# Integrated Impact Assessment for Sustainable Hydropower Planning in the Vjosa Catchment (Greece, Albania)

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# Supplementary Materials

## S1. Calculation of single indicators (mathematical formulas)

### *S1.1. River Regulation*

The River Regulation Index (RRI) is an extension of the Degree of Regulation (DOR), which is defined as the proportion of the annual flow of a river that can be withheld by a reservoir [1].

$$\boldsymbol{DOR = \frac{\sum_{i=1}^{n} s_i}{D} * 100} \quad \text{(S.1)}$$

DOR can be calculated for each river stretch with $n$ being the total number of upstream dams, $s_i$ the storage capacity of dam $i$, and $D$ the total annual discharge of the river. The RRI aims to evaluate the river regulation on a basin scale by weighting the DOR value for each individual reach with its corresponding river volume, and then averaging the results for the entire basin [2,3].

$$\boldsymbol{RRI = \sum_{i=1}^{n} DOR_i \frac{rv_i}{V}} \quad \text{(S.2)}$$

RRI is calculated with formula S.2, with $n$ being the total number of reaches, $DOR_i$ the DOR value for each river stretch $i$, $rv_i$ the volume of stretch $i$, and $V$ the total volume of the entire river network. RRI values can exceed 100% when multi-year storage reservoirs exist in the river network.

The RRI was calculated for each Vjosa sub-basin (HydroBASIN Level 10 [4]) using the ArcHydro Toolbox for ArcGIS [5]. The *drainage lines* feature class contains the stream network which is divided into small sections. A new section starts every time a new tributary enters the system. Some hydropower plants (HPP) were moved manually to fit to the drainage lines.

DOR values were calculated by dividing the total upstream reservoir volume by annual discharge. River volumes are derived from discharge using equations S.3 and S.4, where $W$ is the river's width and $D$ is the depth. $V$ indicates the water velocity [6].

$$\boldsymbol{W = 1.22 * Q^{0.557}} \quad \text{(S.3)}$$

$$\boldsymbol{D = 0.34 * Q^{3.41}} \quad \text{(S.4)}$$

$$\boldsymbol{V = 2.42 * Q^{0.1035}} \quad \text{(S.5)}$$

These calculations are first done for each drainage line, then for the whole network. A local RRI is calculated for each drainage line by multiplying its DOR with its volume and then dividing the product by the total volume. To get the RRI for the whole sub-basin, local RRI values were summed up.

*S1.2. River Fragmentation*

The River Fragmentation Index (RFI) is based on the Dendritic Connectivity Index and conceptually equivalent to the River Connectivity Index as defined in Grill et al. [3,6]. Because the volume is used as an indicator, barriers in the mainstream are weighted more heavily. The index measures the structural connectivity of a river basin or sub-basin by comparing the volume of each fragment created by a barrier to the total volume of the entire network.

$$\boldsymbol{RFI = 100 - \sum_{i=1}^{n} DOR_i \frac{rv_i}{V}} \quad \text{(S.6)}$$

RFI can be calculated with the formula S.6, where $n$ is the number of fragments, $v_i$ the volume of each fragment and $V$ the volume of the whole network.

RFI calculation was carried out in ArcGIS using ArcHydro Tools together with the RRI calculation. To derive RFI values, the *Sub-watershed Delineation* process (ArcHydro) is used to divide the stream network into the respective fragments. Volumes of each fragment are divided by the total networks' volume as shown in formula S.6.

RFI is given in percent and is 0% for an unfragmented river; each subsequent HPP increases the value by 50% up to a maximum of 100% [2].

*S1.3. Sediment Entrapment*

The reservoir life span is the number of years a dam can be in operation until the reservoir is filled with eroded sediment. The number of years it would take until the reservoir area was fully filled with eroded sediment was estimated by Stefani [8] under consideration of the entire river system and including the existing and the projected reservoirs. She used a revised version of the Universal Soil Loss Equation (USLE), an empirical model to predict the annual average soil erosion from surface runoff using information and soil properties, rainfall, topography, and land use [9,10]:

$$\boldsymbol{A = R * K_{st} * LS * C * P} \quad \text{(S.7)}$$

Where $A$ is the potential average annual soil loss $[\frac{t}{ha*y}]$, $R$ is the average rainfall erosivity factor $[\frac{MJ*mm}{ha*h*y}]$ and $K_{st}$ is the soil erodibility factor$[\frac{t*ha*h}{ha*MJ*mm}]$. *LS, C,* and *P* are dimensionless parameters for topography, land use cover, and conservation management, respectively.

The USLE was combined with a Connectivity Index (IC), which is based on topography and represents the probability that soil particles of a given area arrive in a user defined sink [11,12,13].

$$\boldsymbol{IC = log_{10}\left(\frac{D_{up}}{D_{dn}}\right)} \quad \text{(S.8)}$$

$D_{up}$ and $D_{dn}$ are upslope and downslope components of connectivity.

To estimate the amount of sediments which arrives at the river network *E*, *IC* values were converted in probabilities and multiplied with the potential average annual soil loss *A*.

$$\boldsymbol{E = A * IC} \quad \text{(S.9)}$$

Including the contribution of soil erosion calculated with the USLE formula and the connectivity index, Stefani implemented the sediment transport model CASCADE (Catchment Sediment Connectivity and Delivery) to quantify the amount of sediment transported along the fluvial network towards the reservoir areas [14]. A detailed description of her modelling approaches and underlying assumptions can be found in Stefani [7].

*S1.4. Megafauna*

To estimate the number of affected megafauna species, we overlapped spatially resolved data on freshwater megafauna occurrence with future reservoir areas using ArcMap [15, 16, 5].

*S1.5. Protected Area*

The polygon layer from the World Database of Protected Area (WDPA) and the polygon layer with future reservoir areas were projected using Europe Albers Equal Area Conic and then intersected using

ArcMap [17, 5]. The attribute table of the resulting layer included the amount and characteristics of protected areas affected by future reservoirs [m²]. Sometimes different protection categories were attributed to the same area and care had to be taken to ensure that these areas were not included twice in the indicator calculation.

*S1.6. Land Use Change*

A raster layer with landcover information from the European Space Agency (ESA) [18] was clipped to Vjosa catchment and transformed into a polygon layer using ArcMap [5]. To get area sizes of current land use forms within future reservoirs, the polygon layer was projected using *Europe Albers Equal Area Conic.* The projected land use polygon layer was then clipped to the projected future reservoir area, this procedure was repeated for all reservoir areas separately. The attribute table of this clipped polygon layer contained information on grid values (information of land use) and the corresponding shape area within the reservoir. A table with all forms of land use can be found in Table S4.

Land use information was evaluated in two indicator categories: The first category "Agriculture" summarizes for every planned HPP the area of agricultural land use (Cropland) within the future reservoir area. The second category "Vegetation Cover" included all kinds of natural vegetation like forests, shrubland and grassland. Calculations for the two sub-indicators were carried out in Microsoft Excel [19].

*S1.7. Resettlement*

Data on population density was obtained from WorldPop Data from the University of Southampton [20]. To calculate the number of people that must be resettled for a future HPP, a layer containing all merged future reservoir areas was overlapped with a population density raster using the ArcGis tool *Zonal Statistics as table* [5]. This tool creates an output table with sum and mean values of all grid cells inside the respective reservoir.

*S1.8. Potential Evaporation*

Potential evaporation values [mm/year] from the FAO database [21] were imported to ArcGIS and transformed from an AscII-Grid to a raster feature [5]. This raster was clipped to the Vjosa catchment. With the tool *Feature to Point* and *Extract Values To Points,* raster values were bound to reservoir points.

Using the potential evaporation values [mm/year], potential evaporation per reservoir area was calculated using formula S.10:

$$\boldsymbol{E_{Res}}\left[\frac{\boldsymbol{m^3}}{\boldsymbol{year}}\right] = \boldsymbol{E}\left[\frac{\boldsymbol{mm}}{\boldsymbol{year}}\right] * \boldsymbol{A}\,[\boldsymbol{m^2}] = \boldsymbol{E} * \boldsymbol{0.001}\left[\frac{\boldsymbol{m}}{\boldsymbol{year}}\right] \quad \text{(S.10)}$$

Where $E_{Res}$ is the potential evaporation for the specific area of a certain reservoir [m³/year], $E$ the yearly potential evaporation [mm/year], and $A$ the reservoir area [m²].

