Ecosystem Service	**Surface water for non-drinking purposes**
CICES class name	Surface water used as a material (non-drinking purposes)
CICES Section	Provisioning (Abiotic)
CICES Class code	4.2.1.2

Brief Description

- Surface water that humans use for things other than drinking
- Natural, surface water bodies that provide water for uses such as irrigation, production or cooling

Sample Indicators

Indicator values from			
Experiment or direct measurement		Survey	
Expert assessment		Statistical- or census data	
Model or GIS		Literature values	
Stakeholder participation		Not provided	

Table 1: Field Scale

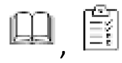
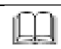
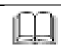
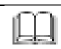
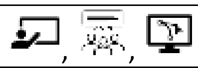
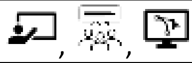
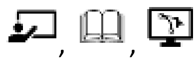
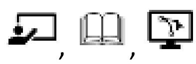
Indicator	**Unit**	**Indicator values from**
[1] Annual total drainage	mm	

Table 2: Farm Scale

Indicator	**Unit**	**Indicator values from**
[2] Mean annual water flow	$m^3 * s^{-1} * ha^{-1}$	
[3] Streamflow calculated by SWAT model	$m^3 * time^{-1}$	
[3] Surface runoff calculated using the ECOSER protocol (www.eco-ser.com.ar)	$m^3 * ha^{-1}$	

Table 3: Regional Scale

Indicator	**Unit**	**Indicator values from**
[1] Annual total drainage	mm	

[6, 13] Precipitation – Evapotranspiration, calculated with InVEST model	$m^3 * ha^{-1} * yr^{-1}$	
[8] Surface water yield: mean annual precipitation - mean annual evapotranspiration, calculated with InVEST model	mm	
[14] Water yield: calculated as annual precipitation - evapotranspiration	$m^3 * area^{-1} * yr^{-1}$	
[12] Potential water yield, calculated as precipitation - evapotranspiration	mm	
[17] Provisioning of water: Groundwater recharge rate based calculated from water balance	mm	
[15] Annual average water yield	$mm * yr^{-1}$	
[15] Annual sectoral water yield (e.g., domestic, agriculture and industry	$mm * yr^{-1}$	
[9] Runoff: renewable water supply. Values were normalized [0-1] using benchmark values where available and observed values otherwise.	mm	
[15] Annual river runoff	$m^3 * yr^{-1}$	
[16] Annual water flow that is available from surface waters	$mm * yr^{-1}$, $m^3 * yr^{-1}$	
[15] Water level	m	
[15] Number of extreme (runoff) events	$\# * yr^{-1}$	
[15] Annual average sediment in rivers	$t * yr^{-1}$	
[15] Total dissolved solids	$mg * l^{-1}$	
[15] Leakage of nutrients	$kg * ha^{-1} * yr^{-1}$	
[10] Surface area of water bodies	ha	
[10] Number of traditional water sources	#	
[7] Freshwater supply: values for land cover classes. The matrix by Burkhard et al., 2012 (DOI:10.1016/j.ecolind.2011.06.019) was adapted and used in this study.	Index 0 - 5	
[11] Water for drinking and non-drinking uses: expert-based index for ecosystem service supply by land cover class [1-5], multiplied by the area of the land cover class	km^2	
[11] Water for drinking and non-drinking uses' value: expert-based index for ecosystem service supply by land cover class [1-5] multiplied by the area of the land cover class and a literature-based monetary value of the ecosystem service	km^2, $\$ * ha^{-1} * yr^{-1}$	
[12] Rating of current service provision per land use class by expert-stakeholders	0 - 10	
[12] Rating of increases/decreases of service supply in scenarios, relative to the status quo	%	
[18] Water purification and provision, calculated as: $W = NPP * (1 - VCNPP) * IC_s * S_{cf} * 1.75$ With: NPP – Net Primary Production [0-1000], VCNPP – coefficient of variation of NPP [0–1], IC_s – soil infiltration	-	

capacity [0–1], S_{cf} – "slope average" correction factor of the study area [0–1]		
[4] Agricultural water use for irrigation: Average irrigation water use over three years	GL * a^{-1}	
[5] Spatial mapping by stakeholders: stakeholders could place green stickers on a map to mark the supply hotspots of this ecosystem service. Red stickers were used to mark locations where the supply of this service is declining. Two different sizes of stickers were used to represent a radius of 0.75 km or 1 km, respectively.	Index 0 - 5	
[22] Irrigated area	Not provided	
[22] Area irrigated using surface water	Not provided	
[23] Freshwater recharge from the entire landscape	m^3/ (km^2 * year)	

