

© UNEP / Still Pictures
Rice cultivation in Asia.



5. Food and Agriculture

The search for green employment opportunities in agriculture is faced with several formidable obstacles. The worlds of agriculture are many and varied, and the range of activities is vast—so much so that any findings may be highly particularistic and ultimately misleading. Moreover, specific and focused research on the subject of green employment in agriculture is quite sparse. And while the interest in sustainable agriculture has grown in recent years, employment is not always a central theme or consideration. Perhaps a further challenge is the rapid and dramatic changes currently taking place in the way food is produced, sold, and consumed, which makes agriculture something of a moving target (or a series of moving targets) as far as this type of research is concerned. All told, the obstacles to sustainability are perhaps far more formidable in the case of agriculture than they are in any other economic sector, and the possibilities for green employment need to be viewed against a set of extremely challenging scenarios.

This section of the report is divided into four parts. The first part looks at the environmental footprint of the global food system. The second offers a highly compressed “plough-to-plate” scan of the present global food system, with the emphasis on changing employment patterns.² In the absence of existing studies that focus on green job creation in agriculture, the intention here is to provide a survey of the challenges to green jobs posed by the present system, in order to better frame the discussion on green alternatives. The third part looks at the potential for green job creation (and retention) in food and agriculture within the present framework. And the fourth part steps outside the existing agro-industrial model to examine the job-creation potential of local food systems, organic production, urban agriculture, and small farming systems.

What is Sustainable? – Competing Visions

The separation of Parts 3 and 4 speak to the fact that there are conflicting visions of sustainability in agriculture. On the one hand, there are those—such as the World Bank and the World Trade Organization (WTO)—who view the present liberalized and increasingly global food system as providing a path from poverty for hundreds of millions of rural dwellers, but who nonetheless recognize that it is a system that needs to do much more in order to become truly environmentally and socially sustainable.⁷⁹⁴ For companies like Monsanto and BASF, biotechnology can (and is) helping farmers take great strides toward sustainability by raising yields through genetically modified seeds while at the same time reducing environmentally damaging inputs, such as nitrogen.⁷⁹⁵ According to Jürgen Hambrecht, BASF’s chief executive, “There is this conflict of nutrition on one side, and renewable resources protecting the climate of the earth, and the only solution is biotechnology.”⁷⁹⁶

On the other hand, there are many farmers’ organizations, NGOs, and others in civil society who regard the existing global food system as fundamentally unsustainable and who propose a more radical change of course—a course that recognizes that the traditional knowledge and skills of farmers are the key to solving the major problems of the existing food system and to meet the challenges of increasing demand.

2 Here, the word agriculture is used to mean the growing of food, whereas “food system” is used to describe the whole “plough to plate” reality, including the transportation, sale and consumption of food.

A discussion on green jobs in agriculture is therefore situated in a much broader debate around the overall performance of the current global food system—a system that has been subject to considerable scrutiny and criticism in recent years. The productivity of agriculture has increased impressively in recent decades.⁷⁹⁷ According to the United Nations Food and Agriculture Organization (FAO), over the past 40 years, per capita food production has increased by 25 percent, and food prices in real terms have fallen by 40 percent.⁷⁹⁸ But still roughly 850 million people suffer from food insecurity, and a similar number are obese.⁷⁹⁹ Every year, 5 million children die of hunger.⁸⁰⁰ According to the World Bank, three out of every four people in developing countries—900 million individuals—live below the \$1 per day poverty line in rural areas, and most depend directly or indirectly on agriculture for their livelihoods.⁸⁰¹ Moreover, the demands on the global food system will increase dramatically as the Earth's population rises (around 50 percent by 2050) and as diets move toward more meat and processed foods. In this scenario, global food production will need to triple by 2050 without using more land or water.

Meanwhile, the pressure on small farmers and producers has turned agriculture into a major political battleground. The WTO's Agreement on Agriculture has triggered massive protests by organizations of small farmers all over the world who feel their livelihoods are threatened by liberalization, falling commodity prices, the power of buyers and retailers, and rich-country subsidies that benefit agribusiness.⁸⁰² In India, the contradictions are captured in the fact that 38 million tons of surplus grain is stored in close proximity to 320 million malnourished citizens, and farmer suicides number tens of thousands.⁸⁰³

The industrial model of agriculture, along with rich-country subsidies to agribusiness, has been identified as one of the primary drivers of urbanization globally, which then spurs a cycle of urban unemployment or underemployment when economic development does not keep up with the growing urban labor supply. Policies that keep farmers on their land, and facilitating green production practices, could generate employment and income both in agriculture and in non-farm occupations.

The Environmental Footprint of Global-Industrial Agriculture

Agriculture has an immense environmental footprint, one made larger in recent decades as it has become more intensive and industrialized. The overuse of water; the increasingly pervasive use of chemicals; the contamination and genetic manipulation of food; the spread of animal diseases and waste due to livestock intensification; and the reduction of biodiversity are all well documented features of today's intensive agriculture.

Today, agriculture accounts for 15 percent of global greenhouse gas (GHG) emissions, according to emissions inventories submitted to the United Nations Framework Convention on Climate Change (UNFCCC). According to the Stern Review, fertilizers are the largest single source of emissions from agriculture (38 percent of the total), followed by livestock (31 percent). Nearly 75 percent of emissions from agriculture are generated by developing countries. Emissions from agriculture are expected to rise almost 30 percent from 2005–2020.⁸⁰⁴



© Vuong Dong / UNEP / Still Pictures
View of rice terraces, Vietnam.

