**Response Option: Promote agricultural practices that reduce water consumption**

Response options that include planting crops that require less water will help conserve water resources. Contour farming can lead to reduced surface runoff and greater infiltration rates (Panagopoulos et al., 2011), and micro-irrigation that minimizes water application to crops can be useful to reduce water consumption (Madramootoo and Morrison, 2013).

Scopus search:

TITLE-ABS ("drought tolerant" OR "contour farming" OR "micro-irrigation") AND TITLE-ABS ("water use" OR "water quality" OR "water consumption" OR "water scarcity") AND TITLE-ABS (biodiversity OR "human health" OR "food security")

Results: 49 documents

Key papers:

Myint S.W., Aggarwal R., Zheng B., Wentz E.A., Holway J., Fan C., Selover N.J., Wang C., Fischer H.A. 2021.

Adaptive crop management under climate uncertainty: Changing the game for sustainable water use

(2021) Atmosphere, 12 (8), <https://doi.org/10.3390/atmos12081080>

FAO. 2021. *The state of the world’s land and water resources for food and agriculture – Systems at breaking point. Synthesis report 2021.* Rome. <https://doi.org/10.4060/cb7654en>

Kaveri Ashok, K. Ramya Natarajan, Poornima Kumar, Kabir Sharma and Mihir Mathur. 2021 Sustainable alternative futures for agriculture in India—the energy, emissions, and resource implications. [Environmental Research Letters](https://iopscience-iop-org.proxy.mul.missouri.edu/journal/1748-9326), <16>, (6) 064001 <https://doi.org/10.1088/1748-9326/abf0cd>

Hadebe, S.T., Modi, A.T. and Mabhaudhi, T. (2017), Drought Tolerance and Water Use of Cereal Crops: A Focus on Sorghum as a Food Security Crop in Sub-Saharan Africa. J Agro Crop Sci, 203: 177-191. <https://doi.org/10.1111/jac.12191>

Madramootoo, C.A. and Morrison, J. (2013), ADVANCES AND CHALLENGES WITH MICRO-IRRIGATION. Irrig. and Drain., 62: 255-261. <https://doi.org/10.1002/ird.1704>

**Response Option: Dam operations to reduced risk and ensure sufficient water quantities**

Providing water releases from dams that create a natural flow regime (Poff et al. 1997) has been recognized as an action that will help restore or conserve native aquatic biodiversity by providing flows that trigger fish migrations and connect the rivers to their floodplains, allowing access to fish, a critical food source of indigenous peoples and contributes to SDG 2 (Zero Hunger). However, trade-offs occur when balancing environmental flows with hydropower, agricultural/irrigation needs, and water for drinking and sanitation. Coordinating dam operations across large spatial scales (and multiple dams) may be one option to balance tradeoffs among the multiple demands for reservoir storage and downstream flows (Messager et al. 2023).

Scopus search:

TITLE-ABS-KEY(Dam OR dam) AND (flows OR flow) and ("water quantity" OR "water security") AND (nexus) AND (biodiversity) AND ("health" OR "food security" OR hydropower OR agriculture OR sanitation)

Also, we included a very recent review (Messager et al. 2023) based on the team's expert knowledge related to environmental flows.

Results:

60 documents

Key papers:

Peng Qi, Xiaoyu Tang, Y. Jun Xu, Zhen Cui, Jiaxin Sun, Guangxin Zhang, Yao Wu, Ming Jiang, 2023.

Optimizing environmental flow based on a new optimization model in balancing objectives among river ecology, water supply and power generation in a high-latitude river, Journal of Environmental Management, Volume 342, 118261, <https://doi.org/10.1016/j.jenvman.2023.118261>.

Dourado G.F., Rallings A.M., Viers J.H. 2023. Overcoming persistent challenges in putting environmental flow policy into practice: a systematic review and bibliometric analysis. Environmental Research Letters, 18 (4), <http://doi.org/10.1088/1748-9326/acc196>

Messager, M. Julian D Olden, Jonathan D Tonkin, Rachel Stubbington, Jane S Rogosch, Michelle H Busch, Chelsea J Little, Annika W Walters, Carla L Atkinson, Margaret Shanafield, Songyan Yu, Kate S Boersma, David A Lytle, Richard H Walker, Ryan M Burrows, Thibault Datry, 2023. A metasystem approach to designing environmental flows, *BioScience*, 2023;biad067, <https://doi.org/10.1093/biosci/biad067>

Pradhan, A., and Veena Srinivasan. "Do dams improve water security in India? A review of post facto assessments." *Water Security* 15 (2022): 100112. <https://doi.org/10.1016/j.wasec.2022.100112>

Everard, M. Om Prakash Sharma, Vinod Kumar Vishwakarma, Dharmendra Khandal, Yogesh K. Sahu, Rahul Bhatnagar, Jitendra K. Singh, Ritesh Kumar, Asghar Nawab, Amit Kumar, Vivek Kumar, Anil Kashyap, Deep Narayan Pandey, Adrian C. Pinder, 2018. Assessing the feasibility of integrating ecosystem-based with engineered water resource governance and management for water security in semi-arid landscapes: A case study in the Banas catchment, Rajasthan, India. Science of The Total Environment,

Volume 612: 1249-1265 <https://doi.org/10.1016/j.scitotenv.2017.08.308>

**Response Option: Limit fertilizer use and water consumption footprint**

Fertilizer application to agricultural crops can runoff into streams degrading water quality while also being more costly to farmers. Therefore., limiting nitrogen-containing fertilizer and manure applications is an action that can be more cost-effective for agriculture but also can improve water quality which, in conjunction with more sustainable water use, can improve ecosystems and biodiversity (V. L. Elliott et al., 2016).

Scopus search:

TITLE ("fertilizer" OR "nitrogen" OR "manure") AND TITLE-ABS (water) AND TITLE-ABS (biodiversity) AND TITLE-ABS("human health" OR "food security")

Results:

45 documents

Key papers:

Penuelas J., Coello F., Sardans J. 2023. A better use of fertilizers is needed for global food security and environmental sustainability. Agriculture and Food Security, 12 (1), <https://doi.org/10.1186/s40066-023-00409-5>

de Vries W., Schulte-Uebbing L., Kros H., Voogd J.C., Louwagie G. 2021. Spatially explicit boundaries for agricultural nitrogen inputs in the European Union to meet air and water quality targets. Science of the Total Environment, 786, <https://doi.org/10.1016/j.scitotenv.2021.147283>

Tyagi J., Ahmad S., Malik M.. 2022. Nitrogenous fertilizers: impact on environment sustainability, mitigation strategies, and challenges. International Journal of Environmental Science and Technology, 19 (11), pp. 11649 - 11672, <https://doi.org/10.1007/s13762-022-04027-9>

Shibata H., Branquinho C., McDowell W.H., Mitchell M.J., Monteith D.T., Tang J., Arvola L., Cruz C., Cusack D.F., Halada L., Kopáček J., Máguas C., Sajidu S., Schubert H., Tokuchi N., Záhora J. 2015. Consequence of altered nitrogen cycles in the coupled human and ecological system under changing climate: The need for long-term and site-based research. Ambio, 44 (3), pp. 178 - 193, <https://doi.org/10.1007/s13280-014-0545-4>