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HANDBOOK

"Support to SHPP-relating Reforms through the Dialogue of Public and RA Nature Protection Ministry for Sustainable Use of River Ecosystems"



Yerevan, 2016



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"Support to SHPP-relating Reforms through the Dialogue of Public and RA Nature Protection Ministry for Sustainable Use of River Ecosystems"

SHPP sector needs reforms for the conservation of river ecosystems. In 2014-2016 "EcoLur" Informational NGO together with RA Nature Protection Ministry implemented "Support to SHPP-relating Reforms through the Dialogue of Public and RA Nature Protection Ministry for Sustainable Use of River Ecosystems" project. The aim of the project is to carry out reforms in SHPP sector by implementing eco-passportization of SHPPs constructed on the river ecosystems and creating databases, to make the operation of SHPP sector transparent, and to establish constructive grounds for the solution to the problems in SHPP sector. This handbook presents the analysis of 87 SHPP monitoring results, eco-passportization methodology, proposals on SHPP sector reforms submitted to RA National Assembly and RA Government, international development banks and SHPP owners.

This handbook has been developed in the frames of "Support to SHPP-relating Reforms through the Dialogue of Public and RA Nature Protection Ministry for Sustainable Use of River Ecosystems" with the support of UNDP/GEF SGP.

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**"Support to SHPP-relating Reforms through the Dialogue of Public and RA Nature
Protection Ministry for Sustainable Use of River Ecosystems"**

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Photos by Monica Yeritsyan, Levon Galstyan, Samvel Pipoyan, Inga Zarafyan, and Victoria Burnazyan

The need for reforms in small hydropower sector is urgent for the preservation of river ecosystems. In 2014-2016 “EcoLur” Informational NGO together with RA Nature Protection Ministry implemented "Support to SHPP-relating Reforms through the Dialogue of Public and RA Nature Protection Ministry for Sustainable Use of River Ecosystems” project. The aim of the project is to develop and present a package of SHPP reform proposals in small hydropower sector aimed at ecopassportization of SHPPs constructed on river ecosystems, creating relevant databases, establishing grounds for the transparency of the activities in SHPP sector and constructive dialogue for the solution to the problems in small hydropower sector.

Information databases has been created during the project, which includes the data of 87 SHPPs. A pattern plan has been developed for carrying out inspections in SHPPs, which can serve as a basis for the development and approval of monitoring methodology of SHPPs.

The pattern plan for SHPP inspection includes 8 categories: General Data, Hydrological Data, Derivation, Water Intake, Equipment, Production, Environmental, Social, which contain 75 criteria. The patter plan for SHPP inspection has been drawn up based on the following data: opinion and “Environmental Expertise” SNCO of RA Nature Protection Ministry and project, water usage permit issued by Water Resources Management Agency of RA Nature Protection Ministry, information and contact data provided by State Environmental Inspection of RA Nature Protection Ministry, licensing data provided by RA Public Service Regulatory Committee, data on SHPP electricity production provided by “Computation Center” CJSC. The inspectional pattern plan was complemented by SHPP study results – environmental flow conditions in water intake section, description of dam and fish passway, functional compliance of fish passway and fish-protecting net, ecological and sanitary state of the river, cases of landscape violation, distance from specially protected areas of nature, SHPP impact on river fish world, efficiency of station equipment, performance of greening and improvement works after SHPP construction, extent of electricity produced in the year before the monitoring, SHPP social impact on affected communities based on the data received during observation, analysis, conclusion and proposals of expert group.

The monitoring results of 87 SHPPs are published on www.ecolur.org in SHPP and Renewable Energy sections in Armenian, English and Russian.

GEOGRAPHICAL AND ADMINISTRATIVE LOCATION OF EXAMINED SHPPS

Tavush Region

Norgetik River: “Gosh” SHPP, developer – “GOSHHEK” LLC

Paghjur River: “Khachaghbyur HPP-1” SHPP, developer – “QAREVARD” LLC, “Khachaghbyur” SHPP, developer – “ENERGY COC” LLC, “Khachaghbyur-2” SHPP, developer – “MEGAENERGY” LLC

Khachardzan River: “Khachardzan” SHPP, developer – “GOSHHEK” LLC,

Aghstev River: “Aghstev- 1” SHPP, developer – “LNX” LLC,

Hakhum River: “Sirarpi” SHPP, developer – “SIRARPI AH” LLC,

Getik Tributary to Aghstev River: “Getik SHPP-4” SHPP, developer – “A&G Style” LLC.

Gegharkounik Region

Getik Tributary to Aghstev River: “Erik” SHPP, developer – “Erik SHPP” LLC, “Getik -1” SHPP, developer – “ARIYO ENERGY” LLC,

Karatoprak Tributary to Getik River: “Vahan” SHPP, developer – “Erik SHPP” LLC,

Martuni River: “Martuni” SHPP, developer – “MKSHG ENERGY” LLC,

Vardenis River: “Vardenik” SHPP, developer – “Jrasahq” LLC,

Argitchi River: “Argitchi” SHPP, developer – “HydroCorporation” CJSC.

Aragatsotn Region

Gegharot River: “Aragats -1” SHPP, developer – “VACUFLO” LLC, “Gegharot” SHPP, developer – “El-Kas” LLC,

Ampur Tributary to Amberd River: “Amberd SHPP -1” SHPP, developer – “Amberd HPP” LLC, “Amberd SHPP -2” SHPP, developer – “Amberd HPP” LLC.

Kotayq Region

Tezh River: “Tezh” SHPP, developer – “Tezh Waterfall” LLC,

Arjadzor Tributary to Tezh River: “Arjadzor” SHPP, developer – “ARJADZOR HPP” LLC,

Goght Tributary to Azat River: “Goght -1” SHPP, developer – “JAGHATSI DZOR” CJSC, “Goght-2” SHPP, developer - “JAGHATSI DZOR” CJSC,

Akunq Tributary to Hrazdan River: “Gndasar” SHPP, developer – “GNDASAR SHPP” LLC.

