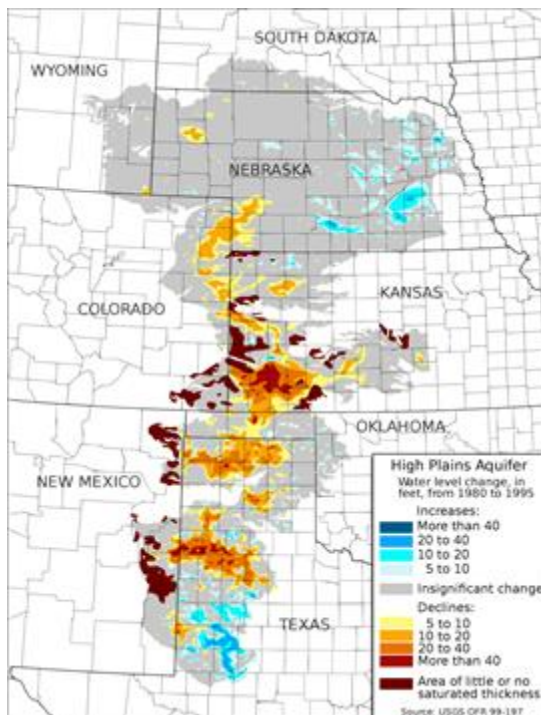


# A Drying Shame: The Ogallala Aquifer

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## Introduction



*Data from the USGS (Wikipedia)*

Covering an area of 174,000 square miles, the Ogallala Aquifer is one of the largest aquifers of the United States of America (APEC Human Resource Development Working Group). Situated under the Great Plains of North America, the water from the Ogallala Aquifer was first extracted for use after the Second World War, and has been one of the most important freshwater resources for irrigation in the United States. It is estimated that more than 90% of the groundwater is used for irrigation purposes, and that the Great Plains area provide \$20 billion USD a year in food and fibre to the U.S. markets (Scientific American). However, after nearly sixty years of intense use of the Ogallala Aquifer, it is now a source of great apprehension as the aquifer shrinks, and the main source of water in the Great Plains area disappears.

## Framing the Problem

As defined in *Wicked Environment Problems: Managing Uncertainty and Conflict*, a wicked problem is “when scientific uncertainty coexists with value uncertainty and conflict” (Balint,

Stewart, Desai, and Walters 9). Based on this definition, the Ogallala Aquifer's rapid depletion is considered a wicked problem due to the vast number of stakeholders involved, resulting in numerous opinions and therefore conflicts regarding how to resolve the issues surrounding the Ogallala depletion. Coexisting with this conflict, is the lack of scientific solutions to reduce pressures on the aquifer and achieve sustainability or long term conservation. In addition to the existing pressures on the Ogallala, new pressures continue to be added to the Aquifer with the potential to further increase the rate of depletion.

As mentioned above, differences of opinion between stakeholders are one of the major disruptors in finding a long-term solution for issues surrounding the Ogallala depletion problem. Because different stakeholders require water at different levels and for different purposes, these conflicts have prevented a single unified plan to conserve water.

Such differences of values are seen not just between groups but within them. One key group of stakeholders, farmers, can be broken into two groups. One group consists of farmers who support conservation, and have taken measures to reduce, and in some cases stop irrigation completely. Another group consists of farmers who are resistant to change in irrigation practices and have only taken minimal precautions to slow down depletion.

Another pressing issue that makes the Ogallala Aquifer a wicked problem is the conflicting laws seen in governance of the Ogallala Aquifer. In 2012, the parts of the Kansas region created local enhanced management areas, enforced by law, in which the goal is to reduce water use by 20% over a five-year period (Wise, 2015). Grants have also been issued for the conservation of existing grasslands in the Ogallala region. However, the proposal to construct an aqueduct, stretching from the Missouri River to the Ogallala region, which would have reduced pressures on the Ogallala by providing a second source of water, the Missouri River, to the Ogallala region, was declined by legislation due to the high cost (Wise, 2015). Although the aqueduct would not have provided a permanent solution to halting the depletion of the aquifer, it would have slowed depletion by relieving some of its current pressures. Traditionally the Texas regions water has been regulated by the "rule of capture", which allows landowners unrestricted rights to the water below their land (Walton, 2015). In such cases, the government is unable to enforce new laws that regulate water use from the aquifer. Here we see that old laws are creating problems in the establishment of new laws and preventing conservation of the Ogallala Aquifer.

