METHOD PROPOSAL

First version of the method ready for national feedbacks and inputs

Version 4
052018

1. Proposed valorisation method

The aim of the valorisation is to identify areas with varying degree of predisposition for development (implementation of small retention facilities/ with different development needs for small retention in non-urban areas (rural areas, including rural housing, open spaces and forests).

As valorisation is meant to be universal, a number of statistical analyses are included and carried out for the selected area, which then allows the selection of appropriate indicators (indicators). Therefore, in this method, an emphasis is placed on supporting the decision-making process. Fig. 1 presents the calculation algorithm. To make the figure more comprehensive, numbers were placed in the vicinity of the individual actions. The following stages can be distinguished in the proposed method:

a) choosing a valorisation goal[2] (No. on fig.1)

b) choosing Spatial Planning Unit (SPU) and indicators dedicated to analysing the goal[3-4]

c) input of data necessary to calculate the indicators[5-9]

d) pre-processing of data using the selected method e.g. interpolation[10-11]

e) calculating indicators and their statistics for SPU (correlation matrix)[12-15]

f) choosing final set of indicators after analysing the correlation matrix[16]

g) choosing the conversion method of indicator to index[17-18]

h) defining an aggregation method for indexes [19-20]

i) computing the aggregated values in SPU[21-23].

a (no. 2)

This step allows to choose four objectives (problems to be solved): general (need for water retention due to environmental and economic requirements), flood protection, drought prevention, water quality improvement. Based on the user's response the indexes recommended for valorisation will be selected.

b (no. 3-4)

The choice of the basic valorisation field, SPU, will depend mainly on the scale of the analysis (size of the valorisation area). We recommend to use hydrographic units (eg. elementary basins, Water Framework Directive surface water bodies or aggregated water bodies) or modelling units (eg HRUs). Practically, this would involve introducing a shapefile layer with spatial units (SPU) for which the valorisation is performed.

After selecting the SPU, the user will receive a list of recommended indicators to solve the problem and will be able to view them through the catalogue of indicators. In the catalogue the indicators will be described by the following attributes: name, label, definition (equations, if needed), indicator unit, and data necessary for calculating the indicators. Additionally, they will be assigned with names of the groups that derive from their type (eg. climatic, physico-geographic, hydrological, hydrogeological, economic, environmental and threat status from biogenic substances) and the purpose of the analysis for which they are recommended. This catalogue will be based on the literature collected by all partners.

The user will be able to remove some indexes and to add indexes from the catalogue, from outside the suggested list. The result will be a set of valorisation indexes (v.1).

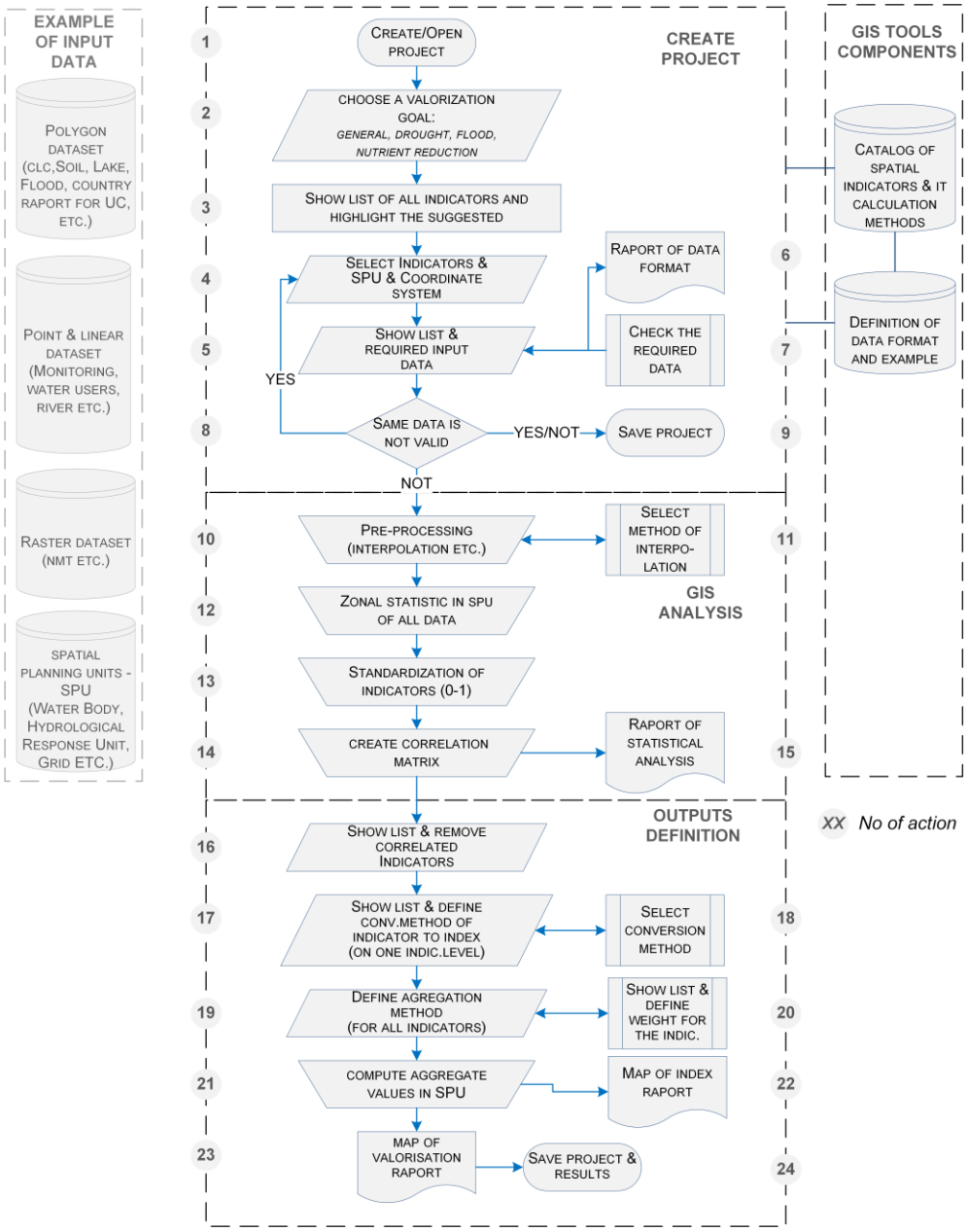

Fig 1 Algorytm GIS tools for NWRM valorization

c (no. 5-9)

In the next stage, the user will get a list of data and their formats needed to calculate the selected indicators. Input must be prepared in the same coordinate system and should have a specified raster or vector format with the appropriate attributes. After providing the input data or during the validation of the data (data format, attribute names, coordinates, etc.), if it does not work correctly, the user will be permitted to resign from calculating that particular indicator.

d (no. 10-11)

Technical processing of data, eg. rasterization, possibly pre-processing, such as the distribution of indicators with a point value (precipitation, temperature) in the area as a result of interpolation.

e (no. 12-15)

Calculation of index values in spatial units SPU (Zonal Statistic function). Standardization of index values to scale <0, 1> ((x-AVGx) / σ) and calculation of a correlation matrix. Proposing indicators to be eliminated due to strong correlation.

f (no. 16)

Final determination of a set of valorisation indexes (v.2).

g (no. 17-18)

Selection of systems for defining threshold values for indicators and calculation of valorisation indexes (eg. division of the index variation range into 3 ranges of intensity for recommended NSWR development: none - index 0, medium - index equal to 1/2, high - index equal to 1).

h (no. 19-20)

Selecting the method for aggregating index values to determine the overall rating (eg, summing all indices for all spatial units, selecting the weights for individual indices).

I (no. 21-23)

Computing the aggregated values in SPU. Presentation of analysis results - general valorisation and valorisation for selected objectives: flood protection, drought prevention, water quality improvement.

A similar analysis was carried out for the Mazovian Region in Poland (Pusłowska-Tyszewska et al., 2008).

Kardel I., Okruszko T., Pusłowska-Tyszewska D., Chormański J., 2015. GIS Based Tool for the Landscape Retention Planning. Case studies. http://isepei.org/case-studies/gwp-cee/gis-based-tool-landscape-retention-planning.