Lori Region

Martz River: “Martziget SHPP-2” SHPP, developer – “ARGISHTI-1” LLC, “Martziget 1” SHPP, developer – “MARTZ ENERGY” LLC,

Sarajur Tributary to Martz River: “POZITRON” SHPP, developer – “AYUDA-LOS” LLC,

Pambak River: “Arjut-2” SHPP, developer – “Ler&Jur” LLC, “Spitak HPP-1” SHPP – developer - “Eliza Pharm” LLC,

Tandzut River: “Vahagni” SHPP, developer – “Apahov Taniq” LLC,

Gargar River: “Kurtan” SHPP, developer – “Tirakal” LLC,

Chanakhchi River: “Chanakhchi HPP-2” SHPP, developer – “Mavr” LLC,

Dzoraget River: “Katnarat” SHPP, developer – “VANSHAYN” LLC, “Dzoraget-5” SHPP, developer – “Hazar u Mek” LLC, “Dzoraget-6” SHPP, developer – “VRB Concern” LLC, “DzoraHEK” SHPP, developer – “DZORAGET HYDRO” LLC.

Shirak Region

Heghnajur River: “Heghnajur” SHPP, developer – “ARNAVAR” LLC,

Akhuryan River: “Marmarashen” SHPP, developer – “ELBIST” LLC, “Paros” SHPP, developer – “LIGHTECO” LLC, “Amasia” SHPP, developer – “ERSTED” LLC.

Syunik Region

Shaqi Tributary to Vorotan River: “Shaqi” SHPP, developer – “Hakobjanyani ev Galstyani HEK” LLC,

Meghri River: “Meghri” SHPP, developer – “QH” LLC, “Nzhdeh” SHPP, developer – “SAR-RUB” LLC,

Litchq and Arevik Tributaries to Meghri River: “Kantegh” SHPP, developer – “GELIEGUZAN” LLC,

Vorotan River: “Vorotna HPP” SHPP, developer – “Hakobjanyani ev Galstyani HEK” LLC, “Apres” SHPP, developer – “Syunik” LLC, “Vorotan-7” SHPP, developer – “HGNQ Group” LLC, “Ishkhanasar” SHPP, developer – “MIEZERQ” LLC,

Sandaghyur River: “Sandaghyur” SHPP, developer – “Single Gor” LLC,

Smbuli Jur Spring: “Smbul” SHPP, developer – “Smbul” LLC,

Vardan Zoravar Springs: “Manuk” SHPP, developer – “Smbul” LLC,

Jaghatsi Spring: “Angeghakot” SHPP, developer – “Zh&K HPP” LLC,

Aragilijur (Aragliget) River: “Getap” SHPP, developer – “Firma G.A.KH.” LLC, “Shaghat” SHPP, developer – “Shaghat” LLC,

Ayri River: “Ayri” SHPP, developer – “Zoraqar” CJSC, “Dastakert” SHPP, developer – “BASA SHIN” LLC

Tsav River: “Tsav” SHPP, developer – “LESOMA” OJSC,

Geghi Tributary to Voghji River: “Geghi-2” SHPP, developer – “EREMIREENERGY” LLC,

Voghji River: “Voghji-1”, “Voghji-2”, “Voghji-3” SHPPs, developer – “KAPAN ENERGY” CJSC,

Baghatsjur Tributary to Voghji River: “Dzagedzor SHPP-2” SHPP, developer – “QAJARAN MONTAZH” LLC.

Vayots Dzor Region

Voghji River: “ARENI” SHPP, developer – “ARENI HPP” LLC, “Jermuk HPP-2” SHPP, developer – “Jermuki Hydrotech” LLC, “Arpa” SHPP, developer – “ARPA-ENERGY” LLC,

Her-Her Tributary to Arpa River: “Her-Her 1” SHPP, developer – “FIRMA G.A.KH” LLC, “Her-Her 1” SHPP, developer – “BG ev Vordiner” LLC,

Sarnaghbyur natural springs and nameless tributaries to Arpa River: “Jermuk” SHPP, developer – “Mushegh HPP” LLC,

Yeghegis River: “Yeghegis-1” SHPP, developer – “Bazenq” CJSC, “Yeghegnadzor” SHPP, developer – “MINA-MAYA” LLC, “Yeghegnadzor SHPP-1” SHPP, developer – “MINA-MAYA” LLC, “Goghtanik” SHPP, developer – “H.H.N.M.S” LLC, “YEGHEGIS-3” SHPP, developer – “SYUNYATS VOTY” LLC, “Yeghegis-2” SHPP, developer – “RAEL GES” LLC, “Yeghegis” SHPP – Developer “Elegis HPP” LLC, “Yegheq” SHPP, developer – “YEGHEGHEK” LLC, “Khachi Qar” SHPP - developer – “BSB” LLC, “Tigran Mets” SHPP, developer - “RUS&HAR” LLC,

Artabunq Tributary to Yeghegis River: “SURB AGHBYUR” SHPP, developer – “SURB AGHBYUR” LLC, “Vayots” SHPP, developer – “SURB AGHBYUR” LLC,

Karakaya Tributary to Yeghegis River: “SUNRISE” SHPP, developer – “SUNRISE ELECTRIC” CJSC, “Vardahovit” SHPP, developer – “VARDAHOVIT” LLC,

Karakaya River and Its Right-wing Tributary: “Karakaya” SHPP, developer – “HAK HPP” LLC,

Aysas Tributary to Karakaya River: “Hermon” SHPP, developer – “Elegis HPP” LLC, “Nane” SHPP, developer – “ARATES ENERGY” LLC,

Qaraglukh River: “Qaraglukh” SHPP, developer – “Hermon MAD” LLC,

Artavan River: “Artavan-1” SHPP, developer – “Jahuk” LLC,

Ankan Tributary to Arpa River: “GNDEVANQ” SHPP, developer – “BSB” LLC,

Martiros Tributary to Zaritap River: “Varantsov” SHPP, developer – “VARANTSOV HPP” LLC.



“Arjadzor” SHPP



“Goght 1” SHPP



“Arjut- 2” SHPP



“Dzoraget 6” SHPP



“Vahagni” SHPP



“Khachardzan” SHPP



“Sirarpi” SHPP fish passway



“Amasia” SHPP



“Heghnajur” SHPP



“Paros” SHPP



“Angeghakot” SHPP



“Apres” SHPP



“Geghi 2” SHPP



Equipment of “Geghi 2” SHPP



“Ishkhanasar” SHPP fish passage



“Manuk” SHPP



“Nzhdeh” SHPP



“Nzhdeh” SHPP fish passway



“Sandaghbyur” SHPP



“Shaghat” SHPP



“Voghji 1” SHPP



“Voghji 2” SHPP



“Voghji 3” SHPP



“Vorotna” SHPP

PROBLEMS

The problems detected as a result of SHPP monitoring are as follows: incorrect project hydroeconomic estimates, not ensuring environmental flow, functional incompliance of fish passways and fish-protecting nets and negative shifts in fish biodiversity and quantitative indicators of local fish species, insufficient level of SHPP productivity, formation of SHPP cascades without cumulative effects assessment.