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**Table S2. Absolute impacts of hydropower plants in each indicator.** River Regulation Index (RRI) and River Fragmentation Index (RFI) have been calculated for planned hydropower plants only. Further details on the calculation of the indicators is given in the Method section of the main article.

| ID | Resettlement [No] | Land Use Change [m²] | | Protected Area | | Sediment Entrapment [years] | | Potential Evaporation [m³/year] | RRI [%] | RFI [%] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *Agriculture* | *Veg.-Cover* | *Area [m²]* | *Nature Monument [No]* | *Amount [kg]* | *Time [years]* | | | |
| *Existing* | | | | | | | | | | |
| 1911 | 524 | 2048525 | 1363602 | 0 | | 11498481 | 26769 | 3060678 | | |
| 1922 | 444 | 1864506 | 1309305 | 3173810 | 1 | 53137183 | 6650 | 2926253 | | |
| 6000 | 252 | 107895 | 1501952 | 1588514 | | 77433919 | 1794 | 1444033 | | |
| 6001 | 233 | 1286838 | 216413 | 1503251 | | 94421191 | 1296 | 1348416 | | |
| 6002 | 18 | 0 | 120474 | 93160 | | 8852032 | 460 | 111077 | | |
| 6003 | 166 | 39750 | 1184132 | 504515 | | 10539126 | 6942 | 1128419 | | |
| 6004 | 64 | 53175 | 865346 | 657545 | | 27402972 | 1579 | 846877 | | |
| 6005 | 144 | 0 | 940899 | 478864 | | 34251637 | 2115 | 870332 | | |
| 6006 | 191 | 563121 | 511612 | 0 | | 54140114 | 3896 | 1211022 | | |
| 6007 | 219 | 1390858 | 0 | 0 | | 98933172 | 650 | 1385968 | | |
| 6008 | 0 | 11421571 | 5437121 | 14304 | 1 | 442347742 | 2575 | 16817769 | | |
| 6009 | 59 | 53395 | 347816 | 0 | | 59603413 | 440 | 359887 | | |
| *Under Construction* | | | | | | | | | | |
| 3234 | 96 | 636003 | 0 | 0 | | 537871 | 57268 | 574311 | | |
| 3255 | 119 | 262025 | 532053 | 0 | | 11863079 | 4564 | 751198 | | |
| 6010 | 19 | 39800 | 67688 | 0 | | 1428 | 2833288 | 97061 | | |
| 6011 | 700 | 1060568 | 3560100 | 4115405 | | 123522913 | 5256 | 4260256 | | |
| 6012 | 34 | 158802 | 199443 | 221377 | | 42046411 | 260 | 204109 | | |
| 6013 | 91 | 23393 | 563806 | 586133 | | 120635207 | 238 | 541397 | | |
| 6014 | 404 | 2647030 | 0 | 0 | | 42195711 | 9751 | 2390268 | | |
| 6015 | 51 | 2223853 | 0 | 0 | | 42195711 | 6458 | 2008139 | | |
| *Planned* | | | | | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1475 | 662 | 3413221 | 842711 | 996306 | | 310195522 | 568 | 3997458 | 217.3 | 47.6 |
| 1479 | 8077 | 50861351 | 1337737 | 6303086 | | 1336095703 | 2355 | 50234649 | 229.4 | 48 |
| 1481 | 5159 | 23664382 | 9207531 | 3801918 | 1 | 676293872 | 4695 | 31677090 | 183.2 | 41.8 |
| 1482 | 227 | 5903460 | 13193 | 0 | | 262510322 | 707 | 5472904 | 208.2 | 19.2 |
| 1486 | 452 | 2887460 | 491361 | 47429 | | 147416034 | 734 | 3330959 | 217.3 | 47.6 |
| 1489 | 767 | 3838894 | 20320 | 0 | 1 | 152896401 | 552 | 5109517 | 148.7 | 20.9 |
| 1492 | 1685 | 11231722 | 110419 | 0 | | 185851059 | 740 | 13853751 | 140.4 | 33.2 |
| 1504 | 1572 | 10350309 | 0 | 0 | | 131842260 | 2185 | 9791392 | 12.8 | 47.6 |
| 1506 | 20 | 133350 | 0 | 0 | | 72669955 | 88 | 125749 | 14.7 | 45.5 |
| 1523 | 90 | 818411 | 0 | 215298 | | 119488470 | 274 | 558060 | 3.1 | 49.9 |
| 1633 | 216 | 1430607 | 0 | 0 | | 118704777 | 723 | 1349062 | 14.7 | 45.5 |
| 1948 | 3144 | 16899564 | 416844 | 0 | 1 | 549453768 | 2110 | 20290276 | 144 | 39.6 |
| 6016 | 173 | 745768 | 56518 | 0 | | 56916 | 275706 | 1164919 | 148.7 | 20.9 |
| 6017 | 952 | 6293595 | 0 | 0 | | 54167071 | 1109 | 6620862 | 36.5 | 0 |
| 6018 | 627 | 3763337 | 0 | 0 | | 78687241 | 1422 | 4214575 | 36.5 | 0 |
| 6019 | 50 | 330199 | 0 | 0 | | 128040047 | 20 | 336473 | 60.1 | 11.2 |
| 6020 | 1551 | 10038787 | 125129 | 0 | 2 | 294470957 | 1477 | 9687418 | 77.7 | 28 |
| 6021 | 286 | 2797200 | 238586 | 0 | | 507886909 | 104 | 3415611 | 165.5 | 43.5 |
| 6022 | 5 | 7118397 | 0 | 0 | | 125589644 | 806 | 6719173 | 4.6 | 0.2 |
| 6023 | 11 | 0 | 65846 | 0 | | 537871 | 2244 | 59459 | 190.9 | 67.4 |
| 6024 | 20 | 0 | 134556 | 0 | | 24720634 | 340 | 121504 | 190.9 | 67.4 |
| 6025 | 33 | 5915 | 238684 | 0 | 1 | 325884689 | 43 | 220873 | 190.9 | 67.4 |
| 6027 | 676 | 8135706 | 0 | 0 | | 198174788 | 1488 | 7525528 | 170.2 | 34.6 |
| 6028 | 107 | 394504 | 0 | 0 | | 433587202 | 16 | 643338 | 137.3 | 17.4 |
| 6029 | 344 | 8590 | 1509138 | 0 | | 17839538 | 5991 | 2046595 | 247.2 | 59.1 |
| 6030 | 522 | 26507 | 2570392 | 6221 | | 69853386 | 2713 | 3097313 | 247.2 | 59.1 |
| 6031 | 106 | 0 | 695174 | 0 | | 25515264 | 2168 | 631913 | 247.2 | 59.1 |
| 6032 | 231 | 140913 | 1368565 | 0 | | 89084694 | 892 | 1496289 | 247.2 | 59.1 |
| 6033 | 142 | 53549 | 904562 | 915873 | | 60232949 | 1125 | 839306 | 139.9 | 65.8 |
| 6034 | 83 | 347656 | 182341 | 529996 | | 154883 | 254733 | 464277 | 139.9 | 65.8 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 6035 | 139 | 252569 | 630359 | 903289 | | 87229830 | 1117 | 791281 | 139.9 | 65.8 |
| 6036 | 940 | 1940929 | 3626829 | 2357560 | | 56588264 | 11461 | 5352645 | 282.7 | 49.8 |
| 6037 | 58 | 0 | 389642 | 389642 | | 47918573 | 516 | 340157 | 282.7 | 49.8 |
| 6038 | 317 | 52753 | 2218192 | 0 | | 10533588 | 33623 | 1982535 | 282.7 | 49.8 |
| 6039 | 1003 | 0 | 6554585 | 126145 | | 81743576 | 8446 | 5781144 | 282.7 | 49.8 |
| 6040 | 138 | 223351 | 689276 | 0 | | 8110531 | 6204 | 796724 | 382.4 | 58.6 |
| 6041 | 180 | 111002 | 1090603 | 2968 | | 1284980 | 77203 | 1049001 | 382.4 | 58.6 |
| 6042 | 168 | 0 | 1116450 | 72477 | | 12314195 | 6851 | 974660 | 382.4 | 58.6 |
| 6043 | 272 | 0 | 1784935 | 967190 | | 2930297 | 75757 | 1535044 | 382.4 | 58.6 |
| 6044 | 73 | 89374 | 431625 | 0 | | 9392927 | 3384 | 454832 | 282.7 | 49.8 |
| 6045 | 244 | 0 | 1590415 | 589300 | | 16564094 | 9534 | 1383661 | 88 | 69.8 |
| 6046 | 151 | 0 | 978742 | 305251 | | 2111130 | 45466 | 851506 | 88 | 69.8 |
| 6047 | 139 | 0 | 910987 | 640652 | | 65763509 | 253 | 792559 | 88 | 69.8 |
| 6048 | 89 | 3853226 | 2703538 | 0 | | 304470656 | 697 | 6263531 | 64.2 | 38.5 |
| 6049 | 68 | 0 | 466383 | 466383 | | 43471919 | 286 | 405753 | 93 | 40.5 |
| 6050 | 115 | 0 | 754380 | 754380 | | 92027038 | 624 | 656310 | 93 | 40.5 |
| 6051 | 4 | 0 | 2747 | 25884 | | 38182879 | 39 | 22519 | 93 | 40.5 |
| 6052 | 256 | 0 | 1699349 | 1699349 | | 66332694 | 3142 | 1478433 | 108.8 | 25.1 |
| 6053 | 82 | 0 | 534176 | 534176 | | 105698127 | 585 | 464733 | 108.8 | 25.1 |
| 6054 | 389 | 0 | 2513854 | 2513854 | | 690107 | 325758 | 2179511 | 86.7 | 64.3 |
| 6055 | 450 | 0 | 2997797 | 2997797 | | 50831183 | 7871 | 2599090 | 86.7 | 64.3 |

**Table S3. Ranking of planned hydropower plants per indicator and overall as a sum of the indicators in quartiles.** Res. – Resettlement; Sed. Entrap. – Sediment Entrapment; Pot. Evap. – Potential Evaporation; RRI – River Regulation Index; RFI – River Fragmentation Index. Gray shading highlights those hydropower dams that end up in the 4th quartile, i.e. have the highest potential impact.