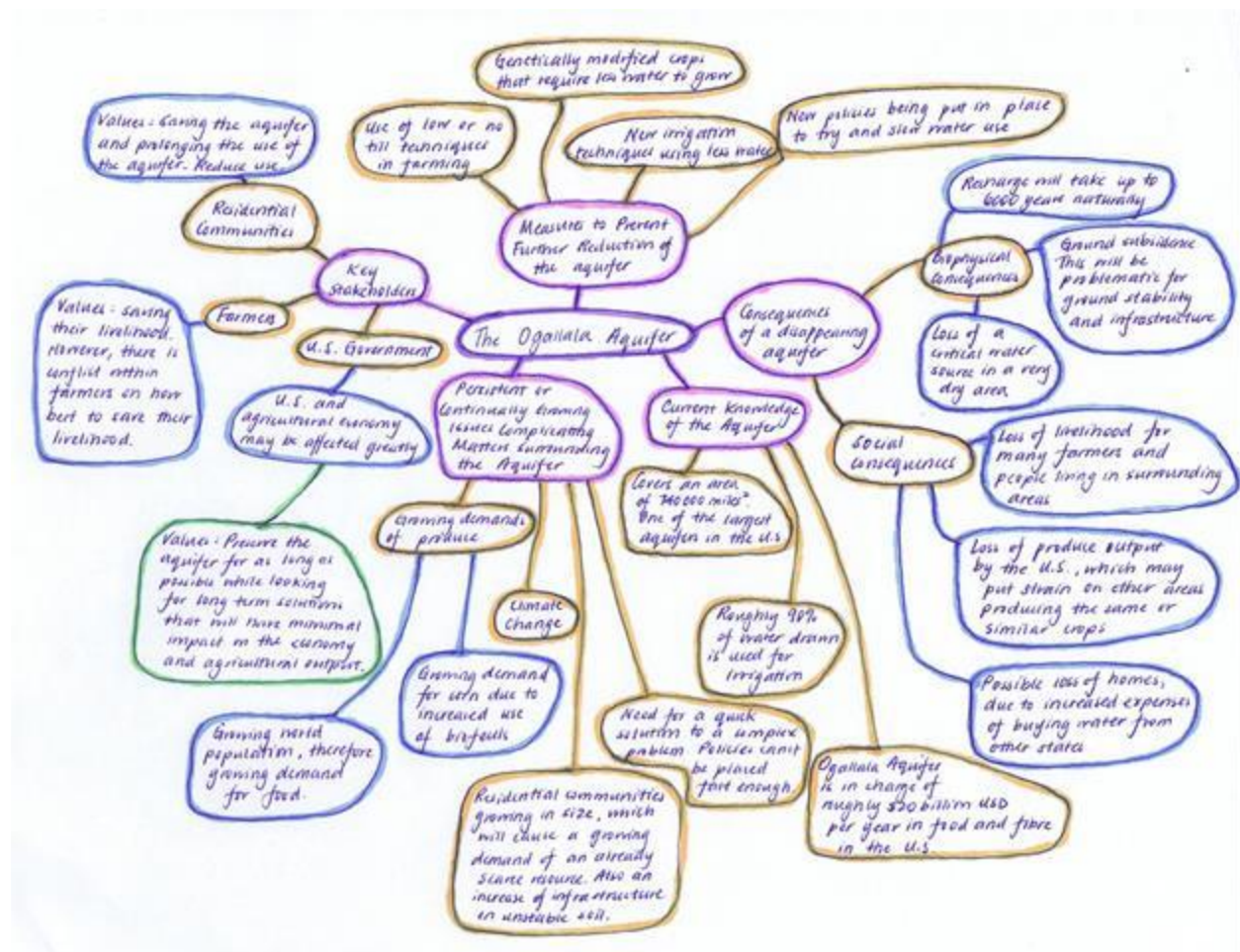
Although more technology is being developed to reduce water consumption, the Ogallala Aquifer is not expected to last past 2070 (Plumer, 2015). New demands are being put on the aquifer despite the need for conservation, making the stress even greater for the resource. For example, the increased use of biofuels requires more corn crops and therefore more irrigation. Increases in ethanol production may cause up to an additional 120 billion litres of water to be drained from the Ogallala Aquifer annually (McElroy, 2008). In the midst of attempting to reduce pressures on the Ogallala and conserve water new demands are being proposed to the region.