UNFCCC data show that developing-country agriculture and deforestation contribute an estimated 22 percent and up to 30 percent of total emissions, more than half of which is from deforestation caused largely by agricultural encroachment (13 million hectares of annual deforestation globally).⁸⁰⁵ In its 2001 report on mitigation, the Intergovernmental Panel on Climate Change (IPCC) estimated the level of GHGs attributable to agriculture at 20 percent, driven by fossil fuel use, emissions generated from rice paddies, land use change, biomass burning, enteric fermentation, and animal wastes.⁸⁰⁶

The overuse of water through irrigation (but also industrial use) is a particularly formidable barrier to environmental sustainability. A major factor here is the global growth in the consumption of meat, which raises the demand for feed, a

commodity that is particularly water intensive to produce. Livestock numbers are expected to double by 2020, according to the IPCC.⁸⁰⁷

Rich-country subsidies, too, are having a simultaneous effect on both employment and the environment. In 2001, the United States accounted for two-thirds of the world's corn exports.⁸⁰⁸ With the onset of NAFTA, the price of corn in Mexico plunged nearly 50 percent, bankrupting many Mexican farmers. To compensate for the fall in price, others expanded production and began using hillsides, causing erosion.⁸⁰⁹ This illustrates the connection between poverty, precariousness, and environmental degradation. As UNEP observes, "Poverty contributes to land degradation as the poor are forced onto marginal lands with fragile ecosystems and in areas where land is increasingly exploited to meet food needs without adequate economic and political support to adopt appropriate agricultural practices."⁸¹⁰

The cheap corn from the United States has hurt Mexican farmers who grow maize on small-to medium-sized plots in difficult environments using low levels of technology. Maize also contributes significantly to biodiversity, as more than 40 natural varieties of maize are grown in Mexico. Meanwhile, U.S. corn is chemical-intensive and grows on 20 percent of harvested land. The run-off from production is a major source of water pollution, affecting drinking water throughout the Corn Belt and contributing to an aquatic "dead zone" in the Gulf of Mexico that is the size of Ireland. U.S. corn also depends heavily upon herbicides and insecticides, despite using genetically altered seed. According to one study, the threefold increase in corn exports to Mexico has led to 100,000 additional tons of nitrogen, phosphorous, and potassium-based loadings to U.S. waters each year.⁸¹¹

The “New Agriculture”

In recent decades, the sharp fall in the prices of grains, sugar, and coffee has led producers to move toward higher-value exports like fruit, wine, and flowers.⁸¹² Some of these high-value products are also more energy and chemical intensive than many low-value products. The International Labour Organization, the International Union of Food and Agricultural Workers (IUF), and others have documented in detail how many workers in the “new agriculture” are required to labor under hazardous conditions and often live in extreme poverty.⁸¹³

The levels of accidents and fatalities endured by waged agricultural workers due to such things as exposure to chemical and pesticide poisoning (the latter claims 40,000 lives every year) is enough to suggest that these jobs are far from green, at least not from a worker health and safety perspective.⁸¹⁴ The World Bank and other agencies advise smallholders to enter the “new agriculture” to serve growing global food demand and to achieve better returns on production. The FAO notes that, “Smallholders who fail to gain a foothold in this globalized marketplace risk finding themselves consigned to a permanently marginalized minority, excluded from the food system both as producers and as consumers.”⁸¹⁵

The expansion of this less-sustainable “new agriculture” is in many cases having a detrimental effect on more sustainable types of production. In Mexico, government officials who are responsible for promoting high-value exports have universally viewed the avocado sector as exemplary.⁸¹⁶ This “green gold” has been so successful that growers are increasingly buying up communal (ejidal) lands. They are denuding forests to grow avocado trees and planting the trees in place of other crops, even on lands that cannot support avocado production for climatic or ecological reasons.⁸¹⁷

Globalization, “Food Miles,” and the Environment

As agriculture has become more intensive and industrial, it has also become more global. In 1998, the value of agricultural goods traded across borders reached \$456 billion, three times more than 20 years earlier.⁸¹⁸ The global nature of food production has added to air, sea, and road traffic—worsening pollution, compromising health, and further contributing to global warming. A U.K. study estimates that CO₂ emissions attributable to producing, processing, packaging, and distributing the food consumed by a family of four amount to roughly eight tons a year.⁸¹⁹

While not all trucks on today’s roads are carrying food, many are. A 1999 study of California’s produce transport industry reported that 485,000 truckloads of fresh fruit and vegetables left the state each year, traveling between 100 to 3,100 miles to reach their destination.⁸²⁰ In the United Kingdom, the importation of food quadrupled between 1992 and 2007, and 31 percent more food was flown into the country in 2006 than in 2005, according to the Department of Environment, Food and Rural Affairs (DEFRA).⁸²¹ There was a 7 percent rise in urban transport in 2005–06 caused by individuals taking more and longer shopping trips.⁸²² A 2005 DEFRA study on food miles discovered that food transport now accounts for 25 percent of all Heavy Goods Vehicle (HGV) kilometers in the United Kingdom, and that food transport produces 10 million tons of CO₂ annually.⁸²³