Ensuring environmental flow and incorrect project hydroeconomic estimates

All the examined SHPPs don't have environmental flow management system, which would enable controlling to what extent the business entity complies with the requirement to adhere to amount set for environmental flow in the water usage permit. SHPPs don't have any water-measuring device to record the environmental flow, which should have been installed in the outlet section of the environmental flow.

According to the methodology for environmental flow set in governmental resolution № 927 dated on 30.06.2011, environmental flow is considered the average value of minimum yields observed in winter 10 days for several years in the section of the river hydrological observation site and the value of the determined environmental flow is the same for all months. Nevertheless, the river regimes vary per year seasons and their hydrological, hydromorphological, hydrobiological and hydrochemical descriptors are not taken into consideration. The amount of the environmental flow set in the water usage permits of SHPPs doesn't ensure the balance and biodiversity of river ecosystem.

Reliable hydrological data on the river are missing, which leads to incorrect hydroeconomic estimates. Estimates are mainly calculated based on average monthly yields, when it's more expedient for the SHPPs to use average daily yields.

A number of SHPPs don't ensure their projected capacities because of hydroeconomic estimates based on incorrect hydrological data. Violations have been recorded in a number of SHPPs ensuring environmental flow through fish passways. Particularly, the entrances of the fish passways are blocked with different constructions, which hinder the passage of the environmental flow into the internal canal pound.

The requirement of assessing water distribution priorities set in RA Water Code hasn't been followed in the process of issuing water usage permit: the requirements of all water users and their interrelations are not taken into consideration. The Public Service Regulatory Committee takes into consideration in determining the tariff the purposes and system of water usage. In the list of water users the priority of water usage for energy purposes is in the bottom of the list prioritizing water users taking water for economic, irrigation and drinking purposes. As a matter of fact, there are SHPPs, which direct the water taken from the SHPP not back to the river, but to irrigation systems.

There are cases when the SHPP simultaneously takes water from two different water courses – both from the river and drinking or irrigation water system. There are cases, when the SHPP should have been constructed on the river, but, in fact, it's constructed on the irrigation system.

Cumulative Effects Assessment

The examination of SHPPs showed there are SHPP cascades available on the rivers. The cumulative effect on the river ecosystem is also not assessed.

In the frames of the project the road overload with SHPPs was calculated taking into consideration the correlation of aggregate length of SHPP derivation with river length.

The project presents those rivers overloaded with SHPPs, 30% of their length is piped or can be piped because of newly constructed SHPPs.

Overload of Yeghegis River with SHPPs: 47km/ 51.46%

Constructed SHPPs

1. “Yeghegis 1” SHPP (length of derivation pipeline - 4000 meters, according to PSRC certificate)
2. “Yeghegnadzor” SHPP (its length is 3250m, 54m, according to the project)
3. “Yeghegnadzor SHPP 1” SHPP (its length is 2650 meters, according to the project)
4. “Yeghegis 3” (derivation length is 931.37 meters, according to the project)
5. “Yeghegis 2” SHPP (derivation length is 2138 meters, according to the project)
6. “Yegheg” SHPP (derivation length is 1924 meters, according to the project)
7. “Goghtanik” SHPP (derivation length is 1400 meters, according to the project)
8. “Yeghegis” SHPP (derivation length is 2450 meters)
9. “Tigran Mets” SHPP (derivation length is 2691 meters, according to the project)
10. “Khachi Qar” SHPP (derivation length is 2240 meters, according to the project).

The following SHPPs are planned to be constructed on the Yeghegis River:

1. “Ainars” SHPP - “Ainars” LLC developer (according to the PSRC certificate, the length of the pipeline is 2300 meters),
2. “Yeghegnut” SHPP – “VTV Energy” developer (according to the PSRC certificate, the length of the pipeline is 2665 meters),
3. “Elis” SHPP – “Elis HPP” LLC developer (according to the PSRC certificate, the SHPP will be constructed on the Yeghegis and Soghanlu Rivers, the length of the pipelines is 2360.0 and 2288.0 meters),

Overload of Karakaya Tributary to Yeghegis River with SHPPs: 15km/ 67.76%

1. “Sunrise” SHPP, developer – “Sunrise Electric” CJSC, (length of pipeline is 2268 meters, according to the project)
2. “Vardahovit” SHPP, developer – “Vardahovit” LLC, (length of pipeline is 3570 meters, according to the project)
3. “Karakaya” SHPP, developer – “HAK HPP” LLC, (according to the project, the length of the pipeline in Karakaya River is 3127 m, 1200 m, right-wing tributary – 1200 m)

Overload of Aysas Tributary to Karakaya River with SHPPs: 12km/ 49.96%

1. “Hermon” SHPP, developer – “Elegis HPP” LLC (length of pipeline is 3270 meters, according to the project)
2. “Nane” SHPP, developer - “ARATES ENERGY” LLC (length of pipeline is 2726 meters, according to the project)

Overload of Artavan River with SHPPs: 19km/ 20.11%

1. “Artavan-1” SHPP, developer – “Jahuk” LLC (3821.5m, according to the project)

The following SHPPs are planned to be constructed on the Artavan River:

1. “Artavan” SHPP 1, developer – “Artavan HPP” LLC (length of pressure pipeline is 945 meters, according to the PSRC certificate dated on 1 October 2015)

2. “Artavan” SHPP 2, developer – “Artavan HPP” LLC (length of pressure pipeline is 1585 meters, according to the PSRC certificate dated on 1 October 2015)

If these SHPPs are constructed, they will pipe 33.42% of the Artavan River.