Rankings of key issues in order of importance:

1. Conflicting values of the stakeholders cause a disruption in providing a solution to the problem.
2. Governance practice: there is no single body of governance across the Ogallala region, laws differ with state, and in some regions, such as Texas, water laws are conflicting.

- Increasing pressures on the Ogallala
- New irrigation techniques/practices such as dryland farming affect crop quality and lead to loss in agriculture and economy and still are unable to achieve the desired levels of conservation.
- Potential loss of residential area as there will be no water left in the area.
- Ground subsidence can be problematic for infrastructure.

The rankings of key issues surrounding the Ogallala Aquifer was based on the magnitude of their impact in preventing the creation of long-term solutions to the depletion of the aquifer. The largest issues are due to conflicting values of stakeholders and scattered governance practices as they have provided numerous obstacles to providing a solution to the depletion of the aquifer. Other risks listed have also proved to be problematic. However, most would be relatively simpler to resolve if the degrees of conflict between stakeholders were resolved, and governance practices were improved and if there were other sources of water made available to the region.



Mindmap

## Governance Framework

Since the Ogallala Aquifer covers the High Plains region of the U.S., the aquifer falls under the jurisdiction of multiple states – South Dakota, Wyoming, Nebraska, Colorado, Kansas, New Mexico, Oklahoma, and Texas. As a result, the responsibility of making key decisions on preserving this important resource fall to both the county and the state governments of these areas. In most of the regions groundwater is governed by state water law and groundwater management districts (GMDs), generally controlled by local farmers (Peterson, Thomas, and Jeffery, 2003). Because it is difficult to make decisions regarding one resource when the decision makers are spread across different states, a national level organization takes charge and helps the different states implement policies and practices that best suit their situation with the Ogallala Aquifer.

On the national level, the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) takes charge of preserving the Ogallala Aquifer. The initiative taken by the NRCS is called the Ogallala Aquifer Initiative (OAI) in which the goal is to “[improve] irrigation efficiency by a minimum of 20 percent on 3.7 million acres; [Apply] nutrient management and conservation cropping system practices to a minimum of 3.4 million acres; [Establish] an equilibrium level of water recharge and water removal from the aquifer over time; [Maintain] water quality to Environmental Protection Agency (EPA) standards; [Help] agricultural producers save billions of gallons of water from the Ogallala Aquifer; [Assist] agricultural producers in developing conservation plans and prescribed voluntary conservation alternatives specific to water quality and quantity resource concerns” (USDA Natural Resource Conservation Service). However, although the NRCS and partner organizations have implemented certain policies, many of these policies are soft law. Although there are bills that have been passed to make sure landowners practice conservation, many of the policies and programs undertaken are at the volition of the landowners. To encourage these landowners to take part in conservation programs and follow policies, subsidies and benefits are given in return.

Although each state that the Ogallala Aquifer is in, has its own water policies, similar legislation has been put in place across the different states – the similarity lies in the method that is used to preserve water. For example, in the different states, there are water restrictions that limit the amount of water that is pumped from the aquifer. The limit however, differs in each state. In the North Plains Groundwater Conservation District set an annual pumping limit of 24 inches per acre in 2005, and decreased it to 18 inches in 2012 (“Conservation Goals Ogallala Aquifer”, Walton). In many of the states, there are also policies in which landowners are required to obtain a permit before being allowed to withdraw water from the aquifer. A fee often accompanies the application process for these permits, and information on the type of water use, and the place of use must be given. Often, permits for the state government allows for water withdrawal. However, the difficulty of obtaining a permit is different in each state, as different systems are used. For example, in Colorado, a judicial “permitting” regulatory system is used where “to obtain the right to withdraw either surface or groundwater, an application must be filed with one of the seven Water Courts in the state” (National Conference of State Legislatures), whereas in Kansas, a permitting and reporting with exceptions regulatory method is used in which “in order to obtain a permit, one must file an application accompanied by a filing fee which is determined by the amount of water to be appropriated. Applications filed within a groundwater management district are reviewed by the district, and recommendations are made based on the policies, and rules and regulations of that district” (National Conference of State Legislatures).