2. Procedure for partners to work with their stakeholders on the national level

In order to refine the method and to adapt it to regional conditions and local issues, partners should work with their stakeholders on the national level to analyse it. In order to improve the analysis in the preliminary stage, the following actions were carried out:

- Overview of projects related to water retention,
- Development of key words and queries for searches in scientific literature databases (Scopus, Web of Science, Google Scholar),
- Collecting and organizing articles,
- Analysing relevant articles concerning valorisation methods,
- Development of climatic and physico-geographic database for Central Europe based on global datasets (Tab. 2 contains an overview of available and selected databases).

Analysis of the valorisation method should follow according to the given steps:

- getting acquainted with the valorisation proposal and sample calculations,

- systematic review of the literature selected by the co-ordinator (eg. in Tab.1, and available on ftp server), in particular literature and projects carried out in the national language (ie. put the data into the GIS_ToolsDB.xlsx workbook),

- development of a list of data available to the public and available on request for the country area and the relevance of such data (ie. expand the information contained in Tab. 2; put the data into the GIS_ToolsDB.xlsx workbook),

- macroscale analysis of global datasets to determine the extent (statistics) of the spatial variability of climatic and physico-geographic indicators (ie. analyse maps and summary of selected indicators developed by WULS and made available on FTP, on this basis, determine a list of the most important for the country / region indicators),

- obtaining detailed data for the pilot catchment or larger region in order to prepare a mesoscale analysis,

- selection of indicators relevant for the national level and depending on global and regional variations and objectives required for mapping (put it to GIS_ToolsDB.xlsx),

- recommending changes to the proposed valorisation method and catalogue of spatial indicators .

2.1. Description of methods used for searches of scientific literature databases

1. The following search engines can be used for searching for literature relevant to the project.

Bibliographic Databases:

a. Scopus

b. Web of Science Core Collections (only commercial access)

c. Science Direct

Web searches:

d. Google Scholar

2. Narrowing down the results according to the Web of Science Categories. By marking the suitable categories it is possible to further filter the search results.

Suggested Categories of interest:

ENVIRONMENTAL SCIENCES

WATER RESOURCES

ENGINEERING ENVIRONMENTAL

GEOSCIENCES MULTIDISCIPLINARY

GEOGRAPHY PHYSICAL

ENVIRONMENTAL STUDIES

GEOLOGY

FORESTRY

AGRICULTURE MULTIDISCIPLINARY

3. The next step is choosing suitable key words to be used in the search.

Proposed searches:

- retention measure

- best management practices (BMP)

- natural water retention measures (NWRM)

- water retention

Sectors/Areas:

- agriculture
- forest
- hydro morphology
- urban
- drainage area

Resolution/Scale

- watershed,
- water body,
- riverbed,
- stream, river,
- geocomplex unit
- landscape unit
- physical catchment descriptors (PCD)
- hydrologically sensitive areas (HSA)
- hydrological response unit (HRU)

Method of valorisation – identifying potential locations:

- valorisation method
- GIS based method
- model based method
- identification method
- estimated location method

Purpose of the method:

- drought protection
- flood protection
- improvement of water quality
- methods for water retention

4. Joining the key words in search strings allows to maximize the search engines capability to find suitable publications.

Such as (for Web of Science):

TS=(method* AND identif* AND location AND water AND retention* AND gis)

5. Keeping records.

The search engines used and the key words/ strings should be recorded (as well as the unsuccessful ones in the "searches" tab in Literature.xls). The information about relevant articles is stored in the

Literature.xls and a folder with pdf of the articles (pdf's are labelled according to the number in the Literature.xls database). The results are presented in Table 1.

2.2. Description of methods used for searches of related projects

The search for project relevant to FramWat was carried out on the basis of similar key words as the ones used for literature search. Search was performed throught the use of an internet browser as well as names of projects specified in the FramWat application, databases such as NWRM.eu, Interreg, Life. The results are presented in Table 3.

The table contains a column called "FramWat Outputs" (2nd column) which contains information on the relationship of the project to FramWat expected outputs. There are 3 (1-3) outputs and an additional "other" label witch indicates for which part of the FramWat project the analysed project can be useful:

(1) Location: choosing the best location for a set of measures to help achieving: water quantity goals (mitigation of droughts and floods), water quality goals (decreasing the N and P loads)."

(2) Monitoring: assessment of effectiveness of those measures.

(3) Guidelines: guidelines for how to apply N(S)WRM in the River Basin Management context.

(4) Other: water retention projects of interest.

2.3. Summary

1. A review of the global datasets found that good quality and high resolution data for Central Europe is available only for: land use (CORINE Land Cover), hydrography (EEA, European

catchments and Rivers network system), digital elevation model (Copernicus) and climate (Water and Global Change). This data will be used for testing GIS Tools.

2. As a result of the review of existing or completed projects, it was established that there was no project dedicated to the development of NSWRM planning tools. Catalog of measures and descriptions will be obtained from http://nwrm.org. Also noteworthy is the FreeWat project, which

aims to simplify the application for water resource management. The WARELA project looks at water retention and land use. The economic, ecological and managerial efficiency of different measures will be assessed. WaReLa will use GISbased systems and open programme-controlled systems to test scenarios, compile a comprehensive overview and elaborate a regional planning framework/decision support system for transnational river basin management. The overall objective of the WETwin project is to enhance the role of wetlands in basin-scale integrated water resources management (IWRM)

3. As a result of the literature review, general assumptions were made about how the valorisation methodology (VM) should be carried out and what to pay attention to when trying to verify it. Most relevant are articles by Pechanec et al. (2015), Rossetto et al. (2015), Agarwal & Garg (2016), Przybyła et al. (2015) and Liu et al. (2015).

4. Proposed (VM) is universal and can be transferred to other areas, but requires individual selection of indices and their ranges

5. The application of VM enables taking into account environmental conditions already at the initial stage of planning activities.

6. Planning which includes a division into spatial units introduces a greater flexibility to management plans.

7. The VM is meant for planning purposes, therefore it should be remembered that each area with high retention needs requires an individual approach. The specific local environmental setting, low flow and needs of other users should be taken into account, including the environmental flow.

8. The quality of the developed VM depends on the quality and resolution of the data used and the knowledge of the expert who applies it.

9. Applying this VM for different types of pilot catchments will enable the development of additional guidelines for future users. The conclusions from the results of the valorisation for pilot catchments, including a comparison of its effectiveness in different climatic conditions and topography will be prepared in further stages.

Tab.1 Literature search results (full text is available on FTP)

No	Title	Goal	Method	Topic	Country	Link	Reference	Project	search word
1	Identifying the most suitable areas for surface flow wetland construction in Lithuania	The main goal of the project was to develop an effective way to select the possible sites for constructed wetlands to improve surface water quality and achieve good ecological status of water bodies in Lithuania.	GIS based approach, criteria	constructed wetlands	Lithuania	http://conf.rd.asu.lt/index.php/rd/article/view/124	Dumbrauskas, A., Bastiene, N., Punys, P. 2015. Identifying the most suitable areas for surface flow wetland construction in Lithuania. In: Raupelienė, A. (Ed.) *Proceedings of the 7th International Scientific Conference Rural Development 2015* DOI: http://doi.org/10.15544/RD.2015.060	The Lithuanian, EEA sponsored project "Strengthening of marine and inland water management – part two" (EEE-LT02-AM-TF-01-002) included the. „Implementation of diffuse water pollution reduction measures in the pilot catchment".	Method water retention gis @web of science
2	Comparing Two Multi-Criteria Methods for Prioritizing Wetland Restoration and Creation Sites Based on Ecological, Biophysical and Socio-Economic Factors	Preparation and comparison of models for prioritizing wetland restoration projects. This study included the social aspect (availability of public lands) as a fundamental factor to locate wetlands.	comparison of two multi-criteria methods (greedy algorithm and a suitability model). The suitability model considered the terrain slope, proximity to watercourses and soil permeability. The greedy algorithm was implemented on the basis of the availability of public lands and the wetland restoration project costs	wetland restoration	Spain	https://www.infona.pl/resource/bwmeta1.element.springer-doi-10_1007-S11269-017-1572-2	Darwiche-Criado, N., Sorando, R., Eismann, S.G., Comin, F.A. 2017. Comparing Two Multi-Criteria Methods for Prioritizing Wetland Restoration and Creation Sites Based on Ecological, Biophysical and Socio-Economic Factors. *Water Resour Manage* 31: 1227. https://doi.org/10.1007/s11269-017-1572-2	European Project Life09 ENV/ES/000431 CREAMAgua	Method water retention gis @web of science