Overload of Martiros tributary to Zaritap River with SHPPs: 12km/ 33.47%

1. “Varantsov” SHPP 2, developer – “VARANTSOV HPP” LLC (length of pressure pipeline is 4017 meters, according to the project)

Overload of Gegharot River with SHPPs: 25km/ 28.83%

1. “Gegharot” SHPP, developer – “El-Kas” LLC (length of pressure pipeline is 4640 meters, according to the project)
2. “Aragats-1” SHPP, developer – “VACULFO” LLC (length of pressure pipeline is 2530 meters, according to the project, the length of dotation pipeline is 219 m)

The following SHPPs are planned to be constructed on the Gegharot River:

1. “Alpiakan” SHPP, developer – “IPRA” LLC (length of pressure pipeline is 2800 meters, according to the PSRC certificate dated on 1 October 2015)
2. “Lusarpi” SHPP, developer – “LUSARPI” LLC (length of pressure pipeline is 1120 meters, according to the PSRC certificate dated on 1 October 2015)

If these SHPPs are constructed, they will pipe 44.51% of the Gegharot River.

Overload of Goght Tributary to Azat River with SHPPs: 16km/ 36.87%

Overload of Gegharot River with SHPPs: 25km/ 28.83%

1. “Goght-1” SHPP, developer – “JAGHATSI DZOR” LLC (length of pressure pipeline is 3850 meters, according to the project)
2. “Goght-2” SHPP, developer – “JAGHATSI DZOR” LLC (length of pressure pipeline is 2050 meters, according to the project)

Overload of Martz River with SHPPs: 29km/ 36.65%

1. “Martziget SHPP 2” SHPP, developer – “ARGISHTI-1” LLC (length of pressure pipeline is 2818 and 2962 meters, according to the project)
2. “Martziget-1” SHPP, developer – “MARTZ ENERGY” LLC (length of pressure pipeline is 4850 meters, according to the project)

Overload of Sarajur Tributary to Martz River with SHPPs: 11km/ 36.36%

1. “POZITRON” SHPP, developer – “AYUDA-LOS” LLC (length of pressure pipeline is 750, 750 and 2500 meters, according to the project)

Overload of Aragilijur (Aragliget) River with SHPPs: 16km/ 36.44%

1. “Getap” SHPP, developer – “Firma G.A.KH” LLC (length of pressure pipeline is 4568 meters, according to the project)
2. “Shaghat” SHPP, developer – “Shaghat” LLC (length of pressure pipeline is 1263 meters, according to the project)

Overload of Gosh River with SHPPs: 8km/ 37.37%

1. “Gosh” SHPP, developer – “GOSHHEK” LLC (length of pressure pipeline is 2990 meters, according to the project)

Functional incompliance of fish pathways and fish-protecting nets and negative shifts in fish biodiversity and quantitative indicators of local fish species

In the frames of the project the fish species inhabiting in individual rivers and SHPP impact on them were examined.

The following fish species inhabit in Getik Tributary to Aghstev River: Brown trout *Salmo trutta fario*, Kura barbel *Barbus cyri*, Sevan Khrumulya *Capoeta sevangi* (red-listed in Armenia), South Caspian sprinlin *Alburnoides eichwaldii*, Rainbow trout *Parasalmo mykiss*.

Norgetik Tributary to Getik River only has Brown trout *Salmo trutta fario*.

Karatoprak Tributary to Getik River may only have Brown trout *Salmo trutta fario*.

The following fish species inhabit in Paghjur River: Brown trout *Salmo trutta fario*, Transcaucasian carp *Capoeta capoeta*, Kura barbel *Barbus cyri*. South Caspian sprinlin *Alburnoides eichwaldii* and Kura loach *Oxynoemacheilus brandtii*, Kura bleak *Alburnus filippii* may also flow up here. Rainbow trout *Parasalmo mykiss* may also penetrate here from the fish farms.

The following fish species inhabit in Khachardzan River: Brown trout *Salmo trutta fario*, Kura barbel *Barbus cyri*, South Caspian sprinlin *Alburnoides eichwaldii*.

The following fish species inhabit in Aghstev River: Brown trout *Salmo trutta fario*, Kura barbel *Barbus cyri*, South Caspian sprinlin *Alburnoides eichwaldii*, Sevan Khrumulya *Capoeta sevangi* (red-listed in Armenia), Kura loach *Oxynoemacheilus brandtii*, Kura bleak *Alburnus filippii*, European chubs *Squalius orientalis*, Prussian carp *Carassius gibelio*, Topmouth gudgeon *Pseudorasbora parva*, Rainbow trout *Parasalmo mykiss*.

The following fish species inhabit in Hakhum River: Brown trout *Salmo trutta fario*, Kura barbel *Barbus cyri*, South Caspian sprinlin *Alburnoides eichwaldii*, Prussian carp *Capoeta sevangi* (red-listed in Armenia), Prussian carp *Carassius gibelio*.

The following fish species inhabit in Martuni River: Gegarkuni Sevan trout *Salmo ischchan gegarkuni* (red-listed in Armenia), Brown trout *Salmo trutta fario*. Sevan Khrumulya *Capoeta sevangi* (red-listed in Armenia) and Sevan barbel (red-listed in Armenia) may also flow up here.

The following fish species inhabit in Vardenis River: Brown trout *Salmo trutta fario*, Sevan Khrumulya *Capoeta sevangi* (red-listed in Armenia), Gegarkuni Sevan trout *Salmo ischchan gegarkuni* (red-listed in Armenia) and Sevan barbel *Barbus goetschaicus* (red-listed in Armenia) may also flow up here. The presence of rainbow trout *Parasalmo mykiss* is also possible, as it is grown in the adjacent lakes.

The following fish species inhabit in Argitchi River: Brown trout *Salmo trutta fario*, Sevan barbel *Barbus goetschaicus* (red-listed in Armenia), Sevan Khrumulya *Capoeta sevangi* (red-listed in Armenia), Gegarkuni Sevan trout *Salmo ischchan gegarkuni* (red-listed in Armenia).

South Caspian sprinlin *Alburnoides eichwaldii* may also flow up here, as it has recently appeared in Lake Sevan basin and has been observed in SHPP adjacent areas. SHPP employees deal with letting out the fish into the river. According to the employees⁸⁸, the fish is regularly let out into the SHPP head section reservoir. The fish may contain Rainbow trout *Parasalmo mykiss*. Additional ichthyologic examinations are needed to clear out the current situation.