Because the Ogallala Aquifer is such an important resource in the U.S., the government and organizations creating policies and bills have been quite active in making the decision process as transparent as possible. When searching for information on regulations for water resource conservation, much of the information can be found on the websites of organizations in charge of water management. The NRCS website contains information on the budget for the OAI. It also contains information regarding its goals, and benefits that proposed conservation programs will help landowners. There are also documents that are downloadable to the public that include analysis of the implemented conservation programs. When searching for state level policies and regulations on water regulation, the NRCS has a list of partnered organizations and government organizations that are partnered with the NRCS for the OAI. Going through the organization websites, there is information on state policies and regulations on water conservation that is up to date. Some of the policies enacted by the different states were found in their water law, and reading through these policies, it can be noted that there is heavy weight put on making landowners accountable for the proper use of water. Many of the states contain water meter policies and strict regulations on the amount of water each household can use. There are also strict rules and an application procedure that must be done in order to use groundwater as a resource. Since there are also many programs that are not mandatory for landowners to partake in, the NRCS creates a reason for landowners to participate by offering aid and subsidies to mainly farmers to try and reduce the amount of water used for irrigation. This creates an incentive for farmers to take part and to conserve water.

Overall, the governance practices have been well established in the different states that the Ogallala Aquifer covers. There is definite transparency, accountability, and participation in the decision-making process regarding the conservation of the Ogallala Aquifer. All states that have a part of the Ogallala Aquifer have adopted legislation and policies to protect the aquifer. However, the fact that the aquifer spans across eight different states is problematic as it leads to disconnected management of the aquifer. Although the NRCS has similar programs that are offered across the different states, these programs are often optional to the landowners, and do not help with the fragmented management of the aquifer. Since the Ogallala Aquifer is one large resource, it would be beneficial to treat the aquifer as such, rather than having so many different jurisdictions and splitting the aquifer into separate parts. Often when looking at studies on the Ogallala Aquifer, we see only one side of the picture from the state that the aquifer is being studied in. We do not see how one part of the aquifer in one state could possibly affect another part of the aquifer in another state. Although in some cases, separating the aquifer into separate regions helps to downsize the management of the aquifer into a more manageable area, it leaves gaps in the governance framework and practices that may potentially have a large effect on the protection of the aquifer.

## **Moving Forward**

As mentioned above, various parties employ differing methods for reducing water usage, this leads to conflicting ways of water regulation. In order to have a unified, cohesive strategy, we suggest the below methods of management. Management options for sustaining the Ogallala Aquifer primarily include methods for reducing agricultural water consumption. The aim of our action is to reduce agricultural water consumption as agriculture consumes the most water in the Ogallala. In Kansas, irrigation accounts for 84% of water usage, while municipal usage is at 11% and industrial usage is only at 3% (Durban, 2011). Agricultural water management options developed in the Ogallala region may also have the potential to impact water

consumption worldwide, as agriculture accounts for approximately two-thirds of global freshwater usage.

Potential methods to reduce agricultural water consumption include changing farming methods, technological innovation, changing crops, changing land use and altering policy to limit water consumption. Farming methods that aid in water conservation include dryland farming (by using crops that do not require irrigation and no-till farming (which involves not tilling the land and leaving crop residue, to prevent evaporation and improve the biological fertility of the soil). Techniques to increase irrigation efficiency include replacing flood irrigation with centre pivot and subsurface drip irrigation systems, which decrease evaporation.