3	Improved framework model to allocate optimal rainwater harvesting sites in small watersheds for agro-forestry uses	This study introduces an improved rainwater harvesting (RWH) suitability model to help the implementation of agro-forestry projects (irrigation, wildfire combat) in catchments.	The model combines a planning workflow to define suitability of catchments based on physical, socio-economic and ecologic variables, with an allocation workflow to constrain suitable RWH sites as function of project specific features (e.g., distance from rainfall collection to application area). The planning workflow comprises a Multi Criteria Analysis (MCA) implemented on a Geographic Information System (GIS), whereas the allocation workflow is based on a multiple-parameter ranking analysis.	Rainwater harvesting for agroforestry	Portugal	http://www.sciencedirect.com/science/article/pii/S0022169417302810	Terêncio, D.P.S., Sanches Fernandes, L.F., Cortes, R.M.V., Pacheco, F.A.L. 2017. Improved framework model to allocate optimal rainwater harvesting sites in small watersheds for agro-forestry uses, Journal of Hydrology, 550, 318-330, ISSN 0022-1694, http://dx.doi.org/10.1016/j.jhydrol.2017.05.003.	INTERACT project – ''Integrated Research in Environment, Agro-Chain and Technology", no. NORTE-01-0145-FEDER-000017, in its line of research entitled BEST	Method water retention gis @web of science
4	Optimization of wetland restoration siting and zoning in flood retention areas of river basins in China: A case study in Mengwa, Huaihe River Basin	Identifying potential sites and functional zones for wetland restoration in a flood retention area in middle and eastern China, optimizing the spatial distribution and functional zones to maximize flood control and human and regional development.	Uses a framework consisting of wetland restoration evaluation, optimization, and model verification. Optimization includes decision variables, objective functions, and constraints. Tools used: ArcGIS, ArcSWAT	wetland restoration, flood control	China	http://www.sciencedirect.com/science/article/pii/S0022169414005034	Xiaolei Zhang, Yuqin Song, 2014. Optimization of wetland restoration siting and zoning in flood retention areas of river basins in China: A case study in Mengwa, Huaihe River Basin, Journal of Hydrology, 519, 80-93, ISSN 0022-1694, http://dx.doi.org/10.1016/j.jhydrol.2014.06.043.	None	Method water retention gis @web of science
5	Monitoring of agricultural drought in Poland using data derived from environmental satellite images	Investigating the extent of drought and crop yield reduction due to drought.	Satellite images taken by environmental and meteorological satellites have been used. Vegetation indices NDVI, VCI and TCI were determined. Analysis of changes in these indices allows preparation of maps showing the emergence and extent of drought.	extent of drought	Poland	http://bc.igik.edu.pl/Content/251/GI_2012_8.pdf	Dąbrowska-Zielińska, K. , Ciołkosz, A. , Malińska, A. , Bartold, M. 2011. Monitoring of agricultural drought in Poland using data derived from environmental satellite images. Geoinformation Issues, V.3, No 1(3), 87-97	None	Method water retention gis
6	GIS-based Approach to Estimate Surface Runoff in Small Catchments: A Case Study	The aim of the paper is to estimate and assess surface runoff	SCS runoff curve number method, modeling in GIS and remote sensing were used.	runoff conditions	Slovakia	http://pressto.amu.edu.pl/index.php/qg/article/view/7560	Vojtek, M. & Vojteková, J. (2016). GIS-based Approach to Estimate Surface Runoff in Small Catchments: A Case Study. Quaestiones Geographicae, 35(3), pp. 97-116. DOI:10.1515/quageo-2016-0030	None	Method water retention gis

7	How to model and map catchment processes when flood risk management planning	This project aims to improve understanding of how existing modelling software, mapping techniques and data can be used to assess a wide range of catchment processes to help develop flood and coastal erosion risk management (FCERM) projects which involve working with natural processes (WwNP) to reduce flood risk.	This publication reviews the available data, models and tools for analysing run-off generation, sediment processes, in-channel barriers, river floodplain barriers, diffuse pollution.	run-off generation, sediment processes, in-channel barriers, river	UK	https://www.gov.uk/government/publications/how-to-model-and-map-catchment-processes-when-flood-risk-management-planning	Hankin, B., Burgess-Gamble, L., Bentley, S., Rose, S. 2016. How to model and map catchment processes when flood risk management planning. Project SC120015/R1, Environmental Protection Agency, Bristol, UK.	UK Enivironmental Protection Agency Project SC120015/R1. Research commissioned by the Environment Agency's Evidence Directorate and funded by the joint Flood and Coastal Erosion Risk Management Research and Development Programme	Method water retention gis @web of science
8	Identifying hydrologically sensitive areas: Bridging the gap between science and application	The goal of this study was to develop a scientifically justified method to identify the locations that generate overland flow	Tested the reliability of the 'distance from a stream,' Ds, and the 'topographic index,' λ, to predict areas with a high propensity for generating overland flow, i.e. hydrologically sensitive areas (HSA). Use of soil moisture routing model.	runoff generation, hydrologically sensitive areas.	USA	http://www.sciencedirect.com/science/article/pii/S0301479705001593	Agnew, L. J., Lyon, S., Gérard-Marchant, P., Collins, V. B., Lembo, A. J., Steenhuis, T. S., Walter, M. T. 2006. Identifying hydrologically sensitive areas: Bridging the gap between science and application, *Journal of Environmental Management*, 78 (1), 63-76, ISSN 0301-4797, http://dx.doi.org/10.1016/j.jenvman.2005.04.021.	No information	Method water retention gis @web of science
9	GIS-based modeling of runoff source areas and pathways	GIS-based landscape analysis for assessing the risks associated with non-linear responses of Hydrologic Response Units to changing rainfall and land use.	Runoff module designed for IDRISI-Andes to calculate runoff amount and routing for single or multiple rainfall events on a hillslope at small catchment scale is presented. Conceptually, the module extrapolates point data of infiltration capacity onto a field or hillslope. A spatially distributed runoff map is calculated based on the addition of layers with rainfall data and the routing of runoff through pathways connecting pixels in a digital elevation model. Unlike outlet-based runoff modeling, the need for parameterization of the catchment is kept to a minimum.	runoff pathways	Germany	https://www.geogr-helv.net/63/48/2008/	Kuhn, N. J. and Zhu, H. 2008. GIS-based modeling of runoff source areas and pathways, *Geogr. Helv.*, 63, 48-57, https://doi.org/10.5194/gh-63-48-2008.	No information	Method water retention gis @web of science

10	A restatement of the natural science evidence concerning catchment-based 'natural' flood management in the UK	This paper describes a project to provide a succinct summary of the natural science evidence base concerning the effectiveness of catchment-based 'natural' flood management in the UK.	Assessment of catchment-based measures that could contribute to flood management	catchment-based 'natural' flood management	UK	http://rspa.royalsocietypublishing.org/content/473/2199/20160706	Dadson, S., Hall, J. W., Murgatroyd, A., Acreman, M., Bates, P., Beven, K., ... Wilby, R. (2017). A restatement of the natural science evidence concerning catchment-based "natural" flood management in the United Kingdom. Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences, 473(2199), [20160706]. DOI: 10.1098/rspa.2016.0706	No information	Method water retention gis @web of science
11	Multi-criteria analysis and GIS modeling for identifying prospective water harvesting and artificial recharge sites for sustainable water supply	The main aim of this study is to present a technically robust and pragmatic methodology for evaluating rainwater harvesting potential and identifying suitable sites for RWH (rainwater harvesting) and artificial recharge structures using Geographic Information System (GIS)-based multi-criteria decision analysis (MCDA). Unlike past studies, this study proposes an approach to prioritize zones/sites for RWH and recharge structures.	Suitable zones and sites for feasible RWH and recharge structures were identified using suitability criteria and GIS-based Boolean logic. In addition, identified zones/sites were prioritized based on the themes of key factors viz., post-monsoon groundwater level, groundwater fluctuation and water demand. After normalizing the weights of the themes and their features, the themes were integrated in GIS environment.Framework for the prioritization of suitable zones/sites for RWH and groundwater recharge is proposed in this study by integrating 'rainwater harvesting potential' and 'rainwater harvesting demand' maps.	rainwater harvesting	India	http://www.sciencedirect.com/science/article/pii/S095965261632025X	Singh, L. K., Jha, M. K., Chowdary, V.M. (2017) Multi-criteria analysis and GIS modeling for identifying prospective water harvesting and artificial recharge sites for sustainable water supply. Journal of Cleaner Production, Volume 142, Part 4, 2017, Pages 1436-1456, ISSN 0959-6526, https://doi.org/10.1016/j.jclepro.2016.11.163.	None	method* AND identif* AND location AND water AND retention* AND gis @science direct

