan, Dilijan, Jermuk, Hankavan, Lichk* have medical characteristics and are used widely in balneology. Mineral waters are exported to Russia, UAE, Lebanon, Iran, Turkey and the Baltic countries. The largest wetland related *sand* and *gravel deposits* are situated on the former bed of River Arax and on the eastern shore of Lake Sevan.

Wetland flora diversity includes 622 species of vascular plants, 135 species of mosses, around 200 species of fungi, 245 species of algae, and thousands of bacteria species.

Ecological communities

Of algae cyanobacteria (*Nostocales*: *Anabaena spp.*, *Aphanizomenon spp.*) are especially important as main forming unit of primary production in the **plankton community** of Lake Sevan and other stagnant water-bodies. **Submerged communities** grow in lakes, ponds, rivers and canals at the depths 0.1-19 m. Stonewort (*Chara*) prefers mineralized stagnant waters. The moss *Fontinalis* occurs in lakes nourished by springs at the altitudes 600-2,400 m. Both can penetrate at the depths up to 19 m (Lake Sevan). *Fontinalis* has never been recorded in polluted water. Hornwort (*Ceratophyllum*) is widespread at the altitudes 800-2,200 m on oozy bottom of stagnant waters at the depths up to 10 m (Lake Ayghr).

Pondweeds (*Potamogeton*) form **submerged air-blooming communities** in large (*P. pectinatus*) and small (*P. pusillus*) lakes and reservoirs at the altitudes 400-2,400 m. The bladderwort (*Utricularia*) is typical in mountain lakes (1,400-2,400 m) at the depths 1-1.5 m. Duckweed (*Lemna*) **floating communities** are typical on all types of stagnant waters at the altitudes 500-2,400 m and form especially thick thickets on the surface of still water zones on drainage canals in Ararat Valley. The floating-heart (*Nymphoides*) is common for the relict ponds of Lori Highland (1,500 m). The Jointweed (*Polygonum amphibium*) is dominant in Lake Arpi due to adaptations to survive under conditions of water-level fluctuations.

Pure stands of cattail (*Typha*) make typical **emergent communities** on large marshes or ponds. Dense thickets of reed (*Phragmites australis*) girdle stagnant water-bodies in Ararat valley and around Lake Sevan. Often cattail and reed grow in mixed stands at altitudes 400-2,000 m. Rush (*Juncus*) stands are a characteristic feature of saline wetlands. Bulrush (*Scirpus*) prefers stagnant freshwater and sandy ground at the depths 10-150 cm (Lake Ayghr, Lake Parz, Lake Lichk). Sedges (*Carex*) occur at all altitudes but are most typical for high mountain floodplains. Pagoda-trees (*Sophora*), an Asian species, grow on transitional zones from saline marshes to meadows. Only small forest Lake Gosh (Tavush Marz) is surrounded by stands of horsetail (*Equisetum*). Mare's-tail (*Hippurus*) once made large stands in the currently dried Lake Gilli (1,916 m). Tamaris (*Tamarix*) makes mixed communities along the rivers and drainage canals in Ararat Valley and Vayots Dzor Marz. Willow (*Salix*) small 'tugay' formations are common on flooded lands of major rivers. As a relict of the glacier period, a small (0.5 ha) *Sphagnum* bog still survives in Syunik Marz.

Economic importance of wetland flora

Some wetland plants are eatable and are collected for **food**: Flowering Rush (*Butomus umbellatus*), water lily (*Nymphaea*), watercress (*Nasturtium*), dock (*Rumex*), sickleweed (*Falcaria*), and *Asparagus*. Tinctures if made of *Althaea officinalis*, *Bidens tripartida*, *Gnaphalium uliginosum*, *Glycyrrhiza glabra*, *Menyanthes trifoliata*, *Mentha longifolia*, *Nuphar luteum*, *Ononis arvensis*, *Polygonum hydropiper*, *Plantago major*, *Tussilago farfara*, *Valeriana sp.* are of traditional **medical use**. Many species serve for **hay** and ornamental **bouquets**. Young willow branches are used to construct fish-traps and baskets. In the past reeds had been

harvested for thatching and structural building (in combination with the clay). Present uses of reeds are crafts, and in rural areas as bedding material and livestock litter.