| ID | Res. | Land Use Change | | Protected Area | Sed. Entrap. | Pot. Evapo. | RRI | RFI | Sum | Quartile |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Agriculture | Veg.-Cover | Area | Years | | | | | |
| 1475 | 4 | 3 | 3 | 4 | 4 | 3 | 3 | 2 | 26 | 4 |
| 1479 | 4 | 4 | 3 | 4 | 2 | 4 | 3 | 2 | 26 | 4 |
| 1481 | 4 | 4 | 4 | 4 | 2 | 4 | 3 | 2 | 27 | 4 |
| 1482 | 3 | 4 | 1 | 1 | 3 | 4 | 3 | 1 | 20 | 3 |
| 1486 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 22 | 4 |
| 1489 | 4 | 4 | 1 | 1 | 4 | 3 | 3 | 1 | 21 | 3 |
| 1492 | 4 | 4 | 2 | 1 | 3 | 4 | 2 | 1 | 21 | 3 |
| 1504 | 4 | 4 | 1 | 1 | 2 | 4 | 1 | 2 | 19 | 2 |
| 1506 | 1 | 2 | 1 | 1 | 4 | 1 | 1 | 2 | 13 | 1 |
| 1523 | 2 | 3 | 1 | 3 | 4 | 1 | 1 | 3 | 18 | 2 |
| 1633 | 2 | 3 | 1 | 1 | 3 | 2 | 1 | 2 | 15 | 1 |
| 1948 | 4 | 4 | 2 | 1 | 2 | 4 | 2 | 2 | 21 | 3 |
| 6016 | 2 | 3 | 2 | 1 | 1 | 2 | 3 | 1 | 15 | 1 |
| 6017 | 4 | 4 | 1 | 1 | 3 | 4 | 1 | 1 | 19 | 2 |
| 6018 | 4 | 4 | 1 | 1 | 2 | 3 | 1 | 1 | 17 | 1 |
| 6019 | 1 | 3 | 1 | 1 | 4 | 1 | 1 | 1 | 13 | 1 |
| 6020 | 4 | 4 | 2 | 1 | 2 | 4 | 1 | 1 | 19 | 2 |
| 6021 | 3 | 3 | 2 | 1 | 4 | 3 | 3 | 2 | 21 | 3 |
| 6022 | 1 | 4 | 1 | 1 | 3 | 4 | 1 | 1 | 16 | 1 |
| 6023 | 1 | 1 | 2 | 1 | 2 | 1 | 3 | 4 | 15 | 1 |
| 6024 | 1 | 1 | 2 | 1 | 4 | 1 | 3 | 4 | 17 | 1 |
| 6025 | 1 | 2 | 2 | 1 | 4 | 1 | 3 | 4 | 18 | 2 |
| 6027 | 4 | 4 | 1 | 1 | 2 | 4 | 3 | 1 | 20 | 3 |
| 6028 | 2 | 3 | 1 | 1 | 4 | 2 | 2 | 1 | 16 | 1 |
| 6029 | 3 | 2 | 4 | 1 | 2 | 3 | 4 | 3 | 22 | 4 |
| 6030 | 3 | 2 | 4 | 3 | 2 | 3 | 4 | 3 | 24 | 4 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 6031 | 2 | 1 | 3 | 1 | 2 | 1 | 4 | 3 | 17 | 1 |
| 6032 | 3 | 2 | 4 | 1 | 3 | 3 | 4 | 3 | 23 | 4 |
| 6033 | 2 | 2 | 3 | 4 | 3 | 2 | 2 | 4 | 22 | 4 |
| 6034 | 1 | 3 | 2 | 3 | 1 | 1 | 2 | 4 | 17 | 1 |
| 6035 | 2 | 3 | 3 | 4 | 3 | 2 | 2 | 4 | 23 | 4 |
| 6036 | 4 | 3 | 4 | 4 | 1 | 4 | 4 | 3 | 27 | 4 |
| 6037 | 1 | 1 | 2 | 3 | 4 | 1 | 4 | 3 | 19 | 2 |
| 6038 | 3 | 2 | 4 | 1 | 1 | 3 | 4 | 3 | 21 | 3 |
| 6039 | 4 | 1 | 4 | 3 | 1 | 4 | 4 | 3 | 24 | 4 |
| 6040 | 2 | 3 | 3 | 1 | 1 | 2 | 4 | 3 | 19 | 2 |
| 6041 | 2 | 2 | 3 | 3 | 1 | 2 | 4 | 3 | 20 | 3 |
| 6042 | 2 | 1 | 3 | 3 | 1 | 2 | 4 | 3 | 19 | 2 |
| 6043 | 3 | 1 | 4 | 4 | 1 | 3 | 4 | 3 | 23 | 4 |
| 6044 | 1 | 2 | 2 | 1 | 2 | 1 | 4 | 3 | 16 | 1 |
| 6045 | 3 | 1 | 4 | 4 | 1 | 2 | 1 | 4 | 20 | 3 |
| 6046 | 2 | 1 | 3 | 3 | 1 | 2 | 1 | 4 | 17 | 1 |
| 6047 | 2 | 1 | 3 | 4 | 4 | 2 | 1 | 4 | 21 | 3 |
| 6048 | 1 | 4 | 4 | 1 | 3 | 4 | 1 | 2 | 20 | 3 |
| 6049 | 1 | 1 | 2 | 3 | 4 | 1 | 2 | 2 | 16 | 1 |
| 6050 | 2 | 1 | 3 | 4 | 3 | 2 | 2 | 2 | 19 | 2 |
| 6051 | 1 | 1 | 1 | 3 | 4 | 1 | 2 | 2 | 15 | 1 |
| 6052 | 3 | 1 | 4 | 4 | 2 | 2 | 2 | 1 | 19 | 2 |
| 6053 | 1 | 1 | 3 | 3 | 3 | 1 | 2 | 1 | 15 | 1 |
| 6054 | 3 | 1 | 4 | 4 | 1 | 3 | 1 | 4 | 21 | 3 |
| 6055 | 3 | 1 | 4 | 4 | 1 | 3 | 1 | 4 | 21 | 3 |

**Table S4. Hydropower plant (HPP) characteristics and impacts normalized to HPP capacity [MW].** Res. – Resettlement; Sed. Entrap. – Sediment Entrapment; Pot. Evap. – Potential Evaporation; RRI – River Regulation Index; RFI – River Fragmentation Index; LHP – Large Hydropower Plant (> 10 MW); SHP – Small Hydropower Plant (1-10 MW).

| Dam ID | Size | Reservoir Area [m²] / MW | Res. [No.] / MW | Land Use [m²] / MW | | Protected Area [m²] / MW | Sed. Entr. [years] / MW | Pot. Evapo. [m³/year] / MW | RRI [%] / MW | RFI [%] / MW |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Agri. | Veg.-Cover | | | | | |
| 1475 | LHP | 144521 | 22 | 113774 | 28090 | 33210 | 18.9 | 133249 | 7.2 | 1.6 |
| 1479 | LHP | 408478 | 62 | 391241 | 10290 | 48485 | 18.1 | 386420 | 1.8 | 0.4 |
| 1481 | LHP | 456607 | 69 | 315525 | 122767 | 50692 | 62.6 | 422361 | 2.4 | 0.6 |
| 1482 | LHP | 169047 | 6 | 168670 | 377 | 0 | 20.2 | 156369 | 6.0 | 0.6 |
| 1486 | LHP | 144510 | 18 | 115498 | 19654 | 1897 | 29.4 | 133238 | 8.7 | 1.9 |
| 1489 | LHP | 84315 | 13 | 63982 | 339 | 0 | 9.2 | 85159 | 2.5 | 0.4 |
| 1492 | LHP | 137332 | 17 | 110115 | 1083 | 0 | 7.3 | 135821 | 1.4 | 0.3 |
| 1504 | SHP | 1035031 | 157 | 1035031 | 0 | 0 | 218.5 | 979139 | 1.3 | 4.8 |
| 1506 | SHP | 66675 | 10 | 66675 | 0 | 0 | 44.1 | 62875 | 7.4 | 22.8 |
| 1523 | SHP | 176870 | 26 | 240709 | 0 | 71766 | 80.4 | 164135 | 1.0 | 16.7 |
| 1633 | SHP | 715303 | 108 | 715303 | 0 | 0 | 361.7 | 674531 | 7.4 | 22.8 |
| 1948 | LHP | 205993 | 31 | 168996 | 4168 | 0 | 21.1 | 202903 | 1.4 | 0.4 |
| 6016 | SHP | 115339 | 17 | 74577 | 5652 | 0 | 27570.6 | 116492 | 14.9 | 2.1 |
| 6017 | SHP | 2860725 | 433 | 2860725 | 0 | 0 | 504.0 | 3009483 | 18.3 | 0.0 |
| 6018 | SHP | 646249 | 98 | 588021 | 0 | 0 | 222.3 | 658527 | 6.1 | 0.0 |
| 6019 | SHP | 194235 | 29 | 194235 | 0 | 0 | 11.5 | 197925 | 30.1 | 5.6 |
| 6020 | SHP | 1020803 | 155 | 1003879 | 12513 | 0 | 147.7 | 968742 | 7.8 | 2.8 |
| 6021 | SHP | 361058 | 29 | 279720 | 23859 | 0 | 10.4 | 341561 | 16.6 | 4.4 |
| 6022 | SHP | 2968882 | 2 | 2965999 | 0 | 0 | 336.0 | 2799655 | 2.3 | 0.1 |
| 6023 | SHP | 65846 | 11 | 0 | 65846 | 0 | 2244.2 | 59459 | 190.9 | 67.4 |
| 6024 | SHP | 61162 | 9 | 0 | 61162 | 0 | 154.5 | 55229 | 95.5 | 33.7 |
| 6025 | SHP | 116476 | 16 | 2816 | 113659 | 0 | 20.7 | 105178 | 95.5 | 33.7 |
| 6027 | LHP | 162714 | 14 | 162714 | 0 | 0 | 29.8 | 150511 | 3.4 | 0.7 |
| 6028 | SHP | 695501 | 107 | 394504 | 0 | 0 | 15.6 | 643338 | 137.3 | 17.4 |
| 6029 | SHP | 225148 | 34 | 859 | 150914 | 0 | 599.1 | 204659 | 24.7 | 5.9 |
| 6030 | SHP | 340739 | 52 | 2651 | 257039 | 622 | 271.3 | 309731 | 24.7 | 5.9 |
| 6031 | SHP | 69517 | 11 | 0 | 69517 | 0 | 216.8 | 63191 | 24.7 | 5.9 |
| 6032 | SHP | 1646083 | 231 | 140913 | 1368565 | 0 | 891.8 | 1496289 | 247.2 | 59.1 |
| 6033 | SHP | 958112 | 142 | 53549 | 904562 | 915873 | 1125.2 | 839306 | 139.9 | 65.8 |
| 6034 | SHP | 529996 | 83 | 347656 | 182341 | 529996 | 254732.8 | 464277 | 139.9 | 65.8 |
| 6035 | SHP | 90329 | 14 | 25257 | 63036 | 90329 | 111.7 | 79128 | 14.0 | 6.6 |
| 6036 | SHP | 613132 | 94 | 194093 | 362683 | 235756 | 1146.1 | 535264 | 28.3 | 5.0 |
| 6037 | SHP | 38964 | 6 | 0 | 38964 | 38964 | 51.6 | 34016 | 28.3 | 5.0 |
| 6038 | SHP | 227094 | 32 | 5275 | 221819 | 0 | 3362.3 | 198253 | 28.3 | 5.0 |
| 6039 | SHP | 655459 | 100 | 0 | 655459 | 12615 | 844.6 | 578114 | 28.3 | 5.0 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 6040 | SHP | 91263 | 14 | 22335 | 68928 | 0 | 620.4 | 79672 | 38.2 | 5.9 |
| 6041 | SHP | 120160 | 18 | 11100 | 109060 | 297 | 7720.3 | 104900 | 38.2 | 5.9 |
| 6042 | SHP | 111645 | 17 | 0 | 111645 | 7248 | 685.1 | 97466 | 38.2 | 5.9 |
| 6043 | SHP | 178493 | 27 | 0 | 178493 | 96719 | 7575.7 | 153504 | 38.2 | 5.9 |
| 6044 | SHP | 52100 | 7 | 8937 | 43162 | 0 | 338.4 | 45483 | 28.3 | 5.0 |
| 6045 | SHP | 159042 | 24 | 0 | 159041 | 58930 | 953.4 | 138366 | 8.8 | 7.0 |
| 6046 | SHP | 97874 | 15 | 0 | 97874 | 30525 | 4546.6 | 85151 | 8.8 | 7.0 |
| 6047 | SHP | 910987 | 139 | 0 | 910987 | 640652 | 252.9 | 792559 | 88.0 | 69.8 |
| 6048 | SHP | 677139 | 9 | 385323 | 270354 | 0 | 69.8 | 626353 | 6.4 | 3.9 |
| 6049 | SHP | 466383 | 68 | 0 | 466383 | 466383 | 286.4 | 405753 | 93.0 | 40.5 |
| 6050 | SHP | 75438 | 12 | 0 | 75438 | 75438 | 62.4 | 65631 | 9.3 | 4.1 |
| 6051 | SHP | 25884 | 4 | 0 | 2747 | 25884 | 38.6 | 22519 | 93.0 | 40.5 |
| 6052 | SHP | 169935 | 26 | 0 | 169935 | 169935 | 314.2 | 147843 | 10.9 | 2.5 |
| 6053 | SHP | 53418 | 8 | 0 | 53418 | 53418 | 58.5 | 46473 | 10.9 | 2.5 |
| 6054 | SHP | 251385 | 39 | 0 | 251385 | 251385 | 32575.9 | 217951 | 8.7 | 6.4 |
| 6055 | SHP | 299780 | 45 | 0 | 299780 | 299780 | 787.1 | 259909 | 8.7 | 6.4 |