12	Integrating Spatial Multi Criteria Decision Making (SMCDM) with Geographic Information Systems (GIS) for delineation of the most suitable areas for aquifer storage and recovery (ASR)	Designate suitable areas for aquifer storage and recovery.	One of the fundamental principles of making aquifer storage and recovery (ASR) systems is delineation of suitable areas based on scientific and natural facts in order to achieve relevant objectives. To that end, the Multi Criteria Decision Making (MCDM) in conjunction with the Geographic Information Systems (GIS) was applied in this study. More specifically, nine main parameters including depth of runoff as the considered source of water, morphology of the earth surface features such as geology, geomorphology, land use and land cover, drainage and aquifer characteristics along with quality of water in the aquifer were considered as the main layers in GIS. The runoff water available for artificial recharge in the basin was estimated through Soil Conservation Service (SCS) curve number method. The weighted curve number for each watershed was derived through spatial intersection of land use and hydrological soil group layers. Other thematic layers were extracted from satellite images, topographical map, and other collateral data sources, then weighed according to their influence in locating process. The Analytical Hierarchy Process (AHP) method was then used to calculate weights of individual parameters. The normalized weighted layers were then overlaid to build up the recharge potential map.	groundwater recharge	Iran	http://www.sciencedirect.com/science/article/pii/S0022169417303207	Zainab Banoo Ahani Amineh, Seyyed Jamal Al-Din Hashemian, Alireza Magholi (2017) Integrating Spatial Multi Criteria Decision Making (SMCDM) with Geographic Information Systems (GIS) for delineation of the most suitable areas for aquifer storage and recovery (ASR), In Journal of Hydrology, Volume 551, Pages 577-595, ISSN 0022-1694, https://doi.org/10.1016/j.jhydrol.2017.05.031.	No information	method* AND identif* AND location AND water AND retention* AND gis @science direct

13	Application of GIS-based multi-criteria analysis for site selection of aquifer recharge with reclaimed water	This work aims to identify potential sites for reclaimed water (secondary treated wastewater) infiltration for groundwater recharge in the northwestern part of the Beira Interior region, using a GIS-based multi-criteria analysis.	A GIS-based multi-criteria analysis was performed, combining ten thematic maps and economic, environmental and technical criteria, in order to produce a suitability map for the location of sites for reclaimed water infiltration.	groundwater recharge	Portugal	http://www.sciencedirect.com/science/article/pii/S0921344911001649	Pedrero, F., Albuquerque, A., Marecos do Monte, H., Cavaleiro, V., Alarcón, J. J. (2011) Application of GIS-based multi-criteria analysis for site selection of aquifer recharge with reclaimed water, In Resources, Conservation and Recycling, Volume 56, Issue 1, Pages 105-116, ISSN 0921-3449, https://doi.org/10.1016/j.resconrec.2011.08.003.	No	method* AND identif* AND location AND water AND
14	Decision support tool for the evaluation of landscapes	This paper presents a full SDSS (spatial extension of Decision Support Systems) for landscape – its design, algorithmization and practical implementation. The created system allows simultaneous analysis and evaluation of landscape from the perspective of ecological stability, erosion susceptibility, retention capacity and the economic value.	The presented system implements products ArcView GIS 3.x, EMDS 2.0 and NetWeaver 1.1. The system implements four methods which are generally accepted for the given analyses and which have been algorithmized and applied in the GIS environment many times. Ecological stability is assessed using the basic coefficients of ecological stability. The susceptibility of soil to water erosion is determined by the RUSLE method. Retention capacity is determined based on the Runoff Curve Number Method and the economic value of the landscape draws on the modified Hessen method.	retention capacity, decision support system	Czech Republic	http://www.sciencedirect.com/science/article/pii/S1574954115000965	Pechanec, V., Brus, J., Kilianová, H., Machar, I. (2015) Decision support tool for the evaluation of landscapes, In Ecological Informatics, Volume 30, Pages 305-308, ISSN 1574-9541,	No	mapping water retention @ science direct
15	Using a map-based assessment tool for the development of cost-effective WFD river basin action programmes in a changing climate	The aim of this paper is to demonstrate and discuss how a map-based PoMs (Programmes of Measures) assessment tool can support the development of adaptive and cost-effective strategies to reduce N losses in a river basin.	The tool facilitates assessments of the application of agri-environmental measures that are targeted towards low retention agricultural areas, where limited or no surface and subsurface N reduction takes place. Effects of climate change on nitrate leaching were evaluated using the dynamic agro-ecosystem model 'Daisy'.	retention, nitrogen, agricultural areas	Denmark	http://www.sciencedirect.com/science/article/pii/S0301479716302146	Bjarke Stoltze Kaspersen, Torsten Vammen Jacobsen, Michael Brian Butts, Niels H. Jensen, Eva Boegh, Lauren Paige Seaby, Henrik Gioertz Müller, Tyge Kjaer, Using a map-based assessment tool for the development of cost-effective WFD river basin action programmes in a changing climate, In Journal of Environmental Management, Volume 178, 2016, Pages 70-82, ISSN 0301-4797, https://doi.org/10.1016/j.jenvman.2016.04.043.	No information	mapping water retention @ science direct

16	Flood regulating ecosystem services—Mapping supply and demand, in the Etropole municipality, Bulgaria	In this study, the capacities of different ecosystems to regulate floods were assessed through investigations of water retention functions of the vegetation and soil cover.	The use of the catchment based hydrologic model KINEROS and the GIS AGWA tool provided data about peak rivers' flows and the capability of different land cover types to "capture" and regulate some parts of the water. Based on spatial land cover units originating from CORINE and further data sets, these regulating ecosystem services were quantified and mapped. Resulting maps show the ecosystems' flood regulating service capacities in the case study area of the Malki Iskar river basin above the town of Etropole in the northern part of Bulgaria. Maps of demands for flood regulating ecosystem services in the study region were compiled based on a digital elevation model, land use information and accessibility data. Finally, the flood regulating ecosystem service supply and demand data were merged in order to produce a map showing regional supply-demand balances.	ecosystem services, flood	Bulgaria	http://www.sciencedirect.com/science/article/pii/S1470160X11001932	Stoyan Nedkov, Benjamin Burkhard, Flood regulating ecosystem services—Mapping supply and demand, in the Etropole municipality, Bulgaria, In Ecological Indicators, Volume 21, 2012, Pages 67-79, ISSN 1470-160X, https://doi.org/10.1016/j.ecolind.2011.06.022.	No information	mapping water retention @ science direct
17	FREEWAT: FREE and open source software tools for WATer resource management	FREEWAT main result will be an open source and public domain GIS integrated modelling environment for the simulation of water quantity and quality in surface water and groundwater with an integrated water management and planning module. FREEWAT aims at promoting water resource management by simplifying the application of the Water Framework Directive and other EU water related Directives	The article consists of an overview of the project	integrated water management modeling	Europe	http://www.freewat.eu/sites/default/files/FREEWAT_ROL_Vol_35_tot_1.pdf	Rossetto, R., Borsi, I., Foglia, L. (2015) FREEWAT: FREE and open source software tools for WATer resource management. Rend. Online Soc. Geol. It., Vol. 35, pp. 252-255, 1 fig. (doi: 10.3301/ROL.2015.113)	project FREEWAT, which has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement n. 642224.	-