The “food miles” issue has understandably drawn attention to the global reach of food supply chains. However, the environmental impact of the domestic movement of food overland is still far more significant than food moving across national borders. A U.K. study shows that agricultural and food produce accounts for 28 percent of goods transported on U.K. roads, imposing estimated external costs of \$4.7 billion (£2.35 billion) per year. The contribution made by sea and air transport is currently trivial owing to low volumes—barely 1 percent of the domestic road costs. Policies that attempt to reduce food miles may result in losses in jobs in the freight or input supply industries. However, proximity alone may not be a good measure of sustainability, as a long journey on water has a lower impact than a shorter one by road.⁸²⁴

The growth in marine freight does, however, add to environmental damage through ship wastes, dredging, spills, and the discharging of bilge water. Intercontinental cargo ships also bring in non-native plant and animal species that can cause major public health and environmental problems and further contaminate urban harbors and ship channels with heavy metals and pesticides.⁸²⁵

Food Waste

A large portion of all food produced by the food system is never eaten and is discarded. Not only are the carbon and chemical inputs that went into the production of this thrown-away food unproductive, but the discarded food also continues to generate potent GHGs such as methane as it rots in landfills.⁸²⁶

Food waste is generated at all points of the global food system. Large retailers have the market power to reject produce if it does not conform to certain standards pertaining to shape, color, and packaging. When standards are not met, farmers and producers are left with unsold crops that are often destroyed. Even if eventually purchased by retailers, supermarkets routinely “cull” foodstuffs that are blemished or have passed a sell-by date. Consumers also waste large amounts of food, especially in wealthier countries where food prices have fallen steadily in recent decades.

A study by the U.S. Department of Agriculture estimates that the United States wastes close to 44 million tons of food each year. Most of this goes to landfills, where it decomposes and causes GHG emissions. A 1999 study by the California Integrated Waste Management Board found that just over half of the state’s 5.6 million tons of discarded food came from commercial sources such as restaurants, hotels, and schools, and just under half—2.7 million tons—was generated by residences.⁸²⁷

In the United Kingdom, homes waste 3.3 million tons of food annually, although the total consumer and industrial wastage may be as high as 17 million tons.⁸²⁸ Previous research by the Waste and Resources Action Programme (WRAP) revealed that U.K. consumers throw away 6.7 million tons of food each year, equivalent to a third of food bought. Most of this could have been eaten, and 40 percent (by weight) of this avoidable food waste consists of fruits and vegetables, worth almost \$6 billion (£3 billion). Nearly 90 percent of this fruit and vegetable waste is fresh produce, about 1.4 million tons, and most is thrown away as a result of not being used in time.⁸²⁹

The level of waste appears symptomatic of the excesses of consumption engendered by the global “lifestyle divide,” whereby 20 percent of the world’s population is responsible for 90 percent of total personal consumption—while 1.3 billion people struggle to live on \$1 per day.⁸³⁰ However, the absence of adequate regulatory frameworks, systems of collection, and well-resourced public educational programs probably also play a role in elevating the levels of food that are ultimately wasted.⁸³¹

The environmental footprint of the global food system is formidable, and the true extent of the damage it causes to human health and the planet can hardly be exaggerated. Any possibilities to create green employment in food and agriculture must therefore be pursued as a matter of urgency.

Employment Trends

Any effort to create green jobs in food and agriculture must confront the fact that labor is being extruded from all points of the system, with the possible exception of retail. Starting at the base of the supply chain, the proportion of people making their main living from agriculture is in sharp decline. In 2006, 36.1 percent of the Earth’s population, or around to 1.3 billion people, were employed in growing food and raising livestock, compared with 44.4 percent in 1995. Productivity improvements throughout the global food system have, along with the globalization of food, generally reduced employment levels in agriculture and related industries, at least as a proportion of the whole.⁸³²

In industrial nations, the number of people employed in agriculture has plummeted by more than 80 percent in some regions since 1950, according to the FAO.⁸³³ In the developing world, agricultural employment has not kept pace with population growth, although rural non-farm employment has increased quite dramatically. Roughly one in four rural workers is employed full time in the non-farm rural sector.⁸³⁴ According to one study, Kenyan smallholders derive approximately 40 percent of their income from off-farm activities, of which 7 percent comes from remittances, 12 percent from commercial activities, and 21 percent from salaries or wages.⁸³⁵

Despite these trends, agriculture remains the world’s second largest source of employment.

Consolidation

Today’s food system is dominated by the market power of increasingly fewer large companies. The 10 largest firms in agriculture control about 80 percent of a world market valued at \$32 billion, according to an ILO study.⁸³⁶ Just two companies distribute 80 percent of the world’s grain.⁸³⁷ And in the United States, just six companies accounted for 42 percent of the food retail market in 2001, a jump from just 24 percent in 1997.⁸³⁸ A similar pattern of consolidation is visible in many parts of the developed and developing world.⁸³⁹

The level of horizontal integration through consolidation has proceeded at enormous speed, but so has the level of vertical integration as retailers connect with the production and processing

stages of the food system. The market share of the large retailers and suppliers has also resulted in a shift in the balance of power away from small farmers and producers and toward large retailers, resulting in lower returns to those who plant and grow the food.⁸⁴⁰ (See Box II.5-1.) These trends and developments have been well documented and will not be detailed here, except to point out that employment patterns within the global food system are also undergoing a process of change. It is in the context of this consolidation and change that the search for green jobs must be conducted.