**Table S5. Spearman's correlation coefficients for correlations between the individual indicators.** Color intensifies with decreasing degree of correlation.

| | Resettlement | Land Use Change (Agriculture) | Land Use Change (Vegetation Cover) | Protected Area | Sediment Entrapment | River Regulation | River Fragmentation | Potential Evaporation | Reservoir Size |
|---|---|---|---|---|---|---|---|---|---|
| **Resettlement** | 1 | 0.51 | 0.29 | 0.15 | 0.39 | 0.13 | -0.18 | 0.86 | 0.86 |
| **Land Use Change (Agriculture)** | 0.51 | 1 | -0.37 | -0.32 | -0.11 | -0.18 | -0.55 | 0.69 | 0.68 |
| **Land Use Change (Vegetation Cover)** | 0.29 | -0.37 | 1 | 0.6 | 0.55 | 0.47 | 0.48 | 0.18 | 0.2 |
| **Protected Area** | 0.15 | -0.32 | 0.6 | 1 | 0.27 | 0.06 | 0.34 | 0 | 0.01 |
| **Sediment Entrapment** | 0.39 | -0.11 | 0.55 | 0.27 | 1 | -0.23 | -0.49 | 0.49 | 0.49 |
| **River Regulation** | 0.13 | -0.18 | 0.47 | 0.06 | -0.23 | 1 | 0.31 | -0.01 | 0 |
| **River Fragmentation** | -0.18 | -0.55 | 0.48 | 0.34 | -0.49 | 0.31 | 1 | -0.37 | -0.36 |
| **Potential Evaporation** | 0.86 | 0.69 | 0.18 | 0 | 0.49 | -0.01 | -0.37 | 1 | 1 |
| **Reservoir Size** | 0.86 | 0.68 | 0.2 | 0.01 | 0.49 | 0 | -0.36 | 1 | 1 |