Table 4: National Scale

Indicator	Unit	Indicator values from
[20] Surface water availability	m^3 * $person^{-1}$ * yr^{-1}	
[20] Water abstracted	km^3 * yr^{-1}	
[19] Supply and demand of irrigation water, calculated by multiplying average modelled surface water runoff [not provided] by the downstream areas of irrigable agriculture [not provided] and estimated annual water demand per hectare per year [not provided]. Water demand per hectare was adjusted for the amount of annual rainfall.	l * d^{-1}	
[19] Supply and demand of water for hydropower dams, calculated by multiplying average modelled surface water runoff [not provided] by the water demand for hydropower dams using electrical production as proxy [MWh]	l * d^{-1}	
[20] Water use per sector	%	
[20] Wetlands: the surface of flood-prone areas	ha	

Table 5: Multinational Scale

Indicator	Unit	Indicator values from
[21] Freshwater supply: values for Corine land cover classes based on values published by Burkhard et al. (2009; DOI: 10.3097/LO.200915) and modified for the context of riparian zones.	Index 0 - 5	

References

No.	Citation
1	Qiu JX, Carpenter SR, Booth EG, Motew M, Zipper SC, Kucharik CJ, Loheide SP, Turner AG (2018) Understanding relationships among ecosystem services across spatial scales and over time. Environmental Research Letters 13(5): 054020. DOI: 10.1088/1748-9326/aabb87
2	Andersson E, Nykvist B, Malinga R, Jaramillo F, Lindborg R (2015) A social–ecological analysis of ecosystem services in two different farming systems. Ambio 44(1): 102-112. DOI: 10.1007/s13280-014-0603-y
3	Nahuelhual L, Benra F, Laterra P, Marin S, Arriagada R, Jullian C (2018) Patterns of ecosystem services supply across farm properties: Implications for ecosystem services-based policy incentives. Science of the Total Environment 634: 941-950. DOI: 10.1016/j.scitotenv.2018.04.042
4	Liu S, Crossman ND, Nolan M, Ghirmay H (2013) Bringing ecosystem services into integrated water resources management. Journal of Environmental Management 129: 92-102. DOI: 10.1016/j.jenvman.2013.06.047
5	Palomo I, Martin-Lopez B, Zorrilla-Miras P, Del Amo DG, Montes C (2014) Deliberative mapping of ecosystem services within and around Donana National Park (SW Spain) in relation to land use change. Regional Environmental Change 14(1): 237-251. DOI: 10.1007/s10113-013-0488-5
6	Zarandian A, Baral H, Stork NE, Ling MA, Yavari AR, Jafari HR, Amirnejad H (2017) Modeling of ecosystem services informs spatial planning in lands adjacent to the Sarvelat and Javaherdasht protected area in northern Iran. Land Use Policy 61: 487-500. DOI: 10.1016/j.landusepol.2016.12.003
7[26] *	Zhang ZM, Gao JF, Fan XY, Lan Y, Zhao MS (2017) Response of ecosystem services to socioeconomic development in the Yangtze River Basin, China. Ecological Indicators 72: 481-493. DOI: 10.1016/j.ecolind.2016.08.035
8	Früh-Müller A, Hotes S, Breuer L, Wolters V, Koellner T (2016) Regional patterns of ecosystem services in cultural landscapes. Land 5(2): 17. DOI: 10.3390/land5020017
9	Rodríguez-Loinaz G, Alday JG, Onaindia M (2015) Multiple ecosystem services landscape index: A tool for multifunctional landscapes conservation. Journal of Environmental Management 147: 152-163. DOI: 10.1016/j.jenvman.2014.09.001
10	Adhikari S, Baral H, Nitschke CR (2018) Identification, Prioritization and Mapping of Ecosystem Services in the Panchase Mountain Ecological Region of Western Nepal. Forests 9(9): 554. DOI: 10.3390/f9090554
11	Huq N, Bruns A, Ribbe L (2019) Interactions between freshwater ecosystem services and land cover changes in southern Bangladesh: A perspective from short-term (seasonal) and long-term (1973-2014) scale. Science of the Total Environment 650: 132-143. DOI: 10.1016/j.scitotenv.2018.08.430
12	Koo H, Kleemann J, Fürst C (2018) Land use scenario modeling based on local knowledge for the provision of ecosystem services in northern Ghana. Land 7(2): 59. DOI: 10.3390/land7020059
13	Li T, Lü Y, Fu B, Hu W, Comber AJ (2019) Bundling ecosystem services for detecting their interactions driven by large-scale vegetation restoration: enhanced services while depressed synergies. Ecological Indicators 99: 332-342. DOI: 10.1016/j.ecolind.2018.12.041

