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March Public Forum Debate Brief

Resolved: In the United States, the benefits of increasing organic agriculture outweigh the harms.

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Background

This year's March topic should be extremely interesting given that it's a departure from topics concerning international relations. While this is initially phrased as a harms and benefits topic, it is debating the implications of increasing organic agriculture, so debaters must consider a world with increased organic culture in comparison to the status quo. However, the topic is vague in some respects. The topic discusses "increasing" organic agriculture without providing a specific and clear way organic agriculture would be increased by. This is likely by design. By saying that organic agriculture will be "increased," the NSDA wording committee could be trying to prevent fringe arguments that rely on a specific quantified threshold to be argued. Rather, the more strategic advocacy on this topic would be to argue that generally, organic agriculture has harms and benefits. However, the status quo the affirmative tries to depart from is quite clear-- less than 1% of land in the US grows organic produce.

The definition of organic agriculture varies based on who defines it, but it's generally agreed to be food grown without pesticides and fertilizers. Although pesticides were initially lauded as a technological solution that enabled industrial farming, we now know their toxic effects on the environment. Thus, the core clash of the topic is between the effect pesticides have on the environment in comparison to the advantages pesticides provide in terms of efficient industrial farming. Besides the stock ground of environment versus crop yields, the affirmative also has excellent arguments on how small farmers would be benefited through adoption of organic agriculture. These arguments will be overlooked by most teams but most of the literature on the matter is decisive that organic agriculture would allow independent farmers to increase their incomes. The impacts off this argument are also quite easy to explain and contextualize to the judge; the affirmative if they choose this line of argumentation should paint a picture of the dying family farm and the crushing results on rural communities across America. This impact is also easy to compare to the negative story about crop yields, because the affirmative can argue that most food production doesn't uniquely come from domestic US production but instead from the wider world; however, only changing US agriculture practices can save the independent farmer. Conversely, the negative seems to have great argumentation based on the environment; while the effects of pesticides on the environment are intuitive, the lessened efficiency of organic agriculture forces higher land use and thus more emissions. The strongest negative offense around crop yields and efficiency also provides inrounds to the aff's environment based argumentation which is an independent justification for the strategic value of small farmer based affs. The negative argument that organic produce has less yields per acre of land compared to industrial conventional farming is most likely true and has devastating impacts. Food production needs to be massively ramped up to deal with additional billions of people; it's projected that by 2050 food production must increase by 60-100%. Under this context, the negative should and must argue that the billions of people with hungry mouths can only be fed with industrial agribusinesses.

Aff

Organic Agriculture benefits the Environment

Organic Agriculture has decreased emissions across the world

Anuradha **Varanasi**, 10-22-20**19**, "Is Organic Food Really Better for the Environment?," State of the Planet from Columbia University, https://news.climate.columbia.edu/2019/10/22/organic-food-better-environment/ //Vikas Nanduri

When you walk into any farmers' market, you're greeted with signs that say "Certified Organic" in bold letters. Despite being far more expensive than its non-organic counterparts, organic agriculture has become the most popular type of alternative farming, not only in the United States but also globally. **According to the** United States Department of Agriculture (**USDA**), as of 2012, **organic farming accounted for 3 percent of the total** sales within the **country's food industry**. Even in **European countries** like Finland, Austria, and Germany, governments **have been** busy **implementing plans** and policies **that** aim to **dedicate 20 percent of land area to organic farming. In South Asia, Bhutan has** ambitious **plans of going 100 percent organic** by 2020. Meanwhile, **Sikkim, a state in north-eastern India had managed to go 100 percent organic in 2016.** The gradual shift towards organic farming has been mainly because we as consumers have become increasingly concerned about the health impacts of accidentally consuming pesticides and chemical fertilizers. During the 1990s, the USDA first standardized the meaning of the term "organic" — basically, farmers do not use any form of synthetic fertilizers, pesticides, herbicides, or fungicides to grow their produce. **Organic farming is widely considered to be a far more sustainable alternative when it comes to food production. The lack of pesticides and wider variety of plants enhances biodiversity and results in better soil quality and reduced pollution from fertilizer or pesticide run-off.** Conventional farming has been heavily criticized for causing biodiversity loss, soil erosion, and increased water pollution due to the rampant usage of synthetic fertilizers and pesticides.

However, despite these glaring cons, scientists are concerned that organic farming has far lower yields as compared to conventional farming, and so requires more land to meet demand. A polarized debate Not surprisingly, the debate over organic versus conventional farming is heavily polarized in academic circles. Of late, the conversation about organic farming has shifted from its lack of chemicals to its impact on greenhouse gas emissions. In December 2018, researchers from Chalmers University of Technology published a study in the journal Nature that found that organic peas farmed in Sweden have a bigger climate impact (50 percent higher emissions) as compared to peas that were grown conventionally in the country. "Organic farming has many advantages but it doesn't solve all the environmental problems associated with producing food. There is a huge downside because of the extra land that is being used to grow organic crops," said Stefan Wirsenius, an associate professor at Chalmers. "If we use more land for food, we have less land for carbon sequestration. The total greenhouse gas impact from organic farming is higher than conventional farming." Soon after the paper was published and widely covered by various news organizations globally, several researchers criticized the study. Andrew Smith, a chief scientist at the Rodale Institute, lashed out in a post saying that it was "irresponsible to extrapolate a global phenomenon based on two crops grown in one country over three years." Smith also added that more data should be included and analyzed before making conclusions. Commenting on this, Wirsenius said, "It is true that we had a small comparison between organic versus conventional farming based on Swedish statistics. This is because Sweden is one of the very few countries that has statistics that include the yields from organic and conventional crops." "It would have been better with bigger sample size and that is a valid concern," he added. It is estimated that by 2050, the demand for food is going to increase by 59 to 98 percent due to the ever-increasing global population. A major challenge for the agriculture business is not only trying to figure out how to feed a growing population, but also doing so while adapting to climate change and coming up with adequate mitigation measures. Some scientists continue to be concerned that with limited land areas that will be available for farming, it might not be sustainable for industrialized countries to go 100 percent organic. A recent study published in the journal Nature Communications concludes that the widespread adoption of organic farming practices in England and Wales would lead to increases in greenhouse gas emissions. This is mainly because agricultural yields would be 40 percent lower. The researchers argued that with fewer crops being grown locally, these two countries would have to import more food supplies. However, if England and Wales did not solely rely on **organic farming**, and both countries' farmers used this alternative form of farming on a smaller scale, it **could result in a 20 percent reduction in carbon emissions.**

"For organic farming to be successful, agribusinesses would have to find the balance between the costs involved and also, its carbon footprint, while taking into consideration the overall need to meet the high demands for food," said Alexander Ruane, a research physical scientist at NASA Goddard Institute for Space Studies and an adjunct associate research scientist at the Columbia University Center for Climate Systems Research. "That's tough because the goal of organic farming in developed countries currently is about meeting the needs of those who can afford the luxury to buy the highest quality food. If the needs of this luxury interfere with the need to feed the entire population, then you have the potential for conflicts." The blurry line between “good” and “bad” Making matters more complicated, some experts worry that the term “organic food” is not always properly regulated. As more large corporations get involved in organic markets, researchers claim that this shift to the mainstream has “led to the weakening of ecologically beneficial standards”. It may also limit organic farming’s ability to reduce greenhouse gas emissions. While researchers and the general public remain divided on whether organic farming is more sustainable than conventional farming, Sonali McDermid, an assistant professor at the department of environmental studies at New York University, says that it is very hard to generalize across any farming systems or label conventional or organic farming as “good” or “bad”. “They have very different manifestations, depending upon where you go,” she said. “An apt example would be the case of a farm involved in the production of organic berries in Central Valley, California. While they are not using additional land area or chemical inputs like in conventional farming, they are using other really strong inputs like sulfur,” explained McDermid. “This can be harmful to farmworkers as they need to wear proper suits and protective gear even though it is not chemically synthetic. Despite that, it is just as powerful in some cases.” McDermid is also concerned that some agribusinesses can farm uniformly without any biodiversity and still call themselves organic. Whereas in developing or emerging economies — for example in India — farmers tend to follow a far more traditional definition of organic farming. “In India, organic farms grow lots of different crops at the same time. They grow plants that can naturally keep pests away and don’t use powerful inputs like sulfur. Instead, the farmers use plants and biodiversity to help regulate their cropping systems,” said McDermid. Indian farmers who grow organic crops also make their fertilizers by filling a field with legumes that they grow in rotations. Once the legumes have fully grown, the farmers manually plow them into the ground. That results in larger quantities of nitrogen being pumped into the soil, as opposed to only using manure or even worse, synthetic fertilizers. McDermid said that in some areas of the developing world, organic farming can actually boost yields over conventional farming because it doesn’t rely on so much water and chemical inputs. These practices also build soil fertility and lead to less pollution. Experts maintain that in the heated debate over organic versus conventional farming, there needs to be more information available for consumers when it comes to labeling and even understanding the certification processes in industrialized countries like the U.S. “A huge fraction, if not the majority of organic goods sold at supermarkets in the U.S. is probably industrial,” added McDermid. For now, in the developed world, the industrialization or commercialization of organic farming has resulted in a lot of difficulty for both consumers and researchers, who are trying to understand what the goals of this booming industry are. To eat organic or not to eat organic In the U.S., even sustainability experts continue to be unsure of whether food items like fruits and vegetables with the “certified organic” labels are in fact, genuinely organic or not. McDermid said that even she sometimes feels uncertain about what to buy in the supermarket. That being said, both Wirsenius and McDermid agree that it is far more environmentally sustainable to eat organic chicken instead of beef that was produced conventionally. Yet, consuming large portions of organically produced meat will still have a bigger environmental impact than eating conventionally produced crops and fruits. Taking into consideration the high costs involved in going 100 percent organic, especially when it comes to buying fruits and vegetables, McDermid said if you can afford to spend extra, she would recommend buying them. It might also help to look for organic food that was grown locally. For instance, several community gardens grow organic vegetables that are sold in nearby farmers’ markets. Keeping that in mind, there’s no need to feel guilty or under pressure to spend extra for organic produce. “I would never put that kind of pressure on anybody. It’s really unfortunate we’re in a situation where agribusinesses focus only on yields, which makes an alternative form of farming comparatively much more expensive,” sighed McDermid. While the organic versus conventional farming debate rages on, there is one clear way to lower the environmental impact of your food, and it won’t hurt your wallet: reducing the amount of meat in your diet.

Even small level adoption of organic food fights climate change

Lauren **Mullen**, 3-17-20**21**, "The Positive Impact of Organic Foods," University of Colorado Boulder, https://www.colorado.edu/ecenter/2021/03/17/positive-impact-organic-foods //Vikas Nanduri

Buying **organic food fights the effects of climate change** Soil has the ability to sequester carbon (for more about this topic check out my last article Carbon Sequestration through Soil Health | Environmental Center) Rodale's research shows that: "**If only 10,000 medium-sized farms in the U.S. converted to organic production, they would store so much carbon in the soil that it would be equivalent to taking 1,174,400 cars off the road, or reducing car miles driven by 14.62 billion miles."** Organic farming supports water conservation and water health American Rivers notes that water runoff from non-organic farms contains harmful pesticides, toxic fertilizers, and animal waste that is a major water pollution threat Organic farming also creates healthy soil that does not need as much water

Organic Agriculture decreases emissions and increases farmer profits as they are more expensive

Olivia M. **Smith**, 9-27-20**19**, "Organic Farming Provides Reliable Environmental Benefits but Increases Variability in Crop Yields: A Global Meta-Analysis," Frontiers, https://www.frontiersin.org/articles/10.3389/fsufs.2019.00082/full //Vikas Nanduri

To promote food security and sustainability, ecologically intensive farming systems should reliably produce adequate yields of high-quality food, enhance the environment, be profitable, and promote social wellbeing. Yet, while many studies address the mean effects of ecologically intensive farming systems on sustainability metrics, few have considered variability. This represents a knowledge gap because producers depend on reliable provisioning of yields, profits, and environmental services to enhance the sustainability of their production systems over time. Further, stable crop yields are necessary to ensure reliable access to nutritious foods. Here we address this by **conduct**ing **a global meta-analysis to assess** the average magnitude and variability of seven sustainability metrics in **organic compared to**

conventional systems. Specifically, we explored the effects of these systems on (i) biotic abundance, (ii) biotic richness, (iii) soil organic carbon, (iv) soil carbon stocks, (v) crop yield, (vi) total production costs, and (vii) profitability. Organic farms promoted biotic abundance, biotic richness, soil carbon, and profitability, but conventional farms produced higher yields. Compared to conventional farms, organic farms had lower variability in abundance and richness but greater yield variability. **Organic farms thus provided a "win-win"** (high means and low variability) **for environmental sustainability**, while conventional farms provided a "win-win" for production by promoting high crop yields with low variability. Despite lower yields, and greater yield variability, organic systems had similar costs to conventional systems **and were more profitable due to organic premiums.** Our results suggest certification guidelines for organic farms successfully promote reliable environmental benefits, but greater reliance on ecological processes may reduce predictability of crop production.

Food Production is the biggest contributor to climate change but organic agriculture can solve

Naomi **Zimmerman**, 2-5-20**20**, "So, Is Organic Food Actually More Sustainable?," State of the Planet from Columbia University, https://news.climate.columbia.edu/2020/02/05/organic-sustainable-food/ //Vikas Nanduri

Recently, in my sustainable development class, we learned about conventional versus organic food systems, and the fact that organic food was not always the most sustainable option blew my mind. Despite my efforts to adopt a sustainable diet, I came to realize that I, and many of my peers, do not know much about the sources of our food and their implications for the planet. Rather, we had grown to accept broad generalizations about what a sustainable diet looks like — plant based, organic, and non-GMO. Using renewable energy and reducing waste are featured prominently in the media, dominating the popular environmental discourse and leaving food systems sorely overlooked. But in my sustainable development class, I was shocked to learn that **food systems are the largest contributor to environmental degradation.** The production, transportation, and consumption of food on a planet containing over 7 billion people is incredibly carbon intensive. **Agriculture contributes to a third of the global greenhouse gas** (GHG) **emissions** due to land conversion. Additionally, global food output is expected to double by 2050. With such high stakes, we need to look beyond the labels and choose systems of food production that are the most sustainable. For me, this journey starts with the questions: What is organic food? How is it produced? And is it really more sustainable than conventional agriculture? **Organic food is grown without** synthetic inputs such as **chemical pesticides or synthetic fertilizers**. Organic farms instead use natural approaches and fertilizers, such as crop rotation and manure, to control pests, diseases and weeds. **This minimizes** the exposure of farm workers, consumers, and the environment more broadly to **harmful pesticides.** When used in conventional agriculture, pesticides and fertilizers can create a host of environmental issues. Certain pesticides can poison non-target organisms such as birds, fish, and plants, and harm organisms of special ecological importance, such as bees and algae. **Pesticides** also often **contaminate soil as well as surface and groundwater.** A United States Geological Service study found that **over 90 percent of water and fish samples from streams contained one or more pesticides.** Fertilizers that run off into streams and other waterways cause eutrophication—a process in which excess nitrogen and phosphorous buildups lead to algal blooms and excess production of carbon dioxide. The process results in acidic waterways with dead zones, or areas that are so low in oxygen that they kill marine life. Since it does not include the use of synthetic pesticides or fertilizers, organic agriculture is very sustainable in many aspects. **Organic farms tend to have more fertile soil, use less energy, and sequester more carbon.** Research has shown that **organic farms use 45 percent less energy, release 40 percent less carbon emissions, and foster 30 percent more biodiversity compared to conventional farming.** This being said, organic farm practices are not necessarily always the most sustainable option. To control pests and weeds without using pesticides, organic farmers often lay down sheets of black plastic over the soil surrounding their crops. This warms the soil and accelerates the rate of plant growth while preventing erosion. Black plastic also allows the usage of drip irrigation, which lets water drip slowly into the roots of plants, saving water. However, the glaring issue with lining huge swaths of land with single-use plastic is that it creates an immense amount of waste. Biodegradable plastic, a more sustainable alternative, isn't allowed under United States Department of Agriculture (USDA) organic rules because it contains petroleum. The overall sustainability of organic agriculture is further complicated when land-use is taken into consideration. Since it does not use synthetic fertilizers or pesticides, organic agriculture has a 25 percent lower crop yield compared to conventional farming. Many organic farms also rely on tilling — stirring up soil by running blades through it — to kill weeds in place of conventional pesticides and herbicides. The resulting loss of topsoil, the most agriculturally productive component of soil, contributes to these lowered yields. In a world that must use finite arable land to feed an ever-growing population, optimizing resources is crucial. A greater demand for agricultural land could incentivize even more deforestation and land clearing, threatening biodiversity and reducing carbon stocks. On the flip side, just because produce isn't labeled "organic," it doesn't mean it's not sustainable. Many small or community-based farms grow crops in a way that is just as, if not more, sustainable than "organic" food production. Obtaining the USDA's organic certification is very expensive and requires going through a heavily bureaucratic process. This can act as a barrier to many small farms, which may not use synthetic pesticides or fertilizers, and may even implement other sustainable practices that go far beyond requirements set by the USDA. For instance, the USDA organic requirements instruct farms to wrap food in plastic, which many smaller farms choose not to do. Small farms also tend to plant more diverse crops compared to conventional industrial agriculture. Additionally, locally sourced food creates less carbon emissions due to reduced transportation distances. Organic doesn't necessarily equate to being local, and oftentimes the latter choice is more sustainable. So, it turns out there isn't a definitive answer to my question. When the costs and benefits are weighed for both organic and conventional agriculture, experts have argued that the most sustainable diet should ideally be sourced from both organic and conventional agriculture, depending on the type of food. Fruit and vegetables, for which nutritional value is the main priority, should be grown organically. Grains and other staple crops, in which caloric density is the main priority, should be grown conventionally. Ultimately, sustainable food production is a tradeoff between optimizing yield and minimizing environmental degradation. Beyond the way food is produced, a sustainable diet is also about the types of foods we choose to eat. A diet that has the lowest environmental impact is plant-based and made up of local, seasonal foods. Cutting out foods with high GHG emissions, like meat and dairy, is imperative to cutting down your carbon footprint. Buying local isn't as impactful as changing what types of foods you are buying, as transportation of food only accounts for 6 percent of the climate footprint of food systems — though, if you can, buying produce that is in season from a local farmers market is optimal. The consumption, or lack thereof, of food is also a major driver of climate change that is often overlooked. Food that is produced but not consumed contributes to 3.3 billion tons of greenhouse gas emissions, making wasted food the third highest emitter of greenhouse gases following the US and China. Whether food was produced using conventional or organic methods is just one component in the complex webs that characterize our food system. Looking beyond labels means engaging more seriously with the environmental costs of our everyday choices, and encourages us to make more holistic and meaningful lifestyle changes.

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Organic Agriculture is Sustainable

Organic Agriculture can feed the world

John **Reganold**(Professor at Washington State University, The Guardian, 8-1-20**16**, "Can we feed 10 billion people on organic farming alone?," https://www.theguardian.com/sustainable-business/2016/aug/14/organic-farming-agriculture-world-hunger //Vikas Nanduri

Organic agriculture occupies only 1% of global agricultural land, making it a relatively untapped resource for one of the greatest challenges facing humanity: producing enough food for a population that could reach 10 billion by 2050, without the extensive deforestation and harm to the wider environment. That's the conclusion my doctoral student Jonathan Wachter and I reached **in reviewing 40 years of science and hundreds of scientific studies comparing the long term prospects of organic and conventional farming.** The study, Organic Agriculture in the 21st Century, published in Nature Plants, is the first to compare organic and conventional agriculture across the four main metrics of sustainability identified by the US National Academy of Sciences: be productive, economically profitable, environmentally sound and socially just. Like a chair, for a farm to be sustainable, it needs to be stable, with all four legs being managed so they are in balance We found that although organic farming systems produce yields that average 10-20% less than conventional agriculture, they are more profitable and environmentally friendly. Historically, conventional agriculture has focused on increasing yields at the expense of the other three sustainability metrics. In addition, organic farming delivers equally or more nutritious foods that contain less or no pesticide residues, and provide greater social benefits than their conventional counterparts. With organic agriculture, environmental costs tend to be lower and the benefits greater. Biodiversity loss, environmental degradation and severe impacts on ecosystem services – which refer to nature's support of wildlife habitat, crop pollination, soil health and other benefits – have not only accompanied conventional farming systems, but have often extended well beyond the boundaries of their fields, such as fertilizer runoff into rivers. Overall, organic farms tend to have better soil quality and reduce soil erosion compared to their conventional counterparts. Organic agriculture generally creates less soil and water pollution and lower greenhouse gas emissions, and is more energy efficient. Organic agriculture is also associated with greater biodiversity of plants, animals, insects and microbes as well as genetic diversity. **Despite lower yields, organic agriculture is more profitable (by** 22–**35%) for farmers because**

consumers are willing to pay more. These higher prices essentially compensate farmers for preserving the quality of their land. Studies that evaluate social equity and quality of life for farm communities are few. Still, organic farming has been shown to create more jobs and reduce farm workers' exposure to pesticides and other chemicals. **Organic farming can help to** both **feed** the world and preserve wildland. In a study published this year, researchers modeled 500 food production scenarios to see if we can feed **an estimated world population of 9.6 billion people in 2050 without expanding the area of farmland we already use.** They found that **enough food could be produced with lower-yielding organic farming**, if people become vegetarians or eat a more plant-based diet with lower meat consumption. The existing farmland can feed that many people if they are all vegan, a 94% success rate if they are vegetarian, 39% with a completely organic diet, and 15% with the Western-style diet based on meat. Realistically, we can't expect everyone to forgo meat. Organic isn't the only sustainable option to conventional farming either. Other viable types of farming exist, such as integrated farming where you blend organic with conventional practices or grass-fed livestock systems.

Organic Agriculture is more nutritious, helps feed more people even if less is consumed

Guardian, 8-1-20**16**, ["Can we feed 10 billion people on organic farming alone?," https://www.theguardian.com/sustainable-business/2016/aug/14/organic-farming-agriculture-world-hunger, DOA: 2-24-2022] // RTS

n 1971, then US Secretary of Agriculture Earl Butz uttered these unsympathetic words: "Before we go back to organic agriculture in this country, somebody must decide which 50 million Americans we are going to let starve or go hungry." Since then, critics have continued to argue that organic agriculture is inefficient, requiring more land than conventional agriculture to yield the same amount of food. Proponents have countered that increasing research could reduce the yield gap, and organic agriculture generates environmental, health and socioeconomic benefits that can't be found with conventional farming. Organic agriculture

occupies only 1% of global agricultural land, making it a relatively untapped resource for one of the greatest challenges facing humanity: producing enough food for a population that could reach 10 billion by 2050, without the extensive deforestation and harm to the wider environment. That's the conclusion my doctoral student Jonathan Wachter and I reached in reviewing 40 years of science and hundreds of scientific studies comparing the long term prospects of organic and conventional farming. **The study, Organic Agriculture in the 21st Century, published in Nature Plants, is the first to compare organic and conventional agriculture across the four main metrics of sustainability identified by the US National Academy of Sciences: be productive, economically profitable, environmentally sound and socially just**. Like a chair, for a farm to be sustainable, it needs to be stable, with all four legs being managed so they are in balance. We found that **although organic farming systems produce yields that average 10-20% less than conventional agriculture, they are more profitable and environmentally friendly.** Historically, conventional agriculture has focused on increasing yields at the expense of the other three sustainability metrics. **In addition, organic farming delivers equally or more nutritious foods that contain less or no pesticide residues, and provide greater social benefits than their conventional counterparts**. With organic agriculture, **environmental costs tend to be lower and the benefits greater**. Biodiversity loss, environmental degradation and severe impacts on ecosystem services – which refer to nature's support of wildlife habitat, crop pollination, soil health and other benefits – have not only accompanied conventional farming systems, but have often extended well beyond the boundaries of their fields, such as fertilizer runoff into rivers. **Overall, organic farms tend to have better soil quality and reduce soil erosion compared to their conventional counterparts**. **Organic agriculture generally creates less soil and water pollution and lower greenhouse gas emissions, and is more energy efficient**. **Organic agriculture is also associated with greater biodiversity of plants, animals, insects and microbes as well as genetic diversity. Despite lower yields, organic agriculture is more profitable (by 22–35%) for farmers because consumers are willing to pay more. These higher prices essentially compensate farmers for preserving the quality of their land.** Studies that evaluate social equity and quality of life for farm communities are few. Still, **organic farming has been shown to create more jobs**

and reduce farm workers' exposure to pesticides and other chemicals. Organic farming can help to both feed the world and preserve wildland. **In a study published this year, researchers modeled 500 food production scenarios to see if we can feed an estimated world population of 9.6 billion people in 2050 without expanding the area of farmland we already use.** They found that **enough food could be produced with lower-yielding organic farming**, if people become vegetarians or eat a more plant-based diet with lower meat consumption. The existing farmland can feed that many people if they are all vegan, a 94% success rate if they are vegetarian, 39% with a completely organic diet, and 15% with the Western-style diet based on meat. Realistically, we can't expect everyone to forgo meat. Organic isn't the only sustainable option to conventional farming either. Other viable types of farming exist, such as integrated farming where you blend organic with conventional practices or grass-fed livestock systems. More than 40 years after Earl Butz's comment, we are in a new era of agriculture.**During this period, the number of organic farms, the extent of organically farmed land, the amount of research funding devoted to organic farming and the market size for organic foods have steadily increased. are rapidly growing in the world, increasing almost fivefold between 1999 and 2013 to $72bn**. This 2013 figure is projected to double by 2018. Closer to home, organic food and beverage sales in 2015 represented almost 5% of US food and beverage sales, up from 0.8% in 1997. Scaling up organic agriculture with appropriate public policies and private investment is an important step for global food and ecosystem security. The challenge facing policymakers is to develop government policies that support conventional farmers converting to organic systems. For the private business sector, **investing in organics offers a lot of entrepreneurial opportunities and is an area of budding growth that will likely continue for years to come**. **In a time of increasing population growth, climate change and environmental degradation, we need agricultural systems that come with a more balanced portfolio of sustainability benefits. Organic farming is one of the healthiest and strongest sectors in agriculture today and will continue to grow and play a larger part in feeding the world. It produces adequate yields and better unites human health, environment and socioeconomic objectives than conventional farming.** John Reganold is a Regents Professor of Soil Science & Agroecology at the Washington State University.

Organic crop yields are profitable for farmers and are often more lucrative than regular crops.