18	Identification of flood-generating forest areas and forestry measures for water retention	A key point of this paper is to identify flood-generating forest areas as a basis for recommending appropriate forestry practices aimed at reducing the occurrence of damaging floods within small watersheds	Geographic information system-based assessment keys were developed on the basis of digital forest site classifications to evaluate the water retention functions that depend on landscape features and land-use. The keys lead to digital maps identifying sensitive forest sites and linear structures. The maps provide a spatial distribution of runoff types and intensities. Forest inventory data are the basis for forestry measures to support water retention. The assessment keys and a tool box of forestry water retention measures are part of a Decision Support System (DSS) that is under development within the WaReLa-project. The DSS includes an evaluation tool for the economic consequences and the eco-efficiency of flood-precaution measures.	forest, decision support system	Germany	http://www.issw.ch/dienstleistungen/publikationen/pdf/7501.pdf	Gebhard Schüler, G. (2006) Identification of flood-generating forest areas and forestry measures for water retention For. Snow Landsc. Res. 80, 1: 99–114	WaReLa-project	-
19	Analytical Hierarchical Process (AHP)-Based Flood Water Retention Planning in Thailand	This paper describes a methodology that can help identify the optimum of flood retention reservoirs based on the use of an analytical hierarchical process (AHP).	The parameters considered in the study were salt crust, soil drainage, slope, land use, and geological formation. AHP was used to compute the weights of the main and sub-criteria. These weights were employed to determine a Water Harvesting Potential Index (WHPI). Based on the analysis, potential areas were categorized as excellent, good, moderate, and poor candidates. These data were converted into vector layers for creating water harvesting zone maps. The capacity of the potential reservoirs was computed in a GIS environment using an analysis of digital elevation models (DEMs) and maps of potential water harvesting zones.	floodwater retention	Thailand	http://www.tandfonline.com/doi/abs/10.2747/1548-1603.45.3.343	Pawattana, C., & Kumar, N. (2008) TripathiAnalytical Hierarchical Process (AHP)-Based Flood Water Retention Planning in Thailand. GIScience & Remote Sensing Vol. 45 , Iss. 3	full article unavailable	TS= (method* AND identif* AND location AND water AND retention* AND gis) @web of

20	Remote Sensing and GIS Based Groundwater Potential & Recharge Zones Mapping Using Multi-Criteria Decision Making Technique	In this present study, groundwater potential and recharge zone maps, are delineated for Loni and Morahi watersheds, Unnao and Rae Bareli district, Uttar Pradesh, India using RS, GIS and Multi-Criteria Decision Making (MCDM) techniques.	The Satty's Analytical Hierarchical Process (AHP) is used as a MCDM technique to normalise the weights of various thematic layers and their classes for delineating the groundwater potential and recharge zone maps. Thematic layers were integrated using weighted overlay in a GIS environment to generate groundwater potential and recharge zone maps. The output potential map is further classified into five zones on the basis of their histograms, viz., 'very poor', 'poor', 'good', 'very good' and 'excellent'.	groundwater recharge	India	https://link.springer.com/article/10.1007%2Fs11269-015-1159-8#copyrightInformation	Agarwal, R. & Garg, P.K. (2016) Remote Sensing and GIS Based Groundwater Potential & Recharge Zones Mapping Using Multi-Criteria Decision Making Technique. Water Resour Manage 30: 243. https://doi.org/10.1007/s11269-015-1159-8	No information	cited articles
21	Challenges for mainstreaming climate change into EU flood and drought policy: Water retention measures in the Warta River Basin, Poland	This paper discusses four challenges for mainstreaming climate change into European flood and drought risk management policies within the water and agriculture sectors: the climate change impact challenge; the robust policy challenge; the EU policy maze challenge; and the implementation challenge	The challenge of reliably estimating the impact of climate change on flood and drought risk at the local and regional scales has led to the pursuit of robust policy solutions. Robust policy solutions, as we demonstrate by comparing reservoirs and small ponds, can be equally intractable given the lack of information on their costs, benefits, and co-benefits, particularly if climate change is taken into account. The mainstreaming challenge is further complicated by the myriad of EU policies targeting flood and drought risks.	flood, drought, policy	Poland	https://link.springer.com/article/10.1007/s10113-014-0643-7	Bayer J., Dubel A., Sendzimir J., Hochrainer-Stigler S., (2015) Challenges for mainstreaming climate change into EU flood and drought policy: Water retention measures in the Warta River Basin, Poland. Journal of Regional Environmental Change Volume 15, Issue 6, pp 1011–1023 DOI 10.1007/s10113-014-0643-7	project RESPONSES "European Responses to Climate Change" under Grant Agreement No. 224092 in the 7th Framework Programme of the European Commission.	pdf library
22	Guidance Manual for Developing Best Management Practices (BMPs)	Manual promotes the integration of pollution prevention concept and practices in BMP plans.	Manual	best management	USA	https://www3.epa.gov/npdes/pubs/owm0274.pdf	US Environmental Protection Agency (1993) Guidance Manual for Developing Best Management Practices (BMPs) EPA 833-B-93-004, Washington, USA.	None	pdf library

23	Hydrological corridors for landscape and climate restoration: Prioritization of re-greening areas in Kenya and Tanzania	The aim is to implement durable re-greening interventions to increase local soil sustainability and regional water availability.	Four potential hydrological corridors have been identified in Kenya and Tanzania, all four of them around Mount Kilimanjaro. To select the most promising corridor, a method was developed to support a decision in a situation where few data are available. The method is based on maps, models and literature from four different disciplines concerning soil, water, climate and social institutions.	indicators, water availability	Kenya and Tanzania	https://www.soil-discuss.net/soil-2016-29/	Klostermann, J. E. M., Fleskens, L., Querner, E., Ter Maat, H., Hutjes, R., Jaspers, F., and de Haas, S. (2016) Hydrological corridors for landscape and climate restoration: Prioritization of re-greening areas in Kenya and Tanzania, SOIL Discuss., https://doi.org/10.5194/soil-2016-29.	None	pdf library
24	Meteorological and agricultural drought indices used in drought monitoring in Poland: a review	The paper contains an inventory of drought measures (indicators) that are applied to evaluate meteorological and agricultural drought in Poland	For meteorological drought monitoring and the assessment of its intensity, four different indices have been used in Poland: relative precipitation index (RPI), effective drought index (EDI), standardised precipitation index (SPI) and climatic water balance (CWB). Agricultural drought is monitored by soil moisture index (SMI), agricultural drought index (CDI) and the potential reduction of final yield (yield reduction ratio YR).	drought, indices	Poland	pdf	Łabędzki, L., and B. Bąk (2014), Meteorological and agricultural drought indices used in drought monitoring in Poland: a review, Meteorol. Hydrol. Water Manag. 2, 2, 3–14.	Summary of 3 systems	pdf library

Tab.2 Results of a global and regional database review

Dataset Name	Description	Web link	Type	Range
Research Data Archive	Search data engine	http://rda.ucar.edu/	all type	Globe
Centre for Ecology & Hydrology	Search data engine	https://eip.ceh.ac.uk/data	all type	Regional and global
Water and Global Change	Model input and output data from 10 models, the step hourly, daily, annual	http://www.eu-watch.org/data_availability	Hydrology, Meteorology, Climate change	Regiona and Global
Global Runoff Data Centre	European Water Archive (EWA of EURO-FRIEND-Water) Flow data (daily/monthly) from 3800 gauging stations, 441 are near-natural catchments	http://www.bafg.de/GRDC/EN/Home/homepage_node.html	Hydrology	Europe
ASTER GDEM	30m resolution , 7-14m vertical accuracy	http://www.ersdac.or.jp/GDEM/E/1.html	Topographic	Globe
NASA SRTM3 DEM	90m resolution, 10m vertical accuracy	http://www2.jpl.nasa.gov/srtm/	Topographic	Globe
EU-DEM	25m resolution source ASTER and SRTM	http://www.eea.europa.eu/data-and-maps/data/eu-dem#tab-gis-data	Topographic	Europe
SRTM4 DEM, Soil Balance, PET	NMT raster 90x90m, Soil-Water Balance raster 1x1km, Global Potential Evapo-Transpiration (Global-PET) and Global Aridity Index (Global-Aridity) 1x1km	http://www.cgiar-csi.org/data	Topographic, Soil, PET	Globe
JRC CID Portal	High resolution (1,2,5,10m) satellite imagery, spatial coverage and dates vary	http://cidportal.jrc.ec.europa.eu/imagearchive/	Channel planform, vegetation/land use	Europe
LandSat Satellite Imagery	Satelite image different resolution and type	https://landsat.usgs.gov	vegetation/land use	Globe
CCM2 Database	Pan-European database of river networks and catchments	http://ccm.jrc.ec.europa.eu/php/index.php?action=view&id=23	Channel network, catchment boundaries and characteristics	Europe