Box II.5-1. Agricultural Employment in the United States

The United States presents a good example of the decline of agricultural and related employment in the advanced economies. Employment in agriculture and its various subsectors was 3.3 million in 2000, or around 2 percent of the economically active population. Some 2.5 million farmworkers are hired to work in the country, most of whom are Mexican and work seasonally.

Livestock production has seen the most significant employment losses (roughly 200,000 jobs) during the past decade as a result of consolidation. The number of hog farms, for example, fell dramatically from 191,000 in 1992 to 109,000 in 1997, according to the U.S. Agricultural Census. The actual number of pigs, however, climbed from 57 million to 61 million over the same five-year period.

The number of U.S. farms with cattle and calves has also showed a marked decline. This decline coincided with a dramatic change in the slaughter concentration of the largest four firms, which grew from 28.4 percent of slaughtered cattle in 1980 to 67.3 percent in 1995. The quality of work in the meat industry has also deteriorated as employment has shifted from higher-paid butchers to lower-paid slaughterers and meatpackers in meatpacking plants.

In addition to those working in agriculture and related subsectors, 1.66 million people were employed in food and related products in 2000, down from 1.82 million in 1989. This decline occurred at a time when the U.S. labor force grew from 117 million to 135 million workers. Employment levels in dairy, canning, beverage industries, and sugar and confectionary products all showed moderate or serious declines. This downward trend has accelerated the long-term decline of the leather trades, such as footwear. In 1990, 152,000 people were employed in these trades; by 2000 the number had slumped to 92,000.

The decline in employment in farming and food manufacturing stands in marked contrast to the growth in retail employment. In 1994, 13.5 million people were employed in retail, growing to 15 million a decade later. The U.S. Department of Labor expects retail employment to grow to 16.7 million in 2014. Some of this increase is being driven by the sale of ready-to-eat foods, especially in larger retail establishments. Superstores, warehouse “box retailers,” and drugstores captured 31.6 per cent of food sales in 2005, up from 17.1 percent in 1994. This trend has been led by Wal-Mart, which in 2002 became the largest food retailer. In 2005, Wal-Mart employed 1.3 million workers in the United States, up from 700,000 in 1995. In response to the gains made by Wal-Mart and other superstores in food marketing, traditional groceries and supermarkets have merged and consolidated their own operations in an effort to cut costs and remain competitive.

Source: See Endnote 840 for this section.

Global Trends

The trend toward consolidation and the growing market power of retailers that is occurring in the United States is also happening at the global level, and in some cases even more obviously so. Small “greener” farmers are losing out to large capital-intensive producers and suppliers. This process has contributed to rural unemployment and accelerated urbanization.⁸⁴¹ And whereas in the industrial countries the rural-to-urban shift took many decades, in the developing world the process of urbanization is moving at a pace two or three times faster.⁸⁴² In China, 81 percent of workers were employed in agriculture in 1950; in 2000, the figure was 50 percent.⁸⁴³

Significantly, at the global level there has been a tendency for people to move directly from agriculture into service employment, thus confounding the expectations of mainstream development theorists. In 2006, 42 percent of the world’s employment was in services. While the quality of service-economy jobs varies enormously, a large number of them are informal and low paying.⁸⁴⁴ Moreover, those leaving the rural areas are often very likely to relocate to one of the many “new cities” where slum conditions are increasingly the norm.⁸⁴⁵ The environmental hazards for those leaving the countryside for the cities are frequently worse than the ones they left behind. These escapees from rural hardship often confront the lack of safe water and sanitation, and find themselves in close proximity to pollutants from manufacturing, food processing, and building construction.⁸⁴⁶ And rural communities in both the global North and South also suffer difficulties as the social fabric built up around farming over generations disintegrates.⁸⁴⁷

Waged Employment (and Unemployment) in Agriculture

The number of wage-earning employees in agriculture is about 450 million globally, although many smallholders also work for wages for some or part of the time. The trend toward waged employment is generally upward, although in some countries there has been a growth in informal labor contracts that has intercepted or reversed the trend toward waged labor.⁸⁴⁸ Employment in soy and palm oil production has increased, but the employment gains in these instances are often small, especially given the amount of land used for these crops. Soybean production is particularly capital-intensive. A 1,000 hectare soybean farm employs only three people.⁸⁴⁹ There are also concerns about decent jobs in agriculture.⁸⁵⁰ (See Box II.5-2.)



© Mark Edwards / Still Pictures
Oil palm plantation nursery, spraying pesticides between rows of trees.

Box II.5-2. Decent Work Deficits in Agriculture

The International Union of Food and Agricultural Workers (IUF) points out that any discussion on green jobs should recognize that the agricultural sector has much to do to ensure decent work in agriculture and address the many decent work deficits. The IUF has consistently pointed to the fact that in many countries it is difficult for agricultural workers to exercise their basic human right to belong to a trade union. Consequently, agricultural employment is characterized by low pay, long hours, and precarious contracts.

ILO statistics also identify agricultural as one of the most dangerous industries to work in (alongside mining and construction), with many workplace fatalities and occupational accidents and diseases. The ILO reports that 70 percent of all child labor takes place in agriculture alone. These are major deficits that have to be addressed if the agricultural industry is to have the sort of skilled workforce it needs to deliver sustainable agriculture and truly green jobs.