Eager **Gardeners**, SARE, 20**03**, ["Economics of Organic Production," https://www.sare.org/publications/transitioning-to-organic-production/economics-of-organic-production/, DOA: 2-23-2022] // RTS

Organic farmers are often the first to admit that as they were transitioning to organic systems, their yields declined. **Many studies have shown that, initially, a decline in yields occurs during the conversion to organic production. However, once the transition period has passed - usually in three to five years - organic crop yields often rebound to within 90 to 95 percent of conventional yields**, according to an Organic Farming Research Foundation review of comparative studies. Perhaps even more important, once the farming system has been certified, price premiums for organic crops, added to the reduced production costs, help boost profitability. (See Table 2). For many organic farmers, equivalent yields are not necessarily the goal. "High yields are not always connected to profitability," said Wende Elliott. On her farm, she expects a 37.5 percent operating profit margin, largely due to lower input costs and a premium price for organic poultry, hay and row crops. Jeff Moyer, farm manager at The Rodale Institute in Kutztown, Pa., explains in a fact sheet published by the Institute (available at www.newfarm.org/depts/midatlantic/FactSheets/transition.shtml) how organic farming makes good economic sense. **In 2001, his organic corn and soybean yields were only 90 percent of conventional yields, yet the organic corn fetched $4.70 bushel compared to $2.10 for conventional. The soybean price disparity was even larger - conventional soybeans went for $3.80 per bushel, while organic livestock feed beans brought $10.50 per bushel and organic food grade beans $15 a bushel.** Ed Fry, who farms 400 acres of grain and has 240 milk cows in Chestertown, Md., points out in a marketing fact sheet from Rodale that while his corn yields were comparable in 2000, his total production costs were lower for organic corn - $1.79/bushel versus $2.23 for conventional. The labor per acre was higher in his organic corn, but because the organic corn fetched $4 a bushel versus $2.50 for the conventional, he didn't need to farm as many acres for the same amount of profit. In organic dairy operations, a similar principle of reduced production and higher profits applies. When Vince Foy and Debbie Yonkers of North Danville, Vt., converted their 70 Jersey cows to organic, their milk production decreased by 10 to 15 percent, but their gross income increased from $125,000 to $165,000. Moreover, they cut their debt-to-cow ratio in half. In fact, said Lisa McCrory, dairy technical assistance coordinator for the Northeast Organic Farming Association of Vermont (NOFA-VT), "organic dairy producers almost always reduce their production numbers, due to management changes such as feeding the animals less grain." And even though the price of organic grain is higher, other costs such as veterinary bills, fertilizer and labor decrease, improving net income. A statewide study conducted in Vermont by the Northeast Organic Dairy Producers Alliance showed that although milk production was lower in the organic systems, the organic producers received an average net return of $477 per cow per year compared to the conventional average of $255 per cow. "Looking beyond production and making decisions based on profitability and the bottom line makes good business sense," McCrory said. **While more research is needed on the economics of transition, the long-term economic viability of established organic systems is quite positive. A 1999 Wallace Institute review of six midwestern land-grant university studies found: Organic grain and soybean production systems are "competitive with conventional production systems." In fact, with current market premiums, producers of organic grain and soybeans earn higher profits than conventional growers. Without a price premium for organic crops, half of organic systems were still more profitable than the conventional systems. Those systems less profitable than conventional quickly surpassed the conventional systems when organic premiums were figured in. In cases where organic systems were more profitable without price premiums, it was generally due to lower production costs, higher net returns due to the types of crops in the organic systems, and better performance of the organic systems under drought conditions or in drier areas. Production costs tend to be lower in established organic systems because of reduced input costs.** One exception to this, perhaps, is labor. Organic farming systems are often more labor intensive because of increased time spent managing weeds and monitoring pests. Labor costs, however, can be measured in different ways. "If a farmer views his/her time spent on the farm in terms of its opportunity costs, e.g., what he or she could be earning off the farm, labor costs for organic farming are higher than conventional," said Jim Hanson, extension economist in the Department of Agricultural and Resource Economics at the University of Maryland. "However," he added, "for those farmers who don't view off-farm income as an alternative source of income the labor costs between the two systems are similar." In a forthcoming study to be published by Hanson, he found that family labor was about 30 to 40 percent higher in an organic mid-Atlantic grain operation than in a conventional one, but hired costs were equivalent between the two systems. Production costs also vary by region, climate and production system. For example in humid areas, pest and weed control measures can raise costs. A recent study in a corn-soybean system in Iowa found costs of conventional production were only slightly higher than organic. The organic farms had lower fertilizer and pesticide costs, but higher seed and machinery costs. However, in a SARE-funded project that compared organic and conventional apple production across California, Sean Swezy, **formerly a researcher at the University of California and now director of UC-SAREP, found production costs of organic apples 10 to 25 percent higher than conventional ones in the coastal fresh market**

systems due to labor and material costs. However, statewide, the organic systems were determined to be commercially profitable. Finally, in a **SARE-funded potato study in Idaho comparing 18 conventional and organic farms, the average material costs were lower in the organic and the labor costs higher, but overall there was no significant difference in fixed and variable costs**. **Organic livestock systems often cost less, thus can be a viable option for beginning farmers or those who have trouble raising capital**, because those systems do not require elaborate or expensive housing. Poultry, for example, can be raised on pasture using inexpensive, easy-to-build structures. As with any successful business, good management is essential. "I've discouraged some farmers from going organic if they were already struggling with their conventional farm and not ready to embrace the mind shift involved in transitioning to organic," said Brad Brummond, the extension agent from North Dakota who specializes in organic production. "Conversion is a learning process, not a fix for a failing conventional farm."

88% of organic farmers are in developing nations

Eva-Marie **Meemken** and Matin Qaim, 3-29-20**18**, "Organic Agriculture, Food Security, and the Environment," Annual Reviews, https://www.annualreviews.org/doi/10.1146/annurev-resource-100517-023252 //Vikas Nanduri

While the largest share of the global organic area is found in developed countries (Figure 2a), **88% of the organic farmers** (2.1 million out of 2.4 million) **live in developing countries** in Asia, Africa, and Latin America (Figure 2b). The countries with the largest number of organic farmers are India (0.6 million), Ethiopia (0.2 million), and Mexico (0.2 million). Organic farmers in developing countries mainly produce traditional export crops, such as coffee and tea (Willer & Lernoud 2017).

Organic Crop Yields are higher than conventional crop yields

Catherine **Badgley**, 7-4-20**07**, "Organic agriculture and the global food supply," Cambridge Core, https://www.cambridge.org/core/journals/renewable-agriculture-and-food-systems/arti cle/abs/organic-agriculture-and-the-global-food-supply/93DD2635AC706B08EE68B881D17A143B //Vikas Nanduri

Figure 1 compares the estimates from Models 1 and 2 to the current food supply. According to Model 1, the estimated organic food supply is similar in magnitude to the current food supply for most food categories (grains, sweeteners, tree nuts, oil crops and vegetable oils, fruits, meat, animal fats, milk, and eggs). This similarity occurs because the average yield ratios for these categories range from 0.93 to 1.06 (Figure 1, Tables 1B and 2). For other food categories (starchy roots, legumes, and vegetables), the average yield ratios range from 0.82 to 0.89, resulting in somewhat lower production levels. The average yield ratio for all 160 examples from developed countries is 0.92, close to Stanhill's average relative yield of 0.9123. According to Model 2, the estimated **organic food supply exceeds the current food supply in all food categories, with** most estimates **over 50% greater than the amount of food currently produced** (Figure 1). The higher estimates in Model 2 result from the high average yield ratios of organic versus current methods of production in the developing world (Tables 1C and 3). The average yield ratio for the 133 examples from the developing world is 1.80. We consider Model 2 more realistic because it uses average yield ratios specific to each region of the world. These two models likely bracket the best estimate of global organic food production. Model 1 may underestimate the potential yield ratios of organic to conventional production, since many agricultural soils in developed countries have been degraded by years of tillage, synthetic fertilizers, and pesticide residues. Conversion to organic methods on such soils typically results in an initial decrease in yields, relative to conventional methods, followed by an increase in yields as soil quality is restored7,25. Model 2 may overestimate the yield ratios for the developing world to the extent that green-revolution methods are practiced. Both models suggest that organic methods could sustain the current human population, in terms of daily caloric intake (Table 5). The current world food supply after losses19 provides 2786 kcal person-1 day-1 . The average caloric requirement for a healthy adult38 is between 2200 and 2500 kcal day-1 . Model 1 yielded 2641 kcal person-1 day-1 , which is above the recommended value, even if slightly less than the current availability of calories. Model 2 yielded 4381 kcal person-1 day-1 , which is 57% greater than current availability. **This** estimate **suggests that organic production has the potential to support a substantially larger human population than currently exists.**

Organic Agriculture has more Yield Resiliency making it more sustainable than conventional agriculture

Verena Seufert, 3-10-2017, "Many shades of gray—The context-dependent performance of organic agriculture," PubMed Central (PMC), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5362009/ //Vikas Nanduri

Organic agriculture is often proposed as a more sustainable alternative to current conventional agriculture. We assess the current understanding of the costs and benefits of organic agriculture across multiple production, environmental, producer, and consumer dimensions. Organic agriculture shows many potential benefits (including higher biodiversity and improved soil and water quality per unit area, enhanced profitability, and higher nutritional value) as well as many potential costs including lower yields and higher consumer prices. However, numerous important dimensions have high uncertainty, particularly the environmental performance when controlling for lower organic yields, but also yield stability, soil erosion, water use, and labor conditions. We identify conditions that influence the relative performance of organic systems, highlighting areas for increased research and policy support. Agriculture today is a leading driver of environmental degradation (1), but despite major increases in production, one in eight people in developing countries remain malnourished (2). Organic agriculture is often proposed as a solution to this challenge of achieving sustainable food security. Although it only covers ~1% of global agricultural land and only contributes ~1 to 8% of total food sales in most European and North American countries (3), "organic" is a label that is recognized and purchased by many consumers, and organic agriculture is the fastest-growing food sector in North America and Europe (3). Given that organic agriculture is a current and rather widespread farming system and is one of the few legally regulated labels in farming, it is important to assess its performance and identify how we can improve it. The benefits of organic agriculture are widely debated. Although some promote it as a solution to our sustainable food security challenges (4–6), others condemn it as a backward and romanticized version of agriculture that would lead to hunger and environmental devastation (7–9). Previous reviews (4, 6, 10–14) have focused on the benefits of organic management, asking the question whether organic agriculture is good or bad. Here, we address a more policy-relevant question, assessed across a suite of different criteria and contexts: Where does organic agriculture perform well, and where does it not? Unlike previous reviews, which only assessed the average performance of organic agriculture relative to conventional agriculture, we also evaluate the range around this central tendency, the contextual factors driving the upper and lower range of responses, and the uncertainty in our understanding. We assessed the benefits and costs of organic agriculture across the following dimensions: (i) production, (ii) environment, (iii) producers, and (iv) consumers. Rather than starting from what is known in the literature on organic agriculture, we developed a framework that identifies important dimensions of agricultural sustainability and specific indicators within each. Accordingly, we also include indicators that have received limited attention in the organic literature to date (for example, water use and farm wages). Often farming system assessments only examine the impact per unit area. However, given that yields vary, and that a primary purpose of agriculture is production, it is important to also assess the performance of farming systems per unit output (15). Per unit output impacts are particularly relevant to the environmental dimensions because of the strong environmental impact of land conversion (1). For each dimension and each variable examined, we assess existing knowledge based on quantitative reviews of the scientific literature, where possible, including (i) average performance per unit area and per unit output (where relevant), (ii) uncertainty around the average performance, (iii) factors influencing low and high performance, and (iv) knowledge gaps. The scope of this review is limited to an examination of impacts at the level of the farming system (including indirect impacts on consumers), with no consideration of other aspects of the food system such as processing and distribution, consumption, or recycling. Our assessment is also restricted to cropping systems, excluding livestock systems (except where integrated into mixed systems). Thus, animal welfare, in particular, is not addressed. Organic agriculture is defined here as a farming system that follows organic certification guidelines (for example, avoidance of synthetic fertilizers and pesticides) and that is intentionally organic (that is, excluding organic-by-default systems that do not apply synthetic inputs due to lack of access). Conventional agriculture is defined as mainstream agriculture as dominantly practiced today. This can represent both high-input and low-input systems, depending on the region. Crop (and animal) production is the primary reason that humans manage agroecosystems. Many studies point to the need to greatly increase food production to meet the needs of a growing human population and the shift to more meat-intensive diets (16). Although the need for increased food supply is still debated because of the inefficiencies and inequities in the current system (17), yields do matter not only for farmers whose incomes critically depend on the yield but also for many environmental outcomes. Even if food production does not need to increase, higher yields could still be environmentally beneficial because we could take land out of production and restore natural ecosystems, which typically are better at delivering ecosystem services than production systems. Numerous meta-analyses have concluded that yields under organic management are, on average, 19 to 25% lower than under conventional management (Fig. 1 and fig. S1) (18-20), and a recent analysis of commercial organic crop yields in the United States reveals a similar average yield gap of 20% (21). However, the magnitude of this yield gap varies by crop type and depends on management practices [for example, crop rotations, amount of fertilizer inputs (Table 1) (18-20)]. The yield gap can be as low as 5 to 9% under some conditions, but as high as 30 to 40% under other conditions (18, 19). Many cereals show, for example, a higher yield gap (18, 21), while forage crops, such as hay, tend to have smaller yield gaps (20) or even higher yields under organic management (21). However, studies disagree on some of the factors that influence the yield gap (table S2), possibly because of the small sample sizes when individual factors are considered. An important caveat is that existing analyses are mostly limited to data from high-income countries (Fig. 2), which prevents a verdict on the relative yield performance of organic agriculture compared to different types of high-input and low-input conventional systems in low-income countries. Studies have typically examined the annual output (in terms of dry matter) of single crop species per unit area of cultivated land (18–20). However, given the diversity of temporal dynamics (for example, fallow periods and multicropping) and the diversity of land uses (including nonedible crops and livestock), **a more useful comparison would be of the total energy**, caloric, or protein **yield across an entire crop rotation available for human consumption** [that is, whole system output per unit area-time (9, 20)]. **Most assessments** of the productivity of agricultural systems **focus on efficiency of production** (that is, how much can be produced per unit area of land in a single year?) **but ignore the resilience of production** (that is, can the same production be achieved over longer time frames?). **Yield stability**, one measure of the resilience of food production, **matters not only for farmer livelihoods but also for food production under a changing climate. Organic agriculture is** often said to be **more resilient and have higher yield stability** (11, 22). A possible mechanism may be **the use of organic amendments leading to higher soil organic matter, resulting in higher yields under drought conditions** (23). In addition, more diverse crop rotations can increase yield stability (24). However, organic systems are sometimes more prone to pest outbreaks (25), can experience high weed pressure (26), or be characterized by highly variable N availability (25), which all can lead to higher yield variability. The relatively few comparisons of yield stability in organic versus conventional systems conducted to date have therefore shown both higher (23, 24) and lower yield stability under organic management (Table 1) (25-27).

There's no need for increased supply-- there needs to be better distribution to meet increasing food demand and agricultural production can't continue to kill the environment

Pete **Smith** (20**13**). Delivering food security without increasing pressure on land. Global Food Security, 2(1), 18–23. doi:10.1016/j.gfs.2012.11.008, https://www.sciencedirect.com/science/article/abs/pii/S2211912412000363 //Vikas Nanduri

The challenge of feeding 9 to 10 Billion people by 2050 is enormous (Godfray et al., 2010). **A number of options have been proposed to help address the food security challenge, including closing the yield gap** (making the difference between the attainable yield and that actually realised smaller), increasing the production potential of crops (largely through use of new technologies and investment in research), **reduced waste, changing diets** and expanded aquaculture, **which all need to be coordinated in a multifaceted and linked global strategy to ensure sustainable and equitable food security** (Godfray et al., 2010). **At the same time as delivering food security, we also need to significantly decrease the climate impact of food production** (Smith et al., 2008), improve the resilience of food production to future environmental change (Nelson et al., 2009), protect biodiversity (FAO, 2010a), protect our freshwater resource (Frenken and Kiersch, 2011), move to healthier diets (WHO, 2004), and reduce the adverse impacts of food production on the whole range of ecosystem services (Firbank et al., 2011). Historical expansion of agriculture into forests and natural ecosystems (Bruinsma, 2003) has contributed significantly to the loss of ecosystem services listed above. This has led to the suggestion that future increases in food supply need to be met without increasing the agricultural area, i.e. to derive more agricultural product from the same area (Godfray et al., 2010; Smith et al., 2010). Since this must be done sustainably, this process has been termed "sustainable intensification" (Garnett and Godfray, 2012; Tilman et al., 2011). Sustainable intensification can be regarded as an enhancement of current "business as usual", in which agricultural systems remain largely unchanged, and demand follows current projections, but in which agricultural production becomes more efficient. The need for sustainable intensification could be reduced if either demand patterns were radically changed relative to projected demand, or if global agricultural systems were changed fundamentally. In the sections below I examine the challenge posed by sustainable intensification, such that food security could be delivered without increasing the pressure on land, and then briefly examine if **more systemic changes in global food** production and consumption patterns **could provide an alternative**, or complementary response, to sustainable intensification. I must first, however, offer a definition of sustainable intensification.

Waste reduction is often cited as a way of reducing food security concerns (Godfray et al., 2010; Foley et al., 2011; Foresight, 2011). About 30–**40% of food in both developed and developing countries is currently wasted**; in developing countries this is dominated by pre-consumer losses whilst in developed countries food waste is dominated by post-consumer losses. **Globally, about 1.3 billion tonnes of food is wasted each year** (Gustavsson et al., 2011). **Reducing waste**, especially from the most resource intensive food products (meat and dairy), **could** play a role in **deliver**ing **food security** (Foley et al., 2011) and reduce the need for sustainable intensification, since more of the food produced would be consumed. Whilst waste reduction alone will not allow us to meet our 2050 food security goals, its contribution is of the same magnitude as the redistribution of nutrients and water to close the yield gap examined by Foley et al. (2011). In terms of food security, Gustavsson et al. (2011) note that because many smallholder farmers in developing countries exist on the edge of food insecurity, a reduction in food losses in developing countries could have an immediate and significant impact on their livelihoods.

Organic Agriculture Helps Small Farmers

Small Farms are going extinct now but organic farming gives a hope, because low prices are the reason for small farms losing money

Alana **Semuels**, 11-20-20**19**, "'They're Trying to Wipe Us Off the Map.' Why Independent Farming in America Is Close to Extinction," Time, https://time.com/5736789/small-american-farmers-debt-crisis-extinction/ //Vikas Nanduri

For nearly two centuries, the Rieckmann family has raised cows for milk in this muddy patch of land in the middle of Wisconsin. Mary and John Rieckmann, who now run the farm and its 45 cows, have seen all manners of ups and downs —

droughts, floods, oversupplies of milk that sent prices tumbling. But they've never seen a crisis quite like this one. The Rieckmanns are about $300,000 in debt, and bill collectors are hounding them about the feed bill and a repayment for a used tractor they bought to keep the farm going. But it's harder than ever to make any money, much less pay the debt, Mary Rieckmann says, in the yellow-wallpapered kitchen of the sagging farmhouse where she lives with her husband, John, and two of their seven children. The Rieckmanns receive about $16 for every 100 pounds of milk they sell, a 40 percent decrease from six years back. There are weeks where the entire milk check goes towards the $2,100 monthly mortgage payment. Two bill collectors have taken out liens against the farm. "What do you do when you're up against the wall and you just don't know which way to turn?" Rieckmann says, as her ancient fridge begins to hum. Mary, 79, and John, 80, had hoped to leave the farm to their two sons, age 55 and 50, who still live with them and run the farm. Now they're less focused on their legacy than about making it through the week. In the American imagination, at least, the family farm still exists as it does on holiday greeting cards: as a picturesque, modestly prosperous expanse that wholesomely fills the space between the urban centers where most of us live. But it has been declining for generations, and the closing days of 2019 find small farms pummeled from every side: a trade war, severe weather associated with climate change, tanking commodity prices related to globalization, political polarization, and corporate farming defined not by a silo and a red barn but technology and the efficiencies of scale.

It is the worst crisis in decades. Chapter 12 **farm bankruptcies were up** 12 percent in the Midwest from July of 2018 to June of 2019; they're **up 50 percent** in the Northwest. **Tens of thousands have simply stopped farming,** knowing that reorganization through bankruptcy won't save them. **The nation lost more than 100,000 farms between 2011 and 2018**; 12,000 of those between 2017 and 2018 alone. Farm debt, at $416 billion, is at an all-time high. More than half of all farmers have lost money every year since since 2013, and lost more than $1,644 this year. Farm loan delinquencies are rising. **Suicides in farm communities are happening with alarming frequency.** Farmers aren't the only workers in the American economy being displaced by technology, but **when they lose their jobs, they also ejected from their homes and the land that's been in their family for generations.**

"It hits you so hard when you feel like you're the one who is losing the legacy that your great-grandparents started," said Randy Roecker, a Wisconsin dairy farmer who has struggled with depression and whose neighbor Leon Statz committed suicide last year after financial struggles forced him to sell his 50 dairy cows. Roecker estimates he's losing $30,000 a month. Even large companies are facing unprecedented challenges; Dean Foods, a global dairy producer that buys milk from thousands of small farmers, filed for bankruptcy Tuesday, November 12, and is seeking a sale, a move that could further hamper farmers looking for places to sell their milk. Farmers have always talked of looming disaster, but the duration and severity of the current crisis suggests an alarming and once unthinkable possibility — that **independent farming is no longer a viable livelihood.** Small farms, defined as those bringing in less than $350,000 a year before expenses, accounted for just a quarter of food production in 2017, down from nearly half in 1991. In the dairy industry, small farms accounted for just 10 percent of production. The disappearance of the small farm would further hasten the decline of rural America, which has been struggling to maintain an economic base for decades. "**Farm and ranch families are facing a great extinction**," says Al Davis, a Nebraska cattle producer and former state senator. "If we lose that rural lifestyle, we have really lost a big part of what made this country great." **A perfect storm of factors has led to the recent crisis in the farm industry.** After boom years in the beginning of the 21st century, **prices for commodities like corn, soybeans, milk, and meat started falling in 2013.** The reason for these lowered prices are the twin forces upending much of the American economy: technology and globalization. Technology has made farms more efficient than ever before. But economies of scale meant that most of the benefits accrued to corporate farmers, who built up huge holdings as smaller farmers sold out. Even as four million farms disappeared in the United States between 1948 and 2015, total farm output more than doubled. Globalization brought more farmers into the international market for crops, flooding the market with soybeans and corn and cattle and milk, and with increased supply comes lower prices. Global food production has increased 30 percent over the last decade, according to John Newton, the chief economist of the American Farm Bureau. If that's a good thing for feeding the planet, it also reduces what comes back to producers, whose costs don't fall with prices.President Trump's trade war hasn't helped matters. After the United States slapped tariffs on Chinese goods including steel and aluminum last year, China retaliated with 25 percent tariffs on agricultural imports from the U.S.. China then turned to other countries such as Brazil to replace American soybeans and corn. "This was a market that took years to develop," says Barb Kalbach, a fourth- generation corn and soybean farmer in Iowa, referring to China. "The president has worked very hard to make our markets unstable." Her soybeans are harvested and sitting in a grain elevator as she waits to see if China will buy despite the tariffs. Agricultural exports between January and August this year were down 5 percent, or $5.6 billion dollars, from the same period last year. The Trump administration has made $16 billion in aid available to farmers affected by the trade war, though small farmers complain the bulk of the money has gone to huge producers with large crop losses. Around 40 percent of the $88 billion in farm income expected this year is going to come in the form of federal aid and insurance, according to the American Farm Bureau Federation. Farm income absent that assistance, at $55 billion, is down 14 percent since last year and is half of what it was in 2013. Smaller farms have found it especially hard to adapt to these changes, which they blame on government policy and a lack of antitrust enforcement. The government is on the side of big farms, they say, and is ambivalent about whether small farms can succeed. "Get big or get out," Earl Butz, Nixon's secretary of agriculture, infamously told farmers in the 1970s. It's a sentiment that Sonny Perdue, the agriculture secretary under President Trump, echoed recently. "In America, the big get bigger and the small go out," Perdue said, at the World Dairy Expo in Wisconsin in October. The number of farms with more than 2,000 acres nearly doubled between 1987 and 2012, according to USDA data. The number of farms with 200 to 999 acres fell over that time period by 44 percent. **Many small American farmers are routinely selling their crops for less than it costs to produce them.** "It's very intimidating, you work hard every day, and every day, it seems like you're just always struggling," says Rieckmann. Prices are so low that farmers like the Rieckmanns are trying to figure out other ways to come up with the money to keep their farm going. But like many other rural areas around the country, their town of Fremont does not have a bustling economy. Both a Kmart and another department store, Shopko, closed in Waupaca county this year, costing dozens of workers their jobs. Mary Rieckmann who will turn 80 in January, got a job delivering newspapers; the family also launched a GoFundMe account. But after Mary crashed her car on a foggy night, her husband and sons convinced her to abandon her paper route. In the past, the family has sold calves to raise extra money, but John recently brought two calves to the stock market and got $20 for one and $30 for another—two years ago, those calves would have brought in $300 to $400 each. "If somebody would have told me 20 years ago what it was going to be like now, I think I would have called him a liar," Rieckmann says. Heavy rain and unseasonable snow this year have also hurt many Midwestern farmers. This year "has been one of the most significant weather event years," said John Newton, chief economist of the American Farm Bureau Federation. Portions of Iowa, Nebraska, and Minnesota experienced record flooding this year, with the upper Mississippi River receiving 200 percent more rain and snow than normal. Unusual rain and snow prevented farmers from planting on 19 million acres this year, the most since the USDA began measuring in 2007. Last year, by contrast, weather prevented planting on just 2 million acres. Mike Rosmann, a clinical psychologist and farmer from Iowa who works with farmers in distress, says that this spring, he got seven calls per week from farmers who were having mental health problems because of their farm's finances. One farmer called Rosmann to say he was considering suicide — floods destroyed the corn he had already harvested and stored in a grain elevator, but neither crop insurance nor flood insurance would cover it, since he had already harvested the crop. "When that farm is lost, it's a huge amount of loss of self," says Scott Marlow, senior policy specialist at the Rural Advancement Foundation, which runs a hotline for farmers in danger of losing their farms. John Hanson, who runs an assistance hotline in Nebraska, says that this year he has gotten calls at midnight from desperate farmers, including one sitting in his kitchen with a loaded shotgun and the lights out. "It's very, very bleak for us, and many farmers I know are in the same boat," said Brenda Cochran, a small dairy farmer in Pennsylvania who says she knows of nine suicides related to low milk prices over the last two years. "It would take a miracle to sustain us for five years." Farm Aid operates a 1-800 hotline for farmers facing crisis, and calls to that hotline were up 109 percent last year from the year before, says Alicia Harvie, director of Farm Aid's Advocacy and Farmer Services. The newest farm bill sets aside $50 million over five years for behavioral health supports for distressed farmers. Rural America has been shrinking for decades, and the Great Recession accelerated that contraction as rural manufacturing jobs disappeared and people moved to cities and suburbs seeking work. That is indeed where the jobs are. Between 2008 and 2017, metropolitan areas that included central cities of at least 50,000 people accounted for 99 percent of all job and population growth, according to data crunched by David Swenson, an economist at Iowa State University. In the Midwest, 81 percent of rural counties saw population declines between 2008 and 2017, and in the Northeast, 85 percent of rural counties shrank over that time period. Kalbach, the Iowa corn and soybean farmer, says on the square mile of land where she lives, five farm different families used to grow corn, beans, hay, cattle, and pigs. Over the past 15 years, the other four families have given up and moved away. As farmers sold to bigger operations, the local businesses that were dependent on small farmers went belly-up, too. The place where the Kalbachs buy chemicals is now 75 miles away. Her county's lone pharmacy closed earlier this year. There is no longer a local place where she can get farm equipment repaired. "All the thousands of farmers that have left the land—all the businesses have gone with them," she says. So have the institutions that make a community. Around 4,400 schools in rural districts closed between 2011 and 2015, the most recent year for which there is data available, according to the National Center for Education Statistics; suburban districts, by contrast, added roughly 4,000 schools over that same time period. In Wisconsin's dairy country alone, the Antigo School District, in north central Wisconsin, closed three elementary schools this year, and 44 schools have closed since 2018. "I used to have a lot of neighbors, now I have almost no neighbors," says George Naylor, an Iowa corn and soybean farmer who is trying to transition to organic farming to stay afloat. Cochran is worried about the future of her rural Pennsylvania community as more farmers give up. Two neighbor farm auctions are scheduled soon. The dairy refrigeration supply business where she buys equipment is on the verge of collapse. Young people, seeing economic despair all around them, get out as quickly as they can. "I see this as a wholesale removal — or extermination — of our rural class," she says. There's nothing on the horizon to turn around these rural areas. Americans are increasingly concentrating in a few metropolitan areas — by 2040, 70 percent of Americans will live in 15 states. The regions surrounding America's family farms may become the country's next ghost towns. "We have to think about what we really want rural America to look like," says Jim Goodman, president of the National Family Farm Coalition. "Do we want it to be abandoned small towns and farmers who can't make a living, and a lot of really big farms that are polluting the groundwater?" (Large farms, which have more animal waste to deal with because of their size, have been found to pollute groundwater and air.) **Most family farmers** seem to agree on what led to their plight: government policy. In the years after the New Deal, they say, the United States set a price floor for farmers, essentially ensuring they received a minimum wage for the crops they produced. But the government began rolling back this policy in the 1970s, and now the global market largely determines the price they get for their crops. Big farms can make do with lower prices for crops by increasing their scale; a few cents per gallon of cow's milk adds up if you have thousands of cows. Smaller farmers warn that a country without local farmers can create problems in the food supply chain. If one company is providing all the milk or cheese to an entire region, what happens when that plant gets contaminated or a storm isolates it from the rest of the country? "It's an incredibly fragile supply chain, and when it fails, it fails completely," says Marlow, of the Rural Advancement Foundation. Family farmers say concentrating farmland among a few big companies is akin to feudalism, and un-American. It also diverts whatever profits might come from farming to faraway investors, aggravating the economic and geographic divisions that feed the nation's political divide. "There's a strong reason to be deeply concerned when instead of having 10 mid-sized dairy farms producing income whose owners spend it in town, you replace that with a large farm owned by a set of investors whose profits go running off to New York and Chicago," said Peter Carstensen, a professor of law emeritus at the University of Wisconsin law school. Farmers say the best solution is government policy that cracks down on consolidation of the grocery stores and food processing facilities that buy food from farmers. Existing antitrust law would allow the government to prevent big mergers that mean farmers have fewer places to sell their crops and that supplies are more expensive, but those laws go largely unenforced, says Carstensen. Earlier this year, a Wisconsin congressman introduced legislation to put a moratorium on large food and grocery mergers. Farmers are advocating for better antitrust enforcement across the country; in October, cattle ranchers held a 'Rally to Stop the Stealin'!' to urge Congress to protect family farmers from monopoly power, and in Vermont, dairy farmers have filed a lawsuit alleging that a conglomerate of milk buyers conspired to set low prices on milk. **One category of small farmers is thriving in the current marketplace: organic farms who can charge a premium for their crops and who**