Corine Land Cover	Land cover data (1990, 2000, 2006,2012), resolution = 100 m	http://www.eea.europa.eu/data-and-maps	Land use	Europe
One Geology Europe	Surficial geology coverage for Europe, resolution varies	http://www.onegeology.org/	Geology	Europe
European Soil Portal (groundwater)	Groundwater resource maps of Europe (38 map sets at 1:500000 scale)	http://eusoils.jrc.ec.europa.eu/esdb_archive/eusoils_docs/other/groundwatercd/start.html	Aquifers	Europe
European Soil Portal	Soil data (shapefiles), 1km resolution	http://eusoils.jrc.ec.europa.eu/ESDB_Archive/ESDB/index.htm	Soil	Europe
European Soil Portal	10km resolution raster data set of USLE K-factor (t.ha.h)/(ha.MJ.mm) (K erodibility factor)	http://eusoils.jrc.ec.europa.eu/library/themes/erosion/Erodibility/	Soil erodibility	Europe
Harmonized World Soil Database (HWSD)	Soil raster 1x1km	http://www.fao.org/soils-portal/soil-survey/soil-maps-and-databases/harmonized-world-soil-database-v12/en/	Soil	Globe
SoilGrids	Soil raster 250x250m. Automated soil mapping based on global soil profile and environmental covariate data. SoilGrids represents a collection of updatable soil property and class maps of the world at 1 km and 250 m spatial resolution produced using automated soil mapping based on machine learning algorithms.	https://www.soilgrids.org/	Soil	Globe
European Soil Portal (PESERA soil erosion estimates)	Modelled soil erosion (t ha-1 yr-1) estimates at 1 km resolution	http://eusoils.jrc.ec.europa.eu/ESDB_Archive/pesera/pesera_data.html	Sediment delivery	Europe
JRC Forest Cover Maps	30m resolution (1990, 2000, 2006), derived from LandSat and Corine data	http://forest.jrc.ec.europa.eu/forest-mapping/forest-cover-map	Vegetation	Europe
TuTiempo	Daily meteorology data for Europe	http://www.tutiempo.net/en/	Meteorologia dla EUROPY	Europe
Global Weather Data for SWAT	Global Weather data formated for model SWAT	http://globalweather.tamu.edu/	Meteorologia	Globe

Model for EUROPE HYdrological Predictions for the Environment	Outputs (Discharge, Nutrients) from model HYPE for Europe (except Russia) main river	http://www.smhi.se/en/2.2139/E-hypeweb/	Hydrology, Nutrient load	Europe
UNEP GRID Arendal	Daugava and Nemunas drainage basins (Zapadnaya Dvina/Neman)	http://enrin.grida.no/databasin/index_data.cfm	Hydrology	Daugava and Nemunas
NCDC/NOAA	Climate Data Online	http://www7.ncdc.noaa.gov/CDO/cdoselect.cmd?datasetabbv=GSOD#Form Start	Meteorologia	Globe

Tab.3 Search results of project referring to the FramWat

No.	Theme	FramWat Output	Project name	Full name	Description/Aim	Results, goals, methods, tools, measures, effectiveness	Country	Home page	Report	Duration	Programme
1	Water availability, irrigation	2	**Construction Works for the artificial Enrichment of the Carstic System of Ypereia and Orfana**	-	Aim of the project: i) increase the aquifer levels so that there will be sufficient water supply for the irrigation needs; ii) decrease the electrical consumption for extracting the ground waters as the level of the aquifer rises; and iii) monitor the quantity and quality of the water resources.	The key activities to achieve the project objective are: i) the construction of a small dam with fortified cement to withhold the Enippeas river flow; ii) the implementation of protective works for the water course and riversides; iii) a water transfer canal and enrichment tunnel with shafts on its floor; iv) measuring stations of the Enippeas river flow and drilling to monitor the aquifer; and v) the installment of four automatic monitoring stations of the water resources.	Greece	http://enrd.ec.europa.eu/enrd-static/policy-in-	not available	2008-2012	The European Network for Rural Development
2	Water availability, irrigation	2	**Modernisation of the Irrigation System in the Municipality of Velventos**	-	Introducing a new system of electronic water abstraction and irrigation. Aims: i) conserve water supplies by reducing the amount wasted; ii) record the amount of water used by each individual irrigation system and also the total amount used throughout the entire irrigation season; iii) reduce the electricity consumption of the pumping stations; iv) reduce the environmental damage caused by the pumping stations. This has resulted in high financial benefits and the better use of resources.	The main project activity was the replacement of the simple water abstraction system of the irrigation net of Velventos with a new system of electronic abstraction. This comprised of the installation of the following equipment at key 'default' positions throughout the irrigation net: control screen, battery box, seal box, card slot system, rechargable card system, card recharge device, the software for the electronic cards, systems to monitor the water consumption of each user.	Greece	http://enrd.ec.europa.eu/enrd-static/policy-in-	not available	2009-2011	The European Network for Rural Development

3	Water availability, irrigation	4	**Modernising the irrigation system in the Flumen Canal of Huesca**	-	It replaced traditional surface irrigation systems with a new irrigation network using a sprinkling method, resulting in water savings and higher yields.The main objective was to modernise irrigation in the area by eliminating old irrigation infrastructure based on irrigation channels and constructing a new irrigation network using a sprinkling method. The distribution network ends in each plot allowing each farmer to modernise his/her holding. The new pressurised irrigation system is governed by remote irrigation automation and control.	Key activities comprised on the one hand the physical elimination of old irrigation channels and on the other hand the construction of a 208,200 m3 dam and a pumping station. The new construction includes two main irrigation pipes, one with natural pressure for 1,995 hectares and another one with forced pressure for 1,075 hectares, both with the necessary network of pipes ending in irrigated fields.	Spain	http://enrd.ec.europa.eu/enrd-static/policy-in-	avaiable only in Spanish	2008-2011	The European Network for Rural Development
4	Water availability, constructed wetlands	2, probably 1	**AQUABRAVA**	-	The project aims to preserve water. This LEADER-funded project created several small wetlands and helped raise awareness of and interest in water protection among landowners. It also contributed to increasing the amount of available water in the island of Gotland.	At first, three ponds and wetlands were created to test the effectiveness of the method which proved to be far better than expected. The 'Aquabrava' project supported the creation of an additional eight wetlands and ponds with a total area of 10 ha.The project further set up a monitoring system, including metrics, methods and templates, and applied it in the year following the construction of the wetlands to document changes	Sweden	http://enrd.ec.europa.eu /projects-practice/water-	not available	2011-2013	The European Network for Rural Development
5	flood risk management	1	**FLOODSCAN**	LArge scale adjustment of new technology for fast, precise and cost-efficient hydraulic 2d-modelling of flood (hazard) areas by combining laser scanning with remote sensing data	New technology for fast, precise and cost-efficient modelling of flood hazard areas through a combination of laser scanning with remote sensing data.	FLOODSCAN successfully demonstrated a new technology that enables fast and cost-effective identification of present and future flood hazard areas. FLOODSCAN's technology uses a hydraulic 2d-modelling of flood hazard areas. This combines laser scanning with remote sensing data and was applied on a large territorial scale. A high-performing Web mapping service infrastructure was also implemented.	Germany	http://ec.europa.eu/environment/li fe/project/Projects/index.cfm?fuse	https://www.lfu.bayern.de/wasser/ hw_ue_gebiete/floodscan/index.ht	2006-2009	Life

6	Water availability, irrigation	3	**HydroSense**	Innovative precision technologies for optimised irrigation and integrated crop management in a water-limited agrosystem	Demonstration of innovative precision technologies for optimised irrigation and integrated crop management in a water-limited agrosystem. Improvement of efficiency in the use of water, fertilisers and pesticides for the production of a major Mediterranean agricultural crop (cotton). It would achieve this aim by employing site-specific management and advanced technologies in proximal remote sensing, such as the employment of advanced canopy sensors. The project would also produce data and tools to evaluate the project's economic effectiveness and the potential to scale it up to the regional level, or transfer the methodology to other regions and other agricultural crops.	The HydroSense project applied precision agriculture methods to achieve the integrated crop management of combined inputs in three pilot cotton fields in the Pinios watershed, in order to reduce irrigation and the use of chemicals (fertilisers, herbicides and pesticides). The innovative use of system demonstrated the benefit of site-specific management for only single inputs such as fertilisers. Innovative technologies for targeted and variable-rate application of irrigation water, fertilisers and herbicides were also employed	Greece	http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_pr	http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&rep=	2010-2012	Life
7	Water availability, irrigation	4	**IRRIGESTLIFE**	Telemanagement Network Using Free Controllers Connected to a GIS for an Optimized Irrigation in VITORIA-GASTEIZ	Demonstration of a smart irrigation system for green spaces in urban areas, whilst minimising water consumption, through the avoidance of leaks, over-watering and human mistakes. It plans to base the system on an accurate measurement of the key parameters	The system has integrated through the GIS some parameters related to weather conditions in order to adapt the irrigation rate to the real watering needs of each garden. As the result of that, water consumption can be saved. A series of sensors adjust the doses of the irrigation needs depending on the results of the parameters and the different needs of species in the flora and theirs maturity status in the garden.	Spain	http://www.irrigestlife.eu/index.php/en/	http://www.irrigestlife.eu/index.php/en/docume	2012-2015	Life