**Table S6. Land Use Changes – area of different land use types affected by projected reservoir areas**

| Dam ID | Projected future reservoir area [m²] | Cropland, rainfed [m²] | | Cropland, irrigated or post-flooding [m²] | Mosaic cropland (>50%) / natural vegetation (tree, shrub, herbaceous cover) (<50%) [m²] | Mosaic natural vegetation (tree, shrub, herbaceous cover) (>50%) / cropland (<50%) [m²] | Tree cover, broadleaved, deciduous, closed to open (>15%) [m²] | Tree cover, needleleaved, evergreen, closed to open (>15%) [m²] | Tree cover, mixed leaf type (broadleaved and needleleaved) [m²] | Mosaic tree and shrub (>50%) / herbaceous cover (<50%) [m²] | Mosaic herbaceous cover (>50%) / tree and shrub (<50%) [m²] | Shrubland [m²] | Grassland [m²] | Sparse vegetation (tree, shrub, herbaceous cover) (<15%) [m²] | Urban areas [m²] | Bare areas [m²] | Total area of agricultural land use [m²] | Total area with vegetation cover (other than land use) [m²] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Herbaceous cover | | | | | | | | | | | | | | | |
| **1475** | 4335638 | 1860121 | 1282967 | 0 | 128118 | 142014 | 164437 | 0 | 0 | 154113 | 0 | 0 | 524161 | 0 | 0 | 79706 | 3413221 | 842711 |
| **1479** | 53102166 | 16940247 | 32527351 | 0 | 1038502 | 355251 | 252888 | 0 | 0 | 435329 | 0 | 184939 | 464581 | 145719 | 213584 | 543774 | 50861351 | 1337737 |
| **1481** | 34245503 | 7852194 | 9129996 | 652536 | 1553325 | 4476331 | 4507463 | 0 | 319103 | 2796515 | 0 | 149231 | 1435219 | 0 | 0 | 1373589 | 23664382 | 9207531 |
| **1482** | 5916653 | 1091646 | 4729187 | 0 | 74913 | 7714 | 0 | 0 | 0 | 13193 | 0 | 0 | 0 | 0 | 0 | 0 | 5903460 | 13193 |
| **1486** | 3612754 | 1238988 | 1496741 | 0 | 58307 | 93424 | 0 | 0 | 0 | 23055 | 0 | 0 | 468306 | 0 | 233933 | 0 | 2887460 | 491361 |
| **1489** | 5058927 | 3236590 | 473733 | 0 | 60760 | 67810 | 0 | 0 | 0 | 0 | 0 | 0 | 20320 | 0 | 0 | 1199713 | 3838894 | 20320 |
| **1492** | 14007837 | 7333115 | 3818843 | 0 | 50267 | 29497 | 0 | 0 | 0 | 0 | 0 | 0 | 110419 | 0 | 784393 | 1881303 | 11231722 | 110419 |
| **1504** | 10350309 | 1717555 | 8273622 | 0 | 359132 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10350309 | 0 |
| **1506** | 133350 | 133350 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 133350 | 0 |
| **1523** | 818411 | 652536 | 165875 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 818411 | 0 |
| **1633** | 1430607 | 624351 | 626015 | 0 | 180240 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1430607 | 0 |
| **1911** | 3412127 | 728583 | 655826 | 0 | 0 | 664116 | 309181 | 0 | 0 | 611755 | 0 | 0 | 442667 | 0 | 0 | 0 | 2048525 | 1363602 |
| **1922** | 3173810 | 1322941 | 218786 | 0 | 227311 | 95468 | 542042 | 0 | 0 | 485923 | 0 | 123646 | 157694 | 0 | 0 | 0 | 1864506 | 1309305 |
| **1948** | 20599265 | 9128108 | 7334055 | 0 | 425711 | 11690 | 2317 | 0 | 0 | 0 | 0 | 105536 | 308991 | 217594 | 217398 | 2847865 | 16899563 | 416844 |
| **3234** | 636003 | 601721 | 34282 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 636003 | 0 |
| **3255** | 794078 | 211285 | 46821 | 0 | 463 | 3455 | 0 | 0 | 0 | 57137 | 0 | 54611 | 420306 | 0 | 0 | 0 | 262025 | 532053 |
| **6000** | 1609847 | 0 | 0 | 0 | 0 | 107895 | 278565 | 0 | 0 | 881652 | 0 | 42919 | 298816 | 0 | 0 | 0 | 107895 | 1501952 |
| **6001** | 1503251 | 199345 | 0 | 0 | 211013 | 876479 | 0 | 0 | 0 | 216413 | 0 | 0 | 0 | 0 | 0 | 0 | 1286838 | 216413 |
| **6002** | 120474 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 120474 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 120474 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **6003** | 1223882 | 0 | 0 | 0 | 0 | 39750 | 105732 | 0 | 0 | 749561 | 0 | 276054 | 52784 | 0 | 0 | 0 | 39750 | 1184132 |
| **6004** | 918522 | 0 | 0 | 0 | 0 | 53175 | 8477 | 0 | 0 | 384373 | 0 | 472496 | 0 | 0 | 0 | 0 | 53175 | 865346 |
| **6005** | 940899 | 0 | 0 | 0 | 0 | 0 | 495684 | 0 | 0 | 445215 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 940899 |
| **6006** | 1276104 | 547810 | 0 | 0 | 15311 | 0 | 137647 | 0 | 0 | 329113 | 0 | 36494 | 8357 | 0 | 0 | 201371 | 563121 | 511612 |
| **6007** | 1460451 | 815826 | 395219 | 0 | 145527 | 34286 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 69594 | 1390858 | 0 |
| **6008** | 18181372 | 4555222 | 3035904 | 522008 | 1450702 | 1857735 | 3255683 | 0 | 315842 | 884293 | 0 | 4450 | 976852 | 0 | 0 | 1322680 | 11421571 | 5437121 |
| **6009** | 401211 | 53395 | 0 | 0 | 0 | 0 | 0 | 706 | 0 | 347110 | 0 | 0 | 0 | 0 | 0 | 0 | 53395 | 347816 |
| **6010** | 107488 | 39800 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 67688 | 0 | 0 | 0 | 39800 | 67688 |
| **6011** | 4620668 | 710104 | 0 | 0 | 312 | 350151 | 52108 | 260444 | 0 | 2922302 | 0 | 0 | 325246 | 0 | 0 | 0 | 1060568 | 3560100 |
| **6012** | 358245 | 0 | 0 | 0 | 0 | 158802 | 40641 | 0 | 0 | 158802 | 0 | 0 | 0 | 0 | 0 | 0 | 158802 | 199443 |
| **6013** | 587199 | 12258 | 0 | 0 | 0 | 11135 | 0 | 0 | 0 | 476923 | 0 | 0 | 86883 | 0 | 0 | 0 | 23393 | 563806 |
| **6014** | 2647030 | 1370620 | 1002548 | 0 | 177228 | 96633 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2647030 | 0 |
| **6015** | 2223853 | 1161238 | 1038769 | 0 | 14631 | 9215 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2223853 | 0 |
| **6016** | 1153386 | 306244 | 408193 | 0 | 29477 | 1853 | 0 | 0 | 0 | 0 | 0 | 0 | 56518 | 36994 | 0 | 314106 | 745768 | 56518 |
| **6017** | 6293595 | 2418922 | 3874673 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6293595 | 0 |
| **6018** | 4135991 | 1833727 | 1929610 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 372654 | 3763337 | 0 |
| **6019** | 330199 | 33511 | 296688 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 330199 | 0 |
| **6020** | 10208028 | 3874151 | 5799405 | 0 | 71764 | 293467 | 125129 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 44112 | 10038786 | 125129 |
| **6021** | 3610583 | 1976765 | 820435 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 119 | 238467 | 125157 | 0 | 449639 | 2797200 | 238586 |
| **6022** | 7125316 | 2557273 | 4457474 | 0 | 103649 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6919 | 0 | 7118397 | 0 |
| **6023** | 65846 | 0 | 0 | 0 | 0 | 0 | 65846 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 65846 |
| **6024** | 134556 | 0 | 0 | 0 | 0 | 0 | 134556 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 134556 |
| **6025** | 244599 | 5915 | 0 | 0 | 0 | 0 | 161823 | 0 | 0 | 76861 | 0 | 0 | 0 | 0 | 0 | 0 | 5915 | 238684 |
| **6027** | 8135706 | 971078 | 7015312 | 0 | 145716 | 3600 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8135706 | 0 |
| **6028** | 695501 | 248840 | 10001 | 0 | 65642 | 70021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 300997 | 394504 | 0 |
| **6029** | 2251480 | 0 | 0 | 0 | 8590 | 0 | 403408 | 0 | 4355 | 763463 | 132299 | 0 | 205614 | 392367 | 0 | 341384 | 8590 | 1509138 |
| **6030** | 3407385 | 0 | 0 | 0 | 26507 | 0 | 178665 | 140485 | 0 | 1599965 | 0 | 124532 | 526745 | 86589 | 0 | 723897 | 26507 | 2570392 |
| **6031** | 695174 | 0 | 0 | 0 | 0 | 0 | 0 | 328608 | 9824 | 356742 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 695174 |
| **6032** | 1646083 | 0 | 0 | 0 | 140913 | 0 | 101845 | 67889 | 52871 | 709021 | 0 | 422316 | 14624 | 38640 | 0 | 97965 | 140913 | 1368565 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **6033** | 958112 | 0 | 0 | 0 | 47391 | 6158 | 175676 | 0 | 0 | 105731 | 0 | 151425 | 471730 | 0 | 0 | 0 | 53549 | 904562 |
| **6034** | 529996 | 190287 | 0 | 0 | 23389 | 133979 | 0 | 0 | 0 | 141280 | 0 | 0 | 41060 | 0 | 0 | 0 | 347656 | 182341 |
| **6035** | 882928 | 138639 | 0 | 0 | 100741 | 13188 | 453769 | 0 | 0 | 153824 | 0 | 0 | 22765 | 0 | 0 | 0 | 252569 | 630359 |
| **6036** | 6131323 | 707553 | 0 | 0 | 286613 | 946762 | 460540 | 136946 | 287135 | 834039 | 0 | 774100 | 1134069 | 145822 | 0 | 417743 | 1940929 | 3626829 |
| **6037** | 389642 | 0 | 0 | 0 | 0 | 0 | 155 | 212755 | 66587 | 110144 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 389642 |
| **6038** | 2270945 | 23847 | 0 | 0 | 0 | 28906 | 681202 | 55521 | 0 | 1055312 | 0 | 0 | 426156 | 0 | 0 | 0 | 52753 | 2218192 |
| **6039** | 6554585 | 0 | 0 | 0 | 0 | 0 | 40730 | 521761 | 197609 | 5384674 | 0 | 145860 | 263952 | 0 | 0 | 0 | 0 | 6554585 |
| **6040** | 912627 | 3894 | 0 | 0 | 0 | 219457 | 0 | 0 | 0 | 267866 | 0 | 76841 | 344569 | 0 | 0 | 0 | 223351 | 689276 |
| **6041** | 1201605 | 0 | 0 | 0 | 0 | 111002 | 64049 | 45968 | 1208 | 979379 | 0 | 0 | 0 | 0 | 0 | 0 | 111002 | 1090603 |
| **6042** | 1116450 | 0 | 0 | 0 | 0 | 0 | 428 | 240232 | 43290 | 832500 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1116450 |
| **6043** | 1784935 | 0 | 0 | 0 | 0 | 0 | 410737 | 506581 | 88749 | 489549 | 0 | 0 | 289319 | 0 | 0 | 0 | 0 | 1784935 |
| **6044** | 520999 | 0 | 0 | 0 | 89374 | 0 | 413771 | 0 | 0 | 17854 | 0 | 0 | 0 | 0 | 0 | 0 | 89374 | 431625 |
| **6045** | 1590415 | 0 | 0 | 0 | 0 | 0 | 521268 | 154224 | 82736 | 821623 | 0 | 10564 | 0 | 0 | 0 | 0 | 0 | 1590415 |
| **6046** | 978742 | 0 | 0 | 0 | 0 | 0 | 0 | 7213 | 0 | 462584 | 0 | 508945 | 0 | 0 | 0 | 0 | 0 | 978742 |
| **6047** | 910987 | 0 | 0 | 0 | 0 | 0 | 0 | 475008 | 0 | 435979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 910987 |
| **6048** | 6771385 | 1587205 | 73254 | 557679 | 759772 | 875316 | 1290905 | 0 | 217490 | 146298 | 0 | 0 | 1048846 | 0 | 0 | 214622 | 3853226 | 2703538 |
| **6049** | 466383 | 0 | 0 | 0 | 0 | 0 | 780 | 106254 | 50906 | 308443 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 466383 |
| **6050** | 754380 | 0 | 0 | 0 | 0 | 0 | 55105 | 508107 | 109115 | 82053 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 754380 |
| **6051** | 25884 | 0 | 0 | 0 | 0 | 0 | 0 | 2657 | 0 | 89 | 0 | 0 | 0 | 0 | 0 | 23137 | 0 | 2747 |
| **6052** | 1699349 | 0 | 0 | 0 | 0 | 0 | 433959 | 434559 | 73489 | 757342 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1699349 |
| **6053** | 534176 | 0 | 0 | 0 | 0 | 0 | 0 | 487625 | 0 | 46550 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 534176 |
| **6054** | 2513854 | 0 | 0 | 0 | 0 | 0 | 0 | 2331135 | 0 | 182719 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2513854 |
| **6055** | 2997797 | 0 | 0 | 0 | 0 | 0 | 0 | 2997797 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2997797 |