can sell them locally. There were more than 14,000 certified organic farmers in 2016, up 58 percent from 2011. But switching to organic is expensive, and for farmers like the Rieckmanns who are already deeply in debt, not an option. They haven't gotten a cent of aid from the government, Rieckmann says, since the assistance goes to the farms with the most farmland and animals. They're not holding their breath that anything will change. "I sometimes feel," says Mary Rieckmann, "like they're trying to wipe us off the map."

Meta Analysis Proves Small Farmers See Increased Revenue using Organic Agriculture

Octavio **Damiani**. (20**03**). The Adoption of Organic Agriculture Among Small Farmers in Latin America and the Caribbean. 10.13140/RG.2.1.2027.9287. https://www.researchgate.net/publication/305682235_The_Adoption_of_Organic_Agriculture_Among_Small_Farmers_in_Latin_America_and_the_Caribbean //Vikas Nanduri

The study compared the impact of shifting agriculture and organic production on small-farmer production and incomes. The results suggest that organic agriculture may be an attractive alternative for diversifying the production of small farmers. While the case studies showed evolution of different production costs, yields and product prices **among small farmers that converted to organic agriculture, all obtained higher net revenues than with their previous practices.** 9. In all case studies, **farmers were able to receive higher prices for certified organic products than if they had sold the same products in conventional markets.** The premium received by farmers over the price of conventional products varied greatly, going from a minimum of 22.2% paid to banana producers in the Dominican Republic in 2002 to 150% paid to cacao producers in Costa Rica in 2001.

Those farmers whose previous systems had approximated the organic one experienced a rapid increase in yields when shifting to organic methods. In contrast, those who had previously applied chemical inputs obtained lower yields during the first years of adoption. Some cases experienced no significant changes in yields (honey in Mexico, banana in the Dominican Republic). All who adopted organic production obtained higher prices for their products than nearby conventional producers. While higher prices are partly explained by the organic nature of the products, the type of relationship that farmers established with buyers also played a key role in price margins, with higher prices being obtained when farmer organizations engaged in long-term relationships with buyers. Specialists participating in the Rome workshop stressed that organic agriculture may lead to more stable prices for small farmers – an effect also identified in one of the case studies (vegetables in El Salvador). 12. The sustainability of these effects depends on many factors, including the capacity to maintain similar or higher yields and the future evolution of prices. Yield capacity depends partly on the application of organic fertilizers in qualities and quantities that compensate for nutrients extracted by crops. The workshop discussions stressed that while organic-product markets are presently growing rapidly, premium prices may decline in the future. 13. Interestingly, small farmers dominated organic production in all the countries in which case studies were carried out – and in most of the other LAC countries – and smallholders accounted for most of the area under organic farming, with the exception of Argentina. Such a dominant presence suggests that small farmers may have some comparative advantages in organic production. First, most **small farmers** in LAC already produce more or less organically, using few or no chemical inputs, and frequently grow crops in the forests and with other species. Thus they **find it relatively easy to convert to organic production**, introducing only marginal improvements in the technologies they already apply. In addition, they are likely to experience a lower incidence of pests and diseases when they switch to certified production. In contrast, larger, more-capitalized farmers, who produce with technologies based on chemical inputs, often face greater difficulties when shifting to organic production. They need to learn quite different technologies, and their crops are initially more vulnerable to pests and disease. Another important factor is that the technologies of organic production are labour intensive and require little investment, thus using the production factor most available to small farmers. Finally, **organic agriculture makes small farmers less dependent on chemical inputs that have to be purchased, which are priced higher for small farmers** because of increased transportation costs in rural areas and higher unit costs for small volumes.

Organic Agriculture costs less for small farmers and thus increases their incomes

FAO 15 (Food and Agriculture Organization of the United Nations, 2015, https://www.fao.org/fileadmin/templates/nr/sustainability_pathways/docs/Compilation_techniques_organic_agriculture_rev.pdf //Vikas Nanduri)

Organic farming appears to generate 30% more employment in rural areas and labor achieves higher returns per unit of labor input. **By using local resources better, organic agriculture facilitates smallholders'** access to markets and thus **income generation; and relocalizes food production in market-marginalized areas.** Generally, organic yields are 20% less as compared to high-input systems in developed countries but could be up to 180% higher as compared to low-input systems in arid/semi-arid areas. In humid areas, rice paddy yields are equal, while the productivity of the main crop is reduced for perennials, though agroforestry provides additional goods. **Operating costs (seeds, rent, repairs and labor) in organic agriculture are significantly lower than conventional production, ranging from 50-60% for cereals and legumes, to 20-25% for dairy cows and 10-20% for horticulture products.** This is due to **lower** input costs on synthetic inputs, lower irrigation costs, and labor cash costs that include both family labor and hired workers.

Lower input costs allow economic independence from debt for small farmers

Ph.D Anna Marie **Nicolaysen**, 20**12**, "Empowering Small Farmers in India through Organic Agriculture and Biodiversity Conservation," University of Connecticut, https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.458.6593&rep=rep1&type=pdf //Vikas Nanduri

"Empowering Small Farmers in India through Organic Agriculture and Biodiversity Conservation" investigates how, through **conversion to organic agriculture**, with its postulated socioeconomic, environmental and health benefits, and through biodiversity conservation, by, for example, creating community seed banks, local farming organizations **enable and empower small farmers to become independent and selfsufficient.** Local farming organizations are defined as movements to improve the economic, health, and social status of independent farmers in the face of global agribusiness through the adoption of sustainable agriculture. I explore the philosophy of these organizations; the agricultural and political ideas they transmit; the challenges they face in involving small farmers; and how farmers who become involved assess this experience. Fieldwork for this study was carried out during 2007 and 2008 in the Indian states of

Punjab, Uttarakhand, Tamil Nadu, and West Bengal. Living in villages in these states– approximately three months per state–I completed 89 in-depth and 16 focus group interviews with female and male farmers, and with the farming organizations' staff, for a total of 250 participants. Interviews and field observations, primarily those carried out in Punjab and Uttarakhand, constitute the data for this dissertation. ii I found that farmers who get involved with these organizations do perceive that their food security is improved through conservation and the revival of traditional crops. Additionally their economic situation is strengthened with less expenditure on inputs such as seed, chemical pesticides, or mineral fertilizers. Finally, it is argued, training provided by these organizations prepares farmers, many of whom become more selfreliant and confident individuals, to stand up for their democratic rights in the midst of the formidable power of globalized corporate agriculture. This study contributes to a growing understanding among small farmers, researchers and international human rights and farming-focused organizations (e.g., the United Nations Human Rights Council and the Food and Agriculture Organization), of how **reinvestment in sustainable agriculture is vital to** the realization of the right to food, and to **rural economic development**, issues that were accentuated by the 2008 global food price crisis and current return to a pattern of rising food prices that are reaching 2008 levels.

In his home district, Pauri Garhwal, Negi works with farmers in more than 100 villages together with three local Navdanya coordinators, and over 50 of these villages are now completely converted to organic methods. "I started to talk to people in 1993, and the following year we started to sow organic. More converted in the last part of the 90s, so they have been growing organic for more than ten years. Most of the farmers 150 were using only a little amount of chemicals earlier, and those who converted completely have not gone back to using chemicals," Negi held, and gave an example of an incident that made many farmers convert. A few years ago the farmers lost almost the whole crop of onions and had to import from Pakistan. Onions, a basic ingredient in Indian cooking, which normally sell at a rate of Rs. 4 per kilogram increased to Rs. 40, end even, for a while, Rs. 60 per kilogram. The conventional farmers had sold the few onions they had for the regular rate, because they could not keep the produce for long before it went bad. The organic farmers had onions for three months, and could benefit from the price increase. The farmers became interested in how the organic onions lasted so much longer, and several stopped using fertilizers, Negi said. "**If you don't use chemicals, the vegetables can be stored much longer, they keep better.** Onions can be stored for six months. With fertilizers they stay fresh for only one and a half months." Several comparative tests in various countries have reported that the quality of organic produce after storage is better than that of conventional produce (Benge, et al. 2000; Raupp 1997; Reganold, et al. 2001). Negi believed farmers in the hills are going to convert to organic, because they are more aware of the harmful effects of chemicals and fertilizers. He told me that the village leaders of Kotdwara have gone to visit the Uttarakhand Agriculture Department to talk with the government along with Navdanya and expressed that they do not want urea or other chemicals in their area, and they asked the government to stop distributing these. They also invited the Minister of Agriculture of Uttarakhand to the village to meet the farmers. The farmers came and talked to him, and explained that they are converting to organic. They expressed that they did not want chemicals and fertilizers or hybrid seed to their area, but that if the Agriculture Department wanted to 151 give them seed, they should give them native seed. The farmers organized a big campaign along with Navdanya and told the government to do other projects, like planting trees, but not distributing chemicals. Negi admitted he sees the state government's proclamation of Uttarakhand as an organic state more as a thing on paper than on the ground. He said the farmers in the plains, for example in Udham Singh Nagar, practice wheat-rice rotation cropping and they are still using chemicals like they had been doing before Uttarakhand became a state. Negi said this is partially because in the districts spanning the plains like Dehradun, Haridwar, Nainital and Udham Singh Nagar, the landholdings are larger, and the land was initially fertile, like in Punjab. The size of the farms here reaches 40 acres or more, and these farmers are using only hybrid seed and chemical fertilizers. "We cannot call Uttarakhand an organic state as long as we have these large exceptions," he said. "If the state government has declared it an organic state they should ban the sale of hybrid seed and chemicals, and provide the farmers with organic products. But some of the government extension workers who are monitoring organic farming have no idea about organic at all," he said. He further argued that the farmers who chose not to adopt hybrid seed and chemical fertilizers do it because organizations like Navdanya are working with them, not because the government is helping them.

Negi and Dr. Bhatt have studied farmers who converted to organic methods. They looked at the changes in the farmers' life, and each year's expenditures and savings. "Every year they saved a lot, and made more money," reported Negi, "especially on crops like ginger, onions, and other vegetables." Most of the farmers they studied have between half an acre and ten acres. "There are so many that are doing great, the small farmers also, when they are getting good prices," explained Negi, adding that "they don't know about import and export, because they stay within their state and district, but they are aware about what's going on here."

Surbeer in Sour village argued Navdanya had saved them from taking loans and getting into debt. "They told us about a better way of living and to do farming, and we are even saving our money by growing organic." He explained that even if they could get loans from the state to do agriculture, he would not like to do that. "So far I have not taken a loan, how would we pay it back?" he asked. "They gave us subsidies, we got fertilizer for half price, and initially they even used to give us fertilizer" he said. **Some** in the village u**sed to get loans from the government to buy fertilizer**, maybe ten years ago, **before they converted to organic, but after** they started working with Navdanya **they** do not want or need loans for fertilizers. "We had to pay a heavy interest on that money," Surbeer said, "We had to take up loans, because it was so expensive. Now we **are completely independent**

economically, we do not need any loan and we are self-dependent." First they reduced the use of fertilizers, and then they stopped completely, he said. From 2002 the whole village of Sour has been organic. "Organic farming has saved some of our farming, but the production has been reduced," he noted. He mentioned there are other villages further up on the hills where they cannot take cow dung and they are still using chemical fertilizer. "People depend on farming and they do not manage to get a good price for organic. If they could get good price for organic produce, then they would stop conventional farming completely," Surbeer said. "Their main source of income is farming. They had to give up farming other crops, but they make their living out of potatoes. They use fertilizer in potato only, because with fertilizer they get more crops," he admitted. Kala in Jakul village nearby said they had also used fertilizers previously for potato, but not for grains and beans. "Now we are 154 using compost and cow dung as fertilizer for the potatoes as well, and the potatoes are tasty and they have no disease. I had noticed a change in the soil in the last four to five years when I used chemical fertilizers; it turned hard like cement," she said.

Small Farms are key to American Agriculture

Farm Bureau, no date, "Fast Facts About Agriculture & Food," No Publication, https://www.fb.org/newsroom/fast-facts

2 million farms dot America's rural landscape. About 98% of U.S. farms are operated by families – individuals, family partnerships or family corporations (America's Diverse Family Farms, 2020 Edition). One U.S. farm feeds 166 people annually in the U.S. and abroad. The global population is expected to increase by 2.2 billion by 2050, which means the world's farmers will have to grow about 70% more food than what is now produced. About 11% of U.S. farmers are serving or have served in the military. Cattle and calves, corn, and soybeans are the top three U.S. farm products. **86% of U.S. ag products are produced on family farms or ranches.** Farming accounts for about 1% of the U.S. gross domestic product.

Helping Small Farmers Solves Starvation + Organic Agriculture is sustainable

Naturland, 8-16-20**21**, "Organic agriculture as a solution to world hunger," No Publication, https://www.naturland.de/en/1544-organic-agriculture-as-a-solution-to-world-hunger.html //Vikas Nanduri

In order to alleviate the world-wide food crisis, it is imperative that smallholders in affected regions be given all the support they need. According to the latest report issued by the Food and Agriculture Organization of the United Nations (FAO), **795 million people are currently suffering from hunger. The majority of those**

starving or malnourished **live in rural areas**, of all places, **where food is** actually **being produced.** On the occasion of World Food Day on 16th October, Naturland therefore calls for a global change of agricultural policy. In the words of Hans Hohenester, chairman of the board of directors of Naturland, the German organic association which for a good thirty years now has also been providing ground support to smallholders throughout the world, assisting them with conversion to organic agriculture, "We must take up arms to combat hunger on a local level, right there along with the farmers. They must be helped to adopt **organic farming** so that they **can increase** their **agriculture yield in a sustainable manner and** to **guarantee** them **local food sovereignty**." **Helping smallholders** with the intensification of organic agriculture Smallholders throughout the world must have reliable rights to the use of land, be free to trade in, exchange and sell their seeds and have access to advisory services. Traditional farming methods can in many cases be improved by applying the latest findings of scientific research, and local strains can be bred to produce agricultural crops which, for example, are adapted to climate change. Fair trading relationships ensure that the farmers receive a reliable income and often go towards the establishment of important local infrastructure. At the same time, rural areas must be made more attractive by introducing measures to enhance the added value of the region. At a summit meeting of the United Nations in late September this year, the UN member states committed to new SDGs (sustainable development goals). The second of the 17 development goals is "End hunger, achieve food security and improved nutrition and promote sustainable agriculture". **Only organic is genuinely sustainable** As Hans Hohenester put it, "The path is clear and now it is time to take determined strides forward", whilst stating in no uncertain terms that only organic agriculture can be considered genuinely sustainable. **Farming practices based on the application of agrochemicals only focus on increases in yields and are therefore massively dependent on external input such as pesticides, fertilisers and genetic engineering.** This is all extremely energy-intensive and depletes the soil for generations to come. Besides this, the export of foodstuffs to the global south disrupts local markets and only serves to exacerbate the hunger crisis there. According to the chairman of the Naturland board of directors, Hans Hohenester, "This system is a road leading nowhere. It is imperative that we therefore put a stop to current practices". In contrast, organic agriculture makes smallholders independent of expensive fertilisers and pesticides and preserves the soil's fertility for future generations. Giving support to smallholders converting to an organic management system is one way of making a considerable contribution towards guaranteeing global food security.

Pesticides are toxigenic and promote negative health outcomes

Pesticides kill millions independent of climate change

Md. Wasim **Aktar**, March 20**09**, "Impact of pesticides use in agriculture: their benefits and hazards," PubMed Central (PMC), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2984095/ //Vikas Nanduri

If the credits of pesticides include enhanced economic potential in terms of increased production of food and fibre, and amelioration of vector-borne diseases, then their debits have resulted in serious health implications to man and his environment. There is now overwhelming evidence that some of these chemicals do pose a potential risk to humans and other life forms and unwanted side effects to the environment (Forget, 1993; Igbedioh, 1991; Jeyaratnam, 1981). No segment of the population is completely protected against exposure to pesticides and the potentially serious health effects, though a disproportionate burden, is shouldered by the people of developing countries and by high risk groups in each country (WHO, 1990). **The world-wide deaths and chronic diseases due to pesticide poisoning number about 1 million per year** (Environews Forum, 1999).

Pesticides affect rural communities

University of Washington, 12-4-20**17**, "Bringing toxic chemicals home from work," https://sph.washington.edu/news-events/news/bringing-toxic-chemicals-home-work //Vikas Nanduri

Children in farm worker families are exposed to higher amounts of harmful pesticides from dust in the home than other children, according to a new study by researchers from the University of Washington School of Public Health. This is most notable in the thinning season, when farm workers are in direct contact with pesticide-treated fruit, and they transport residue into their homes on their skin or clothing. The study, published online Oct. 19 in the journal *Biomarkers*, examined the association between pesticides in house dust and their biological metabolites in urine, in both farm worker and non-farm worker families living in the Yakima Valley in Washington state. Led by Elaine Faustman, professor of environmental and occupational health sciences and director of the Institute for Risk Analysis and Risk Communication at the UW, researchers found that **farm worker households had up to 9 times more pesticide residue** in house dust and 16 times more residue in dust in their vehicles than non-farm worker vehicles. What's more, children in these homes showed a two-fold higher concentration of certain metabolites in their urine in thinning season, indicating higher exposure to these compounds compared to other children in the same communities. "**The higher levels of exposures seen in children of farm workers suggests that farm workers are tracking pesticides home** through an occupational take-home pathway," Faustman says. "**Reducing this exposure** pathway **is critical for protecting farm workers and their families.**" In related studies, the researchers have provided educational information and supplies to farm workers and their families to reduce this pathway, and found that children's exposures can decrease. "Understanding and reducing such avoidable exposures to pesticides is critical since children are particularly vulnerable to the neurotoxic effects of pesticides," Faustman adds. The Institute's Center for Child Environmental Health Risks Research has followed a community-based participatory research strategy in the lower Yakima Valley since 1999 to assess pesticide exposure among families of Hispanic farmworkers. Researchers from the center worked with a community advisory board on this new study, recruiting 100 farm worker and 100 non-farm worker adults, all with a child between the ages of 2 and 6 years. Farm workers worked on apple and pear (pome) orchards, while non-farm workers worked at schools, stores, daycare facilities or factories. Parents and children participated in three data collection periods over the course of one year, from April 2005 through February 2006, which coincided with the three agricultural seasons typical of pome fruit cultivation – thinning, harvest and non-spray. Researchers collected samples of dust in homes and vehicles, as well as urine, saliva and blood. Dust was evaluated for residue of five of the area's most commonly used organophosphorus pesticides and urine samples were evaluated for the dialkylphosphate metabolites characteristic of pesticide exposure. A pesticide called azinphos-methyl (AZM) was found in house and vehicle dust more frequently and in higher concentrations than others tested. Not only were higher concentrations of AZM found in farm worker than in non-farm worker house and vehicle dust, but AZM concentrations were nearly four times higher in thinning season than in non-spray season. In both child and adult urine samples, dimethyl alkylphosphate metabolites (DMAP) were found in significantly higher concentrations than other metabolites. The concentration of DMAP in urine of farm worker children was 8 times higher than two other metabolites (diethylphosphate [DEP] and diethylthiophosphate [DETP]) in thinning season and 22 times higher in harvest season. The concentration of DMAP in urine of farm workers was 25 times higher than DEP and DETP in thinning season, more than 48 times higher in harvest season and 6 times higher in non-spray season. The concentration of DMAP was 8 times higher in farm worker than non-farm worker adults in thinning season, reflecting AZM usage patterns on pome fruits. Co-authors of the study are Catherine Tamaro, Marissa Smith, Tomomi Workman and William Griffith, all from the Institute for Risk Analysis and Risk Communication in the Department of Environmental and Occupational Health Sciences at the UW. Beti Thompson, professor of health services and member of the cancer prevention program at the Fred Hutchinson Cancer Research Center, also took part in the study.

Pesticides cause adverse health effects in farmers and communities

PHD Cynthia L. **Curl**, 5-14-20**18**, "Synthetic Pesticides and Health in Vulnerable Populations: Agricultural Workers," PubMed Central (PMC), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7035203/ //Vikas Nanduri

Current research suggests that exposure to synthetic pesticides may be associated with adverse health outcomes. Agricultural workers represent a potentially vulnerable population, due to a combination of unique social and cultural risk factors as well as exposure to hazards inherent in farm work. **Pesticide exposure among agricultural workers has been linked to certain cancers, DNA damage, oxidative stress, neurological disorders, as well as respiratory, metabolic, and thyroid effects.** There are over 1 billion agricultural workers in the world[1]. In the US alone, there are more than 3 million seasonal and migrant workers, self-employed farmers, family members working on family farms, hired workers and contract laborers[2, 3]. In South Asia and Sub-Saharan Africa, more than half of all employment is in agriculture[1]. In many countries, including the US, farm working populations are becoming increasingly older and are comprised of a growing number of women[2]. Agricultural workers are among the most vulnerable working populations due to social and cultural risk factors frequently associated with their ethnicity, immigration status, social class and rural location, as well as disparities related to language barriers and lack of access to healthcare[4-7]. In addition, these **potential risk factors can be exacerbated by occupational hazards associated with agricultural work, including exposure to environmental hazards such as synthetic pesticides and fertilizers**, diesel exhaust, ultraviolet radiation, biologically active dusts, and zoonotic viruses and bacteria, all of **which may put farm working populations at an increased risk for a variety of adverse health effects**[8, 9].

