Agricultural Drainage

UNIVERSITY OF SASKATCHEWAN
Global Institute for Water Security
USASK.CA/WATER

Knowledge Brief

Down the Drain: Agricultural surface drainage across Canada

Agricultural drainage is the act of removing excess water from farm land to improve the productivity or to increase the size of available cropland.[1]

Drainage is often seen as providing immediate economic benefits to farmers.[2] However, environmental impacts can occur as a result of draining farmland.[3] Loss of wetlands is a prominent example. [3]

Impacts can be seen in the form of increased nutrient pollution, increased erosion, decreased flood protection, impacts on wildlife including waterfowl, and changes in stream flows.[1,3,4]

Drainage is often seen as a conflict between the economic benefits for the farmers and the long-term impacts on the surrounding environment and ecosystem services.[2] Policies need to balance the costs and benefits, and require an understanding both of the resource system and the social systems surrounding agricultural drainage.[1]

Academic research can be used to work towards knowledge-based policy, but effort is required to better understand the focus of academic research to date.

Types of Drainage :

1. **Surface drainage:** includes any man-made efforts to change the way water flows over the land.[1] It can be seen in the form of drainage ditches, sloping of the land, draining of wetlands, etc. [1] This is more common within the Prairie region of Canada.[5]

2. **Sub-surface drainage:** also known as “tile drainage” and usually consists of pipes being installed under the fields to allow more efficient drainage of the soils. [1] This is more common in Ontario and Quebec.[5]

The purpose of this research was to determine what aspects of surface agricultural drainage have been the focus of academic research. To do this, we grouped journal articles based on the different sub-systems of the Social-Ecological Systems Framework (see next page for details).

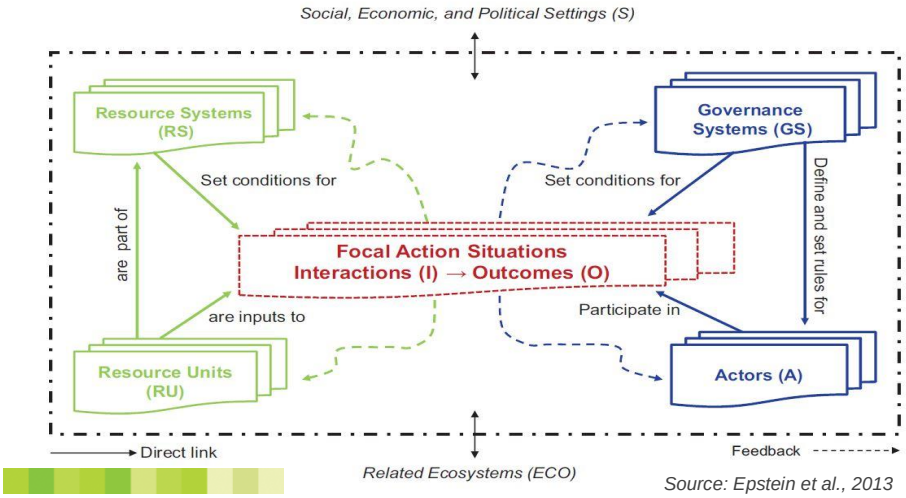
Research Process

Multiple searches with key terms were conducted using two search engines (Google Scholar and Web of Knowledge) to collect a large number of journal articles. Once collected, the articles were scanned to remove any duplicates and those considered not relevant. We also only included papers that studied areas of Canada. In the end, there were 111 articles that were deemed relevant to our research and we categorized them based on the system described below. Each paper could be including multiple sub-systems, but each had to be an important part of the paper to be included.

Social-Ecological System

A social-ecological system (SES) looks at the social (societal) aspects of a system in combination with the ecological (environmental) aspects. We used an academic framework, meaning a previously defined set of terms and interactions was used to categorize the journal articles collected from search engines.