Peat utilization

Ultimate reserves of peat (50 million m³) still are in Torfavan. Other peat excavations were run out or reclaimed or have been stopped. Annual amount of extracted peat estimated 50,000-100,000 m³. Commercial peat is formed by reed, sedge, bulrush, reedmace and moss peat.

Economic importance of wetland fauna

Wetland fauna diversity includes 7 species of mammals, 136 species of birds, 4 species of reptiles, 8 species of amphibians, 36 species of fishes, and about 1,000 species of invertebrates. **Invertebrates** form two ecological groups: zoobenthos and zooplankton. Benthos dominant groups are *Nematoda* (quantity) and *Oligochaeta* and *Chironomidae* larvae (biomass). Plankton dominant groups are *Rotatoria* (quantity) and *Cladocera* and *Cyclopoida* (biomass). The role of invertebrates is tremendous as food for fish and waterfowl. Expected export of Galician Crayfish (*Astacus leptodactylus*) in EU countries and Russia in 2004 is 1,000 tons. Some benthic invertebrates, such as *Oligochaeta*, larvae of *Chironomidae* (*Diptera*) are collected for sale as food for aquarium fish.

The most well known **fish** in Armenia is the endemic Ishkhan (*Salmo ischchan*), which till the 1950s made half of country's fish catch but currently is at the edge of extinction. Among native fish species of commercial importance in Lake Sevan is Koghak (*Varicorhinus capoeta*), in Lake Arpi – Carp (*Cyprinus carpio*) and Chub (*Leuciscus cephalus*), in valley rivers - Cat-fish (*Silurus glanis*) and Chanar Barbel (*Barbus capito*), in mountain rivers - Brown Trout (*Salmo trutta*). At present introduced Whitefish (*Coregonus lavaretus*) and Crucian Carp (*Carassius auratus*) make 90% of country's commercial fishery.

Of **amphibians** the Marsh Frog (*Rana ridibunda*) is subject of increasing export in France. Such **reptiles** as Caspian Tortoise (*Clemmys caspica*), and Minor Asian Newt (*Tritulus vittatus*) caused growing interest as a pet. Waterbird diversity in Armenia is especially impressive and **birds** are the key element of wetland fauna. The waterfowl traditionally is a subject of hunt. Mallard (*Anas platyrhynchos*), Teal (*Anas crecca*) and Garganey (*Anas querquedula*) are among the most abundant, mildest and best-tasting of all ducks and Great Snipe (*Gallinago media*) among the waders. The eating quality of the Coot (*Fulica atra*) is fair but they are hunted intentionally on the fish breeding ponds. A number of **mammals** such as Coypu (*Myocastor coypus*), Muskrat (*Ondatra zibethicus*), Jackal (*Canis aureus*) and Jungle Cat (*Felis chaus*) are hunted for fur. The Coypu was introduced in the 1960's for farming in specialized enterprises, and the Muskrat was introduced in the 1990's specifically for hunting.

Heritage values

Wetlands have played a crucial role in the history of the Armenian nation. Excavated archaeological sites, such as early Stone Age cliff drawings, ruins of Lchashen castle-town (700 B.C.) in Gegharkunik Marz, Metsamor Bronze Age settlements, ruins of castle-town

Argishtikhinili (800 B.C.) in Armavir Marz show strong association between people and wetlands.