Pesticides are deadly, racist, and undemocratic

Ashley **Chesser**, Northwest Center for Alternatives to Pesticides, 7-30-20**20**, ["Racism and Injustice in Pesticide Policy," https://www.pesticide.org/racism_pesticide_policy, DOA: 2-24-2022] // RTS

Last summer, NCAP hosted a film showing of the movie Circle of Poison, inspired by David Weir and Mark Schapiro's book of the same name. The term, coined by authors, refers to the practice of manufacturing and exporting domestically banned pesticides for use on crops elsewhere, some of which returns on imported foods. **Legal loopholes have allowed for the manufacture of pesticides - deemed unsafe for the American people - for**

export to developing countries where they cause devastation in the form of illness, severe birth defects and cancer.1 Staff discussed the film again recently as an example of **American policies that expressly harm non-white communities**. In our previous newsletter, NCAP staff reviewed the history of pesticides and the role pesticides play in violence and systemic racism. Continuing this theme, we detail **some examples of pesticide policy that has effectively protected those with power and privilege to the detriment of non-white communities and those living in poverty**. RACISM IN RISK ASSESSMENT The Agricultural Exclusion Let's start with the Food Quality Protection Act (FQPA), the standard used by the Environmental Protection Agency (EPA) to regulate pesticides with a health-based focus. The FQPA was passed unanimously by Congress and then signed into law by President Clinton in 1996. The FQPA amended the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) to "perform more refined pesticide risk assessments, to better reflect real-world situations."2 When making a registration decision, **a pesticide can only be approved if it has a "reasonable certainty of no harm."2 But there's a clearly carved out exception in calculating risk. Assessments must "consider aggregate risk from exposure to a pesticide from multiple sources (food, water, residential and other non-occupational sources**)."2 Did you catch the exception? Occupational sources of exposure are excluded, including those to farmworkers. **There are about 2.5 million farmworkers in the United States and about 73% of them were born outside of the United States.3 The practice of excluding agricultural workers from Fair Labor Act polices that protect employees is in fact rooted in slavery. The statutory exclusion of agricultural workers from policies like overtime, minimum wage and sick leave was well-understood as a race-neutral proxy for excluding Blacks from benefits and protections made available to most Whites. It made the loss of free slave labor a little easier on farm owners**.4 Remarkably, despite these racist origins, an agricultural and domestic worker exclusion remains in effect today. **Fish Consumption Risk assessments have also systematically excluded Indigenous Peoples in the state of Washington when considering standards for toxic pollutants**. The Clean Water Act requires states to keep water quality standards that protect designated uses of water. The water must be clean enough for recreating, drinking and to safely eat fish caught there. Pacific Northwest tribal populations typically consume significantly more fish and shellfish than other people in the region.5 Yet **Washington's Department of Ecology has grossly underestimated the state's fish consumption rate when determining safety**. Set at 6.5

grams/day, the standard protects those who eat less than a serving of fish per month. “The longstanding inaccuracies found in the [fish consumption rates] have left tribal communities who rely upon fish and shellfish unduly exposed to toxic chemicals,” says Michael Grayum, executive director of the Northwest Indian Fisheries Commission (NWIFC). “**This type of environmental policymaking, which provides less protection for a population of people and subsequently leads to the unequal exposure of pollutants, is undoubtedly an environmental injustice**.”6 When a state is failing its obligations under the Clean Water Act, the Act requires EPA to step in. After years of debate, the EPA issued stricter rules in 2016, setting a fish consumption rate of 175 grams of fish, or about a serving per day.7 The standard matched that of Oregon’s, which was developed in conjunction with tribes through a public process.8 But then, in 2019, the **Trump administration’s EPA sided with industrial polluters and revoked its own rule**. NCAP will continue to advocate with our partners and supporters for a stronger fish consumption rate in Washington. RACISM IN PESTICIDE PROTECTIONS Essential and Exposed As mentioned earlier, farmworker health isn’t considered when assessing risk. So how are workplace hazards around pesticides addressed? The Worker Protection Standard (WPS) is an EPA law designed to protect workers from pesticide poisoning and injury. It contains requirements for pesticide training, notification and use. The pesticide Application Exclusion Zone (AEZ) is a key provision of the WPS law, which states that workers and their families cannot be within 100 feet during an active pesticide spray. The EPA designated 100 feet as a minimal preventative no-spray zone to protect farmworkers. Workers and their families must vacate housing and other buildings that exist within that 100 foot exclusion zone. In recent years in Oregon, there was enormous public outcry when Oregon Occupational Safety and Health Administration (OSHA) proposed that workers and family members should “shelter in place” inside housing to avoid exposure.9 Advocates and attorneys who represent farmworkers, including representatives of Pineros y Campesinos Unidos del Noroeste (PCUN) and Oregon Law Center, argued that due to the poor construction of some farmworker housing and outdoor cooking, eating and play areas being located near crops that are sprayed, the proposed rule would not protect workers and their families from pesticides that may drift.10 After much debate, Oregon adopted stricter standards than federal law in 2018. While we believe both Oregon and federal law could do more to mitigate risk to farmworkers and their families, this is a good example of public pressure leading to positive change. **Turning now to the current pandemic, farmworkers are at increased risk as they continue to bring food to our tables. A global shortage of personal protective equipment has put farmworkers at risk both for coronavirus and for pesticide exposure.** Agricultural workers are excluded from receiving sick pay if they become ill (as referenced earlier), and they usually lack health insurance. The $2 trillion pandemic aid package Congress passed does not offer any assistance to undocumented immigrants, even though they pay billions of dollars in federal taxes annually,11 and Immigration and Customs Enforcement (ICE) continues to detain and deport immigrants. A letter provided to farmworkers in case they are stopped for violating California's shelter-in-place order.12 Letters notifying undocumented workers that they are essential, when they still officially face potential deportation, are sending the same mixed signals that have long been at the root of American agricultural labor policy. “Some people are really confused by the message,” said Reyna Lopez, executive director of PCUN. “The government is telling them it needs them to go to work, but it hasn’t halted deportations.”12 Pesticide Manufacturing Moving from the job site to the home, we find protections lacking for those living near pesticide manufacturing plants. In a 2011 review of 94 studies on residential proximity to environmental hazards, including chemical plants, studies found that those living near hazardous substances had a significant increase in adverse health outcomes, including birth defects, childhood cancers, asthma hospitalizations and chronic respiratory symptoms, stroke mortality, end-stage renal disease, and diabetes.13 Communities living near chemical and hazardous waste plants are a majority non-white or those with limited incomes.14 One might assume that demographics would shift after a plant is installed. Those with more financial means will leave, and those with limited incomes will be unable to afford to move. While that is true to an extent, the reality is much more concerning. According to an environmental justice study by researchers at the University of Michigan and the University of Montana, communities with limited resources and those that are composed predominantly by people of color are targeted by industries when deciding where to locate hazardous waste sites and other polluting facilities. **These communities are seen as the path of least resistance because they have fewer resources and political clout to oppose the siting of unwanted facilities.** 15 And once a manufacturing plant goes in, not enough is being done to protect the surrounding community**. In addition to air pollution, there is the very real threat to physical safety.** In 2013, **an explosion at a fertilizer plant in West, Texas killed 15 people, injured at least 200, and destroyed dozens of homes, schools, and a nursing home**.16 Incomplete government data sets and patchy oversight raised more questions about chemical risks than regulators could answer.17 In the wake of the West, Texas, tragedy, the Obama administration drafted a new policy, called the "Chemical Disaster Rule," to make it easier for the public to access hazard-planning documents and required increased coordination with first responders. It also required companies to provide increased emergency planning information to local officials and to hold more frequent safety trainings.18 EPA delayed implementation of the rule after Trump took office and announced it would largely unwind the regulation that was widely unpopular in the chemical industry. Late in 2019, EPA Administrator Andrew Wheeler finalized rescinding most of the rule.19 WHERE DO WE GO FROM HERE? In a glaringly flawed system rooted in racism, NCAP is dedicated to achieving social justice and equity by dismantling injustices in our environment. **In addition to providing technical information on pesticide risks and alternative methods for pest control, we are monitoring and finding solutions to the root causes of pesticide exposure**. Join us in calling, commenting, testifying and marching so that policy makers know we demand better. And remember to vote! Stay tuned for action alerts on pesticide policy reform. We expect the “Protect America’s Children from Toxic Pesticides Act” to be introduced next Tuesday, which would significantly increase protections for children and frontline communities, as well as give back local control to communities that want to ban specific pesticides. Help us put pressure on Congress to get it passed!

Pesticides kill insect populations

Liz Kimbrough, Mongabay Environmental News, 1-28-2021, ["Are major insect losses imperiling life on Earth?," https://india.mongabay.com/2021/01/are-major-insect-losses-imperiling-life-on-earth/, DOA: 2-24-2022] // RTS

New studies **assessing insect declines around the planet find that on average, the decline in insect abundance, seen on nearly every continent, is thought to be around 1-2% per year or 10-20% per decade**. Precipitous insect declines are being escalated by humanity as soaring population and advanced technology push us closer to overshooting several critical planetary boundaries including biodiversity, climate change, nitrification, and pollution. Action on a large scale (international, national, and public/private policymaking), and on a small scale (replacing lawns with insect-friendly habitat, for example) are desperately needed to curb and reverse insect decline. Chances are, the works of the world's insects touch your lips every day. The coffee or tea you savor, both are pollinated by insects. Apples, oranges, cabbages, cashews, cherries, carrots, broccoli, watermelon, garlic, cinnamon, basil, sunflower seeds, almonds, canola oil — all are insect-pollinated. Honey, dyes, even some vaccines require insects to come to fruition. Vital to the world's food web, nested in nutrient cycling, and embedded in industries — the closer we look, the more we see insects as vital to maintaining life's frameworks. Referring to this fact, famed biologist E.O. Wilson wrote in 1987, "**[I]f invertebrates were to disappear, I doubt the human species could last more than a few months.**" Which is why the precipitous decline of insects is raising alarms. Insect populations are being reduced at varying rates across space and time, but on average, the decline in their abundance is thought to be around 1-2% per year, or 10-20% per decade. "**Think of a landowner with a million-dollar house on a river that's a little bit wild. And they're losing 10% to 20% of their land every decade, and it's horrifying. It means that after even a century, you really don't have anything left**," David Wagner, an entomologist with the University of Connecticut told Mongabay in an interview. That, he says of this comparison, is the danger we now face. Wagner has just edited a newly released in-depth feature in the Proceedings of the National Academy of Science, Global Decline of Insects in the Anthropocene, in which 56 researchers present scientific studies, opinions and news on insect declines. The journal offers perspectives on the ecological, taxonomic, geographical and sociological dimensions of insect declines, along with suggestions on how we move forward to study and reverse this drain on global biodiversity. Insect "death by a thousand cuts" In a perspective piece that leads off the special issue, Wagner and his co-authors address the likely causes of insect decline. **The main stressors to insects, they write, are changes in land use (particularly deforestation), agriculture, climate change, nitrification, pollution and introduced species. However, the importance of each stressor and how they interact still puzzles scientists.** "There are so many good scientists that can't figure out what the cause is," Wagner said. He poses the well-known honeybee as an example. "I mean, this thing is worth billions upon billions of dollars and we don't know why it's having such a hard time. And I think the reason is, it's death by a thousand cuts… most of these things are hit by four or five pretty important stressors, and they're acting synergistically." "Stressors from 10 o'clock to 3 o'clock anchor to climate change. Featured insects: Regal fritillary (Speyeria idalia) (Center), rusty patched bumble bee (Bombus affinis) (Center Right), and Puritan tiger beetle (Cicindela puritana) (Bottom). Each is an imperiled insect that represents a larger lineage that includes many International Union for Conservation of Nature 'red list' species (i.e., globally extinct, endangered, and threatened species)." Illustration by Virginia R. Wagner (artist) from Wagner et al 2020. The articles that follow that opening essay zero in on the key causes for some of the biggest known losses: **A study by Wagner and Peter Raven, president emeritus of the Missouri Botanical Garden, concludes that declines in insect biodiversity and biomass are linked to the intensification of agriculture over the past 50 years.** Research by Dan Janzen and Winnie Hallwachs — both biologists from the University of Pennsylvania who describe themselves as "intense observers of caterpillars, their parasites, and their associates" — focuses on climate change as a stressor. Since the late 1970s, they write, they've watched as insect declines came to the dry forests, cloud forests, and rainforests of Costa Rica's Guanacaste Conservation Area, as the region was plagued by rising temperatures, increasingly erratic seasons and inconsistent rainfall. The top figure shows a normal 1980s assembly of moths at the Cliff Top light trap in dry forests of Costa Rica's Guanacaste Conservation Area. The bottom figure is in the same location in 2019, during the same time in the moon cycle. "This dramatic change in moth density and species richness has now come to represent light trap catches in the dry forest at the beginning of the rains," the authors say. Photos from Janzen and Hallwachs 2020. **Another study in the special feature, titled, Insects and recent climate change, argues that climate may be playing even more of a role in declines than land-use change — which is massive around the planet mostly due to agribusiness expansion.** The authors base their climate findings on a Northern California butterflies case study, where declines were severe even in areas suffering little habitat loss. Similar losses within well-protected areas have been detected in Germany and Puerto Rico. Likewise, butterfly populations in Europe face challenges. In the UK, butterfly numbers have declined by around 50% over the past 50 years, with 8% of known resident species considered extinct. In the Netherlands, upwards of 20% of species have been lost and in Belgium 29%. Researchers suggest habitat loss, habitat degradation and chemical pollution as the primary causes. The authors offer conservation solutions and recommend policy changes to conserve butterflies and other insects — but so far political will has been lacking. Moving from the winged creatures of the day to night fliers, Wagner and colleagues give an overview of the global state of moth declines. Moths are extremely diverse and cosmopolitan. "For every butterfly that Mongabay readers see during the daytime, there are 19 species of moths flying around at night," Wagner revealed. Although moth numbers have declined in some areas, such as in parts of Europe and Central America, in other, mostly temperate areas, many moth taxa are increasing in abundance. Another study found that the overall abundance of arthropods in the Arctic has increased in recent years. Researchers attribute these increases in insect abundance to climate change, which scientists say has both its species winners and losers. As warmer temperatures march northward, new suitable habitats open up for insects. The consequences of this range expansion — and the conflicts which may occur with plant and insect species already occupying those ranges — have yet to be analysed. Insect declines are emblematic of a larger problem: the earth is in the midst of what some call the "sixth mass extinction." Birds, amphibians, freshwater mussels, large mammals, all have seen dwindling numbers. The question for entomologists, Wagner said, is whether or not the decline of insects is actually occurring faster than for some other groups, especially because insects are often the direct target of destruction by human, due to pesticide and herbicide use. Sarah Cornell, a scientist at the Stockholm Resilience Centre (SRC), raises an insect-related question relevant to our time: "There might have been many more mass extinctions. It's just that we only see extinctions with the things that leave a record… things with skeletons… When people [say], 'we're entering the sixth mass extinction.' Okay, well, how do we know that? We might be entering the 17th?… We might make ourselves extinct before we even reach these hallowed glories of the sixth." Overshooting planetary boundaries Clearly, the loss of insect abundance — depending on where and how fast it occurs — could have far more dire, unforeseen impacts than the loss of coffee or cashews. The wholesale transformation of global ecosystems, triggering mass insect declines, could be pushing the Earth past what scientists have dubbed as a "planetary boundary." The planetary boundaries framework, postulated by a group of international scientists in 2009, attempts to set the environmental limits within which life can safely function, and asks the question: how much human-caused disturbance can the planet take without shifting into a new and/or riskier state? According to a 2016 analysis, humanity has passed the "safe" planetary boundary threshold for "biotic intactness" a measure of functional and genetic diversity (biodiversity). Biotic intactness has declined across at least 65% of the Earth's terrestrial surface, the authors say, especially in grasslands and biodiversity hotspots. "The way that people (that's us…) are using land is changing the capacity of ecosystems to continue doing their normal functions," said Cornell, an SRC global change researcher who worked on a 2015 update to the planetary boundaries framework. "This pattern of lost biodiversity is undermining our own longer-term well-being." A conehead mantis (Empusa pennata) in Portugal. Because of its low-density distribution, this species is rarely found in the wild. Photo by Frank Vassen via Flickr (CC BY 2.0) Insect declines will very likely get worse before they get better, Wagner warns, as climate change — a critical planetary boundary — worsens rapidly, and as both human population and human consumption skyrocket, resulting in greater land-use change and increasing pollution — two other planetary boundaries. Importantly, the Global Decline of Insects in the Anthropocene special feature identifies critical gaps in our knowledge. For starters, we have only scratched the surface of identifying and describing the planet's existing insect biodiversity. Entomologists are working aggressively to advance our understanding via deep learning and computer vision — using a variety of cameras and sensors — and ambitious initiatives such as a plan to inventory and DNA barcode the entire biota of Costa Rica over the next ten years. You can help save the world's insects The new feature doesn't only sound the insect alarm, it also offers many suggestions about how to conserve and protect these tiny invertebrates. International, national and corporate policymaking needs to happen, and quickly. In the final piece, researchers layout, "eight simple actions that individuals can take to save insects from global declines." One action urges people to convert lawns, or any green outside space, into more diverse natural habitats. A conehead mantis (Empusa pennata) in Portugal. Because of its low-density distribution, this species is rarely found in the wild. Photo by Frank Vassen via Flickr (CC BY 2.0) Insect declines will very likely get worse before they get better, Wagner warns, as climate change — a critical planetary boundary — worsens rapidly, and as both human population and human consumption skyrocket, resulting in greater land-use change and increasing pollution — two other planetary boundaries. Importantly, the Global Decline of Insects in the Anthropocene special feature identifies critical gaps in our knowledge. For starters, we have only scratched the surface of identifying and describing the planet's existing insect biodiversity. Entomologists are working aggressively to advance our understanding via deep learning and computer vision — using a variety of cameras and sensors — and ambitious initiatives such as a plan to inventory and DNA barcode the entire biota of Costa Rica over the next ten years. You can help save the world's insects The new feature doesn't only sound the insect alarm, it also offers many suggestions about how to conserve and protect these tiny invertebrates. International, national and corporate policymaking needs to happen, and quickly. In the final piece, researchers layout, "eight simple actions that individuals can take to save insects from global declines." One action urges people to convert lawns, or any green outside space, into more diverse natural habitats. Monarch nectaring on swamp milkweed (A. incarnata) in Idaho. Monarch populations have declined dramatically and the species is now qualified for listing under the US. Federal Endangered Species Act. Photo courtesy of Stephanie McKnight/Xerces Society. **The paper recommends growing native plants; using fewer herbicides and pesticides**; limiting the use of exterior lighting; lessening runoff created when washing vehicles and buildings; working to counter negative perceptions of insects; educating others about insects; and getting involved in local politics, supporting science, and voting. "I think if we all did it together… **it would make a very big difference**," Akito Kawahara, lead author of the eight simple actions paper told Mongabay. "Even just the lawn thing… taking a little tiny piece of your lawn and converting it to a natural habitat… the impact that a small piece of space can have on the grand scale is enormous." Butterfly gardens and other such spaces also enrich our lives and offer educational opportunities for awakening natural wonder in children. "These insect papers, the focus on the small things, is a really delightful return to thinking ecologically," Cornell told Mongabay. "It's not all about counting stuff. How many insects? How many extinctions? But rather we need to ask, how is this world changing?" In a world with unchecked insects declines, the answer may be: more than we dare to imagine.

Agriculture and Superbugs

Agriculture creates superbugs

WAP, No Publication, xx-xx-20**19**, ["," https://www.worldanimalprotection.us/sites/default/files/media/us_files/us_pork_superbugs_report.pdf, DOA: 2-24-2022] // RTS

Antibiotic-resistant bacteria, also known as "superbugs," pose an extinction-level threat to all human life. Recently, the **World Health Organization called antimicrobial resistance "an increasingly serious threat to global public health that requires action across all government sectors and society**." Yet **not enough is being done to address the overuse of antibiotics, which is leading to ever less-effective antibiotic medicines. One of the biggest factors behind the growing problem of resistance is that antibiotics are vastly overused in farming.** Globally, by far most of the antibiotic use is for animals. While use of the drugs as growth promoters in feed and water has been increasingly phased out in the United States, approximately 70% of all medically important antibiotics in the country are sold for use in animals. In December 2018, World Animal Protection released a global report on the results of pork samples tested for the presence of bacteria resistant to specific antibiotics. The project was prompted by current research suggesting a link between low-welfare farming systems and overuse of antibiotics. Bacteria resistant to antibiotics considered most critically important to human health by the World Health Organization were found in samples sold by major supermarkets in Brazil, Spain and Thailand, including samples sold in Walmart stores in Brazil. This report turns its attention to the presence of antibioticresistant bacteria found in pork sold in supermarkets in the United States - the country with one of the highest per capita rates of meat consumption in the world - and two well-known national retail chains. The results of these tests have widespread implications for all retailers, as well as pig producers, governments and consumers of pork. Testing conducted by World Animal Protection in 2019 of pork from Walmart stores found bacteria resistant to multiple antibiotics important to human medicine. The spread of antibiotic-resistant bacteria is a global public health crisis, leading to longer durations of illness, higher hospitalization rates, and greater mortality. The United Kingdom's Review on Antimicrobial Resistance estimated that by 2050, 10 million lives each year will be "at risk due to the rise of drug-resistant infections if we do not find proactive solutions now."i Eighty percent of the bacteria isolated from Walmart's pork products were resistant to at least one antibiotic, with significant resistance to classes of antibiotics considered highly important or critically important by the World Health Organization (WHO). **Thirty-seven percent of the bacteria found on Walmart samples were multi-drug-resistant meaning they were resistant to three or more classes of antibiotics, and nearly10% were resistant to a total of six classes of medically important antibiotics.** Further, **roughly 27% of the resistant bacteria found on Walmart's pork were resistant to classes categorized as Highest Priority Critically Important Antimicrobials (HPCIA).** HPCIAs are antibiotics where there are few or no alternatives to treat people with serious infections. The Food and Agriculture Organization of the United Nations (FAO) recommends that these classes should never be used in animal agriculture.

Small organic agriculture > large concentrated firms, sustainability is key

Tam, No Publication, xx-xx-20**21**, ["," https://escholarship.org/content/qt0m16g2r5/qt0m16g2r5.pdf, DOA: 2-24-2022] // RTS

Competition in the agricultural marketplace has significantly declined as a result of decreasing antitrust enforcement and increasing consolidation. In the current market, the **largest firms control disproportionate percentages of market power, threatening consumer prices**, principles of equal economic opportunity, and viability of small farms and ranches. Contrary to the notions promulgated by Robert Bork's "consumer welfare standard," which claims that the federal government should regulate mergers sparingly for the supposed benefit of the consumer, consumer prices have increased due to this perspective being applied to jurisprudence and enforcement. **Market consolidation also harms principles of fairness and objectivity in policy.** Seeing as **large firms often contribute such a substantial percentage of a given agricultural product's output, if the firm is significantly compromised financially, they must be "bailed out" because the market inherently relies on their output and constructed dominance**. When large firms or farms have such robust security, they are **less likely to innovate, improve the quality of their products, and invest in more sustainable agriculture practices**. The Intergovernmental Panel on Climate Change (IPCC) prescribes that the world needs to limit global temperature rise to 1.5 degrees Celsius by 2050, which is contingent upon decreasing greenhouse gas emissions. Agriculture contributes to 10.5 percent of the United States' emissions, and the ability to reduce emissions is hindered by large farms' tendency to employ practices that increase emissions, while small farms, which are being driven out by corporate merges, are more likely to employ sustainable farming practices such no-till, compost as fertilizer, and planting cover crops. Agriculture consolidation has largely increased due to non-precautionary approaches by the Supreme Court and federal regulation agencies, the Federal Trade Commission and Department of Justice. Specifically, the Supreme Court's ruling that the "threat of loss of profits due to possible price competition" does not constitute antitrust harm has hindered the implementation of the Clayton Antitrust Act. Additionally, the federal agencies responsible for regulating mergers have increased the number of mergers they approve, allowing consolidation of the marketplace to continue. The lack of strict antitrust regulation to prevent mergers from holding hostage undue percentages of the marketplace is hindering the growth of regenerative farming, a set of practices that will be integral in meeting the IPCC climate change goals. The failures of the federal courts and agencies to adequately enact antitrust enforcement has resulted in extensive consolidation of the agricultural marketplace creating conditions in which few distributors, meatpacking firms, and farms hold disproportionate percentages of the market power. Such instances of consolidation in the market are intended to be regulated through federal policies such as the Clayton Antitrust Act. However, the influence of Robert Bork and the Chicago School, which both argue to prioritize efficiency through consolidation over small businesses and competition in the market, resulted in an era from the 1980s to the present where the federal courts and agencies have adopted a less precautionary philosophy in interpreting antitrust laws, allowing large firms to merge, and leaving the marketplace largely unregulated. The first gatekeepers that regulate corporation consolidation are the Department of Justice's (DOJ) Antitrust Division and the Federal Trade Commission (FTC), which are responsible for reviewing new and existing mergers. To supplement, the Courts evaluate cases that involve mergers that seek to persist despite the DOJ or FTC preventing the merge. The Courts can also hear cases in which other firms on the market claim they will be substantially threatened by a potential merger. Often, mergers are brought up to the Courts under the Clayton Act, which requires proof of antitrust injury to sue. Suffering "antitrust injury" can include acts that "may substantially lessen competition," as stated in Section 7 of the Act.

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Organic Agriculture is worse for the environment

Organic Agriculture is less efficient and worsens climate change

James **Temple**, MIT Technology Review, 10-22-20**19**, ["Sorry—organic farming is actually worse for climate change," https://www.technologyreview.com/2019/10/22/132497/sorryorganic-farming-is-actually-worse-for-climate-change/, DOA: 2-23-2022] // RTS

Organic practices can reduce climate pollution produced directly from farming – which would be fantastic if they didn't also **require more land to produce the same amount of food**. Clearing additional grasslands or forests to grow enough food to make up for that difference would **release far more greenhouse gas than the practices initially reduce, a new study in Nature Communications finds**. **Other recent research has also concluded that organic farming produces more climate pollution than conventional practices when the additional land required is taken into account.** In the new paper, researchers at the UK's Cranfield University took a broad look at the question by analyzing what would happen if all of England and Wales shifted entirely to these practices. The good news is it would cut the direct greenhouse-gas emissions from livestock by 5% and from growing crops by 20% per unit of production. The bad news: it would slash yields by around 40%, forcing hungry Britons to import more food from overseas. If half the land used to meet that spike in demand was converted from grasslands, which store carbon in plant tissues, roots, and soil, it would boost overall greenhouse-gas emissions by 21%. Among other things, **organic farming avoids the use of synthetic fertilizers, pesticides, and genetically modified organisms, all of which can boost the amount of crops produced per acre**. Instead, **organic farmers rely on things like animal manure and compost, and practices such as crop rotation, which involves growing different plants throughout the year to improve soil health.** The study notes that these biological inputs produce fewer emissions than nitrogen-based synthetic fertilizers, notably including the highly potent greenhouse gas nitrous oxide. Separately, the use of manure and longer crop rotations can increase the amount of carbon stored in soil. The emissions impact of the meat, milk, and eggs produced from organically raised livestock is more complicated. On the one hand, emissions can increase because animals don't plump up as fast without hormones, supplements, and conventional feed. That, for instance, grants cattle longer lives in which to belch out methane, another especially powerful greenhouse gas. On the other, allowing animals to spend more of their lives grazing on open grasslands may stimulate additional plant growth that captures more carbon dioxide, while cutting emissions associated with standard feeds. But the bigger problem, for both crops and livestock, is that these practices end up requiring a lot more land to produce the same amount of food. After all, the whole point of synthetic fertilizer is it boosts crop yields, by providing a "fixed" form of nitrogen that promotes plant growth. The legumes that organic farmers have to rotate in to help convert nitrogen into more reactive compounds in the soil end up cutting deeply into other food crops they could otherwise grow, the study notes. Specifically, the switch to 100% organic practices would require 1.5 times more land to make up for the declines, which would add up to nearly five times more land overseas than England and Wales currently rely on for food. That difference is amplified by the fact that the UK's agricultural system produces particularly high yields compared with other parts of the world. The study found larger effects than some earlier papers. Notably, a 2012 meta-analysis in Nature determined that organic farming yields are between 5% and 34% lower than those from conventional agriculture, depending on the specific crops and practices. In addition, a 2017 Nature Communications study estimated that switching to organic farming would increase land use by only 16% to 33%. By evaluating the entire farming system of England and Wales, the new study helps to address some of the criticisms of earlier organic emissions assessments, which were often limited to specific farms or crops, says Dan Blaustein-Rejto, associate director of food and agriculture at the Breakthrough Institute, a think tank that promotes technology solutions to environmental challenges. "Looking at the farm scale doesn't really tell you what a large-scale transition to organic would look like," he says. "Only a study like this, that takes a system-wide perspective, really does." **The world does need to find ways to cut the emissions and environmental pollution from synthetic fertilizers. But the trick is to clean up these practices in ways that don't require converting more land to agriculture, or forcing large parts of the world to go hungry.** Among other paths, a **number of researchers and startups are trying to develop novel agricultural inputs that could cut emissions without reducing yields**, crops that take up more of the nitrogen in soil, and various meat and milk alternatives.

