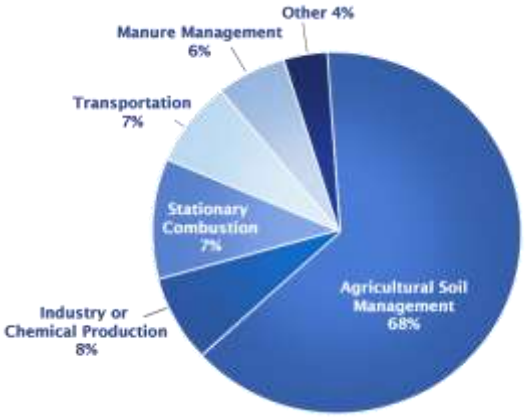
PRACTICE: Case for Organic Sugar in India

PRACTICE

Better Soil Management Reduces Greenhouse Gases Released to Atmosphere

PROBLEM

In agriculture, nitrous oxide is emitted when people add nitrogen to the soil through the use of synthetic fertilizers. Agricultural soil management is the largest source of nitrous oxide emissions in the United States, accounting for about 68 percent of total nitrous oxide emissions in 2010 (See U.S. EPA figure below). Nitrous oxide is also emitted during the breakdown of nitrogen in livestock manure and urine, which contributed 6 percent of nitrous oxide emissions in 2010.[1]



DESCRIPTION AND RESULTS

Organic vs. Conventional Sugarcane Production in India

Organic farming of sugarcane relies on techniques such as crop rotation, “green” manure, compost, and non-synthetic pesticides and practices to promote soil biological activity, nutrient bio-cycles, and biodiversity. Transitioning from conventional intensive farming to organic farming **sometimes initially reduces yields**. As noted in one study, sugar yield was lower during the first two years. However, by the end of third year, the organic farming sugarcane yields were stabilized and **from the fourth year on, the yields became higher than conventional farming**.

Overall, thirty years of side-by-side research[2] demonstrates that organic farming is better equipped to provide supply at a lower cost in difficult climates (uncertain and extreme weather patterns) and high energy cost environments:

- Organic farming outperforms conventional farming in years of drought.
- Organic farming uses 45 percent less energy and is more efficient.
- Organic farming systems are more profitable than conventional systems.
- Soil health in the organic systems has increased over time while soil health in the conventional systems remains essentially unchanged. Organic farming is far superior to conventional systems when it comes to building, maintaining and replenishing the health of the soil.
- Organic fields increased groundwater recharge and reduced runoff.
- Organic yields match conventional yields. After an initial decline in yields during the first few years of transition, the organic systems soon rebounded to match or surpass the conventional systems.

[1] Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2010 – US EPA

[2] Farming Systems Trial, Rodale Institute 2010 – The crops focuses in the study was corn and soybean which have a greater soil nutrient demand of Nitrogen then sugarcane.

When one also considers yields, economic viability, energy usage, and human health, it's clear organic farming is more sustainable and cost efficient, while current conventional practices are not.

When it comes to greenhouse gas emissions, the data shows that conventional systems emit 40 percent more greenhouse gases per pound of crop produced than the organic systems, depending on the nutrient requirements of the soil. The biggest greenhouse gas emission from direct inputs in the conventional system comes from fertilizer production and on-farm fuel use, and in the organic system comes from fuel use and seeds.

NITROGEN FERTILIZER IS INDUSTRY'S BIGGEST EXPENSE

In India, sugarcane requires large amounts of nitrogen to produce optimal yields. Plants receive nitrogen through the atmosphere, soil, and through the decomposition of organic soil matter around the plant. In conventional agriculture, commercial inorganic nitrogen fertilizer (solid or liquid) is applied along the rows of plants to supplement natural nitrogen; and **this fertilizer is biggest expense in growing sugarcane.**

Table 2. Cost of cultivation of organic and conventional sugarcane crop (Indian rupee)

Operations Organic & Conventional Percent change	Organic	Conventional	Percent change
Land preparation	5,838	5,307	10.0 percent
Seed and planting	5,372	6,974	-23.0 percent
Manures	10,534	5,242	101.0 percent
Chemical fertilizers	-	8,980	-
Weeding and inter-culture	5,157	4,959	4.0 percent
Irrigation	5,986	7,587	-21.1 percent
Plant protection	781	1,274	-38.7 percent
Others	1,964	1,792	9.6 percent
Total*	**35,632**	**42,115**	**-15.4 percent**

One ton of wet manure contains approximately the same nutrients that are in a 45-kg (100-lb.) bag of 5-10-5 fertilizer (N-P-K)[3], and costs about $3.50 - $4.50. Thus, to move and apply one ton of manure cannot cost more than about $1 - $2 to be cost effective, assuming all variables are the same (water use, yield, etc.). However, the cost effectiveness of wet manure also depends on its proximity to the crops, given that wet manure is 85 percent water and can therefore be difficult and expensive to transport and use. When available, applying manure and its nutrients to cropland represents a saving to the farmer.