In many of the world's richest countries, agriculture is explicitly excluded from national systems of labor relations. Poverty wages are the rule. Only 5 percent of the world's 1.3 billion agricultural workers have access to any kind of labor inspection system or legal protection of their health and safety rights. Agricultural workers are twice as likely to die at work than are workers in any other sector. Among these fatalities are an annual 40,000 deaths from exposure to pesticides. Every year, an estimated 3 to 4 million people engaged in agricultural work suffer severe poisoning from the hazardous pesticides they are forced to use, including work-related cancer and reproductive impairments.

Agriculture consumes more water than any other human activity, yet agricultural workers are routinely denied access to potable water. Despite enormous advances in productivity, agriculture remains a space of hunger, illness, and premature death.

Source: See Endnote 850 for this section.

Furthermore, the feminization and “casualization” of the waged agricultural workforce has grown in recent years, thus allowing for flexibility for larger growers while increasing precariousness for workers.⁸⁵¹ This is particularly evident in the rapidly expanding new export industries like cut flowers, where casualization has become the norm and many of the workers are women.⁸⁵² The cut flower industry is a major employer of mainly women workers in countries like Columbia (130,000 directly and indirectly), Ecuador, Tanzania, (9,000 workers in horticulture), Zambia (10,000–12,000) and Kenya (56,000 directly in cut flowers).⁸⁵³ Ethiopia has also emerged as a major exporter of cut flowers in recent years and in the process has created about 50,000 new jobs.⁸⁵⁴



© Christophe Smets / Luna / VISUM / Still Pictures
One of the 50000 workers in the sector of the cut roses of Kenya take care of young seedlings in a flower farm located around the lake Naivasha for a salary of approximately 30 euros per month, Kenya.

The “new agriculture” may not be green, but it does generate employment. Because participating in global supply chains is often more lucrative for farmers, this may add to the employment benefits. In Guatemala, studies found that lettuce farmers participating in modern supply chains hire 2.5 times more labor than those who do not, and this labor is typically sourced from local asset-poor households. Studies of tomato growers in Indonesia and kale growers in Kenya find similar results.⁸⁵⁵

Global value chains can generate quality employment in some instances, but they can also be vehicles for passing on the costs and risks to the weakest links in the chain. Sometimes, under pressure from investors (among others), governments in poorer countries have allowed labor standards to be defined by the demands of supply chain flexibility, including easier hiring and firing, more short-term contracts, fewer benefits, and longer periods of overtime.⁸⁵⁶ Women agricultural workers are particularly affected by these arrangements.

Employment benefits generated by global value chains are also confined to a relatively small number of countries. In many countries and regions, the employment picture is far less positive. Trade integration is a two-way process, and countries that export fruit, vegetables, and cut flowers are often importing cheap corn and other staples. According to one ILO study, “trade integration can also lead to job dislocation, increased informality and growing income inequality.”⁸⁵⁷

Young people in particular are having a difficult time finding gainful work in rural areas. The ILO observes that in 2005, young people accounted for an estimated 65 percent of agricultural employment. However, low and precarious incomes and the lack of useful work experience are driving many to look for work in cities, despite the great disadvantages they face in urban labor markets. In Africa, the number of unemployed youth grew by almost 30 percent between 1995 and 2005.⁸⁵⁸

Food Miles = More Truck Drivers

The globalization of food has made a significant contribution to the growth of certain jobs, most obviously in aviation, trucking, shipping, and related infrastructure such as road and airport construction. For example, in the United States, more than 100,000 logistics-sector jobs have been added in Southern California alone since 1990.⁸⁵⁹ In 1965, the country was home to 787,000 registered combination trucks; in 1995, there were almost 1.8 million.⁸⁶⁰ Today, there are 2.8 million truck drivers nationwide and the number is increasing at around 3 percent per year.⁸⁶¹

Overall, the trade, transport and utilities sector in the United States is projected to grow by 10.3 percent between 2004 and 2014. According to the U.S. Department of Labor, transportation and warehousing is expected to increase by 506,000 jobs, or 11.9 percent, through 2014. Truck transportation will grow by 9.6 percent, adding 129,000 new jobs, while rail transportation is projected to decline—a negative trend in terms of both GHG mitigation and air quality issues. Trucks, due to their size and limited maneuverability, also account for a greater share of congestion delays, thus making these problems even worse.⁸⁶² The warehousing and storage sector is projected to grow rapidly at 24.8 percent, adding 138,000 jobs.⁸⁶³ However, the recent sharp increase in fuel costs may mean that these projections will require some modification.

The growth in transportation by sea has not produced additional employment in all instances. Containerization, along with technological change in the world's ports, has made transportation by sea less labor intensive. In the United States, direct employment in water transportation declined from 232,000 in 1960 to 174,000 in 1995. However, as employment contracted the amount of food traveling by boat grew from 215 million tons in 1986 to 303 million tons in 1995.⁸⁶⁴

Employment and the Retail Revolution

The restructuring and consolidation of the food system has also had an impact on urban labor markets and the shape of business activity in towns and cities. Local-level food processing, brewing and baking, and other industries and trades have shown a marked decline in many regions of the world.⁸⁶⁵