Organic Agriculture results in higher emissions and lower crop yields

Anuradha Varanasi, 10-22-2019, "Is Organic Food Really Better for the Environment?," State of the Planet from Columbia University, https://news.climate.columbia.edu/2019/10/22/organic-food-better-environment/

//Vikas Nanduri

When you walk into any farmers' market, you're greeted with signs that say "Certified Organic" in bold letters. Despite being far more expensive than its non-organic counterparts, organic agriculture has become the most popular type of alternative farming, not only in the United States but also globally. According to the United States Department of Agriculture (USDA), as of 2012, organic farming accounted for 3 percent of the total sales within the country's food industry. Even in European countries like Finland, Austria, and Germany, governments have been busy implementing plans and policies that aim to dedicate 20 percent of land area to organic farming. In South Asia, Bhutan has ambitious plans of going 100 percent organic by 2020. Meanwhile, Sikkim, a state in north-eastern India had managed to go 100 percent organic in 2016. The gradual shift towards organic farming has been mainly because we as consumers have become increasingly concerned about the health impacts of accidentally consuming pesticides and chemical fertilizers. During the 1990s, the USDA first standardized the meaning of the term "organic" — basically, farmers do not use any form of synthetic fertilizers, pesticides, herbicides, or fungicides to grow their produce. Organic farming is widely considered to be a far more sustainable alternative when it comes to food production. The lack of pesticides and wider variety of plants enhances biodiversity and results in better soil quality and reduced pollution from fertilizer or pesticide run-off. Conventional farming has been heavily criticized for causing biodiversity loss, soil erosion, and increased water pollution due to the rampant usage of synthetic fertilizers and pesticides. However, despite these glaring cons, scientists are concerned that organic farming has far lower yields as compared to conventional farming, and so requires more land to meet demand. A polarized debate Not surprisingly, the debate over organic versus conventional farming is heavily polarized in academic circles. Of late, the conversation about organic farming has shifted from its lack of chemicals to its impact on greenhouse gas emissions. In December 2018, researchers from Chalmers University of Technology published a study in the journal Nature that found that **organic peas farmed in Sweden have a bigger climate impact (50 percent higher emissions) as compared to peas that were grown conventionally** in the country. "Organic farming has many advantages but it doesn't solve all the environmental problems associated with producing food. There is a huge downside **because of the extra land that is being used to grow organic crops**," said Stefan Wirsenius, an associate professor at Chalmers. "If we use more land for food, we have less land for carbon sequestration. The total greenhouse gas impact from organic farming is higher than conventional farming." Soon after the paper was published and widely covered by various news organizations globally, several researchers criticized the study. Andrew Smith, a chief scientist at the Rodale Institute, lashed out in a post saying that it was "irresponsible to extrapolate a global phenomenon based on two crops grown in one country over three years." Smith also added that more data should be included and analyzed before making conclusions. Commenting on this, Wirsenius said, "It is true that we had a small comparison between organic versus conventional farming based on Swedish statistics. This is because Sweden is one of the very few countries that has statistics that include the yields from organic and conventional crops." "It would have been better with bigger sample size and that is a valid concern," he added. It is estimated that by 2050, the demand for food is going to increase by 59 to 98 percent due to the ever-increasing global population. A major challenge for the agriculture business is not only trying to figure out how to feed a growing population, but also doing so while adapting to climate change and coming up with adequate mitigation measures. Some scientists continue to be concerned that with limited land areas that will be available for farming, it might not be sustainable for industrialized countries to go 100 percent organic. A recent study published in the journal Nature Communications concludes that the **widespread adoption of organic farming practices in England and Wales would lead to increases in greenhouse gas emissions**. This is mainly **because agricultural yields would be 40 percent lower**. The researchers argued that with fewer crops being grown locally, these two countries would have to import more food supplies. However, if England and Wales did not solely rely on organic farming, and both countries' farmers used this alternative form of farming on a smaller scale, it could result in a 20 percent reduction in carbon emissions. "For organic farming to be successful, agribusinesses would have to find the balance between the costs involved and also, its carbon footprint, while taking into consideration the overall need to meet the high demands for food," said Alexander Ruane, a research physical scientist at NASA Goddard Institute for Space Studies and an adjunct associate research scientist at the Columbia University Center for Climate Systems Research. "That's tough because the goal of organic farming in developed countries currently is about meeting the needs of those who can afford the luxury to buy the highest quality food. If the needs of this luxury interfere with the need to feed the entire population, then you have the potential for conflicts." The blurry line between "good" and "bad" Making matters more complicated, some experts worry that the term "organic food" is not always properly regulated. As more large corporations get involved in organic markets, researchers claim that this shift to the mainstream has "led to the weakening of ecologically beneficial standards". It may also limit organic farming's ability to reduce greenhouse gas emissions. While researchers and the general public remain divided on whether organic farming is more sustainable than conventional farming, Sonali McDermid, an assistant professor at the department of environmental studies at New York University, says that it is very hard to generalize across any farming systems or label conventional or organic farming as "good" or "bad". "They have very different manifestations, depending upon where you go," she said. "An apt example would be the case of a farm involved in the production of organic berries in Central Valley, California. While they are not using additional land area or chemical inputs like in conventional farming, they are using other really strong inputs like sulfur," explained McDermid. "This can be harmful to farmworkers as they need to wear proper suits and protective gear even though it is not chemically synthetic. Despite that, it is just as powerful in some cases." McDermid is also concerned that some agribusinesses can farm uniformly without any biodiversity and still call themselves organic. Whereas in developing or emerging economies — for example in India — farmers tend to follow a far more traditional definition of organic farming. "In India, organic farms grow lots of different crops at the same time. They grow plants that can naturally keep pests away and don't use powerful inputs like sulfur. Instead, the farmers use plants and biodiversity to help regulate their cropping systems," said McDermid. Indian farmers who grow organic crops also make their fertilizers by filling a field with legumes that they grow in rotations. Once the legumes have fully grown, the farmers manually plow them into the ground. That results in larger quantities of nitrogen being pumped into the soil, as opposed to only using manure or even worse, synthetic fertilizers. McDermid said that in some areas of the developing world, organic farming can actually boost yields over conventional farming because it doesn't rely on so much water and chemical inputs. These practices also build soil fertility and lead to less pollution. Experts maintain that in the heated debate over organic versus conventional farming, there needs to be more information available for consumers when it comes to labeling and even understanding the certification processes in industrialized countries like the U.S. "A huge fraction, if not the majority of organic goods sold at supermarkets in the U.S. is probably industrial," added McDermid. For now, in the developed world, the industrialization or commercialization of organic farming has resulted in a lot of difficulty for both consumers and researchers, who are trying to understand what the goals of this booming industry are. To eat organic or not to eat organic In the U.S., even sustainability experts continue to be unsure of whether food items like fruits and vegetables with the "certified organic" labels are in fact, genuinely organic or not. McDermid said that even she sometimes feels uncertain about what to buy in the supermarket. That being said, both Wirsenius and McDermid agree that it is far more environmentally sustainable to eat organic chicken instead of beef that was produced conventionally. Yet, consuming large portions of organically produced meat will still have a bigger environmental impact than eating conventionally produced crops and fruits. Taking into consideration the high costs involved in going 100 percent organic, especially when it comes to buying fruits and vegetables, McDermid said if you can afford to spend extra, she would recommend buying them. It might also help to look for organic food that was grown locally. For instance, several community gardens grow organic vegetables that are sold in nearby farmers' markets. Keeping that in mind, there's no need to feel guilty or under pressure to spend extra for organic produce. "I would never put that kind of pressure on anybody. It's really unfortunate we're in a situation where agribusinesses focus only on yields, which makes an alternative form of farming comparatively much more expensive," sighed McDermid. While the organic versus conventional farming debate rages on, there is one clear way to lower the environmental impact of your food, and it won't hurt your wallet: reducing the amount of meat in your diet.

New Startups are decreasing emissions in the status quo, strong uniqueness argument

Daniel L. **Northrup**, PNAS, 7-13-20**21**, ["Novel technologies for emission reduction complement conservation agriculture to achieve negative emissions from row-crop production," https://www.pnas.org/content/118/28/e2022666118, DOA: 2-23-2022] // RTS

Plants remove carbon dioxide from the atmosphere through photosynthesis. Because agriculture's productivity is based on this process, a combination of technologies to reduce emissions and enhance soil carbon storage can allow this sector to achieve net negative emissions while maintaining high productivity. Unfortunately, **current row-crop agricultural practice generates about 5% of greenhouse gas emissions in the United States and European Union.** To reduce these emissions, **significant effort has been focused on changing farm management practices to maximize soil carbon**. In contrast, the potential to reduce emissions has largely been neglected. **Through a combination of innovations in digital agriculture, crop and microbial genetics, and electrification, we estimate that a 71%** (1,744 kg CO2e/ha) **reduction in greenhouse gas emissions from row crop agriculture is possible within the next 15 y.** Importantly, **emission reduction can lower the barrier to broad adoption by proceeding through multiple stages with meaningful improvements that gradually facilitate the transition to net negative practices**. Emerging voluntary and regulatory ecosystems services markets will incentivize progress along this transition pathway and guide public and private investments toward technology development. In the difficult quest for net negative emissions, all tools, including emission reduction and soil carbon storage, must be developed to allow agriculture to maintain its critical societal function of provisioning society while, at the same time, generating environmental benefits. agriculture emission reduction innovationcrop genetics soil health electrification All sectors must reduce their emissions to avert the negative consequences of climate change (1). Although essential, food production and agriculture must participate in this reduction, as emissions from this sector alone will exceed the carbon budget for acceptable temperature increases (2). To this end, **it is important to develop technical roadmaps that preserve economic productivity while reducing emissions. Agriculture has a unique**

potential to provide beneficial contributions to the global carbon budget because its fundamental unit of productivity, carbon fixation through photosynthesis, removes CO2 from the atmosphere. To reduce its environmental footprint, agriculture has two options: dramatic emissions reduction through new technologies and the adoption of methods guided by preagriculture ecosystems to build soil organic carbon stocks. When soil organic carbon accumulation exceeds emissions, the sector will be among the few to achieve net negative emissions and lead in the climate change solution. Unfortunately, **current agricultural practices are optimized primarily for yield and use large amounts of fossil energy to produce fertilizers, chemicals, and mechanical energy**. Consequently, row-crop agriculture contributes nearly 5% of emissions in the United States and European Union (EPA/Eurostat). **A small number of producers have achieved negative emission production using practices that are often termed "regenerative agriculture" (3). Although there is no formal definition of regenerative agriculture, these systems tend to use cover crops, no tillage, and crop rotation while minimizing chemical inputs and emphasizing soil stability for carbon storage and water stewardship.** Many regenerative producers incorporate livestock grazing in their operations. **Despite its appeal, regenerative agriculture will take a long time to scale broadly as change of this magnitude is challenging, expensive, involves long-term soil dynamic processes, and requires new supply chains (4) and new understanding of farm practices in many geographies. Many of the benefits of these systems take time to accumulate, and there is a lack of incentive to invest in practices with a long-term return on investment (5) on rented land** (6). As a final challenge, there is significant debate on the magnitude of soil carbon sequestration (7⇓⇓–10). Outside common row crops, other low- or negative-emission production systems such as perennial grasses for bioenergy are available (11, 12), but farmer adoption is limited because economic viability depends on the development of new markets, end uses, and logistics chains. Fortunately, slow adoption is not a general feature of agriculture and the potential for rapid change should encourage technology developers and policy makers. Producers are quick to adopt new technologies when they are profitable and the annual planting cycle for most row crops enables rapid proliferation of new technology. As an example, adoption of genetically modified row crops grew to over 90% in a matter of 10 y (13). Similarly, Global Positioning System–guided tractors and yield monitors saw rapid adoption as older equipment was replaced (14). Thus, there is an opportunity to improve the environmental footprint in the near term by developing targeted technologies that are readily adoptable and fit within current production systems and established grain markets. In addition to new technology, the transition to negative carbon agriculture requires a value proposition. There is significant interest and market development for emission credits to meet the environmental targets of corporations and other large entities. This new market will promote adoption of new low-emission technologies. Public policy is a second lever that can incentivize transition through payments for ecosystem services, grain valuation methods that incorporate environmental footprint, insurance adjustments, lending/interest rates, grant support, and renewable energy generation credits. Soil carbon storage is a major focus of several voluntary markets due to the negative emission potential. In contrast, technical innovations that reduce emissions receive much less attention although their combination could yield benefits on the same order as most predictions of enhanced soil carbon storage. In this paper, we describe a suite of technologies to dramatically reduce farm emissions that includes digital agriculture for precision input application, crop and microbial genetics for input efficiency and N fixation, and electrification of ammonia synthesis and farm equipment. To estimate the impact of technology adoption on the emission footprint of grain production, we used current maize feedstock emission values from the Greenhouse Gases, Regulated Emissions, and Energy Use in Technologies (GREET) model (SI Appendix) as a benchmark representing the national average emissions. These benchmark values highlight the importance of N fertilizer in farm emissions. It is the largest contributor to row-crop emissions (Fig. 1) because of energy expenditure during manufacture and the emission of nitrous oxide (N2O) from the soil. N2O is a potent greenhouse gas with 265 times the global warming potential of CO2 and a long atmospheric half-life. While N2O emissions are already recognized as a large component of global GHG emissions, actual emissions may be higher, as a recent global inventory estimated that this emission source is underestimated (15). It is important to avoid N2O emissions, because unlike direct air capture for CO2 there is not a technology sector focusing on removing N2O from the atmosphere. Fig. 1. Download figure Open in new tab Download powerpoint Fig. 1. **Technical improvements facilitate deep decarbonization of grain production**. Numbers are shown as kilograms of CO2e per hectare and are separated by the emission source. **The phases (optimize, replace, and redesign) are distinguished by the technical readiness of the enabling innovations. Implementing the optimization phase is largely possible using current technology, while replacement-phase technologies could be available in 2 to 5 y and redesign-phase technologies in 5 to 15 y.** Rather than suggest a single set of futuristic low-emission technologies we chart a green transition for agriculture that can progress through three phases (optimize, replace, and redesign). Each phase provides meaningful improvements in the emission footprint of grain production (Fig. 1 and SI Appendix) and is defined by the technical readiness of the enabling technology (Fig. 2). Based on these inventory assessments, new product innovation can reduce farm emissions by 71% (1,744 kg CO2e/ha; Fig. 1 and SI Appendix, Table S1) from current US maize default values. Fig. 2. Download figure Open in new tab Download powerpoint Fig. 2. Descriptions of the technologies that will be adopted in each phase in response to new policy and farm economics.

Organic Agriculture leads to decreased yields and more energy usage

Hannah **Ritchie**, 10-19-20**17**, "Is organic really better for the environment than conventional agriculture?," Our World in Data, https://ourworldindata.org/is-organic-agriculture-better-for-the-environment //Vikas Nanduri

As the total global population continues to rise and economic growth drives a transition towards more resource-intensive diets, a growing number of consumers are concerned with how to reduce the environmental impact of their dietary choices. Consumers often see organic food as an effective way to reduce their impact: surveys reveal that regardless of geographic location, the primary motivations for organic food purchases are health[1] and environmental concerns.[2] Furthermore, consumers are often willing to pay more for organic products – some studies indicate a willingness-to-pay of up to 100 percent above standard prices.[3] But is this a wise choice? Is going organic really the best way to reduce the environmental impact of our diets? Before we explore the relative impacts of organic vs. conventional agriculture, it is worth clarifying their definitions. Organic agriculture refers to the farming of crops or livestock without the use of synthetic inputs, including synthetic fertilizers, pesticides, plant growth regulators, nanomaterials and genetically-modified organisms (GMOs).[4] Note that organic does not necessitate 'chemical-free' or 'pesticide-free'; chemicals are often used in organic farming, however these cannot be synthetically manufactured, with the exception of a small number which have been approved by the National Organic Standards Board.[5] Conventional (sometimes termed 'industrial') farming is therefore any agricultural system which uses one or more of the above synthetic inputs. The methods applied for weed and pest control in conventional and organic systems can also impact on choices of planting and tillage techniques. Conventional farming often utilises synthetic herbicides for the control of weeds; this approach is typically more conducive to low- or no-till management techniques.[6] Since herbicide applications cannot be widely adopted in organic farming (with some approved exceptions), options for no-till farming can be more limited and places greater emphasis on approaches such as mechanical controls and/or mulching. In arable farming (which concerns the production of crops), nutrients can be added to the soil in the form of organic matter, such as green compost, animal manure (human sewage sludge is typically prohibited), or bone meal. For livestock, organic methods mean animals must be fed organically-certified feed (or graze on land with no synthetic chemical inputs), and antibiotics cannot be used throughout their lifetime (except in emergency cases such as disease or infection outbreak). In conventional livestock production, there are no constraints on feed certification and antibiotics or growth hormones are often used. Animal welfare standards for organic certification can vary by country, however for many, livestock must be raised with access to the outdoors (i.e. caged hens are not permitted). Conventional livestock farming covers a range of production methods: they can be produced in either 'free range' or 'caged' conditions. These are typically monitored and labelled as such on product packaging. In this post, we present the empirical evidence comparing organic to conventional agriculture in terms of environmental impact. Despite strong public perception of organic agriculture producing better environmental outcomes, we show that conventional agriculture often performs better on environmental measures including land use, greenhouse gas emissions, and pollution of water bodies. There are, however, some contexts where organic agriculture may be considered appropriate. Organic vs. conventional: what are the relative impacts? When aiming to provide a comparison of the relative impacts of organic and conventional agriculture, it can often be misleading and misrepresentative to rely on the results of a single comparative study: there will always be single, localised examples where the environmental impacts of a conventional farm are lower than that of a proximate organic farm, and vice versa.[7] In order to provide a global and cross-cutting overview of this comparison, Clark and Tilman (2017) published a meta-analysis of results of published organic-conventional comparisons across 742 agricultural systems over 90 unique foods.[8] Their analysis reviewed relative impacts across the range of food types – cereals, pulses and oilcrops, fruits, vegetables, dairy and eggs, and meat – and across a range of environmental impact categories – greenhouse gas emissions, land use, acidification potential, eutrophication potential, and energy use.

‘Eutrophication’ refers to the over-enrichment or pollution of surface waters with nutrients such as nitrogen & phosphorous. Although eutrophication can also occur naturally, the runoff of fertilizer and manure from agricultural land is a dominant source of nutrients.9 This disaggregation of food types and environmental impacts is important: there is no reason to suggest that the optimal agricultural system for cereal production is the same as for fruits; and there are often trade-offs in terms of environmental impact – one system can prove better in terms of greenhouse gas emissions but higher in land use, for example. Food systems are made up of many phases – ranging from pre-farm activities, crop production, animal feed production, and harvesting, to transportation, distribution, and cooking. To fully and consistently account for the various stages of production, a process called life-cycle analysis (LCA) is used. LCAs attempt to quantify the combined impacts across several stages of production by considering all inputs and outputs in the complete process. The key in comparing LCAs between products is ensuring that the same number of stages of the supply chain are included in all analyses. For this meta-analysis, Clark & Tilman (2017) compared 164 LCAs which account for inputs pre-farm and on-farm (up until the food leaves the farm). The aggregated results of Clark & Tilman’s study is shown in the chart below. This comparison measures the relative impact ratio of organic to conventional agriculture, whereby a value of 1.0 means the impact of both systems are the same; values greater than 1.0 mean the impacts of organic systems are higher (worse) (for example, a value of 2.0 would mean organic impacts were twice as high as conventional); and values less than 1.0 mean conventional systems are worse (a value of 0.5 means conventional impacts are twice as high). We see these relative impacts measured by food type across our range of environmental impacts with averages and standard error ranges shown. We see large differences in impact patterns across environmental categories and food types. For some impacts, one system is consistently better than the alternative; whilst for others, results are mixed depending on crop type and the local agricultural context. **The clearest results are for land and energy use. Organic systems consistently perform worse in terms of land use, regardless of food type. As we explore in detail in our entry on Yield and Land Use in Agriculture, the world has achieved large gains in productivity and gains in yield over the past half-century in particular, largely as a result of the availability and intensification of inputs such as fertilizer and pesticides. As a result, the majority of conventional systems achieve a significantly higher yield as compared to organic systems. Therefore, to produce the same quantity of food, organic systems require a larger land area. This produces the inverse result for energy use. The industrial production of chemical inputs such as fertilizers and pesticides is an energy-intensive process. The absence of synthetic chemical inputs in organic systems therefore means that their energy use is predominantly lower than in intensive conventional agriculture.** The exception to this result is vegetables, for which energy use in organic systems tends to be higher. Some of this additional energy use is explained by the use of alternative methods of weed and pest control in organic vegetable farming; a technique widely applied as an alternative to synthetic pesticide application is the use of ‘propane-fueled flame weeding’.10 The process of propane production and machinery used in its application can add energy costs – especially for vegetable crops. Acidification and eutrophication potential are more mixed, but tend to be higher in organic systems; average values across all food types are higher for organic, although there are likely to be some exceptions in particular contexts. Why are organic systems typically worse in these measures? The supply of nutrients in conventional and organic systems are very different; nitrogen supply in conventional agriculture is supplied with the application of synthetic fertilizers, whereas organic farms source their nitrogen from manure application. The timing of nutrient release in these systems is different: fertilizers release nutrients in response to crop demands, meaning nitrogen is released when required by the crops, whereas nitrogen released from manure is more dependent on environmental conditions, such as weather conditions, soil moisture and temperature. Nutrient-release from manure is therefore not always matched with crop requirements – excess nutrients which are released but not taken up by crops can run off farmland into waterways such as rivers and lakes. As a consequence, the pollution of ecosystems with nutrients from organic farms are often higher than conventional farms, leading to higher eutrophication and acidification potential. Across all food types, there is no clear winner when it comes to greenhouse gas emissions. Results vary strongly depending on food type, although most lie close to a ratio of one (where differences in impact between the systems are relatively small). Based on average values, we might conclude that to reduce greenhouse gas emissions, we should buy organic pulses and fruits, and conventional cereals, vegetables, and animal products. In general, the greenhouse gas emission sources of organic and conventional systems tend to cancel each other out. Conventional systems produce greenhouse gases through synthetic fertilizer production and application, which is largely balanced by the higher emissions of nitrous oxide (a strong greenhouse gas) from manure application.[11] Should we treat environmental impacts equally? Organic agriculture proves better for some environmental impacts, and conventional agriculture for others. These trade-offs can make it difficult to decide which we should be choosing. But should we be considering all environmental impacts equally? Should some have higher importance than others? To evaluate these trade-offs we have to consider a key question: how important is agriculture's contribution to global greenhouse gas emissions, land use, acidification and eutrophication potential, and energy use? Agriculture's role in land use, greenhouse gas emissions, and energy use is summarised in the three charts below: We might therefore conclude that energy use – the only category in which organic agriculture has a clear advantage – is comparatively substantially less important than other impacts. If we are most concerned with areas of environmental change for which agriculture has the largest impact – namely land use, water pollution, and greenhouse gas emissions – for which conventional agriculture tends to be advantaged, is the answer to make global farming as intensive as possible? Not necessarily. There are several reasons why this view is too simplistic. The impacts quantified here fail to capture another important ecological pressure: biodiversity. Conclusive comparisons of the relative impacts of agricultural systems on biodiversity are still lacking. Biodiversity is affected by a number of agricultural impacts, including pesticide application (which can be toxic to some species), soil erosion, and disruption from land tillage methods, and either habitat destruction or fragmentation.[12] Intensive agriculture undoubtedly has severe impacts on local biodiversity.[13] A recent study by Hallmann et al. (2017) reports a greater than 75 percent decline in insect populations over the last 27 years; although unclear as to the primary cause of this decline, it's suggested that pesticide use may be a key contributing factor.[14] Organic farming systems also impact biodiversity, but perhaps less dramatically per unit area, due to lower fertilizer and pesticide use. However, as our land-use metrics show: organic agriculture requires far more land than conventional agriculture. This creates a divide in opinion of how best to preserve biodiversity: should we farm intensively over a smaller area (with understanding that biodiversity will be severely affected over this area), or should we farm organically, impacting biodiversity (perhaps less severely) over a much larger area.[15] There is no clear consensus on how best to approach this issue. Another point to consider is that conventional agriculture is not necessarily better across all food types. Context, both in terms of the food commodity and the local environment, can be important. For example, if greenhouse gas reduction is our main focus, we might be best off eating organic pulses and fruits, and conventional cereals, vegetables, and animal products, based on the results presented above. This leads us to three key conclusions in the organic-conventional farming debate: The common perception that organic food is by default better, or is an ideal way to reduce environmental impact is a clear misconception. Across several metrics, organic agriculture actually proves to be more harmful for the world's environment than conventional agriculture. The debate between organic and intensive agriculture advocates is often needlessly polarized. There are scenarios where one system proves better than the other, and vice versa. If I were to advise on where and when to choose one or the other, I'd advise trying to choose organic pulses and fruits, but sticking with non-organic for all other food products (cereals, vegetables, dairy and eggs, and meat). The organic-conventional debate often detracts from other aspects of dietary choices which have greater impact. If looking to reduce the environmental impact of your diet, what you eat can be much more influential than how it is produced. The relative difference in land use and greenhouse gas impacts between organic and conventional systems is typically less than a multiple of two. Compare this to the relative differences in impacts between food types where, as shown in the charts below, the difference in land use and greenhouse gas emissions per unit protein between high-impact meats and low-impact crop types can be more than 100-fold. If your primary concern is whether the potato accompanying your steak is conventionally or organically produced, then your focus is arguably misplaced from the decisions which could have the greatest impact.

Farmers Changing Methods to Decrease Environmental Impact of Conventional Farming-- Uniqueness

OECD, no date, "Agriculture and the environment," No Publication, https://www.oecd.org/agriculture/topics/agriculture-and-the-environment/ //Vikas Nanduri

A key challenge for the agriculture sector is to feed an increasing global population, while at the same time reducing the environmental impact and preserving natural resources for future generations. Agriculture can have significant impacts on the environment. While negative impacts are serious, and can include pollution and degradation of soil, water, and air, agriculture can also positively impact the environment, for instance by trapping greenhouse gases within crops and soils, or mitigating flood risks through the adoption of certain farming practices. The OECD monitors the linkages between the environment and agriculture, identifies successful agricultural policies that mitigate the negative environmental impacts while enhancing the positive ones, and provides recommendations to improve policy coherence for environmental performance of the agricultural sector. Agriculture's impact on the environment has improved, but there is still much to do **In recent years, there have been some encouraging signs that the agriculture sector of OECD countries is capable of meeting its environmental challenges. In particular, farmers in many OECD countries have made improvements in the use and management of nutrients, pesticides, energy and water, using less of these inputs per unit of land.** Farmers have also made good progress in adopting more environmentally beneficial practices, such as conservation tillage, improved manure storage, or soil nutrient testing. Notwithstanding these improvements, there is still more to do, with an important role for policymakers. Nitrogen balances are increasing in several OECD countries, farmland bird populations continue to decline and the sector's contribution to water use and contamination is still high relative to other uses. To address these long-standing issues, more effort and co-operation is needed between farmers, policymakers, and the agro-food value chain. In addition, the twin policy challenge of ensuring global food security for a growing population while improving environmental performance will require raising the environmental and resource productivity of agriculture, enhancing land management practices, minimising pollution discharges, curtailing damage to biodiversity, and strengthening policies that avoid the use of production and input subsidies which tend to damage the environment. Monitoring and evaluating agriculture's environmental performance can help guide future policy choices To help countries improve the sustainability of agriculture, the OECD has developed recommendations on how to develop cost-effective agri-environmental policies , how to manage water issues for agriculture, how to deal with climate change challenges, and how to preserve biodiversity and manage ecosystem services related to agriculture. We have also developed insights on the potential environmental impact of agriculture policies by identifying possible policy mis-alignments and how to jointly address sustainability and productivity growth goals. While there is unlikely to be a "one-size-fits-all" solution for dealing with environmental concerns in agriculture, as agro-ecological conditions and public preferences differ across countries, policymakers must have at their disposal a deep understanding of, and capacity to measure, the linkages between policies and outcomes in order to evaluate and achieve better environmental outcomes in a cost-effective manner.