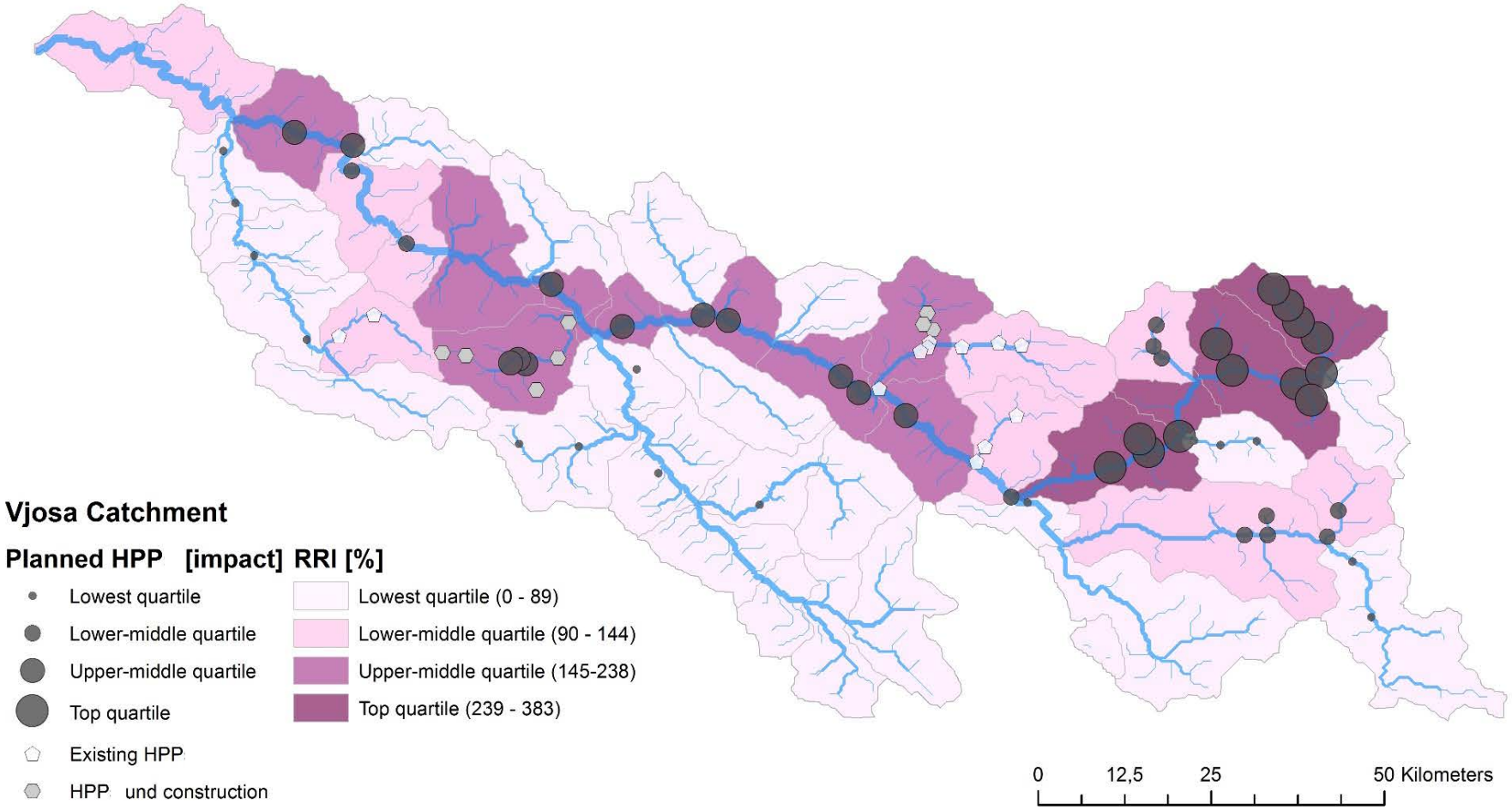


**Figure S7. Results of impact assessment for the indicator River Regulation (RRI: River Regulation Index).** Circles (dark gray) indicate planned Hydropower Plants (HPP). White pentagons indicate existing HPP, gray hexagons HPP under construction. Circle size increases with impact of planned HPP. The base map presents RRI values in quartiles for sub-catchments. Quartiles increase with impact.

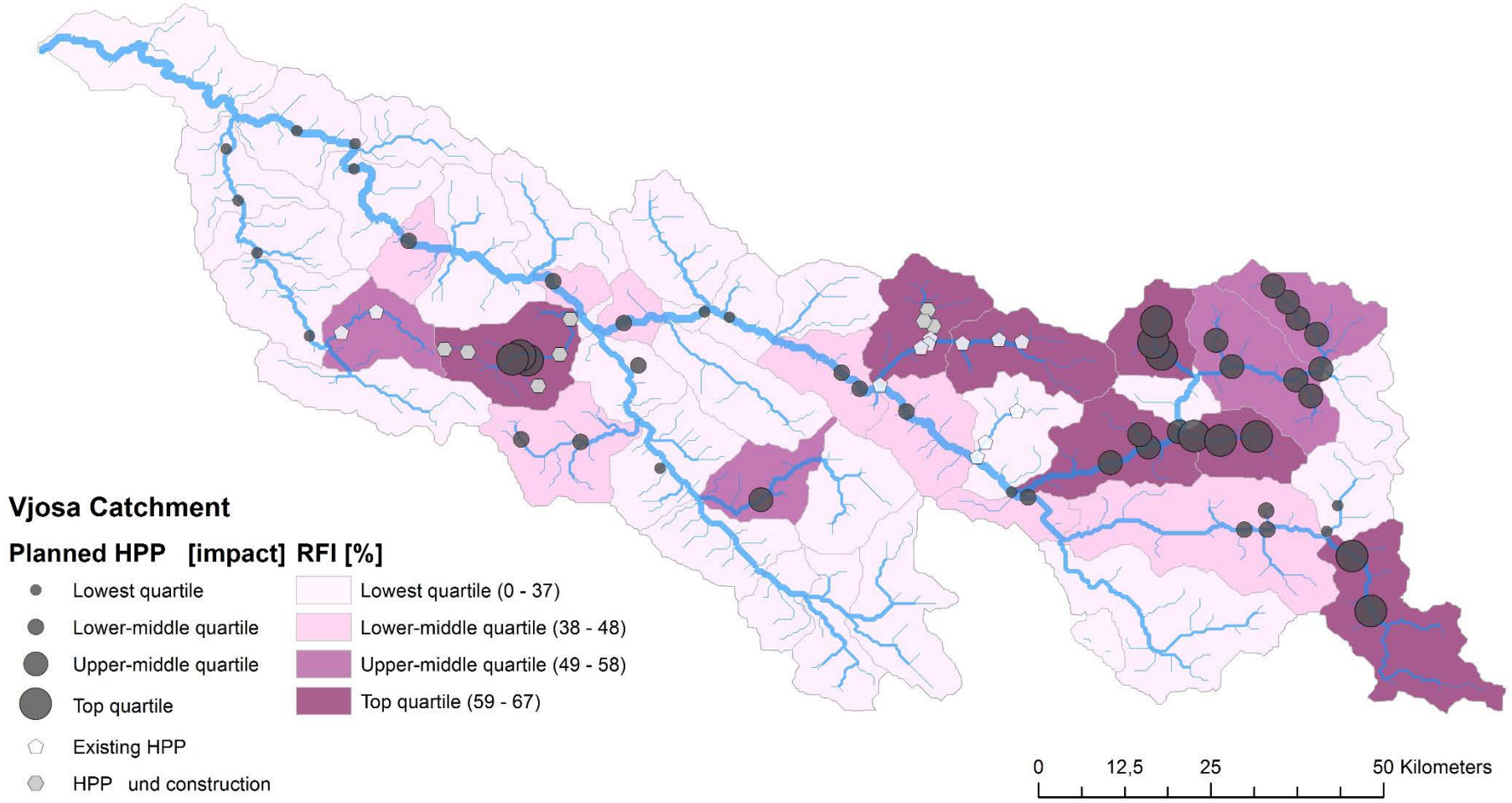


**Figure S8. Results of impact assessment for the indicator River Fragmentation (RFI: River Fragmentation Index).** Circles (dark gray) indicate planned Hydropower Plants (HPP). White pentagons indicate existing HPP, gray hexagons HPP under construction. Circle size increases with impact of planned HPP. The base map presents RFI values in quartiles for sub-catchments. Quartiles increase with impact.