[26]* The impact area discussed on this factsheet is not a focus of the cited paper

No.	Citation
14	Peng J, Tian L, Liu Y, Zhao M, Hu Y, Wu J (2017) Ecosystem services response to urbanization in metropolitan areas: Thresholds identification. Science of the Total Environment 607-608: 706-714. DOI: 10.1016/j.scitotenv.2017.06.218
15	Pham HV, Torresan S, Critto A, Marcomini A (2019) Alteration of freshwater ecosystem services under global change - A review focusing on the Po River basin (Italy) and the Red River basin (Vietnam). Science of the Total Environment 652: 1347-1365. DOI: 10.1016/j.scitotenv.2018.10.303
16	Santos-Martín F, Zorrilla-Miras P, Palomo-Ruiz I, Montes C, Benayas J, Maes J (2019) Protecting nature is necessary but not sufficient for conserving ecosystem services: A comprehensive assessment along a gradient of land-use intensity in Spain. Ecosystem Services 35: 43-51. DOI: 10.1016/j.ecoser.2018.11.006
17	Kay S, Crous-Duran J, Ferreiro-Domínguez N, García de Jalón S, Graves A, Moreno G, Mosquera-Losada MR, Palma JHN, Roces-Díaz JV, Santiago-Freijanes JJ, Szerencsits E, Weibel R, Herzog F (2018) Spatial similarities between European agroforestry systems and ecosystem services at the landscape scale. Agroforestry Systems 92(4): 1075-1089. DOI: 10.1007/s10457-017-0132-3
18	Barral MP, Oscar MN (2012) Land-use planning based on ecosystem service assessment: A case study in the Southeast Pampas of Argentina. Agriculture, Ecosystems and Environment 154: 34-43. DOI: 10.1016/j.agee.2011.07.010
19	Neugarten RA, Honzak M, Carret P, Koenig K, Andriamaro L, Cano CA, Grantham HS, Hole D, Juhn D, McKinnon M, Rasolohery A, Steininger M, Wright TM, Turner WR (2016) Rapid Assessment of Ecosystem Service Co-Benefits of Biodiversity Priority Areas in Madagascar. PLoS One 11(12): e0168575. DOI: 10.1371/journal.pone.0168575
20	Maes J, Liquete C, Teller A, Erhard M, Paracchini ML, Barredo JI, Grizzetti B, Cardoso A, Somma F, Petersen JE, Meiner A, Gelabert ER, Zal N, Kristensen P, Bastrup-Birk A, Biala K, Piroddi C, Egoh B, Degeorges P, Fiorina C, Santos-Martín F, Naruševičius V, Verboven J, Pereira HM, Bengtsson J, Gocheva K, Marta-Pedroso C, Snäll T, Estreguil C, San-Miguel-Ayanz J, Pérez-Soba M, Grêt-Regamey A, Lillebø AI, Malak DA, Condé S, Moen J, Czúcz B, Drakou EG, Zulian G, Lavalle C (2016) An indicator framework for assessing ecosystem services in support of the EU Biodiversity Strategy to 2020. Ecosystem Services 17: 14-23. DOI: 10.1016/j.ecoser.2015.10.023
21	Clerici N, Paracchini ML, Maes J (2014) Land-cover change dynamics and insights into ecosystem services in European stream riparian zones. Ecohydrology and Hydrobiology 14(2): 107-120. DOI: 10.1016/j.ecohyd.2014.01.002
22	Chatzinikolaou P, Viaggi D, Raggi M (2018) Using the Ecosystem Services Framework for Policy Impact Analysis: An Application to the Assessment of the Common Agricultural Policy 2014-2020 in the Province of Ferrara (Italy). Sustainability 10: 890. DOI: 10.3390/su10030890
23	Gasparatos A, Romeu-Dalmau C, von Maltitz GP, Johnson FX, Shackleton C, Jarzebski MP, Jumbe C, Ochieng C, Mudombi S, Nyambane A, Willis K (2018) Mechanisms and indicators for assessing the impact of biofuel feedstock production on ecosystem services. Biomass & Bioenergy 114: 157-173. DOI: 10.1016/j.biombioe.2018.01.024