8	Water availability, urban, sewers	3	**AQUAVAL**	Sustainable Urban Water Management Plans, promoting SUDS and considering Climate Change, in the Province of Valencia	Test and promotion of Sustainable Urban Drainage Systems in the province of Valencia (ES).The project's specific aims were to prevent sewer overflow; to reduce energy consumption; to avoid urban flooding by making the drainage infrastructure versatile enough to cope with the effects of climate change; to reduce 'hot spot' impacts caused by large impermeable surfaces; and to exploit collected rainwater for irrigation and street cleaning. Furthermore, the project developed community environmental policy through the integration of the environment into urban water policies.	The project successfully presented solutions for addressing the runoff from drained areas that previously caused environmental damage by discharging pollutants and by the physical impact of higher flows.AQUAVAL's results support the application of Sustainable Urban Storm Water Management Plans, and water and urban policies developed for both municipalities.	Spain	http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage	avaiable only in spanish	2010-2013	Life

9	Water availability, groundwater recharge		**AQUOR**	Implementation of a water saving and artificial recharging participated strategy for the quantitative groundwater layer rebalance of the upper Vicenza's plain	The AQUOR project aimed to develop an adaptive strategy to climate change to facilitate the sustainable governance of the groundwater resource of the upper Vicenza. It planned to rebalance the area's water budget, make better use of the water resource and improve infiltration processes. Create an integrated knowledge system on the hydro-geological and territorial system of the upper Vicenza plain using GIF; Alert all stakeholders to the importance of groundwater, water saving, and groundwater recharge; Demonstrate the technical feasibility, the economic benefit and the environmental sustainability of technical solutions for recharging groundwater layers; Develop an integrated groundwater resource policy at a local level to ensure that experience collected from the project is transferred into a strategy for the governance of the territory	AQUOR demonstrated the effectiveness of a model for the management of the groundwater system based both on the implementation of artificial recharging systems and on an awareness campaign aimed at reducing water uptake. The set of planning and operative tools developed in the project will be used to sustainably manage the groundwater resources in the project area over the next 10 years. The tools are designed to be used by other bodies looking to restore the natural balance between groundwater recharge and uptake in their regions. Four different recharging techniques (wells, recharging forests, recharging fields and river restoration) were tested during the project in seven different sites within the Vicenza area. The sites were chosen by a GIS software tool developed within the project that was based on a set of key parameters which enabled the team to quickly identify the most suitable areas to install recharging systems. A detailed cost-benefit analysis for the different recharging techniques created during the project shows that even the most expensive techniques have great potential to generate revenues that also make the infrastructure economically sustainable. These recharging systems will become a permanent part of the artificial recharging network.Flow meters and piezometers were installed for each of the recharging systems used. They created quantitative and qualitative data on the infiltrated water, which was also monitored with a permanent network of bio-indicators (moss bags) located in the rivers supplying the infiltrated water. A monitoring protocol was developed by the team enabling them to assess the health of the resurgent water ecosystem. The monitoring is still being continued.	Italy	http://www.lifeaquor.org/en	http://www.lifeaquor.org/en/download_en	2011-2015	Life

10	Water availability, irrigation	3	**FIGARO**	Flexible and Precision Irrigation Platform to Improve Farm Scale Water Productivity	The objective of the FIGARO project is to significantly reduce the use of fresh water on farm level through developing a cost-effective, precision irrigation management platform.	The FIGARO platform collects real-time data captured by sensors installed in farmers' fields, by remote satellite meteorological data from weather forecast stations. It utilizes in addition simulations models calibrated for various crops, soils and climate. The data is fed into state-of-the-art agronomic models in order to provide accurate, precise and reliable recommendations for how and when farmers should irrigate and in this way make the best farm operation decisions.	Europe	http://www.figaro-irrigation.net/	http://www.figaro-irrigation.net/outputs/projec	2012-2016	EU FP7-KBBE - Specific Programme "Cooperation":
11	River restoration	2, 3	**REFORM**	REstoring rivers FOR effective catchment Management	The overall aim of REFORM is to provide a framework for improving the success of hydromorphological restoration measures to reach, in a cost-effective manner, target ecological status or potential of rivers. Cost-effective implies an optimisation of both ecosystem health and the goods and services that natural, modified and restored rivers, floodplains and connected groundwater provide	D5.1 Review of methodologies for benchmarking and setting end-points for restoration projects D6.3 Guidelines and decision support for cost-effective river-floodplain restoration and its benefits	Europe	http://www.reformrivers.eu/home	http://www.reformrivers.eu/system/files/5.1%20Measuri	2011-2015	for research, technological Development and Demonstration
12	Climate change impact and adaptation	3	**REFRESH**	Adaptive Strategies to Mitigate the Impacts of Climate Change on European Freshwater Ecosystems	The key objective of REFRESH is to develop a framework that will enable water managers to design cost-effective restoration programmes for freshwater ecosystems. This will account for the expected future impacts of climate change and land-use. REFRESH will evaluate a series of specific adaptive measures that might be taken to minimise adverse consequences of climate change on freshwater quantity, quality and biodiversity. The focus is on three principal climate-related and interacting pressures; i) increasing temperature; ii) changes in water levels and flow regimes; and ii) excess nutrients.	Deliverable 1.2: Review of published climate change adaptation and mitigation measures related with water	Europe	http://www.refresh.ucl.ac.uk/	http://www.refresh.ucl.ac.uk/webfm_send/1470	2010-2014	European Union Seventh Framework Programme, Theme 6 (Environment

13	IWRM, wetland management	3	**WETwin**	Enhancing the role of wetlands in integrated water resources management for twinned river basins in EU, Africa and South-America in support of EU water initiatives	The overall objective of the WETwin project is to enhance the role of wetlands in basin-scale integrated water resources management (IWRM),with the aim of improving the community service functions while conserving good ecological status. Strategies will be identified for: utilizing the drinking water supply and sanitation potentials of wetlands for the benefit of people living in the basin, while maintaining (and improving as much as possible) the ecosystem functions	**WP6** Data integration and gap analysis. The main outcome of this WP is a functional database that will be used by the other WP-s for modelling and analyses purposes. **WP7** Development of evaluation and decision support tools. **WP8** Management solutions for the study areas. **WP9** Guideline development	Europe, Africa and South America	http://www.wetwin.eu/index.html	http://www.wetwin.eu/downloads.html	2008-2011	7th Framework Programme of the European Union
14	flood protection, flood risk	3	**CE frame**	Central European Flood Risk Assessment and Management in CENTROPE	The overall aim of CEframe is to ensure sustainable integrated flood protection management in a region with densely used small-areas by different national authorities. The focus of CEframe lies in flood protection facility operation and maintenance and flood protection measures elaboration for CENTROPE.	The objective of **WP5** is the production of an action plan, which shows the best way for future integrated handling of flood risk - on the basis of all identified useful measures and under consideration of the current conditions and the joint objectives	Central Europe	http://www.ceframe.eu/	http://www.ceframe.eu/downloads.html	2010-2013	CENTRAL EUROPE programme cofinanced
15	flood protection, flood risk	3	**Label**	ELBE-LABE - adaption to flood risk in the Elbe river basin	Preparation and agreement of joint application to flood risk management and the implementation of the EU flood risk management guideline at the Elbe river basin. Identification of measures to adapt different uses to flood risk along the river with focus on tourism and shipping. Raising awareness of flood risk of the affected population.	4.1 Increasing the natural retention of water 4.2 Securing and expanding retention areas	Central Europe	http://www.label-eu.eu/	http://www.label-eu.eu/uploads/media/EN	2008-2012	Interreg