According to the residents and SHPP employees, you won't see any fish in **Gegharot River**, though the hydrological type of the river complies with the biological requirements of Brown trout *Salmo trutta fario*.

The hydrochemical composition of the river is another problem, which may be unfavorable for the life of the fish. This issue needs additional examinations.

The following fish species inhabit in Ampur Tributary to Amberd River: Kura barbel *Barbus cyri* and South Caspian sprilin *Alburnoides eichwaldii* may inhabit here.

The hydrological type of **Goght River** complies with the biological requirements of Brown trout *Salmo trutta fario*.

Regular drying of the riverbed can't contribute to the existence of Brown trout for the preservation or restoration of this fish species in this river.

The following fish species inhabit in Hrazdan River: Brown trout *Salmo trutta fario*, South Caspian sprilin *Alburnoides eichwaldii*, Kura barbel *Barbus cyri*, Sevan Khrumulya *Capoeta sevangi* (red-listed in Armenia), Kura loach *Oxynoemacheilus brandtii*, Prussian carp *Carassius gibelio*, Topmouth gudgeon *Pseudorasbora parva*, Rainbow trout *Parasalmo mykiss*, which may penetrate into the tributaries flowing into Hrazdan, particularly **Akunq River**.

The following fish species inhabit in Debd River: Brown trout *Salmo trutta fario*, South Caspian sprilin *Alburnoides eichwaldii*, Kura barbel *Barbus cyri*, Sevan Khrumulya *Capoeta sevangi*, Transcaucasian carp *Capoeta capoeta*, Kura bleak *Alburnus filippii*, Mursa *Luciobarbus mursa*, Gobio *Gobio* sp., Kura loach *Oxynoemacheilus brandtii*, Sunbleak *Leucaspis delineatus*, Commoan bream *Abramis brama*, Prussian carp *Carassius gibelio*, as well as Rainbow trout *Parasalmo mykiss*, sometimes carp *Cyprinus carpio* penetrating here from different fish farms. The aforementioned fish species can be met in the place, where Dzoraget and Pambak Rivers join together and flow up Dzoraget river.

The hydroenergetic and hydrotechnical structures built on Dzoraget River hinder the migration of the fish. As a result, most fish species inhabiting in Debed, which inherently migrate in reproduction seasons, don't have any opportunity to flow up Dzoraget River to inhabit and reproduce there.

The following fish species inhabit in Debed River: Kura barbel *Barbus cyri* and South Caspian sprilin *Alburnoides eichwaldii*. Martz River was famous for its large reserves of brown trout *Salmo trutta fario*.

SHPP fish passages constructed on Martz River don't contribute to the migration of the fish flowing from Debed River: the fish flowing up the river from the lower part of the river meet insurmountable obstacles, which leads to essential decrease in fish biodiversity in the river.

The following fish species inhabit in Sarajur Tributary to Martz River: Brown trout *Salmo trutta fario*, Kura barbel *Barbus cyri*, South Caspian sprilin *Alburnoides eichwaldii*.

The following fish species inhabit in Pambak River: Brown trout *Salmo trutta fario*, South Caspian sprilin *Alburnoides eichwaldii*, Kura barbel *Barbus cyri*, Sevan Khrumulya *Capoeta sevangi* (red-listed in Armenia). Rainbow trout *Parasalmo mykiss* often penetrates here from the fish farms.

The following fish species inhabit in Tandzut River: Brown trout *Salmo trutta fario*, South Caspian sprilin *Alburnoides eichwaldii*, Kura barbel *Barbus cyri*. Rainbow trout *Parasalmo mykiss* often penetrates here from the fish farms and Prussian carp *Carassius gibelio* may penetrate from the nearby lake.

The following fish species inhabit in Gargar River: Brown trout *Salmo trutta fario*, South Caspian sprilin *Alburnoides eichwaldii*, Kura barbel *Barbus cyri*.

The temperature in the lake generated from the development of the dam in the SHPP constructed on the Gargar River essentially differs from the temperature of the water flowing in the river, which doesn't establish favourable conditions for the natural life of the fish in the river. The lake is favorable for the introduction and penetration of Prussian carp *Carassius gibelio*, which is not a desirable phenomenon.

The following fish species inhabit in Chanakhchi River: Brown trout *Salmo trutta fario*, South Caspian sprilin *Alburnoides eichwaldii*, Kura barbel *Barbus cyri*, Sevan Khramulya *Capoeta sevangi* (can rarely be met, red-listed in Armenia). Rainbow trout *Parasalmo mykiss* often penetrates here from the fish farms.

Only Brown trout *Salmo fario trutta* inhabits in Heghnajur River.

SHPP dam construction on Heghnajur River caused formation of a lake-like pond, which can generate favorable conditions for the intrusion and climate accustomization of Prussian carp *Carassius gibelio*, which is not a desirable phenomenon. On the other side, the water collected in the lake gets warmer in the summer and gets colder in the winter months, which also disturbs the natural migration and living way of Brown trout in the river.

The following fish species inhabit in Akhuryan River: Brown trout *Salmo trutta fario* (meets accidentally), Blackbrow bleak *Acanthalburnus microlepis*, Transcaucasian carp *Capoeta capoeta capoeta*, Sevan Khramulya *Capoeta sevangi*, Kura nase *Chondrostoma cyri*, European chubs *Squalius orientalis*, Kura barbel *Barbus cyri*, South Caspian sprilin *Alburnoides eichwaldii*, Angora loach *Oxyemacheilus angorae*, Kura loach *Oxyemacheilus brandtii*, Asp *Aspius aspius* (red-listed in Armenia), Kura bleak *Alburnus filippii*, Common carp *Cyprinus carpio*, Monkey goby *Neogobius fluviatilis*, Golden loaches *Sabanejewia aurata* (red-listed in Armenia), Prussian carp *Carassius gibelio* (climate accustomed), Topmouth gudgeon *Pseudorasbora parva* (climate accustomed). Rainbow trout *Parasalmo mykiss*, Silver carp *Hypophthalmichthys molitrix* and Grass carp *Ctenopharyngodon idella* may penetrate here from the fish farms.

The following fish species inhabit in Vorotan River: Brown trout *Salmo trutta fario*, South Caspian sprilin *Alburnoides eichwaldii*, Kura barbel *Barbus cyri*, Mursa *Luciobarbus mursa*, Sevan Khramulya *Capoeta sevangi* (red-listed in Armenia), Kura bleak *Alburnus filippii*, European chubs *Squalius orientalis*, Prussian carp *Carassius gibelio*. Rainbow trout *Parasalmo mykiss* often penetrates here from the fish farms.