The framework we chose to use was Epstein's version[6] of Ostrom's (2009)[7] SES Framework. Versions of Ostrom's framework are well-known within academic circles and is commonly used to identify and explore SESs. The diagram on the top-right shows the sub-systems and their interactions within the system. Each sub-system is clarified in the space to the right.



Source: Epstein et al., 2013

Breaking it Down: Subsystems within the SES Framework

There are eight key sub-systems within the SES Framework.

Social, Economic and Political Settings: focuses on the influence of general settings on the system, such as economic trends or political stability.

Resource System: focuses on the resources as a system. This may include the size and boundaries of a farm or agricultural area, along with aspects such as the productivity, location or storage capability of a system.

Resource Units: looks at the specific resources within the system and their characteristics. Resource units are more than just the crops being grown, but may include; wetlands, nutrients, plants and animals, sediment, and water.

Governances Systems: focuses on both organizations (such as the government and non-government organizations), along with processes in place (such as policies, rules, regulations, etc.).

Actors: focuses specifically on the people involved in the system and their important characteristics. It may include discussing who's involved, their history, use of technology, or importance of resources.

Interactions: primarily focuses on the interactions of the actors and may include conflicts, processes for making decision, or other activities.

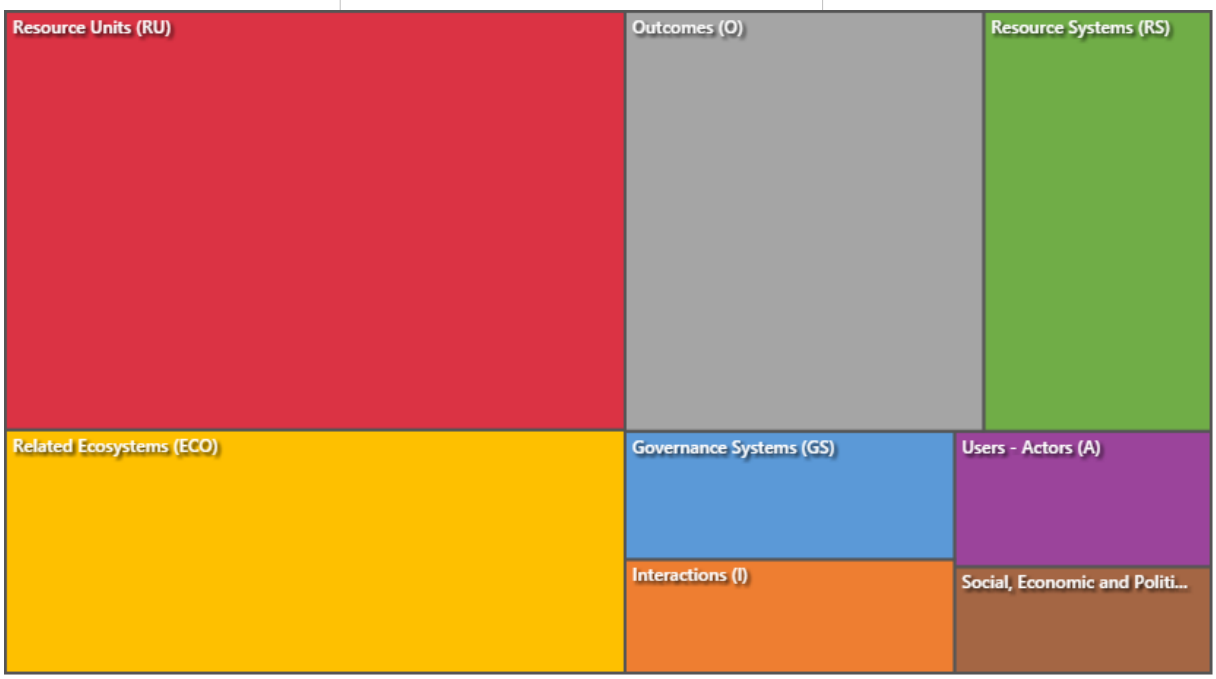
Outcomes: the outcomes of the resources, interactions, or the collective SE system may be external, environmental, or social.