Another option for farmers may be to change to alternative crops that are sustainable and drought resistant; such as cotton, wheat or sunflowers. Furthermore, genetic modification can also create crops that require less water for growth by selection for traits that increase the rate of photosynthesis and depth of root structure, as well as decrease the rate at which water is lost through transpiration (MIT, 2015). Implementation of policies that support water conservation will also be necessary. Possible policy changes may address farming methods and land use as well as stricter legislation for groundwater extraction. Financial assistance may be provided for farmers who are undergoing adaptation of their farming practices.

In conclusion, the aim of our plan would be to conserve the aquifer for future generations by reducing agricultural water demand. The recommendations made above are all potential management options that can be adopted by farmers, it is preferable that a combination of all of the options mentioned above are used, as the Ogallala is a finite resource and the only actions that can be taken are those to sustain it. These recommendations work best if they are implemented as soon as possible, and will need to be ongoing and continued for as long as the aquifer exists, in order to prolong its use.

## References

### **Peer Reviewed Articles:**

Balint, Peter J., Ronald E. Stewart, Anand Desai, and Lawrence C. Walters. "Wicked Environmental Problems." *Google Books*. N.p., n.d. Web. 17 Sept. 2015.

In this peer reviewed article, the authors attempted to define a wicked problem by outlining parameters of a wicked problem. The authors also attempted to outline ways of managing a wicked problem. This article was used to help explain why the depletion of the Ogallala Aquifer is considered a wicked problem.

Basso, B., Hyndman, D., & Kendall, A. (2013). The future of agriculture over the Ogallala Aquifer: Solutions to grow crops more efficiently with limited water. *Earth's Future*. 1(1), 39-41. doi:10.1002/2013EF000107

Basso, Hyndman and Kendall's peer reviewed journal article argues that in order to sustain the Ogallala Aquifer and therefore the agricultural industry (and economy) farmers need to find alternatives to mining the Ogallala Aquifer. Here we see that choices are being made so that the economy benefits causing the aquifer to deplete. This article is necessary because it suggests not only that the Ogallala has an impact on the economy but also that economic benefits are negatively impacting the Ogallala (causing it to deplete). Providing

further insight that in order to sustain a healthy economic state (with little alteration to irrigation practice) it is necessary to sustain the Ogallala Aquifer. This article is useful for our research because it shows that there is a direct correlation between the agricultural industry and economy and the Ogallala Aquifer. The article and source are reliable as they use reliable sources such as "Science" journal. One of the weaknesses is that the article doesn't explain its methods of research.

### **Government Documentation:**

*Ogallala Aquifer Initiative*. Natural Resources Conservation Service United States Department of Agriculture. N.p. Web.

This is a website run by the U.S. government to provide those interested with information on the Ogallala Aquifer. The focus of this source is on the explaining the Ogallala Aquifer Initiative, which is an initiative to monitor and conserve the Ogallala Aquifer. This was useful for our research as it is one of the methods being used to try and reduce the negative effects of the depleting aquifer.

*State Water Withdrawal Regulations*. National Conference of State Legislatures. N.p., 20 Feb. 2013. Web.

This government document outlines the different water withdrawal regulations regarding the Ogallala Aquifer. This was used as a resource to help define and identify different water withdrawal regulations being used in the different states that the Ogallala Aquifer falls within.

### **Popular Media:**

Durban, E. (2011, 11 10). *Drought pushes the limits of irrigation*. Retrieved 11 28, 2015, from Harvest Public Media: <http://harvestpublicmedia.org/article/868/drought-pushes-limits-irrigation/5>

This is a news story that tells of the struggles of farmers to provide their farms with enough irrigation water as the Ogallala dries up and rainfall decreases.

Peterson, Jeffrey M., Thomas L. Marsh, and Jeffery R. Williams. "Conserving the Ogallala Aquifer: Efficiency, Equity, and Moral Motives." *Choices Magazine*. N.p., Feb. 2003. Web. 03 Nov. 2015. <<http://www.choicesmagazine.org/2003-1/2003-1-04.htm>>.

Plumer, Brad. "How Long before the Great Plains Runs out of Water?" *Washington Post*. The Washington Post, 12 Sept. 2013. Web. 22 Sept. 2015. <<http://www.washingtonpost.com/news/wonkblog/wp/2013/09/12/how-long-before-the-midwest-runs-out-of-water/>>.