Despite the overall growth in retail employment, there is evidence that food superstores lead to serious net job losses in the food retail sector (and other smaller retail operations, such as chemists.)⁸⁶⁶ The U.K.-based National Retail Planning Forum reports that many of the new superstore jobs are also part-time, lower paying, and generally of poorer quality.⁸⁶⁷ Another report from the United Kingdom notes: "A job that is lost at an independent store cannot simply be replaced by one job at a supermarket. Superstores benefit from economies of scale and computerization, and are designed that the individual employee can shift the maximum number of products per customer visit. Asda has the highest number of sales per employee, at £104,490 pa. This is compared to Tesco - £91,591, Sainsbury - £85,986, and Safeway, £94, 897."⁸⁶⁸

Nevertheless, in the advanced economies the proportion of food workers involved in manufacturing and retail today dwarfs the numbers of farmers operating at the base of the supply chain. In the United Kingdom, food and grocery chain workers numbered 2.3 million in 2004, of which 44 percent were in retail and just 4 percent in agriculture.⁸⁶⁹ The food and grocery chain is one of the country's largest employers, providing at least 2.8 million permanent jobs, or 11 percent of all U.K. jobs.⁸⁷⁰

In the developing world, supermarkets are growing at a spectacular pace. They now control 55 percent of food retailing in South Africa; 60 percent in Argentina and Mexico, and 50 percent of fresh-produce retailing in Brazil.⁸⁷¹ In Latin America, East Asia (excluding China and Japan), Northern Central Europe, and South Africa, "the average share of supermarkets in food retail went from mere niche—roughly 10 to 20 percent of food retail circa 1990—to dominate the market with 50 to 60 percent of food retail by the early 2000s." Southeast Asia and Southern Central Europe appear to be heading in a similar direction.⁸⁷²

The growth of supermarkets in the global South is having a marked effect on farmers, and some maintain that this effect is bigger than that of trade liberalization.⁸⁷³ Leading supermarket chains have shifted away from the wholesale markets where small farmers make their living, and toward procuring food through a few medium-to-large firms that can deliver a consistent quality product at large volumes. The World Bank acknowledges that, "For smallholders, being competitive in supplying supermarkets is a major challenge that requires meeting strict standards and achieving scale and delivery." It concludes that some farmers in certain regions may need to "transition out of agriculture" and move into "the provision of environmental services."⁸⁷⁴

The consolidation of retail has meant that farmers and producers often receive dwindling returns on their produce, as large retailers are in a position to lay down “take it or leave it” conditions.⁸⁷⁵ Retailers are also in a position to dictate terms to processors and distributors and even large food manufacturers, which results in manufacturers being more concerned to serve the interests of the retailers and less concerned to maintain a good relationship with farmers.⁸⁷⁶

Opportunities for Green Employment in the Existing Food System

World Bank, IPCC, and WTO approaches

Ever since the United Nations Earth Summit in Rio de Janeiro in 1992 and the adoption of *Agenda 21*, the idea of “sustainable development” has become firmly embedded in policy discourse. Among other things, *Agenda 21* articulated what sustainability would mean for agriculture, emphasizing the need to conserve and manage natural resources in ways that preserve these vital resources for future generations. The extent and severity of the degradation and depletion of natural resources, and the dangers of pesticides, fertilizers, and other inputs, has been documented in numerous reports and studies, such as UNEP’s *Global Environmental Outlook*.⁸⁷⁷

Reports released in recent years by leading agencies have echoed these concerns, examining issues of environment and sustainability in agriculture. In its *World Development Report 2008*, the World Bank offers a range of proposals to advance sustainability. Regarding climate change, the IPCC’s 2000 report *Land Use, Land Use Change and Forestry* makes proposals on how altered agricultural practices can aid GHG mitigation and contribute to carbon storage. These proposals have been developed in subsequent reports. In a 2007 report, the FAO addresses adaptation to climate change in agriculture, forestry, and fisheries.⁸⁷⁸ Finally, the United Nations Development Programme’s *Human Development Report* for 2007–08 has much to contribute on climate change, the human development challenges facing the developing world, and the need for a much higher level of international action.⁸⁷⁹

Limited Attention to Employment

It is important to note that employment issues do not feature frequently in these reports, and specific details pertaining to jobs—green or otherwise—are almost invariably absent. The World Bank’s *World Development Report* discusses and details employment trends and prospects for rural workers and smallholders in the context of the changing dynamics of the global food system, but the proposals it makes for sustainability are not accompanied by any explicit considerations with regard to employment. The report does, however, invite speculation with regard to the employment potential of these proposals and provide an agenda for future research on the issues. The same is somewhat true of the work of the IPCC and the FAO. In its *Fourth Assessment Report* on climate change, the IPCC acknowledges that certain GHG mitigation practices in agriculture show synergy with goals of sustainability, such as increasing soil carbon, which also improves food security.⁸⁸⁰

Some rural development and anti-poverty policies are also synergistic with mitigation, such as water management and agroforestry. Employment gains can be expected here, but there are few details. Importantly, UNEP notes that, for poorer countries, “the priorities of jobs, employment, and addressing stagnant economies” have prevailed over integrated planning to prevent or reduce land degradation—thus drawing attention to the fact that environmental concerns are often low on the agenda in countries that are struggling economically.⁸⁸¹ In a similar vein, the IPCC notes how existing policies to slow tropical deforestation have had minimal impact due, in part, to “countervailing profitability incentives.”⁸⁸² In other words, people are getting paid to cut down trees, or they can make money in the business of doing so.

