'Considerable scope' for improvement in agricultural pollution

April 22 2015

During the industrial era, financial indicators were a company's primary measuring stick. But as the concept of sustainable development has gained relevance, a fundamental change in the assumptions underlying how businesses are measured has also started to take hold.

While different sustainability indicators have been developed at an aggregate level, less attention has been paid to farm-level sustainability measures. A study from a University of Illinois expert in production economics and efficiency analysis has developed technical and environmental efficiency indices for agriculture that can be used to assess sustainability at the farm level.

Moving toward sustainable agricultural practices entails minimizing the production of bad outputs while maximizing good output production, which in turn involves maximizing technical and environmental efficiency levels. In the study, farms are regarded as multioutput firms that produce both good outputs (crops) and bad outputs(nitrogen runoff and leaching) given the use of a certain quantity of inputs, such as land, fertilizer, labor and seeds, says Teresa Serra, a professor of agricultural and consumer economics at Illinois.

The paper, which was published in the European Journal of Operational Research, analyzed data from a sample of farms in the Catalan region of Spain that specialized in the production of cereals, oilseeds and protein crops. The results identify significant room for efficiency improvements both in crop production and in the control of pollution from nitrogen-

fertilizer runoff, Serra said.

Output technical efficiencies – that is, how efficient farmers were at growing crops – averaged 87 percent. But environmental performance measures that analyzed nitrogen pollution show more scope for improvement, with an efficiency rating of 80 percent, Serra said.

"This paper models farm technology by explicitly allowing for production risk, and its findings confirm that ignoring this risk tends to produce biased efficiency estimates," Serra said.

Results show that environmental efficiency fluctuates according to crop-growing conditions. It's especially low (70 percent) when growing conditions are good, indicating that farmers tend to over-fertilize when preparing for good crop-growing conditions.

"When you look at farms from a technical point of view, the ratings that you get in terms of technical efficiency are higher than the ones for environmental efficiency. Why is that? It's because environmental pollution is not well regulated," she said. "There's not a big incentive for farmers to become more efficient, since there's no actual price on nitrogen pollution."

Although there are no market prices for pollution, any move toward deriving a baseline would help in implementing regulatory policy, Serra said.

"The methodology developed in the paper can be easily used to assign monetary values to pollution in terms of the tradeoff between pollution and crop production," she said.

According to Serra, developing and implementing new farm assessment indicators is an important research topic that has economic, social and

political implications.

While its initial objectives were focused on farm income support, the European Union's Common Agricultural Policy has expanded to encompass environmental preservation, Serra noted.

"Increasingly, one of the things Europeans want to see is, if we give subsidies to farms, they should reciprocate by conserving the environment," she said. "If it's a public expenditure, then they expect environmental as well as economic benefits. So the question becomes, is there a way for us to achieve a better distribution of the subsidies by measuring farms not only in terms of how efficient their production is, but also whether they minimize their pollution for the amount of output they create?"

Implementing such a redistribution scheme requires empirically based tools to measure a farm's success in achieving those goals. According to Serra, the paper marks a step toward the eventual implementation of such schemes.

"The methodology developed in this paper can be implemented in other empirical settings," she said. "For example, fertilizer used by farmers in Illinois is contributing considerably to pollution in the Gulf of Mexico. Determining the environmental efficiency of Illinois farmers would help in identifying nitrogen overuse and being able to make specific recommendations to minimize its use at the farm level."

More information: "Measuring technical and environmental efficiency in a state-contingent technology," *European Journal of Operational Research*, Volume 236, Issue 2, 16 July 2014, Pages 706-717, ISSN 0377-2217, dx.doi.org/10.1016/j.ejor.2013.12.037