The main fish species in **Shaqi Tributary to Vorotan River** is Brown trout *Salmo trutta fario*. You can also meet here South Caspian sprilin *Alburnoides eichwaldii*, cyprinid *Capoeta sp.*, Kura barbel *Barbus cyri*. Recently fish farms work on the banks of this river, from where Rainbow trout *Parasalmo mykiss* and Prussian carp *Carassius gibelio* may penetrate.

The following fish species inhabit in Meghri River: Brown trout *Salmo trutta fario*, Kura barbel *Barbus cyri*, Cyprinid *Capoeta sp.*, South Caspian sprilin *Alburnoides eichwaldii*, Kura loach *Oxyemacheilus brandtii*.

The presence of **Brown trout** *Salmo trutta fario*, South Caspian sprilin *Alburnoides eichwaldii*, Transcaucasian carp *Capoeta capoeta*, Kura barbel *Barbus cyri* is possible in **Sandaghbyur River**. The large lake formed above the SHPP dam enables inhabiting of Prussian carp *Carassius gibelio*. Rainbow trout *Parasalmo mykiss* often penetrates here from the fish farms.

The following fish species inhabit in ShaghatRiver: Brown trout *Salmo trutta fario*, Kura barbel *Barbus cyri*, South Caspian sprilin *Alburnoides eichwaldii*, cyprinid *Capoeta sp.* The penetration of Rainbow trout *Parasalmo mykiss* and Prussian carp *Carassius gibelio* is possible.

The following fish species inhabit in Ayri River: Brown trout *Salmo trutta fario*, Kura barbel *Barbus cyri*, South Caspian sprilin *Alburnoides eichwaldii*.

The lake generated because of the head section dam constructed on Ayri riverbed and the operating type of the fish passway don't create favorable conditions for the natural life of the abovementioned fish species.

The following fish species inhabit in Tsav River: Brown trout *Salmo trutta fario*, Transcaucasian carp *Capoeta capoeta*, Kura barbel *Barbus cyri*, South Caspian sprilin *Alburnoides eichwaldii*, Kura loach *Oxyemacheilus brandtii*, Rainbow trout *Parasalmo mykiss* often penetrates here from the fish farms.

The following fish species inhabit in the middle reach of Voghji River: Brown trout *Salmo trutta fario*, South Caspian sprilin *Alburnoides eichwaldii*, Kura barbel *Barbus cyri*, Cyprinid

Capoeta sp., Prussian carp *Carassius gibelio*. Rainbow trout *Parasalmo mykiss* often penetrates here from the fish farms.

The following fish species inhabit in the lower reach of Geghi Tributary to Voghji River:

Brown trout *Salmo trutta fario*, South Caspian sprilin *Alburnoides eichwaldii*, Kura barbel *Barbus cyri*, Cyprinid *Capoeta* sp. Rainbow trout *Parasalmo mykiss* and Prussian carp *Carassius gibelio* often penetrates here from the fish farms.

The following fish species inhabit in the Baghatsjur Tributary to Voghji River: Brown trout *Salmo trutta fario*: Kura barbel *Barbus cyri*, Rainbow trout *Parasalmo mykiss* may also be met here, as they grow in the ponds located adjacent to SHPP.

Different hydrotechnical dams in Voghji River basin - SHPP dams, irrigation systems, Geghi reservoir as well as artificially generated lack of water because of water intake carried out for mining, waste water regularly dumped into the river cause irreversible damage not only to the fish world, as well as the whole ecosystem. For this very reason, urgent environmental measures are needed aimed at the construction of fish passways and other fish-protecting structures, elimination of wastewater, new determination of environmental flows in the rivers.

The following fish species inhabit in Arpa River: Bulatmai barbel *Luciobarbus capito*, Mursa *Luciobarbus mursa*, Cyprinid *Cyprinus carpio*, Topmouth gudgeon *Pseudorasbora parva*, South Caspian sprilin *Alburnoides eichwaldii*, Kura loach *Oxynoemacheilus brandtii*, Prussian carp *Carassius gibelio*, Kura bleak *Alburnus filippii*, Kura barbel *Barbus cyri*, Sevan Khramulya *Capoeta sevangi* (red-listed in Armenia), Transcaucasian carp *Capoeta capoeta*, Kura nase *Chondrostoma cyri*, European chubs *Squalius orientalis*, Brown trout *Salmo trutta fario*. You may also meet here Blackbrow bleak *Acanthalburnus microlepis*, Asp *Aspius aspius* (red-listed in Armenia), Rainbow trout *Parasalmo mykiss*.

The following fish species inhabit in Her-Her River: Brown trout *Salmo trutta fario*, Cyprinid *Capoeta* sp., Kura barbel *Barbus cyri*, South Caspian sprilin *Alburnoides eichwaldii*, Kura bleak *Alburnus filippii*, Rainbow trout *Parasalmo mykiss* may also penetrate here.

The following fish species inhabit in Yeghegis River: Brown trout *Salmo fario*, Kura barbel *Barbus cyri*, South Caspian sprilin *Alburnoides eichwaldii*, Sevan Khramulya *Capoeta sevangi* (red-listed in Armenia).

The hydrological data of **Artabuynq Tributary to Yeghegis River** (flow, abundance of water etc.) comply with the biological needs of Brown trout *Salmo trutta fario*.

There is no fish inhabiting in Artabuynq. The local residents also outline the absence of the fish. Most probably it's connected with certain chemicals present in the water, which needs additional hydrochemical studies.

The following fish species inhabit in Karakaya Tributary to Yeghegis River: Brown trout *Salmo trutta fario*, South Caspian sprilin *Alburnoides eichwaldii*, Kura barbel *Barbus cyri*. Rainbow trout *Parasalmo mykiss* may penetrate here from the fish farms.

The following fish species inhabit in Aysas Tributary to Karakaya River: South Caspian sprilin *Alburnoides eichwaldii*, Kura barbel *Barbus cyri*, Brown trout *Salmo trutta fario*. You may only meet Brown trout *Salmo trutta fario* in Qaraglukh Tributary to Yeghegis River.