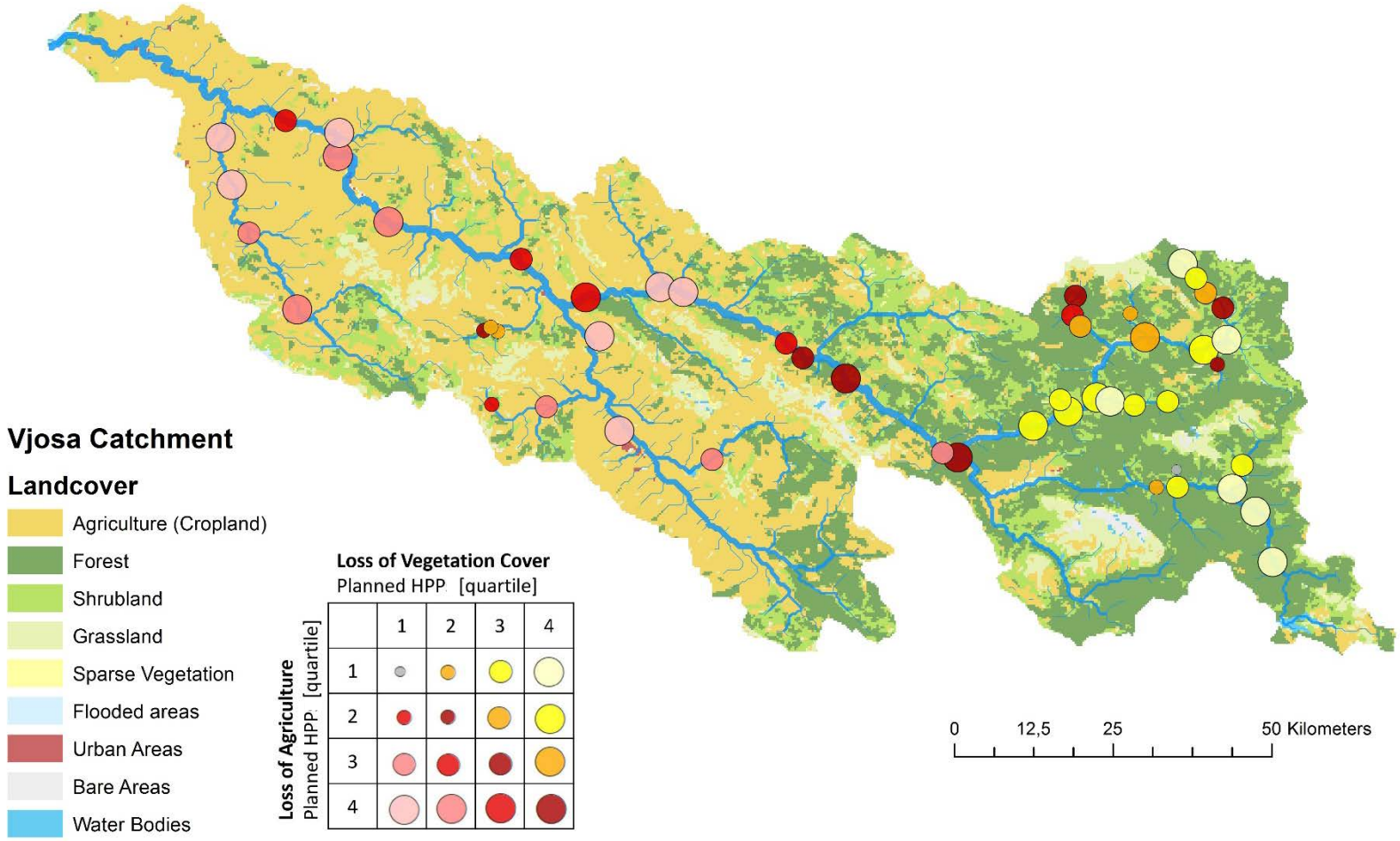


**Figure S9. Results of impact assessment for the indicators Land Use Change – Agriculture (LUC-A) and Land Use Change – Vegetation Cover (LUC-V; including forest, grassland and shrubland).** Circles indicate planned Hydropower Plants (HPP). Each planned HPP is given its respective quartile value for the indicator LUC-A and LUC-V. Quartile values increase with impact. Size of circles increases with quartile values. Color intensifies if high quartile values in both LUC-A and LUC-V were reached. For yellow/orange colored planned HPP, higher impacts in the indicator LUC-V were reached. For rose/pink colored planned HPP, higher impacts in the indicator LUC-A were reached. Dark red colored HPP reached similar quartile values for both indicators.

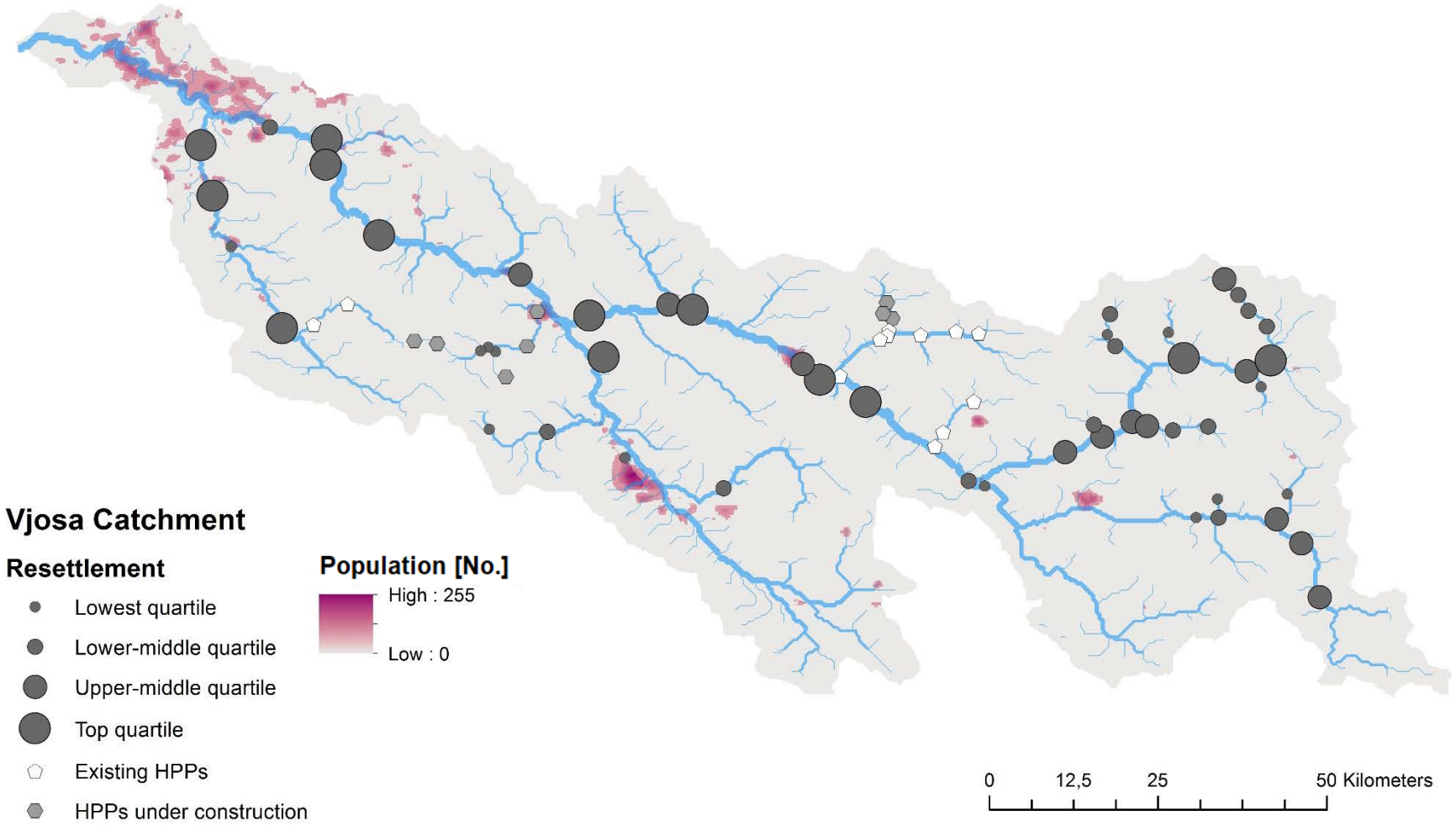


**Figure S10. Results of impact assessment for the indicator Resettlement:** Circles indicate planned (gray) Hydropower Plants (HPP). White pentagons indicate existing HPP, gray hexagons HPP under construction. Circle size increases with impact of planned HPP. The base map presents number of people living in the catchment area (2018).