More Organic Farming Worsens Global Warming

Courtney **Vinopal**, 10-23-20**19**, "How more organic farming could worsen global warming," PBS NewsHour, https://www.pbs.org/newshour/science/how-more-organic-farming-could-worsen-global-warming //Vikas Nanduri

For decades, the conventional wisdom surrounding organic farming has been that it produces crops that are healthier and better for the environment as a whole. In the U.S., where organic food sales totaled nearly $50 billion last year and made up 5.7 percent of total food sales, companies such as Annie's and Organic Valley market their products as leaving a low carbon footprint. They remind consumers that their ingredients "matter…to the planet we all share," or that their farming practices "remove excess carbon dioxide from the air." The International Federation of Agriculture Movements promises in its literature that organic farming can "help reduce greenhouse gas emissions within the agricultural sector of the European Union and beyond." But a new study out this week challenges this narrative, predicting that **a wholesale shift to organic farming could increase net greenhouse gas emissions by as much as 21 percent.** "We're not saying that organic is wrong," said Adrian Williams, an associate professor of environmental systems at Cranfield University in the U.K., but that consumers and environmental organizations would be wise to consider what these farming practices would look like on a much larger scale before making assumptions about the environmental impacts. Williams worked on the study published in Nature Communications on Tuesday. While it's unlikely that any country will pursue a complete, 100 percent transition to organic farming anytime soon, the study falls in line with others that raise questions about the degree to which these practices can mitigate the effects of climate change — and how market forces limit their ability to do so. What would a shift to 100 percent organic look like? Much research has been done about the link between organic farming and greenhouse gas emissions in smaller, niche settings, from grassland farms in Southern Germany to suckler-beef producers in Ireland. Results have been varied — while organic farming practices lowered greenhouse gases in some scenarios, in others, emissions grew or remained constant. A team at Cranfield University sought to expand this scope of research by predicting how far the food supply would carry if England and Wales made a switch to 100 percent organic farming. “The question was, how much could we produce using only organic methods?” Williams said. **Forty percent less,** it turns out. Organic farming typically produces lower **crop yields due to factors such as the lower potency fertilizers used in the soil**, which are limited to natural sources such as beans and other legumes. Williams’ model found that a 100 percent organic farming system in England and Wales would mean much smaller crop yields. For wheat and barley, for example, their production would be halved relative to conventional farming. “Having established that **there would be a shortfall in massive production, the gap would be filled by increased imports**, ” Williams said. This outcome could lead to a 21 percent rise in greenhouse gas emissions from England and Wales because those imports would likely be raised overseas through conventional agriculture. **Such a transition would render moot the potential reductions in greenhouse gas emissions that would otherwise be achieved by the switch.** Even though the Cranfield study is hypothetical in nature, environmental sociologist Julius McGee said “it’s a useful tool to pick apart agriculture’s relationship to climate change.” McGee took a similar approach back in 2015, when he authored a study that found the rise of certified organic production in the United States did not correlate with declines in greenhouse gas emissions. Governments and organizations should consider these driving market forces more carefully when touting the potential environmental benefits of organic farming, he said. “The goal of agriculture is not to produce enough food to feed people, it’s to make the most money,” said McGee, who works at Portland State University and wasn’t involved in the Cranfield study. “I was trying to get people to look beyond the elements of consumer society. Organic is a niche market, and it’s able to make a certain amount of money based on people’s desire to consume organically produced goods.” Will profits prevent an organic cleanup? Some scientists posit that as long as agriculture remains focused primarily on profit, organic farming will only have a minimal impact on environmental protection and reducing climate change. Michel Cavigelli, a soil scientist with the U.S. Department of Agriculture, works with farmers in the mid-Atlantic who are seeking to convert to organic farming. He said while the farmers in this region express concerns about the environmental harms and impacts of the agrochemicals used in conventional farming, the reason they decide to switch to organic practices is often partly driven by economics. Market demand for organic products is expected to reach $70 billion by 2025, making these crops more profitable in the long run. “In general, it’s accepted that you are going to have lower yields, but the price premium makes up for that on the economic side, from a farmer’s perspective,” said Cavigelli, who wasn’t involved in the Cranfield study. He added “they’ll live and die” by their bottom line, not their yields. Cavigelli also noted that while the USDA has had standards for labeling organic products for more than 20 years and its creation was as much about market demand as anything. “USDA doesn’t say that organic is better or worse,” Cavigelli said. “There’s a public demand for it, we need to meet that need. That’s kind of been USDA policy since 1997.” Adrian Williams of Cranfield University said the U.K. could not sustain a switch to 100 percent organic with the national diet the way it currently is, but that might not be the case if market demand for certain foods changed. “The real message is that if we try to have the same diet and convert to organic, we can’t really do it without expanding agricultural land demands, simply because it yields less than the current system,” Williams said, adding that testing a model where consumers sought out less red meat and more plant-based foods and fish could result in lower greenhouse gas emission yields from organic farming. Organic farms and the regenerative movement face a long road to sustainability Proponents of organic farming acknowledge the issue of low crop yields raised by the Cranfield Study, but maintain that farmers can still find ways to reduce their carbon footprint by focusing on “regenerative practices.” Erin Callahan, director of the Climate Collaborative, based in Vermont — an organization that seeks to reverse the emissions pollution effects created by climate change in the natural food industry — recognizes that “the yield question is a big one” when it comes to mitigating the harmful environmental effects of agriculture, but warns against reducing the discussion to a matter of "organic versus conventional." **Making the food system more efficient, wasting less food, and trying to shrink the gap in yield…is the right method forward if we actually want to have agriculture be the solution for climate change**," Callahan said, who said that the current food system in the U.S. would have to change in order for organics to make a significant impact on reversing the effects of climate change. Callahan's organization advocates for companies like General Mills — which pledged in March to regenerate 1 million acres of farmland by 2030 — to find ways to capture more carbon in their soil, even if that doesn't mean switching over entirely to organic practices. As part of their initiative, General Mills launched a regenerative agriculture scorecard for farmers to assess their soil. They also tested regenerative practices on one of their partner pastures that resulted in 68 percent less greenhouse gas emissions. There is evidence that these practices do work to cut down on greenhouse gas emissions in certain controlled situations. A widely cited white paper by the Rodale Institute in Pennsylvania found that shifting all global cropland to a regenerative model could cut annual CO_2 emissions by more than 100 percent. (Reminder: The planet will likely need to achieve a state of negative emissions to waylay climate change.) "Organic is a really important piece of the puzzle when you're looking at how to fix the food system," Callahan said. "But until then, introducing regenerative practices of any kind to do that can help."

Sustainable Conventional Farming is Better than Organic Farming

Alon **Tal**, 4-4-20**18**, "Making Conventional Agriculture Environmentally Friendly: Moving beyond the Glorification of Organic Agriculture and the Demonization of Conventional Agriculture," MDPI, https://www.mdpi.com/2071-1050/10/4/1078/htm //Vikas Nanduri

The article reviews the most recent research surrounding the potential role of organic agriculture in providing food for the planet. It challenges the claims of organic agriculture's environmental superiority compared to well-managed, conventional agriculture. The relative advantages of these contrasting approaches to farming in areas such as aggregate land requirements, biodiversity/habitat loss, water quality, land degradation and climate change are considered. Legitimate concerns about conventional agriculture's adverse environmental and health impacts need to be addressed and many harmful practices transformed. Nonetheless, **careful, sustainably-run, conventional operations can avoid many of the pitfalls and hazards which are often associated with high-input agriculture. The higher yields provided by conventional agriculture offer a more sustainable strategy** than a chemical-free agricultural system at the global level **for meeting the needs of burgeoning populations and reducing agriculture's aggregate environmental impact.**

Advocates also often conveniently overlook research indicating the many instances where **conventional agricultural systems actually show better environmental outcomes than organic alternatives.** Frequently, factors associated with the total food system enterprise (e.g., distance of crop delivery or methods of plowing) will dominate the relative sustainability of a given farm operation, regardless of its utilization of chemicals and inputs. Most importantly, notwithstanding the actual magnitude of potential risks from conventional agriculture, **its higher yields relative to organic agriculture cannot be dismissed, especially in a planet where expanding population levels make food security a paramount concern for humanity.** The question that policy makers at the macro-level need to answer is: "Given present technologies and anticipated demand for food, should organic agriculture be scaled up as the normative approach to farming at the global level?" This article considers the question based on criteria associated with global environmental sustainability, and unequivocally concludes that the answer is "no". To reach this conclusion, this article reviews the most recent research surrounding this critical debate, questioning the claims of organic agriculture's absolute environmental superiority. The relative advantages of the different approaches in areas such as aggregate land requirements, biodiversity/habitat loss, water quality, land degradation and climate change are considered. Broader aspects of sustainability, involving the economic and social issues that affect food security, are of course also important and cannot be separated from deliberations about an optimal global strategy for feeding the planet. Clearly, not only the total volume of production matters with regards to a population's ability to feed itself, but also the accompanying distribution systems along with public policies regarding distributive justice and equal access to food across societies and nations. Many commentators have made the point that, in theory, enough food is already grown on the planet to adequately feed more people than presently live on earth [32,33]. The problem can surely be framed as one of distribution and distributive justice. However, these broader socio-economic issues involve complex political dynamics and lie beyond the scope of the present article. Legitimate concerns about conventional agriculture's adverse environmental and health impacts need to be addressed and many harmful practices transformed. Yet, careful, sustainably-run, conventional operations can avoid much of the environment abuse which is often associated with high-input agriculture. Data suggest that there are circumstances where **responsibly run conventional agricultural operations may actually cause less**

environmental damage than large scale, organic farming operations. Rather than clinging to a given ideology, sustainable practices that improve environmental performance should be integrated into both existing organic and conventional farm operations. Effective, sophisticated management will allow more food to be grown on less land with only modest off-site impacts, something which is not only economically sensible, but ecologically critical.

Good Studies Say Organic Agriculture is Bad for Environment

Adrian **Muller**, 11-14-20**17**, "Strategies for feeding the world more sustainably with organic agriculture," Nature, https://www.nature.com/articles/s41467-017-01410-w //Vikas Nanduri

Organic agriculture is one concrete, but controversial, suggestion for improving the sustainability of food systems. It refrains from using synthetic fertilizers and pesticides, promotes crop rotations and focuses on soil fertility and closed nutrient cycles4, 12. The positive performance of organic agriculture when measured against a range of environmental indicators has been widely reported13,14,15,16. However, **organic systems produce lower yields17 and thus require larger land areas to produce the same output as conventional production systems. In consequence, environmental benefits of organic agriculture are less pronounced or even absent if measured per unit of product than per unit of area**14, 18. Furthermore, abandoning synthetic N-fertilizers could lead to nutrient undersupply, even with increased legume cropping19. As a consequence, **the ability of organic agriculture to feed the world sustainably has been challenged**19, 20. Some authors contribute to the discussion on lower yields in organic agriculture by considering nutrient availability, but none of these provide a robust analysis of nutrient availability in organic production systems19,20,21. In addition, these studies do not pursue a detailed food systems approach, and do not address the role that animal feeding regimes, consumption trends and food wastage (i.e. food loss and waste) may play—all of which represent factors for strategies that could substantially reduce land demand, while alleviating environmental impacts and contributing to global food availability2, 10, 22,23,24,25,26.

Going Fully Organic Increases Emissions

Matt **Mcgrath**, 10-22-20**19**, "Climate: 100% organic farming would boost emissions," BBC News, https://www.bbc.com/news/science-environment-50129353

A new study suggests that a switch to 100% organic food production in England and Wales would see an overall increase in greenhouse gas emissions. **While going fully organic would produce fewer direct emissions than conventional farming, researchers say it would limit food production.** As a result more imports would be needed, resulting in up to five times more land being used overseas. Overall emissions could rise by 21% compared to the conventional approach. Farming is generally estimated to be responsible for around 9% of overall UK greenhouse gas emissions, due to the use of artificial fertilisers, but also through emissions of methane from animals and from changes in soil conditions. This new study aims to assess what the impact would be on greenhouse gases if all food production in England and Wales switched to organic. Such a move, the researchers say would see a drop in emissions of about 20% for crops and around 4% for livestock. However, the study predicts significant drops in food production, by around 40% compared to conventional farming. **The scientists involved say that decrease is due to smaller crop yields and the introduction of nitrogen-fixing legumes into crop rotations, reducing the amount of land available for production.** So crops like wheat and barley would see significant falls in production. For livestock, the numbers of sheep and beef cattle in the scenario would increase but the volume of meat would go down, due to lower carcase weights and longer finishing times under organic management. To meet the demand for food, the study says the shortfall would have to be made up from imports. The researchers assume that a proportion of these imports would have to come from changing land use overseas. Due to significantly lower productivity in other countries, this would require five times the amount of land that is currently used for food in England and Wales. Converting grassland overseas to arable uses also reduces the amount of carbon stored in the soil. In the best case scenario, with the least amount of land change, then overall emissions are comparable to those under conventional agriculture. However, if half the land is changed from grassland, then overall emissions from UK food production would go up by 21%. "We estimate that, were organic farming to be adopted wholesale without any change in diet, we would need nearly six million more hectares of land," said one of the authors, Philip Jones, from the University of Reading. "Much of which would need to come from Europe. This has an associated impact on the environment, adding potentially unnecessary food miles and greenhouse gas emissions to our food systems." The authors acknowledge that there would be significant benefits for cleaner air and water and improved biodiversity under a fully organic farming future. But critics of the study have focused on the fact that it presumes that there will be no change in people's diets. "The assumptions behind the study's conclusion that there will be a net increase in greenhouse gas emissions under organic are fundamentally flawed," said Rob Percival of the Soil Association. "The study assumes no change in diet, which is clearly untenable given the global dietary health crisis, and that we would keep diverting most of our cropland to over-production of the wrong things - livestock feed, commodity crops for processed food and biofuels." The researchers involved in the study responded to these criticisms by underlining the fact that that wasn't the goal of this piece of research. "The assumption about diets is crucial:

today's organic consumers are a self-selecting group and not typical of the nation," said co-author Dr Adrian Williams from Cranfield University. "Whether a different national diet could be provided by the same land area under all organic production is a different study. This was aimed at understanding limits to production. The study was based on rigorous modelling that had its foundations in establishing the biophysical limits of crop production without manufactured nitrogen."

Status Quo Reforms Independent of Organic Agriculture Solve Environmental Concerns

Ben **Riensche**, 9-20-20**19**, "Here's how we can use agriculture to fight climate change," World Economic Forum, https://www.weforum.org/agenda/2019/09/here-s-how-we-can-use-agriculture-to-fight-climate-change/ //Vikas Nanduri

2019 will go down in history as the most difficult planting season for North American farmers, with over 10 million acres of crops going unplanted due to extreme weather conditions. At the same time, farmers in Punjab, in India, are experiencing rain showers almost every month and, for the first time in its history, more humid air is leading to greater pest infestations. The effects of climate change can be felt daily, especially by farmers, but very few solutions have been discussed to address this catastrophic threat. However, there is one, widely unknown solution to reducing the amount of greenhouse gases trapped in the atmosphere: agriculture. **Reducing tillage, expanding crop rotations, planting cover crops and reintegrating livestock into crop production systems have proven to reduce agriculture's own footprint as well as capture the excess carbon generated by other industries.** This captured carbon is then converted into plant material and/or soil organic matter, improving soil health and increasing the ability to produce food on the land in the future. These practices often reduce input costs as well. Adopting these practices seems like the obvious choice, so you might be curious why a majority of farmers globally have continued using traditional agriculture practices. We have an answer to that. As lifelong farmers in two different geographies, we reflect on our difficult journeys as we begin to adopt these management practices and the multiple barriers we are facing along the way. Pursuing a greener production system requires farmers to embark on uncharted territories with no guarantee of immediate success. Farmers usually experience decreased yields during the transition process, as they gain the required experience to learn and perfect the implementation of more regenerative and beneficial practices. A decrease in production poses a difficult financial challenge to overcome – especially for Indian farmers, who already have a hard time competing with developed nations, where subsides have artificially driven down the price of agriculture produce. The government's import and export policy decisions, which heavily favour consumers over producers by keeping prices artificially low, also have a large impact on the ability of farmers in India to adopt more sustainable practices. In the US, farmers face systematic financial challenges, like difficulty accessing sustainable inputs at a reasonable price. Farm input suppliers are highly concentrated, exerting significant pricing power and making systems innovation unattractive to their bottom line. The resulting high operating costs, along with the required upfront costs, increase the need for access to external capital. However, capital is most available to farmers with the most traditional, low-return production systems. In short, generally the systems that are least regenerative, emit the most greenhouse gases, and result in the most land degradation, are the most likely to have access to capital. Subsidies and regulations play a role in the availability of external capital, since these cash streams serve as a de-risking mechanism for finance players. The US government's policies, such as a federally subsidized crop insurance, focus on ensuring a stable food supply rather than on the nutritional value or environmental impacts of the food being produced. This focus on quantity over quality is the same in India, where decision makers have rolled out an initiative to increase food production by the year 2050. This goal has become the cornerstone of India's national policy and the metric for measuring farmers' success. Another key challenge we face is the lack of data and available information on these management practices as well as the lack of ways to measure which of these new, innovative systems store the most carbon in the earth’s soil. Such a tool would open the door to private parties compensating farmers for sequestering carbon. In the meantime, governments' regulations, along with growers' low profit margins, stifle farmer innovation, limiting the ability for new, creative thinkers to join the industry or for current farmers to test new practices. For example, subsidized crop insurance in the US inflates the value of farmland and locks producers into a low risk, low reward system, making it hard for new smallholder farmers to enter the business or current farmers to walk away from the easy revenue. Additionally in the US, the tax code makes it financially efficient to sell or exchange farms and farmlands only after death. Also, farmland investments may be used to shelter gains realized on non-agriculture real estate, further increasing the barrier to entry. In both the US and India, there is a lack of financial incentives for farmers to pursue innovation, while public funding for fundamental research and the application of research to agricultural practices, have been reduced in real terms. Starved of funds, the public research system has taken the easier path and focused on identifying ways to maximize farm yields through mono-cropping and chemical usage, both of which increase agriculture emissions. This research further dissuades farmers from adopting sustainable practices. One way to incentivize farmers to focus on increasing soil health is through de-commoditizing production and making it easier to identify and track producers, as food makes its way from farm to table. Doing so would unlock consumer demand as an incentive for greener farming. If consumers are willing to pay a higher price for food products that have been grown in an environmentally friendly manner, the economics of the system could be turned on its head. Unfortunately, US crop buyers currently blend and commoditize production, leaving no pathway for consumers to reward farmers for establishing more favourable production systems. In India, where disposable income is fairly limited, increasing the price of foods could limit individuals' ability to purchase foods, amplifying the fear of food inflation, a problem the government dreads. As we have experienced firsthand, farmers face a variety of misaligned incentives when trying to adopt sustainable management practices – some of which require the whole ecosystem of actors to work together to overcome. Each country, climate, and plot of land poses their own set of challenges, and it is clear there is no "one size fits all" solution. However, addressing these barriers is critical to unlocking agriculture's ability to solve a portion of the climate change problem. We haven't heard of a more compelling solution, have you?

Agricultural Innovation solves Emissions

Jeffrey **Sayer** and Kenneth G. Cassman, 5-21-20**13**, "Agricultural innovation to protect the environment," PNAS, https://www.pnas.org/content/110/21/8345

In a world of 9.5 billion people, global demand for food, fiber, and biofuels has to be met with minimal possible increases in land, water, fossil fuels, and the minerals **used to produce** fertilizers (1⇓⇓–4). The problem is debated at three levels: first, that agriculture will not be able to produce enough because it will come up against both biophysical and environmental limits that restrict yields (3, 5, 6); second, that the need to expand and intensify agriculture will destroy the broader environmental values of forests, wetlands, marine systems, and their associated biodiversity (7⇓–9); and third, that there are institutional obstacles to the diffusion and **adoption of** the **innovations** that **could solve these problems.** Although there is debate on these issues, **there is** also s**trong consensus that we are witnessing unprecedented changes in our major agricultural systems** (6). **Major shifts are occurring in the way food and other agricultural commodities are produced,** in the scale at which this happens, in the geographical locations of agriculture, and perhaps most notable, the agencies and actors driving these processes (10⇓⇓⇓–14). Growth in demand for agricultural products will mainly occur in markets of emerging economies, particularly in the most populous countries of Asia and Sub-Saharan Africa. Therefore, the ways in which China, India, Indonesia, Bangladesh, Nigeria, Ethiopia, and South Africa respond to growing food demand will be major determinants of environmental change at a global scale (3, 6, 11). The papers in this special feature of PNAS highlight innovations in agriculture that could contribute to producing more food without increasing environmental pressures. The papers are based on some of the more exciting ideas that emerged from a forum in Beijing in October 2011 that brought together agricultural and environmental scientists from China with their peers from the rest of the world (12, 13). The papers collectively consider how agricultural science is responding to environmental challenges. Agricultural land is now required to deliver multiple environmental and production services (9, 14, 15). The issues are often beset by "wicked problems" (16, 17) where different communities of scientists and practitioners are unable to agree on the framing of questions and therefore advocate divergent solutions (18, 19). The papers explore implications of different combinations of technologies, institutional arrangements, and policies on the agriculture–environment nexus (20, 21) and attempt to link the global resource management discourse with the realities faced by poor farmers in developing countries (3). They endorse four strategic objectives: ensuring production of adequate food, alleviating poverty, achieving better health and nutrition for a growing population, and conserving the natural resource base upon which all of this depends (22⇓–24). Agricultural innovation is essential to address environmental problems in a world that must soon support more than 9 billion humans. Poverty and food insecurity go hand in hand (1). For the 2 billion malnourished poor in developing countries, short-term food security is inevitably a higher priority than long-term environmental sustainability. A large proportion of rural poor in the tropics live in regions with marginal land and climate for agriculture (25) or in areas with more favorable climate that lie at the interface between agriculture and remaining carbon-rich and biodiverse natural ecosystems such as rainforests, wetlands, grasslands, and savannas (26). Feeding 9 billion people and lifting rural poor out of poverty is a prerequisite for maintaining the planet's environment. Many people are leaving rural areas and seeking employment in manufacturing and services in cities. However, this opportunity is not open to all. Large numbers of poor farmers continue to practice extensive agriculture. Inevitably they will continue to encroach on hitherto uncultivated lands unless they can adopt innovative systems that allow for agricultural intensification and development of agricultural equipment industries, farm inputs, and food processing capacities. To this end, much agricultural research continues to focus on how to increase productivity on this existing farm land. Improved efficiency in the use of land and agricultural inputs is already contributing to environmental goals. Quantifying food production capacity of currently farmed land has focused on estimating "yield gaps" (i.e., the difference between current farm yields and the potential that can be achieved with good crop and soil management). Yield gap analysis allows the identification of regions with the greatest potential for higher yields (27⇓–29). Need for more precise and geospatially explicit yield gap estimates are the target of the Global Yield Gap Atlas (www.yieldgap.org). However, increasing productivity is necessary but not sufficient to ensure food security, reduce poverty, improve nutrition, and maintain the natural resource base for sustainable development (6). Innovations across a broader spectrum of policies and technologies are needed to confront the complex array of challenges at the agriculture–environment nexus (1, 21). Many practicing agricultural scientists are working to solve immediate problems of poor farmers. A marked shift is occurring in the way agricultural research is conducted. In particular, there has been a move from single-factor, mainly on-station research toward active engagement with farmers and farm communities to encourage experimentation and innovation. A recurring theme is the use of concepts such as Integrated Agricultural Research for Development (IAR4D) (30). This "systems science" approach (31) and a number of similar concepts share much with the underlying principles of Sustainability Science. IAR4D attempts to harness science to address complex multifunctional agricultural objectives and to engage farmers and their communities in the process (30, 32). It seeks to influence multiple drivers of change in agricultural landscapes (17, 15). There is broad consensus among agricultural researchers that such integrated approaches are needed although the empirical evidence for their impact is still weak (13, 33). There are methodological challenges to assessing the impact of such complex, multidimensional research (34, 35). A range of approaches to measuring impact, such as Theories of Change and Impact Pathways, are now available (30). IAR4D and other integrated approaches are seen as best practice in achieving rural innovation rather than as a magic bullet (12, 13, 30). This collection of papers exemplifies the evolution of understanding of agricultural innovation practices and provides empirical evidence on policies and technologies that allow more crops to be produced on less land, with more efficient use of inputs and under conditions of global change. One major area of uncertainty has been the impact of agricultural intensification on land use (11, 36). Studies in different situations have come to contrasting conclusions on the extent to which intensification can lead to "land-sparing" (37, 38). Several studies have shown that it is difficult to make simple generalizable statements about the land-sparing role of agricultural intensification and that effects are highly context specific (39, 40). Analysis of the land-saving claims made for the Asian green revolution shows that some land was spared—although not as much as earlier authors had claimed because higher food prices would have occurred without the green revolution and price increases would have resulted in reduced global food demand (38). It is clear that negative impacts of higher food prices on poverty and hunger under this scenario would likely have dwarfed the welfare effects of agricultural expansion. This ex-post analysis of the impacts of green revolution crops reveals the complex web of interacting drivers of change that combined to transform

Asian landscapes (36, 38). More food was produced and some natural habitats were spared. However, it also emerges that parallel changes in policies, infrastructure, markets, and other dimensions of the agricultural landscape made significant contributions to these changes. This work highlights the need for improved understanding and models that fully capture the interacting economic, political, social, and biophysical contexts of agricultural innovation within the IAR4D framework (31, 32). Governance and institutions mediate all changes in rural landscapes. The importance of institutions is illustrated in Western China where improved environmental outcomes in managing common-property pastureland required changes in six nested tiers of institutional structures (41). Integrated biophysical and policy research achieved positive outcomes in this situation, but there are very many situations around the world where such an orchestrated cascade of change has been difficult to achieve. The paper by Kemp et al. (41) shows how an appropriate institutional context can allow agricultural production to be expanded while also achieving more favorable environmental outcomes. Reliance on use of nitrogen fertilizer to support high yields is perhaps the Achilles heel of modern crop production (42, 43). Nitrogenous fertilizer is essential for modern agriculture, and the lack of access to it is a major obstacle to yield increases in Africa. However, its misuse has negative impacts on water quality and climate through emissions of nitrous oxide, a greenhouse gas (GHG) 300 times more potent in global warming impact than carbon dioxide (44). Industrial production of reactive nitrogen, mostly used to fertilize food crops, now exceeds the global total produced from all natural sources (45). Although atmospheric N2 is relatively inert, reactive nitrogen, including ammonia, nitrate, and organic forms including nucleic and amino acids, and other amines and amides are required as building blocks of all living organisms. Chinese agriculture is particularly egregious in this regard because it uses far more nitrogenous fertilizer per unit of crop production than comparable systems in Europe or North America. Recent research has shown that **emissions** of GHGs **from the entire nitrogen fertilizer life cycle in China could be reduced by up to 60% by 2030** (46). Of particular note is that the potential improvements will be achieved equally from increased efficiency of fertilizer production and from its more efficient on-farm use (47). A comparison of ecological efficiency of agriculture in Australia, China, and Zimbabwe shows that Australian farmers are approaching biophysical limits to achieving further improvements in efficiency but that major improvements remain possible in China and Zimbabwe and by extension in much of the developing tropical world. However, the scope for improving eco-efficiency is not the same for all cropping systems (47). The value of on-farm biodiversity is both advocated and contested—often in the absence of empirical evidence (18, 19). Simple, specialized systems with their economies of scale and high yields are consistent with a model of economic rationalization. Complex, biodiverse systems appeal on grounds of ecological efficiency and aesthetics and possibly confer resilience to external shocks to agricultural systems (18, 19). An empirical study of biological diversity and pollination in coffee growing regions of southwest India shows that, whereas on farm biodiversity values may have been exaggerated, they are nonetheless significant and complement positive effects on productivity that can be achieved with improvements in crop management (48). Fish are vital sources of food for many of the world's people, both rich and poor. Conventional wisdom holds that the move to intensive aquaculture to meet burgeoning demand is inevitable. Fish would therefore join trees and commodity agricultural crops in being produced in intensive industrial systems, and harvesting from near natural ecosystems would become less important. However, evidence is presented (49) that, for many, especially the poor in developing countries, wild capture fisheries will continue to be vital resources for decades to come—and with proper management they have the capacity to meet greatly increased demand. Natural aquatic systems can yield multiple products and values so perhaps the juggernaut of intensification and simplification will not always overwhelm traditional diverse production systems. Timber and environmental services from managed natural forests (50), diverse products and services from agroforests, and mosaics of production and conservation uses (15) may represent alternative scenarios for the agriculture–environment nexus (18).