Different fish farms are located on Yeghegis River and its tributaries, which gets water supply from the river and discharge it back to the river without cleaning it. These fish farms mainly grow Rainbow trout *Parasalmo mykiss*, which can accidentally appear in the river. The main concern is that the fish in such fish farms regularly get sick with different diseases, which can be infectious for local wildlife fish.

The following fish species inhabit in Artavan River: Brown trout *Salmo trutta fario*, South Caspian sprinlin *Alburnoides eichwaldii*.

The following fish species inhabit in Martiros Tributary to Zaritap River: Brown trout *Salmo trutta fario*, the presence of South Caspian sprinlin *Alburnoides eichwaldii* and Kura barbel *Barbus cyri* is possible.

“Fish Passways of Small Hydropower Plants on Agshtev and Hakhum Rivers and Their Significance in Fish World Preservation” scholarly article has been published based on monitoring results. “Fish Passways of Small Hydropower Plants in Debed River Basin and Their Significance in Fish World Preservation” and “Fish Passways of Small Hydropower Plants and Their Significance in Fish World Preservation in Rivers of Kura Basin” will be published, the authors of which are S. Kh. Pipoyan, A. S. Araqelyan, L. Galstyan, I.S. Gabayan.

“Fish Passways of Small Hydropower Plants on Agshtev and Hakhum Rivers and Their Significance in Fish World Preservation” scholarly article particularly says, “SHPP activities have already resulted in a number of problems and obstacles, which increase SHPP riskiness in environmental viewpoint. Mostly constructed on small riverbeds, SHPP water intake head section structures, from where river water flows into pressure pipeline and flows into SHPP turbines, the riverbed is usually blocked with concrete or metallic dam. As a result, the water in small rivers gets decreased, while the set amount of environmental flow and the structure of fish passways don’t often ensure free movement of fish species and other organisms from one section to another. Besides, the absence of fish-protecting nets in head section structures of SHPP water intake or large slots of existing garbage-collecting nets is not an obstacle for the fish living in the upper reach of the river, particularly young fish to appear in the pressure pipeline of SHPPs, where they are exposed to mechanical or other impacts.”

Thus, the analysis of the types and structural solutions of SHPP fish passways constructed on the riverbeds belonging to Kura River and flowing through Armenia shows that the essential part of the fish passways doesn’t comply with the biological needs and physical capacities of the fish species living in those rivers and performing regular migrations. In this sense, most of them are ends in themselves and don’t comply with the contemporary requirements of such structures, which are the main reasons for their improper functioning. On the other hand, the fish passways in Armenia are projected under the existing standards, which, as a matter of fact, are mainly developed for large rivers in plains. As a result, majority of the fish species living in the rivers of Armenia can’t overcome the obstacles established after the construction of SHPPs, while fish passways don’t perform their main aim – to bridge fish species inhabiting in different sections of the river for their free movement and preservation and natural reproduction of fish reserves.”

Insufficient Level of SHPP Productivity

Monitoring results show the real production of SHPP productivity doesn’t comply with the projected production. The main causes of low productivity are as follows: lack of water in the rivers, incorrect hydroeconomic estimates, low ECE and poor-quality equipment. As a result, SHPP takes more water for electricity production than it’s set in the water usage permit or entirely stops in low-water months.

SHPP Impact on Specially Protected Areas of Nature and Forest Areas

The monitoring showed that SHPPs have been constructed in the buffer zones of “Khosrov Forest”, “Shikahogh” state reserves, “Sevan”, “Dilijan”, “Arevik” national park areas, “Jermuk Hydrological Reserve”, “Yeghegnadzor”, “Getik”, “Arjatkhlani” and “Ijevan” reserves and in Dsegh and Gugark forestry enterprises.

SHPP impact on the ecosystems of these areas is not assessed. Since 2012 bill on making amendments to RA Law “On Lake Sevan” (Պ-010-21.06.2012-ԳԲ-010/0), which bans the construction of SHPPs on the rivers flowing into Lake Sevan is on the agenda of the National Assembly, but it hasn’t been selected for voting so far.