This article gives a general description of the Ogallala depletion problem, and points to some important statistics and works of research to prove its points. It explores how long the Ogallala Aquifer is expected to survive with and without conservation practices. This article is important for our research because it provides an estimated timeline about how long we have to solve the issues around the Ogallala and how much current conservation is helping in terms of extending the Ogallala's lifetime.

Wise, Lindsay. "A Drying Shame: With the Ogallala Aquifer in Peril, the Days of Irrigation for Western Kansas Seem Numbered." *Kansascity*. The Kansas City Star, 24 July 2015. Web. 22 Sept. 2015. <<http://www.kansascity.com/news/state/kansas/article28640722.html>>.

Wise's article describes a farmer's point of view of overcoming the issues surrounding the Ogallala Aquifer, and what measures Kansas farmers have been taking to reduce use for irrigation. Methods of conservation range from dryland farming (no water use), to changing sprinkler systems so plants are irrigated in a less wasteful manner and less water is required from the aquifer. This article is important for our research as it exposes the issues surrounding the Ogallala Aquifer from a farmer's perspective.

### **Grey Literature:**

"Ground Subsidence". *Colorado Geological Survey*. N.p., Web. 26 Nov. 2015. <<http://coloradogeologicalsurvey.org/geologic-hazards/ground-subsidence/>>.

This publicly funded organization provides information on different geological hazards and their consequences. This website helped explain the potential hazards related to ground subsidence – a problem faced by people living in areas with a depleting aquifer.

MIT. (2015, 11 28). *Genetically Modified Crops*. Retrieved 11 28, 2015, from Water For All: <http://12.000.scripts.mit.edu/mission2017/genetically-modified-crops/>

This article provides information on how genetically modified crops can contribute to the reduction of global food insecurity. It sheds light on possible methods that can be used through modified crops to reduce the stresses on the Ogallala Aquifer.

"The Ogallala Aquifer and Its Role as a Threatened American Resource." *APEC HRDWG*. N.p., n.d. Web. 20 Sept. 2015. <[http://hrd.apec.org/index.php/The\\_Ogallala\\_Aquifer\\_and\\_Its\\_Role\\_as\\_a\\_Threatened\\_American\\_Resource#Full\\_Text&gt;](http://hrd.apec.org/index.php/The_Ogallala_Aquifer_and_Its_Role_as_a_Threatened_American_Resource#Full_Text&gt;)>

United States Department of Agriculture, Natural Resources Conservation Service. (2011). Ogallala aquifer initiative 2011 report. Retrieved from [http://www.nrcs.usda.gov/Internet/FSE\\_DOCUMENTS/stelprdb1048827.pdf](http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1048827.pdf)

Although this report doesn't directly critically examine the relationship between the economy and Ogallala Aquifer, it brings forward some key points regarding the economy and the impacts depleting and conserving the Ogallala could make. For example Ogallala supplies 30% of the US groundwater for irrigation and depletion would cause this crop to go dry (unless methods of farming are changed). An interesting fact that the article brings forth (not brought up in the previous articles), is that conserving and improving the water quality can help save money (therefore benefit the economy) by reducing cost for energy, labor and chemicals and increasing farm profit due to improved crop quality, resulting in a healthier overall economy. This article outlines (although, not in depth) some of the key benefits of conserving the Ogallala Aquifer.

Walton, B. "Legal Challenges to Water Conservation Are Plentiful." *Circle of Blue*. N.p., 19 Jan. 2014. Web. 03 Nov. 2015. <<http://www.circleofblue.org/waternews/2014/choke-point-index/legal-challenges-water-conservation-plentiful/>>.

### **Data Sources:**



Little, Jane Braxton. "The Ogallala Aquifer: Saving a Vital U.S. Water Source." *Scientific American Global RSS*. N.p., 1 Mar. 2009. Web. 20 Sept. 2015.  
<<http://www.scientificamerican.com/article/the-ogallala-aquifer/?page=1&gt;>>

McElroy, Anduin K. "The Future of the Ogallala Aquifer." *Ethanol Producer Magazine – The Latest News and Data About Ethanol Production*. N.p., 01 Jan. 2008. Web. 2 Nov. 2015.  
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