The World Bank generally approves of the present structure and trajectory of the global food system, but calls for the right mix of market measures and government interventions to encourage better land and resource use as well as better management of modern farm inputs.⁸⁸³ It maintains that agriculture will become more sustainable when more capital, knowledge, and labor are directed toward improved natural resource management. However, these activities have not yet been developed through private markets, which means that powerful incentives will need to be put in place to pull business toward these activities, or they will depend on high levels of public investment and a more “command-and-control” approach.

Natural Resource Management and Preservation

The World Bank’s proposed improvements in natural resource management appear to have employment-creating potential. Activities like terracing or contouring of land, building irrigation structures, etc., are labor intensive and are urgently needed to prevent further resource depletion and degradation. Employment could also be generated as part of the broad effort to raise water productivity—a high priority area given the unsustainable use of water in many parts of the world. The Bank proposes removing subsidies that makes water inexpensive (or sometimes free), reasoning that if users were required to pay for water, they would have an incentive to use it more sparingly and judiciously. This would stimulate on-farm investments in field leveling and drainage, which would also generate employment.⁸⁸⁴

Substantial public investments in off-farm infrastructure are also required, supported by water management institutions staffed by people with the necessary background in hydrology. Additional investments will be required to store and save water, thus creating employment in producing, installing, and maintaining the necessary equipment.⁸⁸⁵ The move toward integrated water management, which involves canal lining and micro-irrigation, also involves labor inputs. Other sources of work include rehabilitating dams, barrages, and embankments that improve the flow of rivers. There also appears to be employment potential in combating soil erosion via tree planting and straightforward stone bunding.⁸⁸⁶ The IPCC has developed a similar list of mitigation measures.⁸⁸⁷

Reducing Harmful Inputs, Managing Livestock

The greening of high-input farming is critical to achieving sustainability as well. Here, modern inputs like fertilizers and pesticides can, according to the World Bank, be administered in a way that sustains

high yields without damaging the environment. According to some estimates, approximately 25 percent of pesticide use is prophylactic and administered “just in case” a particular species appears in the field.⁸⁸⁸ Such inputs could be reduced by methods of integrated pest management and also removing government subsidies on pesticides and fertilizers where they exist.

High-input farming has reduced both biological and genetic diversity, but farmers could be encouraged to rotate and diversify their crops—thus reducing the need for pesticides and fertilizers. Here, the employment implications are also positive. This kind of farming is knowledge intensive and requires research and extension systems “that can generate and transfer knowledge and decision-making skills to farmers rather than provide blanket recommendations over large areas.”⁸⁸⁹ Developing the ecological literacy of farmers could, therefore, create significant employment.

Managing intensive livestock systems is another challenge. For the World Bank, a key goal is to move intensive livestock facilities away from ecologically sensitive areas, and to prevent others from taking their place. Employment growth is not an obvious outcome here, although the general lack of sufficient and adequately trained inspectors in intensive livestock could be solved by training and employing more of them.

Payment for Environmental Services

Payment for environmental services (PES) is another strategy that appears to have very significant green employment potential. A description of the full range of these services is not possible here, but they include activities such as watershed and forest protection. These activities generate universal social benefits, such as clean drinking water, stable water flows to irrigation systems, carbon sequestration, and protection of biodiversity. The World Bank maintains that providers of these services should therefore be compensated through payments from beneficiaries of these services, and that the social and ecological benefits far outweigh the cost of paying for the services.⁸⁹⁰

The FAO’s *State of Food and Agriculture* report for 2007 explores PES in considerable depth.⁸⁹¹ It concludes that this approach can contribute to alleviating poverty, although PES-related problems do exist, such as the high administrative cost of involving small farmers. The experience of PES to date has been relatively limited. In the OECD countries, farmers have been compensated for foregoing more intensive and more profitable farming practices in order to prevent soil erosion and other forms of environmental degradation. And in Central and South America, silvopastoral practices have been developed in Columbia, Costa Rica, and Nicaragua to conserve forests. In these latter cases, the incomes of cattle farmers typically rose by 10–15 percent, suggesting that PES can establish a “win-win” relationship between poverty reduction and environmental protection—a situation that could generate more employment in rural areas as a result of farmer re-spending or taking on additional paid help.

Several studies in the developed countries point to real employment benefits of PES. In the United Kingdom, the English Countryside Stewardship Scheme has created jobs for farmers, contractors, and other small rural businesses.⁸⁹² The Tir Cymen scheme in Wales was created to

promote sustainable farming in three areas of rural Wales. This scheme produced 204 casual jobs and 62 person-years of environmental work. A government study found that if the scheme were replicated across Wales, it would generate 1,230 years in full-time jobs. A 1997 study found that wildlife conservation supported 10,000 full-time jobs in Britain.

These examples suggest that a global shift toward PES could generate very large numbers of jobs, especially when administered as public works projects. An impressive example of job creation is South Africa's "Working for Water" program. This public project has provided work for 25,000 previously unemployed people in the removal of high water-consuming invasive vegetation.⁸⁹³ However, converting land from agricultural production to forestry will release labor, while moving from silviopastoral production systems from conventional systems is likely to absorb it. The FAO warns against making blanket assumptions that PES programs will assist the poor or stimulate employment.⁸⁹⁴ Moreover, PES programs are still few in number and quite small scale, and most exist in developed countries. The public sector has been the main driver of these programs thus far, and here is where there appears to be potential for further growth.