ORGANIC NITROGEN FERTILIZER CHEAPER, AS EFFECTIVE

While inorganic nitrogen is the most popular choice of nitrogen fertilizer applied by sugarcane producers, organic fertilizer (manure and green manure) is less expensive and accomplishes the same.

- Nitrogen content in manure varies with the type of animal and feed ration, amount of litter, bedding or soil included, and amount of urine concentrated with the manure. Moisture content is also a major consideration.
- Generally, poultry manure is highest in nitrogen content, followed by hog, steer, sheep, dairy cow, and horse manure. Faster nitrogen-release sources, such as poultry manure, require more frequent application but in lower quantities to maintain nitrogen availability.
- Sources of organic nitrogen fertilizer can also include composted municipal and agricultural waste and municipal sewage sludge. Research shows that in most countries these materials are safe and effective sources of nutrients

[3] Conservation of Fertilizers and Livestock Manure: Pollution Prevention By David Pimentel, Ph.D., Professor of Insect Ecology & Agricultural Sciences, Dept. of Entomology & Section of Ecology & Systematic, Cornell University

for sugarcane production. They are also good sources of organic matter, which helps improve soil structure and water infiltration and storage in soils.

ORGANIC FARMING REQUIRES BETTER TILLAGE PRACTICE

Tillage—the plowing of land for weed and pest control and to prepare for seeding—has long been part of the cropland farming enterprise. Tillage systems influence physical, chemical, and biological properties of soil and have a major impact on soil productivity and sustainability. Conventional tillage practices may adversely affect long-term soil productivity due to erosion and loss of organic matter in soils. Sustainable soil management can be practiced through conservation[4] tillage (including no-tillage), high crop residue return, and crop rotation.[5] A reduction in how often or how intensively the soil is tilled allows the soil to retain more organic matter, which stores or "sequesters" carbon and nitrogen, which then is not available to contribute to global warming as carbon dioxide and nitrous oxides, which are powerful greenhouse gases.

The adoption of less intensive tillage practices on a large number of farms could sequester substantial amounts of carbon and nitrogen, allowing agriculture to contribute to global efforts to reduce and control greenhouse gas emissions. Studies conducted under a wide range of climatic conditions, soil types, and crop rotation systems have shown that no-tillage and reduced tillage practices have resulted in soils with significantly higher soil organic matter contents compared with conventionally tilled soils.[6]

ORGANIC FARMING CONSERVES WATER

In the state of Maharashtra, India, about 80 percent of water is utilized for agriculture (World Bank, 2003), and more than 60 percent of it is utilized for the sugarcane crop alone. Moreover, farmers mine water from deeper aquifers for the sugarcane crop. This is a cause of great concern and demands conservation and judicious use of water, as it has endangered the stability and sustainability of agriculture.

The costs incurred by the sampled organic farmers for irrigation as well as the irrigation cost per unit of sugarcane production were observed to be substantially lower than of conventional farming, implying less use of water for irrigation (see Table 2 on the previous page). One of the factors responsible for the reduction is that incorporation of organic matter into soil improves its structure and enhances its micro-porosity, leading to improved moisture-retention capacity and reduced or ceased use of chemical fertilizers.

RESOURCES

Background on nitrous oxide as a greenhouse gas

Nitrous oxide (N_2O) is naturally present in the atmosphere as part of the Earth's nitrogen cycle, and has a variety of natural sources. However, human activities such as agriculture, fossil fuel combustion, wastewater management, transportation and industrial processes are increasing the amount of nitrous oxide in the atmosphere. Globally, about 40 percent of total nitrous oxide emissions come from human activities. The impact of one pound of nitrous oxide on warming the atmosphere is over 300 times that of one pound of carbon dioxide.

[4] Conservation tillage is defined as a tillage system in which at least 30 percent of crop residues are left in the field and is an important conservation practice to reduce soil erosion

[5] P. R. Hobbs, K. Sayre, and R. Gupta, "The role of conservation agriculture in sustainable agriculture," Philosophical Transactions of the Royal Society B, vol. 363, no. 1491, pp. 543–555, 2008.

[6] R. Alvarez, "A review of nitrogen fertilizer and conservation tillage effects on soil organic carbon storage," Soil Use and Management, vol. 21, no. 1, pp. 38–52, 2005.