16	flood protection, flood risk	2, 3	**WARELA**	Water Retention by Land Use	Development of transnational instruments for spatial planning to decrease flood disasters by precautionary land-use in meso-scale catchment areas	looks at preventative water retention measures implemented across the NWE. The economic, ecological and managerial efficiency of different measures will be assessed by calculating their effects across different landscape structure, meteorological situations and types of land use in the Member States involved. WaReLa will use GISbased systems and open programme-controlled systems (and promote training in them) to test individual flood scenarios, compile a comprehensive overview and elaborate a regional planning framework/decision support system for transnational river basin management.	North West Europe	http://3b.nweurope.eu/page/projet.php?p=318id=524	not available	2003-2006	Interreg
17	river restoration	4	**MoRe**	The Morava River Restoration	The main objectives are to restore the original character of the meandering lowland river, to achieve a dynamic equilibrium according to the ecosystem approach and to improve the diversity of natural habitats in the floodplains.	These aims are achieved through the gradual restoration of the natural interaction between the river bed and flood plain that are currently isolated from each other. The project objectives are in line with the requirements of the EU Water Framework Directive (achievement of good ecological status)	Eastern Europe	http://www.etc-more.eu/	http://www.etc-more.eu/fileadm	2007-2013 ?	Interreg
18	flood risk mapping	1, 2, 3	**Danube floodrisk**	-	The DANUBE FLOODRISK project focuses on the most cost-effective measures for flood risk reduction: risk assessment, risk mapping, involvement of stakeholders, risk reduction by adequate spatial planning. Transnational methodology and models will be defined and implemented for flood risk assessment and mapping. This results in proposals for flood mitigation measures, adjustments of spatial development plans, assessment tools for economic development in flood plains and raised awareness of flood risk of stakeholders, politicians, planners and the public. Infrastructures at risk like industry, power stations and supply infrastructure will be considered in the project.	WP6 – Map production (hazard, risk) WP7 – Integration methods for risk managament + planning	South-East Europe	http://www.danube-floodrisk.eu/	http://www.danube-floodrisk.eu/2012/10/materials/	2009-2012	South-East-Europe Transnational Cooperation Programme

19	floodplain restoration	4	**Life-Sumar**	Sustainable use and management rehabilitation of flood plain in the Middle Tisza District	The project aimed to improve the water management of the floodplain of the River Tisza at Vezseny via comprehensive floodplain restoration The project's proposed landscape rehabilitation was to focus on a) Habitat restoration b) Expansion of the floodplain's water retention capacity, in order to reduce flood risks.	Several technical measures were carried out to restore the floodplain	Hungary	not available	http://ec.europa.eu/environment/life/project/Pro	2003-2007	Life
20	heavy rain risk mapping	1, 3	**2nd Rainman**	Integrated Heavy Rain Risk Management	RAINMAN aims to improve integrated management capacities of public authorities to mitigate heavy rain events and to reduce health and environmental damages. jointly develop practice-oriented innovative methods and tools intended to map, assess and reduce heavy rain risks with the aim to cut down fatalities and damages.	Ultimately, recommendations for the integration of heavy rain risks into the EU floods directive will be developed and presented to the EU working group on floods. WP1 Mapping Risks WP4 Rainman Toolbox	Central Europe	http://www.interreg-central.eu/Content.Node	ongoing	2017-2020	Interreg
21	land use management	3	**Proline-CE**	Efficient Practices of Land Use Management Integrating Water Resources Protection and Non-structural Flood Mitigation	The need for adapted and target-oriented land-use activities concerning the protection of water resources and balancing conflicts of land-use pressure on water is evident and will be tackled by the project PROLINE-CE.	The main objective of PROLINE-CE is therefore the creation of a concrete transnational plan for the implementation of sustainable land use and fl ood/drought management leading to an improved protection of drinking water resources.	Central Europe	http://www.interreg-central.eu/Content.Node	ongoing	2016-2019	Interreg

22	Rainwater retention	1, 2	**Revitalization of the Climate in Dried-Out Communitities in Slovakia via Hydro-Climate Recovery**	-	Recovery of the climate and landscape via integrated rainwater retention in the damaged parts of the country utilizing water retention measures.Making use of various technologies for the prevention of excessive storm water run-off from forested and agricultureal landscape. Reviving the climate by retaining rainwater where it falls. Increasing the supply of water resources of the water basin while preventing flooding, drought, erosion and other negative effects of climate change. Involving local communities in environmental protection (creating employment opportunities).	The main task of the project is to capture water in small water retention measures in non-permanent watercourses - e.g. on forest roads, erosion grooves on the edge of the fields and farmland, or directly in roadside ditches and gardens.	Eastern Europe	http://www.ludiaavoda.sk/life-project/	http://www.ludiaavoda.sk/data/files/152 final-report-life11envsk1019.pdf	2012-2015	Life
23	ecotones, pollution	2, 3	**EKOROB**	Ecotones for reducing diffuse pollution	The goal of the project is setting up a program of activities for reducing diffuse pollution in the basin of the Pilica River by means of cost-effective ecohydrologic methods, that will help achieve a good ecological status of water in the Sulejowski Reservoir. Another goal is preparation of a manual for optimal ecotone formation, with special attention being paid to the effectiveness of diffuse pollution removal and formation of biodiversity.	Action 1. Formation of the ecotones. Action 2. Monitoring ecotone effectiveness. Action 3. Preparation of a manual for ecotone formation. Action 4. Development of a program of actions based on cost-effective ecohydrologic methods for reducing the diffusion pollution in the Pilica River Basin, helping achieve a good status of water in the Sulejowski Reservoir.	Poland	http://en.ekorob.pl/glowna	http://en.ekorob.pl/publications-and-reports	2010-2015	Life
24	water management	1, 3	**Freewat**	FREE and open source software tools for WATer resource management	FREEWAT aims at promoting water resource management by simplifying the application of the Water Framework Directive and other EU water related Directives.	FREEWAT main result is an open source and public domain GIS integrated modelling environment (the FREEWAT platform) for the simulation of water quantity and quality in surface water and groundwater with an integrated water management and planning module. Simulation of models related to the hydrological cycle and water resources management: flow models, transport models, crop growth models, management and optimization models (also related to irrigation management and rural issues). Work Package 5 - Application Of The FREEWAT Platform To Rural Water Management.	Europe	http://www.freewat.eu/	http://www.freewat.eu/public-deliverables	2015-2018	Horizon 2020

25	Sediment and water managment	1.3	**DANUBESEDIMENT**	Danube Sediment Management - Restoration of the Sediment Balance in the Danube River	A main project result will be the first “Danube Sediment Management Guidance” (DSMG). This document will deliver key contributions to the 3rd Danube River Basin Management Plan and the 2nd Danube Flood Risk Management Plan.	Their goal is to improve water and sediment management as well as the morphology of the Danube River..	Danuble Region	http://www.interreg-danube.eu/approved	ongoing	2017-2019	INTERREG DANUBLE
26	water management and flood risk prevention	1.3, 2.3.1, 3.4	**DANUBE FLOODPLAIN**	Reducing the flood risk through floodplain restoration along the Danube River and tributaries	The main objective of the project is improving transnational water management and flood risk prevention while maximizing benefits for biodiversity conservation. The expected change is improved knowledge, among the countries located within Danube River Basin, related to integrative water management through restoration of floodplains, combination of classical and green infrastructure, natural retention measures, involving all related stakeholders.	The main activities of the project are: updating the floodplain areas inventory and their ranking using the Floodplain Evaluation Matrix-FEM; assessing, by using the pre-selected pilot areas, of the efficiency of floodplain projects in the Danube District and developing tools for increasing the knowledge and cooperation of experts, practitioners, decision makers and stakeholders on floodplain restoration. The Project will develop tools contributing to DTP SO2.1: 1) The Danube basin wide floodplain restoration and preservation manual addressed mainly to practitioners; 2) A DRB Sustainable Floodplain management Strategic Guidance summarizing the key findings of the manual targeting a wider audience; 3) A DRB Roadmap comprising agreed next steps towards realizing floodplain projects.	Danuble Region	http://www.interreg-danube.eu/approved-projects/danube	ongoing	2018-2020	INTERREG DANUBLE