“Amberd 1” SHPP



“Gegharot” SHPP



“DzoraHEK” SHPP



“Martsiget 1” SHPP



“Martsiget 2” SHPP



“Pozitron” SHPP



“Khachaghbyur” SHPP



“Khachaghbyur 1” SHPP



“Khachaghbyur 2” SHPP



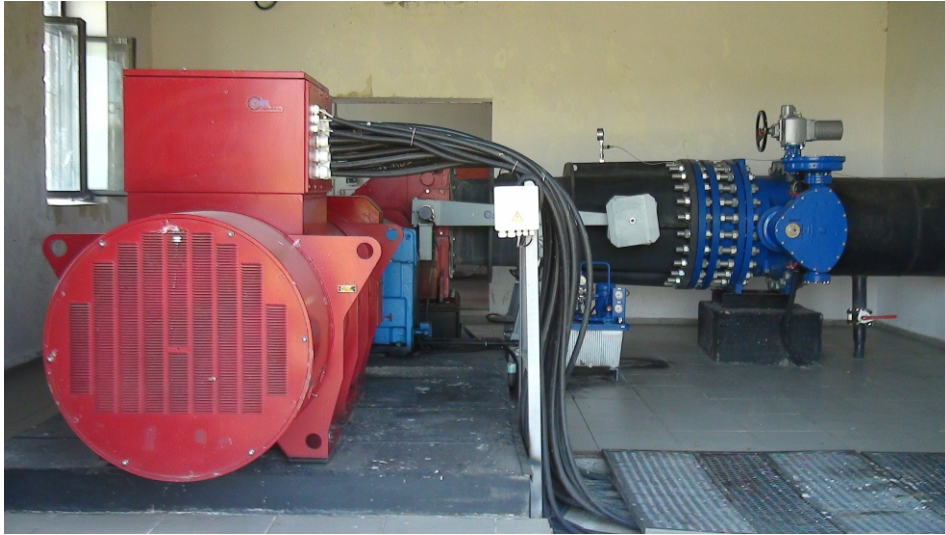
“Argichi” SHPP



“Martuni” SHPP



“Vardenik” SHPP



Equipment of “Heghnajur” SHPP



“Marmashen” SHPP



“Tsav” SHPP



“Dastakert” SHPP



“Dzagedzor PHEK-2” SHPP



Equipment of “Dzagedzor PHEK-2” SHPP



Equipment of “Sandaghbyur” SHPP



“Shaqi” SHPP



Shaqi waterfall



Equipment of “Smbul” SHPP



“Vorotan 7” SHPP fish passway



“Hermon” SHPP



“Nane” SHPP



“Goghtanik” SHPP



“Karakaya” SHPP



“Sanrise” SHPP



“Vardahovit” SHPP



“Tigran Mets” SHPP



“Yegheg” SHPP



“Yeghegis” SHPP



“Yeghegis 1” SHPP



Station of "Yeghegis 3", Head section of "Yeghegis 2" SHPP



"Yeghegis 3" SHPP



"Yeghegnadzor", "Yeghegnadzor PHEK-1" SHPPs

PROJECT PROPOSALS

For the preservation of river ecosystems and sustainable water usage the following reforms are proposed to **Nature Protection Ministry of Armenia**:

1. To assign companies operating SHPPs:

- To ensure automated management of environmental flow in SHPP head sections and to equip them with online control water-measuring systems.
- When drawing up projects on the construction of fish passways already existing or planned to make use of the consultation of a relevantly certified ichthyologist to ensure the migration of the fish species inherent to the river. To equip the entrance of the pressure pipelines with fish-protecting structure.
- To file a claim for reviewing water usage permit given the need to decrease environmental risks arising from SHPP operation ՓՀԷԿ-ի with reliable hydrological data serving as a basis for calculating environmental flow.
- To equip transformers with oil-collecting system to decrease the risk of environmental pollution with persistent organic pollutants.

2. To come up with the following legislative initiatives:

- Developing a bill on making amendments and supplements to RA Law “On Environmental Impact Assessment and Expertise”, including there the following proposals:

To remove Article 14 (6(1)) b point: “6. Category C includes 1)The following types of activities in energy sector or production units or all their structures or all their substructures b) hydropower stations with 1-10 MW capacity” and to shift it to Article 14 (5(1)) B category laying down “up to MW capacity” instead of “with 1-10 MW capacity”.

- Developing a bill on making amendments and supplements to RA Law “On Specially Protected Areas of Nature”, including there the following proposals:

To supplement “a” point of Article 16 of RA Law “On Specially Protected Areas of Nature” with the following words:

“including SHPP construction”, to supplement Article 17(2(a)) with the following words: “including SHPP construction”, thus prohibiting the construction of SHPPs in reserves, areas of national parks, as well as to impose a relevant ban in hydrological reserves and drainage basin of waterfalls being monuments of nature making relevant amendments in their charters in line with Articles 18 and 19 of this law.

- Developing a bill on making amendments and supplements to RA Water Code, including there the following proposals:

To supplement Chapter 4 of RA Water Code with new Article 21.1 with the following content: “1. Ecological passport is issued for the operation of hydropower plants. 2. The form and procedure of issuing an ecological passport is set by RA Government.”

To set water usage limitations per different water users in low-water years.

- Developing a bill on making amendments and supplements to RA Law “On Lake Sevan”, including there the following proposals:

Article 10 (2) of RA Law “On Lake Sevan”: “2. It’s banned in immediate impact zone” to supplement “e” point with “Construction and operation of SHPPs on the rivers flowing into Lake Sevan. The current operation of SHPPs and their further construction is banned.”

3. With the governmental resolution set the form and procedure of issuing ecological passports of SHPPs. The main indicator shall be environmental flow taking into consideration river basin management plans (if any) making it compliant with RA Water Code and RA Law on National Water Program.

4. To review the method of assessing environmental flow set by governmental resolution 927-Ն dated on 30.06.2011 to ensure the balance of water ecosystem. The priority is to review the methodology for calculating environmental flow and to introduce determination methods of flow based on ecological approaches for each river basin individually on monthly and not yearly basis, which will enable making additions in the set environmental flow in case of special conditions (for example, fish spawning season, matters with biodiversity preservation).

5. To ban the construction of new SHPPs on the rivers overloaded 30% and more with derivation with a governmental resolution.

6. To conduct relevant studies together with scientific structures on the expediency of SHPP operation in specially protected areas of nature and in adjacent areas.

7. To recover the damage caused to river ecosystem and fish world at the expense of SHPPs, particularly restoring water ecosystem and letting out proper amount of fish into the river.

8. To stop issuing new water usage permits and licenses before implementing these reforms.

The following reforms are proposed to **Energy and Natural Resources Ministry of Armenia**:

- To award state grants to SHPP subject to closedown to take part in renewable energy development processes,
- To develop technical requirements to increase SHPP electricity production effectiveness and to save water resources obliging SHPPs to re-equip with up-to-date efficient equipment.
- To stop the operation of those SHPPs, which are inefficient and don’t ensure environmental standards till their reconstruction in line with environmental standards,
- To review SHPP development scheme approved with protocol resolution of the Armenian Government dated on 22 January 2009 taking into consideration updated hydrological data and the results of SHPP impact analysis on the rivers.

The following reforms are proposed to **Territorial Administration Ministry of Armenia**:

- To set fees to be charged for ecosystem services with the governmental resolution (to be charged from SHPPs as well) and to direct these fees to the affected community as compensation.

The following reforms are proposed to **Public Service Regulatory Committee**:

- When considering the applications on prolonging the term of SHPPs with expired license to review electricity prices with a tendency to decrease them,
- To review licensing procedure and conditions, particularly not to issue any license without approved project,
- To stop issuing any new licenses till implementation of these new reforms.

The following reforms are proposed to **Ministry of Emergency Situations of Armenia**:

- To develop methodology for “Criteria for Assessing Ecological State of Areas To Detect Emergency Ecological Situation and Ecological Disaster Zones” to determine standards for

licensing new SHPPs in the rivers taking into consideration that a number of SHPPs, as a matter of fact, are cascades of SHPPs, which overload the rivers with their aggregate capacity.

The following reforms are proposed to **Urban Development Ministry of Armenia**:

- To develop scientifically grounded criteria for hydrosections, fish passways, pipelines and other structures to minimize their impact on environment and to make all SHPP structures compliant with these criteria,

The following reforms are proposed to **development banks**:

- To grant loans for SHPP construction in line with European Water Directive requirements and to monitor the performance of these requirements.



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