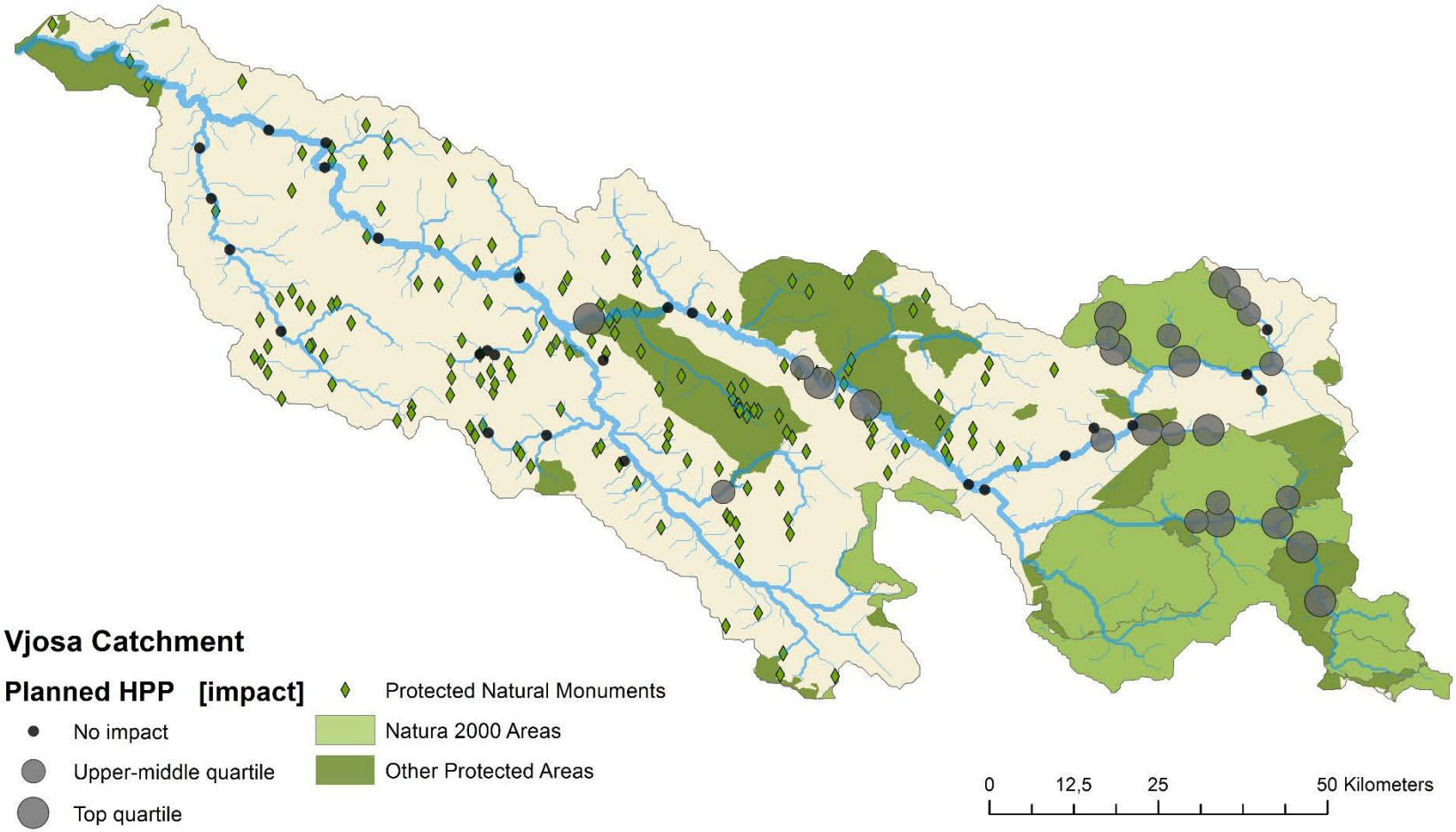


**Figure S11. Results of impact assessment for the indicator Protected Area.** Circles indicate planned (gray, black) Hydropower Plants (HPP). Circle size increases with impact of planned HPP. Black colored planned HPP do not affect Natura 2000 or other areas under protection. The base map presents Protected Natural Monuments (diamonds), Natura 2000 and other areas under regional or national protection.

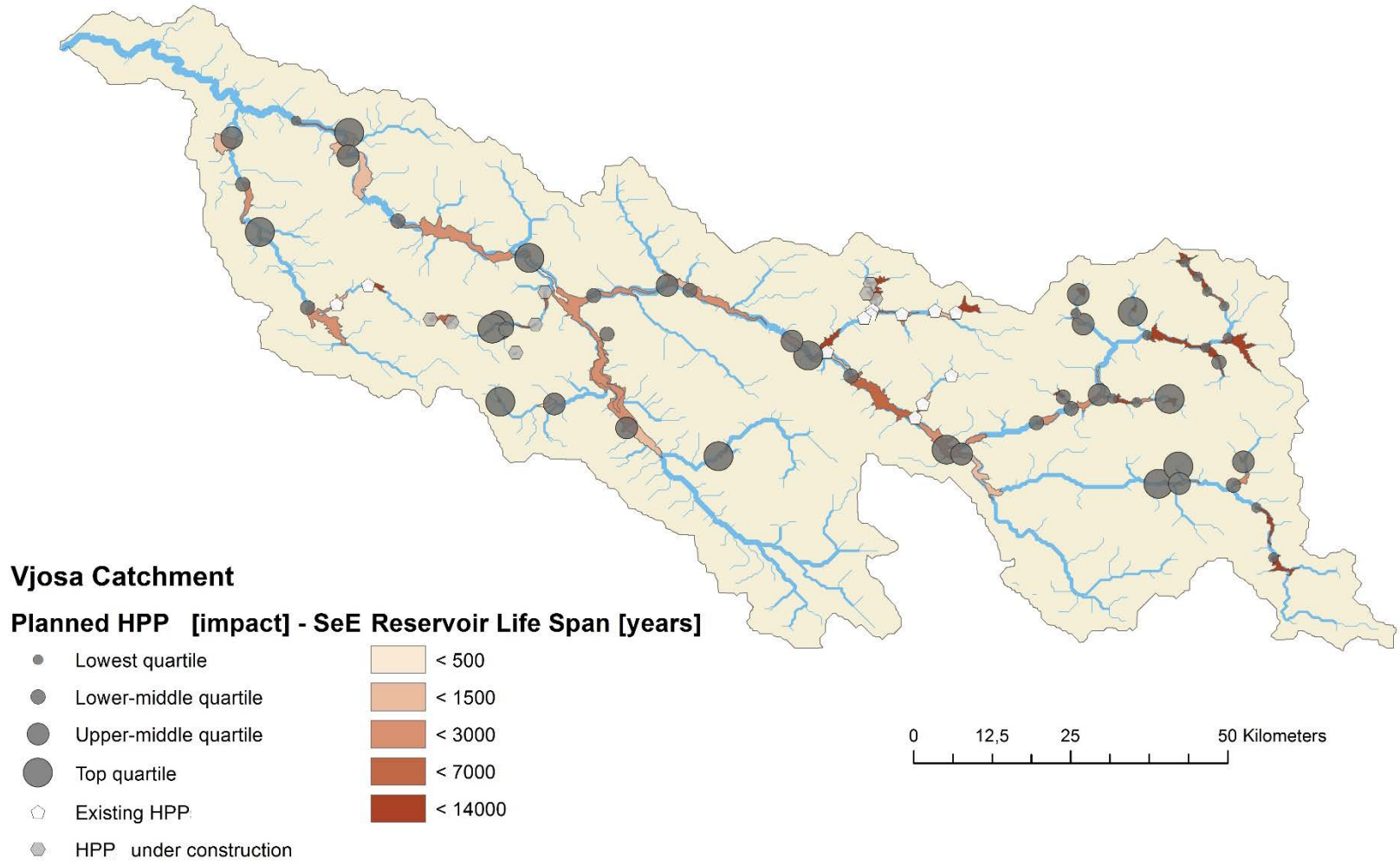


**Figure S12. Results of impact assessment for the indicator Sediment Entrapment.** Circles (dark gray) indicate planned Hydropower Plants (HPP). White pentagons indicate existing HPP, gray hexagons HPP under construction. Circle size increases with impact of planned HPP. The base map presents present and projected reservoirs and their calculated live span, increasing with color.

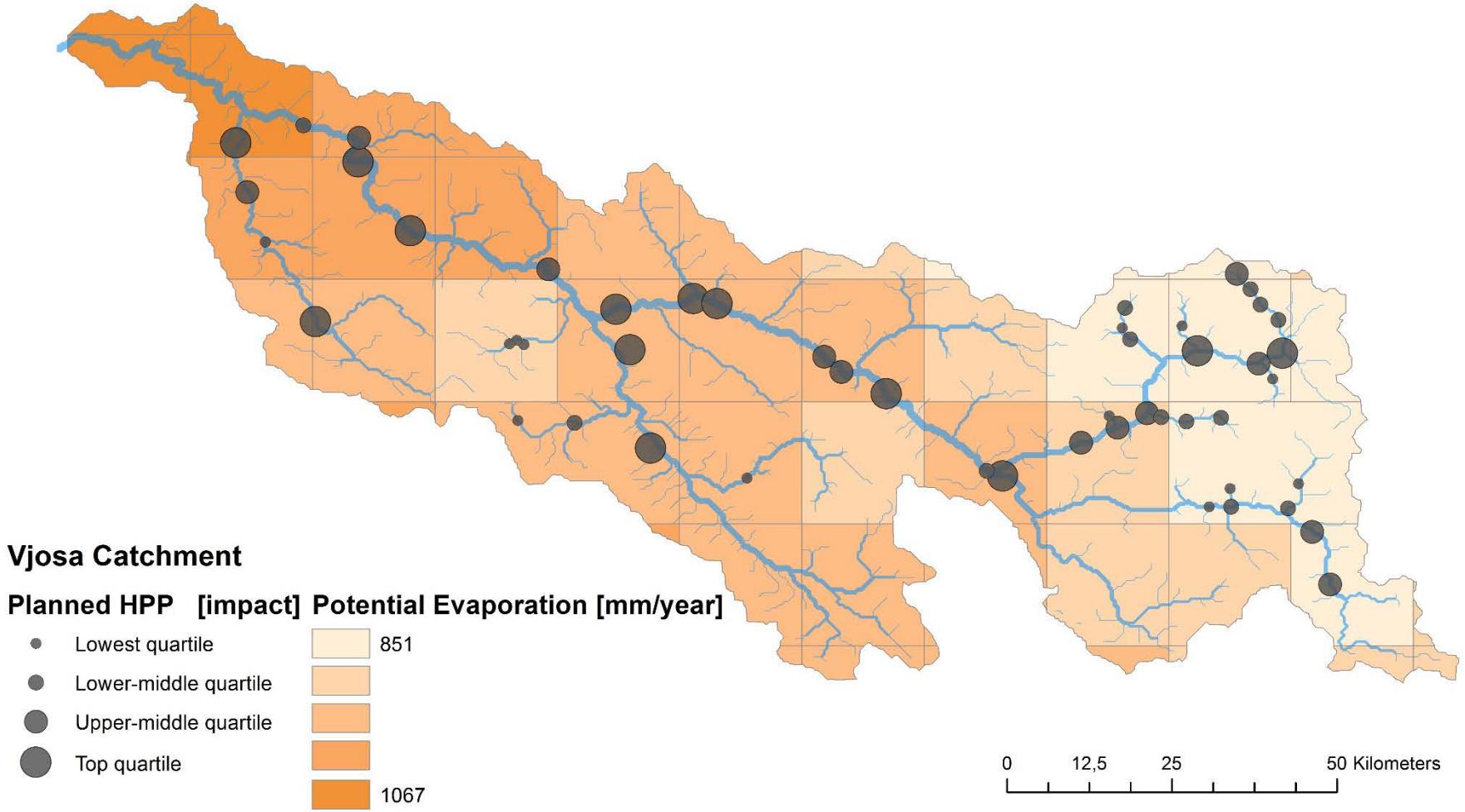


**Figure S13. Results of impact assessment for the indicator Potential Evaporation.** Circles indicate planned (gray) Hydropower Plants (HPP). Circle size increases with impact of planned HPP. The base map presents potential evaporation values [mm/year] for the catchment area.