Related Ecosystems: focuses on related ecosystems, such as climate, pollution, or resource units that may cross into another system (such as water flowing from a drainage ditch to river downstream).

Results

One of the key messages from this study is understanding where existing research has focused and what knowledge is available to decision makers. The size of the rectangles in the diagram below corresponds to the number of papers categorized to that sub-system. Most of the existing research focuses on the specific Resource Units, Related Ecosystems, and Outcomes. Very little focus has been placed on the social aspect of these systems, including the Actors, Governance Systems, and Interactions.

The research related to resource units and its outcomes tends to focus on the natural sciences or the ecological side of the SES. An example of this could be looking at water quality impacts of draining wetlands or productivity of soil from a drained wetland. Social science research focused on areas like Actors or Governance. An example would be looking at how farmers decide to preserve a wetland on their farm. But very few papers discuss the social side of agricultural drainage, as is seen by the difference of size in the diagram below. This suggests a gap in existing research.



Implications

This research has three main implications:

1. It shows what information is available to decision makers, including government organizations. The information is primarily focused on the natural sciences, which may unintentionally focus decisions on existing information or result in decisions based on incomplete information.

2. It emphasizes what knowledge has been prioritized within the study of agricultural drainage. It is clear that the most money and effort has been focused on the ecological aspect of the system, with far less being focused on the social sciences.

3. It provides a clear path forward as to what research still needs to be done. There is a gap in the knowledge of the social sub-system, and more research efforts should be focused in that direction.

Further Reading:

1. * Madramootoo, C. A., Johnston, W. R., & Willardson, L. S. (1997). Management of agricultural drainage water quality (Vol. 13). Food & Agriculture Org. Retrieved from http://www.fao.org/docrep/w7224e/w7224e00.htm#Contents
2. Cortus, B. G., Jeffrey, S. R., Unterschultz, J. R., & Boxall, P. C. (n.d.). The Economics of Wetland Drainage and Retention in Saskatchewan. Canadian Journal of Agricultural Economics/Revue Canadienne D'agroeconomie, 59(1), 109–126. https://doi.org/10.1111/j.1744-7976.2010.01193.x
3. * Huel, D., & Harrison, T. (2000). Managing Saskatchewan Wetlands - A Landowner's Guide. Saskatoon, Saskatchewan: Saskatchewan Wetland Conservation Corporation. Retrieved from http://www.southsaskriverstewards.ca/ckfinder/userfiles/files/ManagingSaskatchewanWetlands.pdf
4. * Council of Canadian Academies. (2013). *Water and Agriculture in Canada: Towards Sustainable Management of Water Resources.* The Expert Panel on Sustainable Management of Water in the Agricultural Landscapes of Canada. Ottawa: Council of Canadian Academies. Retrieved from http://www.deslibris.ca/ID/237509
5. Madramootoo, C. A., Johnston, W. R., Ayars, J. E., Evans, R. O., & Fausey, N. R. (2007). Agricultural drainage management, quality and disposal issues in North America. Irrigation and Drainage, 56, S35–S45. https://doi.org/10.1002/ird.343
6. Epstein, G., Vogt, J. M., Mincey, S. K., Cox, M., & Fischer, B. (2013). Missing ecology: integrating ecological perspectives with the social-ecological system framework. International Journal of the Commons, 7(2), 432–453.
7. Ostrom, E. (2009). A general framework for analyzing sustainability of social-ecological systems. Science, 325(5939), 419–422.

*Should be available to the public. Use the link within the reference to access.

For more information visit:
https://gwf.usask.ca/drainage/

Author: Maggie Norris

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PRAIRIE DRAINAGE GOVERNANCE

RPLC RURAL POLICY LEARNING COMMONS

CAPR COMMUNAUTÉ D'APPRENTISSAGE DES POLITIQUES RURALES