<u>Organic Agriculture Increases Food Prices</u>

Organic Agriculture is resource intensive, drives up food costs and increases final prices

Andrea **Carlson**, 5-24-20**16**, "USDA ERS," United States Department of Agriculture, https://www.ers.usda.gov/amber-waves/2016/may/investigating-retail-price-premiums-for-organic-foods/ //Vikas Nanduri

Since USDA began regulating organic labels on food in 2002, the organic food sector has been one of the fastest growing sectors in the food industry. According to the *National Business Journal*, total sales for organic food were just under $11.5 billion in 2004, climbing to an estimated $37 billion in 2015. Organic food sales even grew during the Great Recession, as organic products became available in more retail outlets, and growth has continued since. The Organic Trade Association reports that from 2011 to 2012, organic food sales grew 10.2 percent versus 3.7 percent for all food sales, and that organic sales were up 11.3 percent from 2013 to 2014. ERS research in 2005-06 found that organic premiums ranged from about 15 percent for onions and carrots to about 109 percent for skim milk. A 2010 study by the Hartman Group, a private marketing consulting company, reported that consumers believed that the price gap between organic and nonorganic foods was getting smaller. The same study claimed that <u>**many consumers were unwilling to pay a premium of more than 30 percent for organic food.** A recent ERS study set out to determine what price premiums consumers *are* paying for organic foods and whether those premiums are declining over time. In estimating the retail price difference between 17 organic products and their nonorganic counterparts from 2004 to 2010, the researchers found that **all organic products were more costly than their nonorganic counterparts** and that **the premium was above 20 percent** for all but spinach.</u> Most premiums did not steadily increase or decrease during the 7 years studied, but fluctuated. Of the 17 products examined, only 4—spinach, canned beans, granola, and coffee—saw premiums generally decline. Only strained baby food's and yogurt's price premiums generally increased. Product-specific supply and demand factors help explain some of the differences among the estimated organic price premiums for the 17 products.

Price Premiums are 30%

Eva-Marie **Meemken** and Matin Qaim, 3-29-20**18**, "Organic Agriculture, Food Security, and the Environment," Annual Reviews, https://www.annualreviews.org/doi/10.1146/annurev-resource-100517-023252 //Vikas Nanduri

Organic farming can only contribute to sustainable agricultural development when it is economically viable for farmers, meaning that the income derived from organic production is at least as high as that from conventional farming. A recent meta-analysis has analyzed this issue and includes studies from 14 different countries (Crowder & Reganold 2015). Results show that organic farming is 22–35% more profitable than conventional agriculture on average. While organic yields are significantly lower, organic farmers receive higher prices for their products in certified organic markets. **Average price premiums at the farm level are on the magnitude of 30%.** Without price premiums, organic farming would be less profitable than conventional farming (Crowder & Reganold 2015).

Increasing Food Prices hurts Poor People

Rosemary **Green**, 6-17-20**13**, "The effect of rising food prices on food consumption: systematic review with meta-regression," BMJ, https://www.bmj.com/content/346/bmj.f3703 //Vikas Nanduri

This is the first review to quantify systematically **the relation between food prices and demand for food worldwide**, and the first to explore differences in this relation between household income groups. To demonstrate the value of the elasticities presented, we estimated the effect of price changes on presumed consumption (as estimated from Food and Agriculture Organization data on food availability). Food and Agriculture Organization food availability data are a proxy for national level food consumption that have been shown to correlate with other measures of food intake and health outcomes.[21,22] Based on our predicted price elasticities, **a 10% increase in the** global **price** of cereals **would reduce demand** for cereals **by 6.1%** in low income countries and 4.3% in high income countries, equivalent to 301 kJ (72 kcal) and 167 kJ (40 kcal) reductions on average in cereal availability per person per day in low and high income countries, respectively. The estimated 75% greater reduction in low income countries in demand for cereals that often form the predominant part of the diet shows the unequal impacts of global changes in food prices. Our analysis also suggests that **poorer people** in low income countries **will**

suffer the most and highlights that **higher food prices may substantially increase their risks of undernutrition**. For wealthy countries aiming to use taxes and subsidies beneficially to influence dietary patterns, the analyses suggest that compared with low income countries the influence of food prices on demand is attenuated and that household income will largely determine the effectiveness of such strategies at a population level.

Organic Agriculture isn't Sustainable

Organic Culture can't meet increased demand by 2050

Eva-Marie **Meemken** and Matin Qaim, 3-29-20**18**, "Organic Agriculture, Food Security, and the Environment," Annual Reviews, https://www.annualreviews.org/doi/10.1146/annurev-resource-100517-023252 //Vikas Nanduri

Organic agriculture is often perceived as more sustainable than conventional farming. We review the literature on this topic from a global perspective. In terms of environmental and climate change effects, organic farming is less polluting than conventional farming when measured per unit of land but not when measured per unit of output. Organic farming, which currently accounts for only 1% of global agricultural land, is lower yielding on average. Due to higher knowledge requirements, observed yield gaps might further increase if a larger number of farmers would switch to organic practices. Widespread upscaling of organic agriculture would cause additional loss of natural habitats and also entail output price increases, making food less affordable for poor consumers in developing countries. Organic farming is not the paradigm for sustainable agriculture and food security, but smart combinations of organic and conventional methods could contribute toward sustainable productivity increases in global agriculture. Organic food is increasing in popularity. The growing demand is mainly attributable to consumer concerns about negative implications of conventional agriculture for human health and the environment. Especially in developed countries, most consumers consider organic food to be safer and healthier than conventionally produced food (Funk & Kennedy 2016). Rich-country consumers often also perceive organic farming to be better for the environment, climate protection, and animal welfare (Seufert et al. 2017). In Europe in particular, organic farming has such a positive public image that it is commonly touted as the paradigm for sustainable agriculture (Mercati 2016). A representative survey carried out in Germany showed that approximately 50% of the population considers wider adoption of organic agriculture as an important strategy to fight global hunger (Klümper et al. 2013). The same survey revealed that agrochemicals and genetically modified organisms (GMOs) are often perceived as major threats to food security. In developing countries, the awareness of organic agriculture is still lower, but European perceptions and food preferences are also starting to gain ground, especially among better-off urban consumers (Greenpeace 2015, Probst et al. 2012). In the academic literature, the views are more nuanced, but the conclusions about the role of organic agriculture for global sustainable development differ widely. Some consider organic agriculture as inefficient and mainly driven by ideology (Connor & Mínguez 2012, Lotter 2015, Trewavas 2001). Others see great potential in organic farming to feed the world in an environmentally friendly way (Badgley et al. 2007, Reganold & Wachter 2016). Over the last several decades, green revolution technologies, including high-yielding crop varieties and complementary inputs such as synthetic fertilizers, pesticides, and irrigation water, have contributed substantially to productivity growth in agriculture and improvements in global food security (Evenson & Gollin 2003, Qaim 2017). Nevertheless, approximately 800 million people are still chronically undernourished, most of them living in Asia and Africa (FAO 2017). Over the next few decades, the demand for food will increase further due to population and income growth. In addition, plant-based products are increasingly being used as renewable resources. **To keep up with this rising demand,** it is estimated that **global agricultural production will have to increase by at least 60%** and possibly up to 100% **until 2050** (Godfray et al. 2010, Hertel 2015). This is a major challenge because land, water, and other natural resources are becoming increasingly scarce. Furthermore, the input-intensive agricultural production systems observed in many parts of the world are responsible for—or at least contribute to—major environmental problems, such as land degradation, biodiversity loss, water pollution, and climate change (Foley et al. 2011). Increasing production while reducing the environmental footprint will require profound changes in food and agricultural systems and the types of technologies used. But is organic agriculture the solution? This question is addressed here by reviewing the extensive literature on various aspects of certified organic farming, including economic, social, environmental, and health effects.

When evaluating the potential of organic agriculture to contribute to sustainable development, a central question concerns the yields obtained in comparison to conventional farming. Estimating yield effects of organic practices is not easy, as confounding factors have to be controlled for. For instance, when organic farmers obtain lower yields, this may be due to the organic practices, but it is also possible that the farmers are less talented or operate in less-favorable environments than their conventional colleagues. In the latter case, organic farmers would have lower yields anyway, even when applying the same technology, so the yield gap of organic farming practices would be overestimated. On the other hand, it is also possible that organic farmers are systematically more talented than their conventional counterparts, which would lead to underestimated yield gaps when simply comparing observed organic with conventional yields. Surprisingly little research has tried to control for such selection bias in estimating yield effects of organic farming based on observational data. Nevertheless, numerous studies have tried to estimate yield effects of organic farming, often using data from trials on experimental stations. Experimental data help to avoid bias through confounding factors but have their own problems in terms of external validity (see below). Available studies show a wide range of results, depending on the particular context. In some situations, organic yields were found to be higher than conventional yields, whereas in other situations they were considerably lower. More recently, a few review papers have tried to synthesize the evidence. A first attempt in this direction was a study by Badgley et al. (2007). The authors used results from various sources to conclude that organic agriculture had 33% higher average crop yields than conventional agriculture at the global level. In developed countries, organic yields were 9% lower than conventional yields, but in developing countries, the authors claimed that organic practices would increase crop yields by 74% (Badgley et al. 2007). **However, this study was heavily criticized on various grounds** (Cassman 2007, Connor 2008, Goulding & Trewavas 2009). **Many of the studies included in the review by Badgley et al. (2007) did not meet minimum**

scientific standards in terms of experimental design (Cassman 2007). Other relevant studies were simply ignored (Goulding & Trewavas 2009). For developing countries, Badgley et al. (2007) mostly compared yields of crops that had received high levels of organic nutrients as the organic version with crops that had received very little or no fertilizer as the conventional version (Connor 2008). Hence, despite being highly cited, the results of Badgley et al. (2007) are not reliable and meaningful. **Three scientifically more rigorous meta-analyses of organic-conventional crop yield comparisons were published in the last few years (de Ponti et al. 2012, Ponisio et al. 2015, Seufert et al. 2012).** Results of these analyses are summarized in **Table 2**. Across all crops, mean yield gaps of organic agriculture are in the magnitude of 19–25%. Considerable differences can be observed across different crop species, with legumes and fruits showing smaller yield gaps than cereals and root and tuber crops. There is some evidence that the yield gap increases as conventional yields increase (de Ponti et al. 2012). Under best management practices for both systems, yield gaps do not seem to differ significantly between developed and developing countries (Ponisio et al. 2015). However, in all three meta-analyses, observations from developing countries are heavily underrepresented (Seufert & Ramankutty 2017), so statements about geographic differences of yield gaps need to be interpreted with caution. Longer-term research was recently started to improve knowledge about the productivity effects of organic farming in developing countries (Forster et al. 2013).

Many see organic agriculture as the most sustainable form of farming and as the paradigm for global food production in the future. Hence, the question of whether organic agriculture alone could actually feed the world with its 7.5 billion people today, and likely over 9 billion people by 2050, arises time and again (Badgley et al. 2007, Connor 2008, Erb et al. 2016, Seufert & Ramankutty 2017, Muller et al. 2017, Taheri et al. 2017). Given that organic farming today only accounts for 1% of the agricultural land, **a total conversion to organic agriculture does not seem to be a realistic scenario in the foreseeable future**, but it is nevertheless an interesting thought experiment.

6.1. Food Production Quantities As discussed, average crop yields are lower in organic than in conventional agriculture. Consequently, total conversion to organic practices would require more land to produce the same quantity of food. Section 3 discussed the average organic yield gaps of 19–25%, which would mean additional land requirements of 23–33%. But in Section 3 we also discussed that yield gaps could increase if more farmers adopted organic agriculture. Organic farming is more knowledge intensive than conventional farming; therefore, there is little reason to assume that organic yields obtained on experimental stations or on 1% of the agricultural area could be extrapolated to all agricultural land worldwide. Larger yield gaps are especially likely when it comes to upscaling organic agriculture in the developing-country small farm sector, where levels of formal education are often low, and access to agricultural training is limited. **Average yield gaps of** 30–**40% would already mean that** 43–**67% of additional land would be required to produce the same quantity of food with organic practices, implying a significant loss of natural habitats.** Another relevant question is whether sufficient nutrients from organic matter would be available if all of the world's agriculture were converted to organic practices (Tomich et al. 2011). Today, organic agriculture often relies on nutrient inputs from conventional farms and heavily depends on the livestock sector (Nowak et al. 2013). But would there be enough animal manure available to supply nutrients to a much larger area under organic production? Currently only about 11% of the nitrogen inputs to global crop production come from animal manure, and another 8% are from crop residues (Seufert & Ramankutty 2017). Completely replacing synthetic fertilizers, which are banned in organic farming, would mean significantly increasing the number of farm animals kept. Given the climate effects of animal husbandry and the additional land required for fodder production, this would hardly be a sustainable scenario. Alternatively, more leguminous cover crops could be grown to restore nitrogen in the soil. However, providing sufficient nitrogen would require a legume cover crop on each field every year, which would not be possible without reducing the area available for food production (Connor 2008). Providing insufficient nutrients would mean additional yield gaps. In summary, providing sufficient food for the growing world population through organic farming alone might be possible but not without taking significantly more land into production. The expansion of agricultural land is a major contributor to biodiversity loss and climate change (Foley et al. 2011, Green et al. 2005). As discussed in Section 5, the biodiversity gains from organic production cannot offset the biodiversity losses associated with additional land-use change. In other words, **complete conversion to organic agriculture would likely be associated with additional** GHG **emissions and a net loss in biodiversity**. 6.2. Sustainable Consumption When calculating the food quantities that have to be produced to feed the world population, current patterns and trends of food consumption are typically assumed. However, a significant share of the food produced is lost or wasted along the value chain, including foods thrown away by the end-consumer (FAO 2011). Moreover, the high consumption of meat and dairy products in many parts of the world is associated with considerable resource inefficiencies. In other words, much less food production would be required if food losses and waste were reduced and if all people became vegetarians or vegans. Such a scenario could certainly change the conclusions about the potential of organic agriculture to feed the world. Indeed, in recent simulations, Erb et al. (2016) and Muller et al. (2017) showed that the predicted world population in 2050 could be fed even with lower yields and without the loss of additional natural habitat if only vegan diets were consumed.

Organic Agriculture has lower crop yields and thus demands more land

Daniel T **Cross**, 12-17-20**18**, "Organic farming isn't all that sustainable, a new study says," Sustainability Times, https://www.sustainability-times.com/environmental-protection/organic-farming-isnt-all-that-sustainable-a-new-study-says/

Organic farming is much better for the environment because fewer or no chemicals are used in crop cultivation. Or so it is commonly believed. Yet **because organic farming tends to have significantly lower crop yields, far more land is required to grow the same amount of food** that intensive agriculture can produce, according to a recent study. To feed the billions of hungry mouths on the planet, going fully organic would entail reclaiming vast swathes of additional land for agriculture. Much of that extra land would have to be taken from forests, which would harm the environment. A new study, published in the journal Nature, now underlines the same point. An international team of researchers studied peas and wheat cultivated organically in an area of Sweden. They found that organically farmed food has a bigger climate impact than the conventionally farmed variety because organic farming requires significantly more land. As a result, organic farming can also lead to much higher levels of greenhouse gas emissions. "Our study shows that organic peas, farmed in Sweden, have around a 50 percent bigger climate impact than conventionally farmed peas," says Stefan Wirsenius, an associate professor from Chalmers University of Technology in Sweden who was an author of the study. "For some foodstuffs, there is an even bigger difference – for example, with organic Swedish winter wheat the difference is closer to 70 percent." Organic food is worse for the climate than conventionally farmed food because the lack of fertilizer use results in much lower yields per hectare. That is why **growing food organically and reducing carbon emissions at the same time is not a viable strategy**. "A finite global land area implies that fulfilling these strategies requires increasing global land-use efficiency of both storing carbon and producing food," the researchers write. "The greater land-use in organic farming leads indirectly to higher carbon dioxide emissions, thanks to deforestation," Wirsenius says. "The world's food production is governed by international trade, so how we farm in Sweden influences deforestation in the tropics. If we use more land for the same amount of food, we contribute indirectly to bigger deforestation elsewhere in the world." There's another aspect to this issue, however. Even though organic farming may be worse for the climate, at least on a large scale, it is better for local environments around farms. Toxins from chemicals used in fertilizers and pesticides often leach into water sources and accumulate in soils where they can wreak havoc with local ecosystems.

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Organic Agriculture Harms Small Farmers

Enormous Costs of Organic Agriculture hurt Small Farmers

Eva-Marie **Meemken** and Matin Qaim, 3-29-20**18**, "Organic Agriculture, Food Security, and the Environment," Annual Reviews, https://www.annualreviews.org/doi/10.1146/annurev-resource-100517-023252 //Vikas Nanduri

Organic farming can only contribute to sustainable agricultural development when it is economically viable for farmers, meaning that the income derived from organic production is at least as high as that from conventional farming. A recent meta-analysis has analyzed this issue and includes studies from 14 different countries (Crowder & Reganold 2015). Results show that organic farming is 22–35% more profitable than conventional agriculture on average. While organic yields are significantly lower, organic farmers receive higher prices for their products in certified organic markets. Average price premiums at the farm level are on the magnitude of 30%. Without price premiums, organic farming would be less profitable than conventional farming (Crowder & Reganold 2015). Whereas the meta-analysis by Crowder & Reganold (2015) includes data from different parts of the world, most of the original studies refer to the United States and other developed countries. Only a few of the studies refer to developing countries, and no single study looked at the situation in Africa. In terms of absolute numbers, most organic producers are smallholder farmers in developing countries. Moreover, **smallholder farmers comprise a large share of the world's poor and hungry people (FAO 2014, Qaim 2017).** Hence, a better understanding of what organic farming can mean economically for farmers in developing countries is important (Jouzi et al. 2017). A review of studies focusing on socioeconomic aspects or organic farming in Africa, Asia, and Latin America is provided below. 7.1. Smallholder Farmers and Organic Yields As discussed in Section 3, yields obtained with organic production methods tend to be lower than those in conventional agriculture. However, yield differences depend on the particular context. In situations where most farmers have limited access to modern production technologies and apply low quantities of purchased inputs anyway, organic yields can be similar to conventional ones (Beuchelt & Zeller 2011, Jena et al. 2017, Kramol et al. 2013, Parvathi & Waibel 2016). This is not an untypical situation of smallholders in developing countries, especially in Africa. With intensive training and a substantial increase in the use of organic fertilizers, organic yields can even be significantly higher than those obtained from low-input conventional farming (Bolwig et al. 2009, Ibanez & Blackman 2016, Wollni & Andersson 2014). Employing organic soil management practices can also reduce yield variability and vulnerability to drought and other weather extremes (Niggli 2015, Scialabba & Müller-Lindenlauf 2010). However, where modern inputs are available and more commonly used, organic farmers typically have lower yields than conventional farmers. Yield gaps tend to increase during the process of economic development (Valkila 2009). 7.2. Price Premiums Most organic farmers in developing countries produce cash crops (e.g., coffee, tea, cocoa, tropical fruits) for export to rich countries, where consumers pay a significant price premium for certified organic products (Raynolds 2004, Willer & Lernoud 2017). However, **the price premium at the retail level is not necessarily reflected in the price that farmers receive for their organic produce** because various actors along the value chain also capture some of the benefits (Minten et al. 2018). In some cases, **prices received by organic farmers** in developing countries **are not higher than those in conventional markets** (Chiputwa et al. 2015, Parvathi & Waibel 2016). Nevertheless, most studies find that organic premiums at the farmer level range between 6% and 44% (Beuchelt & Zeller 2011, Bolwig et al. 2009, Ibanez & Blackman 2016, Jena et al. 2017, Jones & Gibbon 2011, Kleemann et al. 2014, Mitiku et al. 2017, Valkila 2009). However, **oftentimes organic smallholders do not sell all of their harvest in certified markets** (Jena et al. 2012, 2017; Kleemann et al. 2014). There are several reasons why they may decide to sell some or all of their crops in conventional markets. First, sometimes the quality requirements of certified markets cannot be met (Bolwig et al. 2009, Weber 2011). Second, there can be situations when the farmer organizations lack the capacity to handle the large supply of certified crops delivered by their members (Jena et al. 2012, Snider et al. 2017). Third, price premiums vary and can be small during certain periods (Snider et al. 2017). Finally, even when price premiums are more significant, selling in certified markets is often associated with payment delays. When facing urgent cash needs, organic farmers sell to local traders at lower prices but in return for immediate cash (Bacon 2005, Beuchelt & Zeller 2011, Valkila 2009). Given these conditions and constraints, **the average price that organic smallholders receive may be lower than what the reported price premiums may suggest.** 7.3. Production Costs In the small farm sector, certification fees and related administrative costs are typically covered by farmer cooperatives, exporters, or development organizations. However, meeting certification requirements is often associated with certain investment costs (e.g., new equipment) that farmers have to bear individually (Kleemann et al. 2014). Also, **organic certification involves a three-year transition period**, which can be understood as **a sunk cost**. During this transition period, farmers cannot yet benefit from an organic price premium, but yields are often particularly low due to learning and experimentation with the new production methods (Caldwell et al. 2014, Ruben & Fort 2012, Weber 2011). Organic certification can also influence variable production costs. Although costs for chemical inputs are saved, maintaining and increasing yields requires large quantities of organic material (e.g., manure). The organic matter available at the farm itself may not suffice, so that additional material has to be purchased (de Ponti et al. 2012). **The cost can be substantial, especially when local market supply of organic matter is limited** (Jena et al. 2017, Kloos & Renaud 2014). Furthermore, **organic farming is typically more labor intensive, as manual labor is needed for** weeding, application of organic fertilizers, and other **operations** (Valkila 2009). Consequently, households have to hire additional labor or use more family labor (Beuchelt & Zeller 2011, Kleemann et al. 2014, Ruben & Fort 2012). Most studies focusing on developing countries do not account for the opportunity cost of family labor. With the increasing availability of off-farm income opportunities, this may lead to underestimation of the total production costs in organic farming. 7.4. Indirect Economic Benefits In addition to possible price premiums, organic certification may also be associated with indirect economic benefits. In developing countries, certified farmer organizations (or buyers) usually offer services, such as price information, training, credit, or value addition, to help farmers meet certification requirements and produce the quality demanded in international organic markets (Bolwig et al. 2009, Jones & Gibbon 2011). As smallholder access to rural services is generally low, such initiatives by certified organizations can improve the situation more broadly and result in income gains (Mitiku et al. 2017, Parvathi & Waibel 2016). However, the range and quality of services to be provided is not specified in organic standards, so the relevance of such indirect benefits varies (Jena et al. 2012, Meemken et al. 2017a). Collective marketing or contractual arrangements are also commonplace in smallholder organic value chains. Such arrangements can be beneficial for farmers irrespective of organic certification (Bellemare 2012, Fischer & Qaim 2012). But as new marketing institutions are often established as part of certification initiatives, related gains for individual farmers can also be considered as indirect benefits of participating in organic agriculture. 7.5. Overall Profitability and Income The previous subsections showed that yields, prices, and production costs in organic farming are highly context specific. As a result, studies come to different conclusions regarding the overall profitability of organic certification. Some studies find that the price premium is insufficient to compensate for lower yields and/or higher production costs (Barham & Weber 2012, Ibanez & Blackman 2016, Mitiku et al. 2017). Other studies suggest that organic certification contributes to higher profitability in the small farm sector (Bolwig et al. 2009, Kleemann & Abdulai 2013, Kleemann et al. 2014). We conclude that the profit effects of organic farming are less clear cut in developing countries than what the global meta-analysis of Crowder & Reganold (2015) suggests. However, a narrow focus on the profits from one certified crop alone may yield an incomplete picture of the overall economic impacts of organic farming. This is especially true in the small farm sector, where households usually engage in multiple farm and off-farm activities. For instance, when households decide to allocate land, labor, and capital to organic production, the income from other economic activities may also be affected through resource reallocation and other types of spillovers. Several studies have analyzed the effects of organic certification on total household income, thus implicitly capturing spillovers. Again, the results are mixed and context specific. While some studies suggest that organic certification has no effect or even negative effects on income and the likelihood to be poor (Barham & Weber 2012, Beuchelt & Zeller 2011, Chiputwa et al. 2015, Jena et al. 2017, Mitiku et al. 2017, Valkila 2009), others find exactly the opposite (Ayuya et al. 2015, Jones & Gibbon 2011, Kleemann & Abdulai 2013). 7.6. Broader Social Development Goals Unlike other sustainability standards, such as Fairtrade, most organic standards do not include specific certification requirements related to social issues, such as child labor or gender equality (Meemken & Qaim 2018, Seufert et al. 2017). Nevertheless, studies suggest that organic certification can affect social outcomes in positive and negative ways. If it improves income, organic certification may enable households to make beneficial investments in human capital formation. For instance, Gitter et al. (2012) show that double organic-Fairtrade certification has a positive effect on child education in Mexico. Such investments in better child education are unlikely to occur in the absence of income gains, as Meemken et al. (2017a) show with data from organic coffee producers in Uganda. Several studies have also analyzed nutrition effects, suggesting that organic certification helps to improve food security and dietary quality in farming households (Becchetti et al. 2012, Chiputwa & Qaim 2016, Meemken et al. 2017a). Positive effects on dietary diversity can even occur in the absence of income gains (Meemken et al. 2017a). One reason is greater production diversity on organic farms, which is known to affect household dietary diversity through the subsistence pathway (Sibhatu et al. 2015). Organic farming can also reduce occupational health hazards, as farmers and farm workers are less exposed to chemical pesticides (Asfaw et al. 2010, Forman & Silverstein 2012, Shreck et al. 2006). The ban of chemical pesticides can also have interesting gender implications. On the one hand, pesticide bans can increase women's workload, as women are often heavily involved in labor-intensive activities such as weeding (Bolwig 2012, Lyon et al. 2010). On the other hand, pesticide-free production can promote women's participation in cash cropping (Kloos & Renaud 2014). The reason is that the handling of pesticides is primarily considered a male task in many parts of Africa and Asia. More generally, organic certification can have effects on labor markets and employment conditions in the farming sector and also further downstream (Taheri et al. 2017). Such effects are not yet sufficiently understood. 7.7. Summary of Socioeconomic Effects The results on socioeconomic effects of organic farming in developing countries are mixed. In some situations, organic certification contributes to significant welfare gains. But switching to organic is not always beneficial for smallholders and should therefore not be considered a general strategy for poverty reduction. The benefits of organic production methods tend to be larger in regions where conventional crop yields are low, due to farmers' limited access to modern inputs and production technologies. With better access to markets and technologies, yield gaps between organic and conventional production increase, and the benefits of organic production tend to get smaller. However, the evidence on causal effects is still limited. Most available studies use cross-section observational data, and not all control for possible selection bias (exceptions include Bolwig et al. 2009, Chiputwa et al. 2015, Ibanez & Blackman 2016, Kleemann & Abdulai 2013, Weber 2011). Very few studies use panel data models (Meemken et al. 2017a), and to our knowledge, no study thus far has used randomized experiments to evaluate the socioeconomic impacts of organic farming in developing countries. One aspect that needs to be kept in mind is that much of the research in developing countries involves case studies of communities where organic farmers received support through specific development projects. Project support typically includes intensive training in organic agricultural practices, facilitation of links to certified markets, and sometimes financial subsidies (Chiputwa et al. 2015, Jouzi et al. 2017, Stolze & Lampkin 2009). Hence, even when farmers benefit significantly under such conditions, upscaling of these benefits will be difficult, unless the same intensive support is provided to other farmers and communities as well. Organic farming is not a practice that spreads automatically in developing countries simply by other farmers copying what successful early innovators have done. Another important aspect to remember is that most organic farmers in developing countries so far produce cash crops for the export market. Results from these examples cannot be transferred to the production of food crops for the domestic market. Positive socioeconomic effects for farmers are most likely when significant price premiums for organic products can be obtained. While some high-income consumers in developing countries are willing and able to pay more for organic foods, many domestic consumers are poor and unable to pay significant price premiums.

