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The Double Edged Sword of Conventional and Organic Farming

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Water is the number one entity for human survival, but food is number two. Through cultivation, domestication of animals, and advanced technologies, the global farming industry has been able to provide the seven billion people of the world with a continual food supply. What happens when the population drastically increases, though? According to four crop and soil scientists of the School of Biology, University of Leeds, Leeds, UK, "The global demand for food and farmland is rapidly growing…[because] agricultural production has to increase globally to supply the food required for the estimated over nine billion people by 2050" (Benton et al. 355-356). This situation has become a serious concern in the agriculture industry because farmland availability is scarce, and yet the population continues to grow. The higher demand for food production forces the industry to increase conventional applications such as chemicals and create more genetically modified organisms. Meanwhile, an increase of skepticism from consumers about the safety of conventionally grown foods has increased the demand for organic alternatives. However, the insignificant amount of inclusive research that has been conducted does not prove conventional foods to be dangerous for human consumption, and although organic farming operations do exist, the production level of output will not feed a world of nine billion people. So what is the farming industry to do?

Food safety organizations, such as the U.S. Food and Drug Administration and others around the globe, need to supply funding for further research on conventional and organic farming practices. Research on food safety and efficiency is more crucial than ever because the high yielding results of conventional farming make the practice a necessity for survival, but the

uncertainty of conventional farming's sustainability and pesticide residue contributing to human health conditions, direct consumers to demand more of the safe alternative of organic farming. The downfall of this consumer trend is that organic farming cannot supply the world with the same quantity of food as conventional practices do. Therefore, additional scientific research must be conducted to conclude or increase the safety and efficiency of the industry.

Science has been able to date farming practices back roughly 10,000 years ago to present day Turkey and the Middle East. Hunting and gathering was slowly abandoned as civilians of Catal Huyuk and Jericho began harvesting plant seeds and saving them to plant in future seasons (Rymer). Up until the early 1900s, all farming was what the 21st century refers to as organic, in that the use of any synthetic chemicals or genetically modified organisms were nonexistent. Nitrogen, a crucial element for increasing soil fertility in crop fields, was obtained through the input of animal manure on fields or the planting of nitrogen-rich cover crops such as legumes (Pearce, Smith, and Williams 284). Cover crops are planted after harvest in the late fall to reduce weed penetration in the field, increase soil fertility, prevent soil erosion, and diversify soil nutrients and organisms. In the spring, cover crops are killed off and/or grain crops are planted over them. In 1910, chemists Fritz Haber and Carl Bosch developed an ammonia synthesis process that made nitrogen readily available in a synthetic form (Chemical Heritage Foundation). The practice of conventional farming was thus born. Conventional farming now consists of various synthetic fertilizer applications, chemical herbicide and pesticide use, antibiotics in the animal sector, and genetically modified organisms (GMOs). GMOs are created by scientists in a lab through changing a single or multiple genes in a plant seed to get a specific trait such as weed and drought resistance. Conventional farming is more prevalent around the world, but organic farming practices are increasing in popularity for commercial use.

The number one concern of any production sector is yield rate. Yield rates become more pressing when the life or death of the world's population is at stake. A two billion person increase in the world population equates to a 30 percent increase in food production. Professor Jan Bengtsson from the Department of Ecology, Swedish University of Agricultural Sciences, Uppsala, Sweden, concludes from a study, "in the present case, organic yields were <50% of conventional" (52). If the world economy relies on organic exports and imports alone, organic farming will have to increase its production output by 80 percent by 2050 for yields to be equivalent to the growing population. A triple increase in production within a 35 year time period is highly unrealistic for any production sector, but even more so for the currently inefficient practice of organic farming. In order for organic farm systems to compete with the high yield increase requirement, additional land would have to be cleared for farming, "resulting in more widespread deforestation and biodiversity loss, and thus undermining the environmental benefit of organic practices" (Foley, Ramankutty, and Seufert 229). The alternative method of conventional farming has the capability of maximizing yield rates with the farmland already in production due to synthetic applications, preventing further deforestation.

Due to the significantly higher yield difference of conventional method to organic, conventional farming has to be continually practiced today. Consumers of organic products should not worry about long-term low organic yields, though. Agriculture researchers Foley, Ramankutty, and Seufert from the *Natural Publishing Group* explain that, "improvements in management techniques that address factors limiting yields in organic systems…may be able to close the gap between organic and conventional yields" (231). A better understanding of yield efficiency for organic farming will come in time with good management practices. There is a possible downfall to the high yield rates of conventional farming, however. Some studies suggest

that there is evidence that the increased yield rates of conventional farming do cause a decline in biodiversity, a contributing factor to agricultural sustainability (Benton et al. 357).

Sustainability has become a front runner of debates for conventional and organic farming. Research analysts S. Kaswan, V. Kaswan and Kumar from the Anand Agricultural University, India, Department of Livestock Production & Management, specify sustainable agriculture as "establishing soil fertility, providing diversity and, therefore, resilience to food production systems in light of the many uncertainties of climate change" (28). Organic farming is the epitome of sustainable agriculture because it uses biological processes to supplement plant nutrition and to control pest and weed pressures instead of synthetic applications as conventional practices use (Lima and Vianello 1). The biological processes promote biodiversity in the soil, resulting in an increase in gas exchange and nutrient uptake for agricultural crops. Conventional farming strives for sustainability as well, but conventional practices are beginning to face challenges of maintaining biodiversity.