Moreover, of 13 Armenian capitals of different historical periods 5 were situated in direct neighboring to the wetland areas: Tushpa (Van, 800 B.C.), Erebouni (800 B.C.), Armavir (300 B.C.), Artashat (200 B.C. – IVth century), Dvin (IV–IX c.). The medieval bridges over the rivers Kasakh (Aragatsotn Marz), Azat (Kotayk Marz), Debed (Lori Marz) are among the most important monuments of engineering art in Armenia. Many Armenian ('Torfavan' – Peat Village, 'Metsamor' – Great marsh, 'Yeghegnadzor' – Reed Canyon, 'Urut' – Osier-bed, 'Yeghegnavan' – Reed Village, 'Yeghegnut' – Reed Stands) and Turkish ('Ghamishtala' – Reed Field, 'Hamzachimian' – Dense Marsh) geographical names remind that once the area was wetland.

Conflicts and threats to wetlands

All threats to Armenia's wetlands are human induced. At the heart of conflicts is underestimation of economical and especially ecological values of wetlands. In XX c. all more or less large wetland areas in Armenia had been crossed with drainage canals or drainage pipes. Dams and reservoirs had regulated the flow of many rivers. The main reason of draining the wetlands was land reclamation into agricultural and urban. Estimated area of wetland loss in Armenia is 40,000 ha.

Water loss is the most important threat to Armenia's wetlands. Wetlands have commonly been drained mainly in Ararat Valley. Another type of water loss was artificial increase of the outflow from Lake Sevan with the purpose to obtain hydropower and irrigation water for Ararat Valley farmlands including newly drained lands. Natural **water balance disturbance** happens because of uncontrolled water use and influenced negatively on wetland habitants. As a result of agricultural usage the level of Lake/Reservoir Arpi descend sharply throughout the nesting period producing disturbance to the largest world colony of endemic Armenian Gull (*Larus armeniacus*) numbering around 10,000 pairs. River Vardenik, which is of vital importance for Lake Sevan population of fish Koghak, is completely drained in drought summers because of flow diversion for irrigation. Turning of water from pond Ardenis (2,040 m, Shirak Marz) to the Village Ardenis for cattle watering made impossible breeding of Red-necked Grebe (*Podiceps grisegena*).

Exposure of wetland soils to drying in Ararat Valley brought to **soil deterioration**. At present the area of lands exposed to salination is 15,000 ha. **Soil erosion** on riverbanks is a natural process, which is pronounced while human induced. During the last 60 years the undercurrents of some tributaries of Lake Sevan formed 5-13 m deep U-shape valleys on the soft soils of former bottom. Soil erosion augment significantly sedimentation rate in Lake Sevan.

Sedimentation is another natural process, which becomes serious when aggregated by soil erosion and deforestation. Currently sediments filled up considerable part of net storage volume of Lake/Reservoir Arpi and other reservoirs and canals. Seasonal and regular rivers and creeks of the northeastern shore of Lake Sevan, upstream of rivers Aghstev, Getar, Elegis, Meghriget run highest degree danger of **mudflows**.

Only 400 ha are under the **waterlogging** in Armenia due to rise of underground waters. The gravity of the problem is that waterlogging experience a number of settlements around Metsamor Marsh in Armavir Marz and Village Lichk in Gegharkunik Marz. Surface water in Armenia generally seems to be of remarkably high quality as compared to EU water quality standards. Groundwater resources are well protected from **pollution**. However, without proper attention the situation could change easily. The discharge of domestic sewerage, agricultural run-off and industrial pollutants into wetlands increases the organic loading; in its turn decomposition of organic matter decreases the oxygen concentrations in the water. Worsening of oxygen conditions contaminate the water, endangering the plant and animals living in and near the wetland. Big problem for urban wetlands, especially in Yerevan (Yerevanyan Reservoir, Pond Vardavar, Pond Vardashen, River Getar) is illegal **garbage dumping**.

Increased demand on wetland resources lead to **over-exploitation**. Extensive use of water resources of Lake Sevan had had a chain of negative effects on the ecosystem: from physical conditions to fish community. Livestock overgrazing on Lake Lichk area brought to degradation of vegetation and serious deterioration of waterfowl habitats. Serious decline of fish stocks in Lake Sevan is the result of uncontrolled fishery. People and cattle access in wetland areas influenced adversely on the waterfowl. Waterfowl is especially sensitive to the **factor of disturbance** during the breeding period.