Small Organic Farmers are Reverting to Conventional Farming

Monica **Evans**, 6-30-20**21**, "What role should organic agriculture play in sustainable food systems?," Landscape News, https://news.globallandscapesforum.org/51489/what-role-should-organics-play-in-sustainable-food-systems/ //Vikas Nanduri

Organic agricultural practices are already being applied much more widely than the 1.5 percent of global farmland that is currently certified organic conveys: while it's currently impossible to ascertain the true land area under organic cultivation, it's estimated that millions of smallholder farmers across the globe are currently employing these practices – without official recognition. But one of the biggest challenges for scaling up further is the yield-to-land ratio. At present, a number of meta-analyses have concluded that organic agricultural yields are an average of 19 to 25 percent lower than those for conventional agriculture, though there's a wide range of estimates depending on the crop and conditions; some crops – such as rye, raspberries and snap beans in one 2014 U.S.-wide study – often have higher yields under organic management. "Yields do matter," says Verena Seufert, an assistant professor at the Free University of Amsterdam. "I've talked to **organic farmers in India** who told me th**a**t they'**re considering reverting back to conventional agriculture because their yields are too low, and the premium prices** [that organics can carry in the market] in their context **do not make up for that.**" From a wider perspective as well, that takes into account other challenges such as emissions reduction and biodiversity recovery, it can make sense to try to reduce the amount of land on which food is grown. While land that's farmed organically, on average, does emit less greenhouse gas than conventionally-farmed land, this pales in comparison to the carbon-sequestering potential of, say, an intact tropical forest, which can absorb up to 600 kilograms (1,323 pounds) of carbon per hectare per year. "A natural ecosystem can support biodiversity and contribute to climate mitigation much better than any agricultural land can," says Seufert. "From that point of view, it makes sense to produce high amounts of outputs from your agricultural land so that you can – ideally, in theory – leave more land to nature."

However, Seufert notes that there are likely ways to close that gap, such as by dedicating more research funding to organic agriculture, which has received very little such investment in the past few decades. For example, when it comes to crop breeding, she says that around 95 percent of the crop varieties used in organic croplands were actually bred for conventional agriculture, despite needing different traits in order to thrive. Other mixed land uses, such as agroforestry – which integrates trees and shrubs with crops or pastureland, and is sometimes conducted within existing forests – also hold important potential for upping food yields whilst maintaining critical ecosystem services like carbon sequestration.

Organic Farming isn't economically viable

Terry Cacek, 1986, "The economic implications of organic farming," No Publication, https://www.eap.mcgill.ca/MagRack/AJAA/AJAA_2.htm //Vikas Nanduri

Many farmers are turning to organic or "low input" farming as a strategy for economic survival Several comparisons of actual grain farms in the central and northern states showed that organic farming equals or exceeds conventional farming in economic performance. These findings are supported by studies that used yield data from research plots as inputs to economic models. However, models that relied more heavily on hypothetical data showed an economic disadvantage for organic farming This may have been a result of the failure of the hypothetical models to incorporate valid assumptions on conservation and efficient utilization of water, nutrients, fuel, labor, and capital Established organic farmers are less vulnerable to natural and economic risks than conventional farmers because their systems are more diversified. They also are less able, however, to take advantage of income tax deductions Future trends in commodity prices, input prices, pollution regulation, and research can be expected to have mixed effects on conventional and organic farmers, but the net impact will probably favor organic farmers. On a macroeconomic (i.e. national) scale, conversion to organic farming would have many benefits. It would reduce federal costs for supporting commodity prices, reduce depletion of fossil fuels, reduce the social costs associated with erosion, improve fish and wildlife habitats, and insure the productivity of the land for future generations However, widespread conversion to organic farming would have an undesirable impact on the balance of trade. Future research on the economics of organic farming at the farm or micro-economics level should be directed at horticultural crops, southern latitudes, marketing, and the process of con version from conventional to organic farming Future macroeconomic research should quantify the social benefits described above, enabling decision makers to compare organic farming with other policy options During the past 20 years, farmers have shown steadily increasing interest in organic farming. Many farmers who adopted organic farming methods early in this period were motivated by reasons relating to the health and safety of their families, consumers, and livestock, and by idealistic convictions about soil and land stewardship. More recently, as costs of chemicals and credit have increased and commodity prices have stagnated, thousands of conventional farmers have begun to search for ways to decrease input costs. These economic pragmatists might deny identification with the organic farming movement, but they are moving in that direction. "Low input farming" is the new, socially-acceptable term for organic farming, and economic survival is the motivation for many newcomers. This paper summarizes and analyzes available economic data on organic farming which is pertinent to decision makers at the farm (microeconomic) level and the national (macroeconomic) level. We will use the USDA's definition of organic farming (USDA, 1980): "Organic farming is a production system which avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators, and livestock feed additives. To the maximum extent feasible, organic farming systems rely upon crop rotations, crop residues, animal manures, legumes, green manures, off-farm organic wastes, mechanical cultivation, mineral-bearing rocks, and aspects of biological pest control to maintain soil productivity and tilth, to supply plant nutrients, and to control insects, weeds, and other pests." The term "conventional farming" will be used here to refer to a production system which employs a full range of pre- and post-plant tillage practices (e.g., plow, disk, plant, cultivate), synthetic fertilizers, and pesticides. Conventional farming is characterized by a high degree of crop specialization. By contrast, organic farming is characterized by a diversity of crops. Economics of organic farming at the farm level Research on the economic feasibility of organic farming can be grouped into three categories: 1) direct comparisons of economic returns between organic and conventional farms, 2) analysis of economic returns based on research plot yield data, and 3) modelling comparisons of organic and conventional farms. Studies of actual farms Several studies directly compared returns on organic and conventional farms. Lockeretz et al. (1978) compared the economic performance of 14 organic crop/livestock farms in the Midwest with that of 14 conventional farms. The study farms were paired on the basis of physical characteristics and types of farm enterprises. The market value of crops produced per unit area was 11 percent less on the organic farms. But since the cost of production was also less, the net income per unit area was comparable for both systems. A study by Roberts et al. (1979) compared data from 15 organic farms in the western Corn Belt with USDA data on representative conventional farms in the same area. In most cases the net returns were greater on the organic farms. Both studies showed that production costs were longer on the organic farms. Two studies comparing cash grain farms were conducted in the state of Washington. In the first study, Eberle and Holland (1979) compared three organic and three conventional farms and found that net returns per unit area were 38 percent higher on the conventional farms. However, the author of a follow-up study of six organic farms found that net returns on these farms were 22 percent higher than on the representative conventional farms (Kraten, 1979). Berardi (1979) compared 10 organic and 10 conventional farms in New York and Pennsylvania for returns from wheat (Triticum aestivum) production only. When cash operating costs alone were included, the returns were higher on the organic farms. However, **when the costs of land and unpaid family labor were included, the conventional farms had a higher average net return.** The above-mentioned studies comparing organic and conventional farms had several weaknesses. The most obvious was the small sample sizes, which made it diff~cult to do any statistical tests of differences. The averages did not reflect the high variability that occurred in both yields and net returns on both types of farms. Pairing farms for the studies also caused problems, especially in work by Eberle and Holland (1979) and Berardi (1978). Finally, none of the studies included the livestock enterprises, which may be essential for optimum economic performance of organic farms. A 1984 survey of the members of the Regenerative Agriculture Association (Brusko et al., 1985) offered further information on the economic performance of organic methods compared to conventional methods. Of 213 respondents, 88 percent said their net income either stayed the same or increased when they began farming with fewer purchased inputs, while 12 percent said net income declined. The sample may not have been a representative sample of organic farmers, and many of the responses may have been based on perceptions rather than on well-kept records. Nevertheless, the survey seems to indicate a high lever of satisfaction with the economic performance of low input farming. Studies involving data from research plots The second type of research used yield data from research plots as inputs to economic analyses. A Nebraska study (Helmers et al., 1984) attempted to measure the performance of a fully organic system, so the first three years of data, which represented a conversion period from conventional to organic practices, were excluded from the analysis. Animal manure was available, but other aspects of the livestock operation were excluded from the economic analysis. Six possible cropping systems were considered, three organic rotations, two conventional rotations, and continuous corn (Zea mays). The organic systems had the lowest costs of production, and all rotational systems performed better than continuous corn. The scenario most representative of an organic farm assumed that straw was sold and that the cost of manure was equal to application costs only. With this scenario, the returns were comparable to those from the conventional rotations. Yield data from the Rodale Research Center in Pennsylvania were used to evaluate profits during the period of conversion from conventional to organic farming (Brusko et al., 1985). The organic farming system with livestock had returns over variable costs that averaged $74 more per unit area than for the conventional corn-soybean (Glycine max) system. **The organic farm system without livestock fell short, on the average, of the**

conventional grain system. However, the organic farm averages were hurt by the plots on which corn was planted in the first year of the conversion, an unlikely choice of crop for a farmer because of the potential problems with nitrogen deficiencies, weeds, and soil-borne insects. On the organic plots without animals, where the rotation was initiated with a clover (Trifolium spp.) and oats (Avena saliva) mix, the economic returns of the organic plots compared favorably with those from conventional grain plots. Modelling comparisons The third type of study involved modelling of organic and conventional farm systems and comparing the net returns. A USDA study (1980) compared a conventional corn-soybean rotation with three organic rotations. The conventional rotation returned 22 to 44 percent more income above variable costs than the organic rotations. Profitability was directly linked with the proportion of corn and soybeans in the rotation. An Iowa study (James, 1983) modelled six different scenarios that included livestock enterprises. Conventional farming was found to be more profitable than organic farming. The study concluded that organic practices were most feasible on small farms and on farms with large proportions of land in pasture. It also concluded that livestock operations were essential to maximize returns. Although there are only a few studies in each category, and although they all have shortcomings, the direct comparisons and the plot data suggest that organic farming is economically feasible and can compete with conventional farming, at least in certain geographic areas and for certain farming enterprises. Only in the modelling studies were **returns from organic farming consistently lower than returns from conventional farming. Some of the reasons for these results are examined in the next section.** Unmeasured economic benefits of organic farming According to actual field data, organic farming is more economically successful than the modelers predict. The stated assumptions of the models seem reasonable. Therefore, examination of the unstated assumptions may be instructive, since there are differences between the two systems that are difficult to incorporate into models. **The models assumed that soil structure, infiltration rates, and erosion rates were the same for organic and conventional agriculture, or that any differences had no economic consequences.** Some organic farmers claim their soils have better tilth and less compaction. They also claim that they use less power and operate their tractors in a higher gear, thereby saving fuel. These claims, although plausible, have not been sufficiently tested. Changes in soil structure, coupled with improved ground cover, decreased runoff by about 10 to 50 percent and increased infiltration by about 10 to 25 percent. All these factors combined to reduce soil erosion on organic fields by at least two-fifths, and sometimes over four-fifths (Cacek, 1984). It is difficult to place a monetary value on the water lost as runoff and the nutrients contained in the eroded soil. In part, they are just displaced to other locations on the farm, where they remain available for crop production. Some nutrients are present in excess of crop needs and some are unavailable biochemically. Nevertheless, there may be a significant difference between organic and conventional farms in the costs of replacing needed nutrients and water. Vulnerability to natural events may be a critical factor in comparing the performance of organic and conventional farms. During the conversion period, organically produced crops are vulnerable to weeds and nitrogen deficiences. However, once organic practices are established, the crops are often less vulnerable to drought and other natural disasters than conventionally grown crops. Organically farmed soils absorb more of the available rainfall, providing protection from drought (Cacek, 1984). Because organic farmers grow a greater diversity of crops, the entire production on a farm is not vulnerable to the same pests or seasonal weather events. If there is a total crop failure, organic farmers suffer fewer economic losses because they have invested less in purchased inputs. The diversity of crops on organic farms can have other economic benefits. Diversity provides some protection from adverse price changes in a single commodity. Diversified farming also provides a better seasonal distribution of inputs. A corn farmer might require two tractors to plant all his land during the short corn-planting season. The tractors are then underutilized during the remainder of the year. An organic farm with the same total area would probably have less land in corn, so one tractor might be sufficient. The same tractor could then be used during other seasons to produce wheat, hay, and other crops that have staggered planting and harvest dates. Likewise, labor is more fully utilized. However, organic farms require more intensive management than specialized conventional farms. Organic farmers need to borrow less money than conventional farmers for two reasons. First, organic farmers buy fewer inputs such as fertilizer and pesticides. Second, costs and income are more evenly distributed throughout the year on diversified organic farms. For example, profits from July's wheat harvest can buy fuel for the corn harvest, reducing the need to borrow for the corn harvest. Organic farmers have complained that they are discriminated against by lenders, a possible economic disadvantage of organic farming. However, Blobaum (1983) concluded that this problem is more perceived than real. Organic farmers are generally at a disadvantage compared to conventional farmers with regard to the tax system. The U.S. tax code incorporates several features such as investment credit, accelerated depreciation, and interest deductions that were designed to stimulate investment. The definition of organic farming does not preclude the use of confinement feeding systems, irrigation systems, and other investments that offer substantial tax benefits. However, the reluctance of organic farmers to use prophylactic antibiotics decreases the feasibility of confinement feeding systems. Organic farmers have less need for irrigation because they use more crop rotations and because of higher soil permeability. Organic growers tend to be less capital intensive, so tax breaks are less advantageous to them. Investigators once believed that organic farmers' reluctance to use fertilizers led to depletion of phosphorus, potassium, and other soil-borne elements, and that this depletion would have unfavorable long-term biological and economic consequences (USDA, 1980). It can be argued, however, that organic farming is a superior system for managing soil-borne elements because of manure recycling and reduced soil erosion (Cacek, 1984). Data from Washington State (Patten, 1982) indicate that organic farming may even increase the amount of biochemically available phosphorus in the soil. These arguments point to future economic benefits of organic farming from soil improvement. Future trends The relative economic performance of organic farming and conventional farming is sensitive to the ratio of input costs to the value of outputs. Both organic and conventional farmers are vulnerable to fluctuations in both input and output prices, but the effect of a given change will differ between the two farming systems. The future of commodity prices is not clear. However, changes in commodity prices can be expected to have greater impacts on conventional than organic farmers. Conventional producers have higher average yields for most grain crops. Therefore, assuming constant production costs, price increases will increase the net returns of conventional farmers by a greater proportion than those of organic farmers. Conversely, price decreases will decrease conventional returns by a greater proportion than organic returns. Differential price changes (increases in some commodity prices and decreases in others) would also tend to have effects of greater magnitude, whether positive or negative, on conventional farmers, since they depend on fewer crops for their income. Because organic systems are more diversified, the effects of differential price changes on income would partially offset each other. Increases in the cost of variable inputs would be less damaging to organic farmers because they purchase fewer inputs. The most likely price increases in the near future will be for energy, with consequent increases in the price of synthetic nitrogen fertilizers. Organic farmers use less energy than conventional farmers, primarily because they use less synthetic nitrogen. In the Lockeretz study (1978), the organic farmers used 60 percent less energy per unit of value of production. The Berardi study (1978) showed that conventional wheat farmers use 48 percent more energy for 29 percent higher yields. Farmers may face increasing pressure from governments to control the movement of sediment, pesticides, and nutrients from farmland to the off-farm environment. Organic farming controls erosion and reduces or eliminates the use of pesticides and highly soluble forms of nitrogen. Therefore, organic farmers are already controlling pollution. If conventional farmers are forced through regulation or other policy instruments to control runoff, organic techniques and reduced tillage possibly would be their cheapest alternatives. Finally, research on organic farming can improve the economic performance of organic methods. The lack of reliable information on problems specific to organic farming, such as non-chemical weed control, is a serious barrier to its adoption. Government-sponsored agricultural research has focused on chemical-intensive agriculture, leaving organic farmers to rely on the organic industry or a small number of organic research groups for information (Blobaum, 1983). Intensive research on agricultural chemicals has been conducted for four decades, but organic research is in its infancy. Therefore, the economic benefits to farmers from an incremental investment in organic research may be greater than from a corresponding investment in chemically-oriented research. Developments in genetic engineering could benefit both organic and conventional agriculture (Butter and Youngberg, 1983). Organic farming and national policy During the 1985 debates on agricultural legislation, the major concerns were soil erosion, the farm credit crisis, overproduction, and international trace. A shift toward organic farming would have favorable impacts on all but the lest problem. Organic farming was debated in the 99th Congress, but it was rarely mentioned as a solution to these problems. The low prices received by farmers and the cost of federal programs aimed at increasing these prices are major policy issues. In the past five years, net budget outlays by the Commodity Credit Corporation for price supports and related programs have ranges from a low of $2.7 billion in 1980 to a high of $18.8 billion in 1983 (USDA, 1984). Despite these expenditures, farm income remains relatively d¢pressed. Conversion to organic farming decreases the production of price-supported commodities by substituting hay crops, which receive no price supports, and by reducing yields. Therefore, conversion to organic farming could reduce the cost of federal programs while raisin" grain prices because of reduced supplies. However, improved grain prices could have an undesirable effect on the trace deficit. A study at Iowa State University predicted that a nationwide conversion to organic methods would decrease production, increase commodity prices, increase net farm income, decrease export potential, and increase the land used for agriculture (Olsen et al., 1980). Energy conservation, a major policy issue during the energy crisis of the 1970's, is being overlooked during the energy glut of the mid-1980's. The glut is surely temporary and energy conservation should remain a national goal. Organic farming is more energy efficient than conventional farming, in some cases even outperforming reduced tillage (Cacek, 1984). Therefore organic farming could be an element in the nation's energy policy. Soil erosion has macroeconomic as well as microeconomic implications. The Conservation Foundation estimated that off-site impacts of erosion-related pollutants from cropland cause $2.2 billion in damages annually across the nation (Clark et al., 1985). These damages involve recreation, water storage and transport facilities, navigation, flood damages related to sediments, and water treatment. Damages of this magnitude are an incentive for the government to control pollution from cropland, and regulation is often proposed as the solution. However, research and extension on organic farming and conservation tillage may be effective alternatives to regulation and should certainly supplement any regulatory effort. Damage to wildlife was not included in the Conservation Foundation estimate. Federal, state and private fish and wildlife organizations spend several billion dollars per year conserving wildlife. The wildlife gains resulting from these expenditures, however, are overshadowed by agricultural land use changes that have caused precipitous declines in populations of farm game (Farris and Cole, 1981). Agricultural pesticides pushed brown pelicans (Pelecanus occidentalis) and peregrine falcons (Falco peregrinus) to the brink of extinction. Agricultural activities have harmed fisheries in 30 percent of all streams nationwide (Judy, 1984), and siltation has degraded waterfowl breeding habitat in the northern plains. Conversion to organic farming would improve upland habitat, safeguard wetland habitat from siltation, and reduce the pesticide threat (Cacek, 1984). Enhanced fish and wild life populations offer potential economic gains to farmers who can permit hunting or fishing on their farms for a fee. Losses of soil productivity caused by erosion are of little concern in the near future (Crosson, 1984), but what of the loss of productivity over the centuries? The Middle East and Northern Africa are littered with the remains of ancient civilizations that abused their soils (Lowdermilk, 1975). Some Chinese soils, by contras", have been farmed with organic technology for 40 centuries. Perhaps in the final reckoning these soils will have fed more humans than America's conventionally farmed soils. Policies based on Crosson's conclusions could jeopardize the food supply for future generations. The availability of land for food production could become problem in the future, so protecting the productivity of existing land is all the more critical. Conclusions and research needs Organic farming is a sophisticated alternative agricultural system. Ample data exist to conclude that it can compete economically with convention farming in the Corn Belt and the semiarid Northwest. Further research is needed on the economics of organic farming with horticultural crops and in other geographic regions. Particular attention should be given to optimum approaches for conversion to organic farming. Information needs of organic farmers should be surveyed and information delivery systems should be tailored to meet those needs. Organic farming benefits society substantially by reducing pollution and flooding; conserving energy, soil, nutrients, fish, and wildlife; reducing federal costs for grain price supports; and insuring the supply of food for future generations. However, virtually no credible data are available to policy makers on the magnitude of these benefits, they are unable to compare organic farming with other policy alternatives. Policy makers also need information on the impact of organic farming on international trace, input suppliers, the food marketing chain, and rural communities. In areas where organic farming is known to be economically feasible, federal policy barriers to conversion should be identified and evaluated. Finally, the impacts of the 1985 Farm Bill and other legislation on the economic viability of organic farming should be analyzed. Organic farming is an attractive alternative for both farmers and policy makers. With the development and delivery of better information, both will be able to make the best use of this alternative.

Debate Basics

- Public Forum Debate is a 2v2 debate format in which competitors convince a judge with arguments in favor (pro) or against (con) a **resolution** (or topic)
    - These arguments are made in a series of 4 sets of speeches
- One team speaks first for each set of speeches, the other team goes second
- Within every partnership, each debater takes a different role
    - One will be the **first speaker**, who gives the first and third speeches of the round
    - The other will be the **second speaker,** who gives the second and last speeches
- Order (1st vs 2nd) and side (Pro vs Con) are decided by a coin toss, forcing debaters to gain experience on both sides of the debate, thus broadening their perspectives

Round Structure/Speeches:

1. Constructives
    a. Both sides get 4 minutes to present their main arguments in the round, called a case, that was prepared beforehand
    b. First speaker gives the case
2. First Crossfire: 3 minute period where the opposing first speakers ask each other questions regarding their cases (and answer the questions)
3. Rebuttal
    a. Both sides get 4 minutes to give a rebuttal which presents counter-arguments to the concepts **made in the speech before it** (case).
    b. Second speaker gives rebuttal
4. Second Crossfire: 3 minute period where the opposing second speakers ask each other questions regarding cases or rebuttals (and answer the questions)
5. Summary
    a. 3 minutes for both sides
    b. The summary must **frontline** or address any responses made to their case, **weigh** (or compare) against the opposing team's arguments, and **extend** (or remind the judge) of their own arguments made both in rebuttal and constructive
    c. First speaker gives rebuttal
6. Grand Crossfire: 3 minute period where **both** partners ask the opposing team questions regarding any arguments in the round
7. Final Focus:
8. This is where the round comes to close

9. Each side has 2 minutes to explain or clarify the most important arguments in the debate round and summarize to the judge why they deserve their ballot
10. A final focus is the pinnacle of your round strategy and every speech must be geared towards making this final speech easier

Debate Round Examples:

- For anyone with some time looking to grasp everything better, watch this round: https://www.youtube.com/watch?v=MUnyLbeu7qU. Feel free to slow the video down a bit!

Debate Terminology:

- Events
  - PF (Public Forum)
  - LD (Lincoln Douglas)
  - CX (Policy)
- Terms within a debate round
  - Flow (The paper you jot notes down on when listening to speeches)
  - The flow (Something debaters use to describe the technical aspect of debate - solely based on the notes taken and not any presentation aspects)
  - Lay judge (Derived from the term *laymen*, it's what debaters use to describe parents or inexperienced judges. Make sure to emphasize persuasion in these rounds)
  - Tech judge (Experienced judge - coaches, past competitors, etc. Keep a strong emphasis on persuasion but understand you can debate a bit faster)
  - Extensions (Reminding the judge of your case through re-explaining it)
  - Defense (Arguments that prove their case wrong. Ex: They argue economic development causes climate change since industrialization requires coal. Defense would say economic growth **does not** cause climate change because X reason)
  - Offense (Arguments that you read in constructive which are unique reasons to vote for you. Offense tells the judge why you win the debate round)

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