Conventional methods such as pesticide use "contribute toward imbalances in the ecosystem and polluting the environment" (Kaswan, Kumar, and Vineet 29). An imbalance in the ecosystem equates to a loss of biodiversity. Conventional farms are not always lower in biodiversity than organic, though, because biodiversity differs between taxa in farm fields. The researchers of a study comparing yields to biodiversity in both organic and conventional agriculture observed that "plants, earthworms, [and] bumblebees had higher abundance and species densities in organic fields. In contrast, hoverflies…and farmland birds had higher abundance and species density in conventional fields" (Benton en al 358). All of these organisms promote plant and soil health, which fosters a sustainable ecosystem. Conventional methods succeed at maintaining constant high yields each season, but without sustainable farm

management, soil fertility will deplete and in time the soil will lose its ability to produce a viable crop altogether. Although it is evident that organic farming is a higher promoter of sustainable agriculture than conventional farming, "knowledge is very limited for the costs, in terms of yield loss, that are associated with biodiversity gains through organic farming" (Benton et al. 357). More research must be conducted to conclude if there is an advantage of biodiversity over yield rates.

Another consequence associated with conventional farming, that is non-existent in organic, is chemical residue. Conventional farmers apply artificial fertilizers, insecticides, fungicides, and other pesticides on their crops to achieve high yield returns. Research has found trace elements of the various synthetic chemicals on conventional retail produce. Consumption of the chemicals has been reported to cause health defects. In an article from *Rural Sociology*, professors from the Department of Sociology, University of Kentucky, Lexington, KY, explain that, "pesticides in particular are of concern because they are linked to increased rates of cancer… [And] are tied to reproductive disorders and birth defects" (Bell, Brislen, and Hullinger 286). Biochemists of University of Padova, Padova, Italy and UNESP, Brazil, report in the *International Journal of Food Science and Technology* that a study of "organic tomatoes presented a lower content of undesirable compounds, such as pesticides and nitrates" as compared to conventional tomatoes (Lima and Vianello 4). The discovery of the chemical and pesticide residue on conventional products has not gone unnoticed.

It is evident that consumers are becoming alarmed by the pesticide risks of conventional products because there is a higher demand for organic goods. Consumers are finding that organic products are not as cost effective as conventional products, though. Organic practices require additional labor compared to conventional practices for procedures such as mechanical weed

control because herbicides cannot be used to combat weeds and plant diseases (Pearce, Smith, and Williams 282). It costs more money for organic farmers to produce a smaller yield than conventional farmers because of the absence of synthetic chemicals. The appeal of synthetic chemical and pesticide applications is that input costs are lower than organic methods, resulting in lower prices for conventional goods. High organic prices are not a concern for the wealthy consumers of the world economy, but consumers on a low-income budget cannot afford to pay the price for organic goods. Society must not eliminate the use of pesticides altogether because there must be lower food cost alternatives for consumers and a significant increase of yield in food production (Lima and Vianello 9). Producers and consumers can reduce the consumption of chemical residue, though, by thoroughly washing all produce before cooking or eating it.

Organic farming is not concerned about chemical residue because it does not use synthetic fertilizers or toxic chemicals for weed control, but it does face the issue of organic fertilizer residue. Cover crops are an effective way for organic farmers to get excess nitrogen into the soil, but typically cover crops do not give off enough nitrogen for a farmer to grow a yielding profit. To supplement the remaining nitrogen needed for nutrient uptake, farmers use organic fertilizers such as high nitrogen content hog and cow manures. Implications can arise from the application of the animal manures. Biochemists Lima and Vianello affirm "it has been suggested that the application of manure and the reduced use of fungicides, and antibiotics in organic farming could result in a greater contamination of organic foods" (2). The contamination is contributed by manure-borne pathogens such as *Escherichia coli*, mycotoxins, and parasites, all of which are harmful to consumers (2). There are also preventative measures that farmers can take to reduce the threat of manure-borne pathogens in the soil and plant material. Organic farmers must "establish appropriate time limits between the application of noncomposted manure

and vegetable harvest" (2). The US Department of Agronomy suggests 120 days of manure decomposition before field application (2). Decomposition of organic manures is an important biological process for agricultural sustainability. The amount of nitrogen accumulating in fresh manure is too high for agricultural crops so an early application will burn and kill the plant. Decomposition releases some of the nitrogen from the soil and beneficial bacteria breaks down harmful plant and animal pathogens, leaving healthy and nutrient rich organic fertilizer to be applied in crop fields. Another method producers and consumers can use to prevent organic fertilizer consumption is to wash the produce just as stated for conventional goods. But if both practices result in residue, which is better? Lima and Vianello conclude from their study that "the comparison of the contaminant content in organic and conventionally grown raw materials showed no conclusive evidence whether conventional products are more or less safe than organic ones (3). It is apparent that more research must be conducted on organic and conventional foods to determine the level of safety for food consumption.

Food consumers, producers, and scientists are at a standstill when it comes to agriculture. The questions concerning the safety of conventional goods, the sustainability of conventional and organic farming, and the capability of farmers to produce enough food for the increasing world population, are plaguing the agricultural and farming industry. Answers need to be found to relieve consumers' reservations and for farmers to continue feeding the world. The only way for any of these uncertainties to be resolved is through research. Farmers cannot afford to pay for conclusive research to be done on their farm products; therefore, a second party must fund the scientific research. The research will be a costly and time consuming endeavor, but the overall impact it will have on the agriculture industry will be tremendous and beneficial for the world population.

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