Deforestation upstream resulted in increase of surface run-off and sediment load as it has happened in Lake Parz (Tavush Marz). This reduces light penetration in waters and result in loss of productivity.

Invasive species of plants and animals are well known for their destructive impacts on wetland areas. Unpremeditated introduction of Crucian Carp in the fishponds of Ararat Valley (1960's) and later on in Lake Sevan (1978) influenced negatively first of all on the quantity of Koghak since their fries are food competitors. There is also the constant risk of new introductions as it had been happened recently with the Muskrat in Pond Ardenis. In three-year period the Muskrat completely destroyed the rush stands around this small (10 ha) sub-alpine lake.

During the contact with static and unpurified water an increase in the incidence of transmissible **diseases** can be expected. This already had happened in a number of settlements around the foul canals of degraded drainage system in Ararat Valley. Here around one thousand morbid events of malaria, a few events of cholera and dysentery had been registered during the recent years. Other wetlands seem secured against human diseases.

Endangered species

Plants Red Data Book of Armenia (1989) includes total 387 species; of them 42 species (11%) ecologically depend on wetland. Of 99 vertebrate species listed in Animals Red Data Book of Armenia (1987) 26 (26%) are species related to wetlands. Of them 2 fish species Ishkhan and Sevan Barbel (*Barbus goktschaicus*) are endemic to Lake Sevan. Armenian Gull considered endemic due to two known large breeding colonies situated on small islets on Lake Arpi and Lake Sevan. More 10 globally threatened species are listed in the IUCN Red List Database (2000): Medicinal Leech (*Hirudo medicinalis*), Asp

(*Aspius aspius*), European Tree Frog (*Hyla arborea*), Dalmatian Pelican (*Pelecanus crispus*), White-tailed Eagle (*Haliaeetus albicilla*), Lesser White-fronted Goose (*Anser erythropus*), Marbled Teal (*Marmoronetta angustirostris*), White-headed Duck (*Oxyura leucocephala*), Ferruginous Duck (*Aythya nyroca*), and European Otter (*Lutra lutra*).

Protected areas that include special wetland protection measures are obviously underrepresented in existing network. **Sevan National Park** aims to protect unique plant and animal communities of Lake Sevan and its catchment, ensuring natural ecological balance, development and protection against eutrophication; proper organization and service of recreation. **State Conservation Area Sev Lich** aims on protection of unique alpine watershed of Lake Sev with plant and animal communities, **Hankavan** and **Jermuk** – on safety of mineral water catchments. With exception of lakes Sevan and Sev, and some small rivers and streams within the territories of different protected areas, more 2 lakes have a conservancy status: 1) forest *Lake Parz* (27 ha, 1,334 m) within the territory of Dilijan National Park; and 2) *Lake Kari* (12 ha, 3,207 m) as main part of **Aragats State Conservation Area**.

Armenian Ramsar sites

Recognizing the true values of wetlands, Armenia became a Party to the Convention on wetlands in 1993, less than 2 years after independence from the former USSR.

<i>Site Name</i>	<i>Designated</i>	<i>Area</i>	<i>Coordinates</i>	<i>Location</i>
Lake Arpi	06/07/93	3,139 ha	41°03'N 043°37'E	Shirak Marz
Lake Sevan	06/07/93	489,100 ha	40°24'N 045°17'E	Gegharkunik Marz

Ramsar Shadow List

The following sites will be designated in the Ramsar List of Wetlands of International Importance first of all.

Site Name	Area	Coordinates	Location
<i>Pond Ardenis</i>	15 ha	41°05'N 043°43'E	Shirak Marz
Relict Wetlands of Lori	(?)	41°05'N 044°19'E	Lori Marz
Khor Virap Marsh	351 ha	39°46'N 045°37'E	Ararat Marz