

Conclusions

Based on the simulations that we performed as part of this project, sensor network adoption by greenhouse, container, and field ornamental growers provides a number of public benefits. Sensor networks have been shown to reduce the volume of water used, which also impacts the carbon dioxide emissions associated with pumping water. We have also calculated reductions in nitrogen and phosphorus runoff, which would yield major benefits for surface and groundwater reserves and the aquatic life that inhabits them.

As we have discussed, it is too early to directly measure public benefits of sensor networks, because this technology is just beginning to be adopted by commercial growers. As this technology spreads however, public benefits will be able to be measured directly. It will be interesting to see how actual benefits track with our estimates given the advances that we have seen with this technology over the 5 year lifespan of this project.

Based on the assumptions described here, it is reasonable to expect that sensor networks have the potential for major public benefits through reductions in water, CO₂, nitrogen and phosphorus. The relatively high up-front costs of sensor networks may hinder some potential adopters from purchasing systems, which decreases the overall public benefit. Cost share or other financial incentives would be ways to reduce the initial cost of these systems, and increase the public benefits associated with them.

Additionally, extending the use of these sensor networks into other areas of plant production, including fruit and vegetable production, is a promising possibility as their use becomes more widespread. We are excited to see this technology become widely used in agriculture.



Wireless sensor networks can have a role to play in restoring water quality through reductions in agricultural sediment and nutrient runoff.

References cited:

Behe, B. K., B. L. Campbell, C. R. Hall, H. Khachatryan, J. H. Dennis and C. Yue (2012). "Consumer preferences for local and sustainable plant production characteristics." *HortScience* **48**(2): 200-208.

Evenson, R. E. and D. Golin 2003. "Assessing the impact of the green revolution, 1960 to 2000." *Science* **300**: 785-762.

Majsztrik, J., D King, and E. Price. 2014. Understanding the public benefits of sensor networks. *In*: Managing Irrigation through Distributed Networks Knowledge Center, M. Chappell, P. Thomas, and J.D. Lea-Cox (Eds.). Published online at: <https://myelms.umd.edu/courses/1110348> 17p.

Majsztzik, J. 2011. Modeling Nitrogen, Phosphorus and Water Dynamics in Greenhouse and Nursery Production Systems. Ph. D., University of Maryland.

Majsztzik, J. C., E. W. Price and D. M. King 2013. "Environmental Benefits of Wireless Sensor-based Irrigation Networks: Case-study Projections and Potential Adoption Rates." HortTechnology **23**(6): 783-793.

National Research Council 1997. Precision Agriculture in the 21st Century. Washington, D.C., National Academy Press.

Paarlberg, R. L. 2010. "Food Politics: What Everyone Needs to Know. Oxford Press. New York, New York."

Pingali, P. L. 2012. "Green revolution: Impacts, limits, and the path ahead." Proceedings of the National Academy of Science of the United States **109**(31): 12302-12308.

U.S. Department of Agriculture 2010. Farm and Ranch Irrigation Survey (2008), USDA National Agricultural Statistics Service: 268 p.

Image credits and locations

Grain harvesting image credit: <http://haysvillelibrary.files.wordpress.com/2010/05/harvesting-corn-iowa-state-university1.jpg>

Sensor image credit: <http://www.decagon.com/products/soils/volumetric-water-content-sensors/5te-vwc-ec-temp/>

Early cell phone image credit: http://12for2012.files.wordpress.com/2012/07/e0313d63f94fc310526303d18588c633_1m-png.jpeg

Cell phone technology over time image credit: <http://www.linkedandloaded.com/wp-content/uploads/2011/07/1g.gif>

Coal fired power plant image credit: http://2.bp.blogspot.com/-Fn-804peOVA/T84wzpLqt4I/AAAAAAAAAPY/z-ZBHhL-Og/s1600/Project_-_PowerPlant2.jpg

Acre-foot of water image credit: http://upload.wikimedia.org/wikipedia/commons/thumb/a/a3/Acre_foot.svg/350px-Acre_foot.svg.png

Bare ground production image credit: <http://www.jeffriesnurseries.com/northernblaze.JPG>

Chesapeake Bay image credit (Licensed under Creative Commons Attribution): http://commons.wikimedia.org/wiki/File:Chesapeakewatershedmap.png#mediaviewer/File:Chesapeake_watershedmap.png

Healthy stream image credit: <http://tycho.knowlton.ohio-state.edu/images/good4.jpg>

Majsztzik, J., D King, and E. Price. 2014. Understanding the public benefits of sensor networks. *In*: Managing Irrigation through Distributed Networks Knowledge Center, M. Chappell, P. Thomas, and J.D. Lea-Cox (Eds.). Published online at: <https://myelms.umd.edu/courses/1110348> 17p.