Agriculture, GHG Mitigation/Adaptation, and Jobs

The Stern Review on the Economics of Climate Change notes that, compared to other sectors, relatively little thinking has been dedicated to reducing emissions from agriculture.⁸⁹⁵ The Review's proposals focus on more efficient use of fertilizers to cut nitrous oxide emissions; reducing methane from animals by administering nutritional supplements and capturing the methane for fuel, and stopping the burning of crop residues. Some of the World Bank's proposals referred to previously may also contribute to the effort to limit GHGs. As mentioned earlier, the IPCC has developed its own list of priorities with regard to mitigation practices.

Exactly what these proposals might mean for employment remains an open question. To the extent that any employment that helps mitigate GHGs or assists adaptation to climate change can be categorized as a "green job," then growth potential appears more likely in some areas than others. Certainly, changes in agricultural land management, such as conservation tillage, agroforestry, and rehabilitation of degraded crop and pasture land could create jobs.⁸⁹⁶ However, some proposed changes may reduce labor inputs.

For example, conservation tillage can make a major contribution to GHG mitigation and also enrich soil and improve yields. The global loss of soil carbon due to agriculture has been estimated at around 55 gigatons from 1,600 million hectares of cropland. This soil carbon loss can be reversed by techniques that increase the rate of carbon input into agricultural soils. Some conservation techniques reduce the period of bare fallow and also plant cover crops to stop erosion and soil loss. Other conservation techniques include tillage practices that reduce aeration of the soil, such as no till, ridge till, or chisel plough planting. Conservation tillage is thought to have potential to store at least 25 gigatons of carbon over the next 50 years if these methods were applied to all cropland.⁸⁹⁷

Conservation tillage, however, is sometimes presented to farmers as a way of *reducing* labor inputs. It also uses half as many tractors to cultivate a field as conventional tillage, which means lower

fuel consumption and decreased material inputs. However, conservation tillage also requires specialized equipment, such as grain drills, straw choppers, and spreaders for combines that uniformly dispense residues for easy double-crop planting, as well as row cleaners that brush aside heavy residue concentration.⁸⁹⁸ If conservation tillage became far more widely practiced by farmers, then demand for these technologies would presumably increase and manufacturing jobs would grow accordingly. However, demand for equipment germane to conventional plowing (such as tractors) would weaken, and jobs could be lost as a result. In general, mitigation efforts promise to stimulate the development of technology to improve production, biomass utilization (including biofuels), and organic agriculture, all of which have employment potential in terms of the research, development, and deployment.⁸⁹⁹

The implications for employment are also unclear in the case of developing low-emission rice and even low-emission livestock breeds. These proposals could create jobs in agricultural R&D but may have little employment impact, positive or negative, on the ground.

Adapting to climate change could create employment as well. For example, new irrigation schemes in dryland farming would create work, as might retrofitting existing ones as part of the adjustment to greater variability of rainfall. Climate information and forecasting, as well as R&D into crops adapted to new weather patterns, could also generate specialized and high-skill employment. However, according to the World Bank, “The cost of modifying irrigations schemes, especially when those depend on glacial melt...or regulation of water flow by high-altitude wetlands, could run into millions if not billions of dollars.”⁹⁰⁰ Spending of this magnitude would be expected to create employment, but this has to be weighed against the areas of the economy that may be deprived of investment capital in order to free up revenues for these and similar strategies for adaptation. Contributions to existing adaptation funds are under \$300 million a year and the UN’s “Nairobi Framework” is expected to provide no more than 10 percent of the funds needed for adaptation.⁹⁰¹

Funds for Mitigation and Adaptation Are Insufficient

These proposed climate-friendly alterations to farming-as-usual may create many green jobs, but making them happen on a significant scale will require considerable resources at a time when both public and private investment in rural areas in developing countries is worryingly low. The low investment problem has not been helped by the fact that the financial commitments for adaptation to climate change made by rich-country governments as signatories to the UNFCCC in the early 1990s have not been met. Thus, the UNDP concludes that, “To date, international cooperation on adaptation has been characterized by chronic under-financing, weak coordination and a failure to look beyond project-based responses.”⁹⁰²

The lack of funding is having a particularly negative impact on agriculture in the developing world, where climate change is already having an effect. As for the mitigation measures needed in agriculture, the IPCC observes that little progress in implementation has been made because of the costs involved, along with various institutional and educational barriers.⁹⁰³ The mitigation potential of the world’s forests is also being impeded by “the lack of institutional capacity, investment capital, technology, [and] R&D and transfer.”⁹⁰⁴

Meanwhile, the contrast in the amounts being spent on climate change adaptation efforts in the rich versus poor countries could not be more stark. The United Kingdom, Germany, the Netherlands, Italy, and the United States have spent billions of dollars on flood defenses and other protection measures, creating thousands of jobs in the process. However, only \$26 million has been spent multilaterally for adaptation measures—the equivalent of one week’s worth of spending on flood defenses in the United Kingdom, according to UNDP. The lack of adaptation spending not only impedes the development of green jobs, it can lead to many existing jobs being lost and livelihoods wrecked (particularly in agriculture) as a result of climate events.

The lack of funding for adaptation in the developing world has called into question the effectiveness of various funds established under the UNFCCC’s Global Environmental Facility. Leaving aside the failure of donors to honor the pledges they have made, the funds distributed have been project-based and have not been integrated into a broader strategy to advance sustainable development. The funds have therefore had minimal positive impact on the overall situation.

An effective global adaptation financing strategy is clearly needed. The UNDP has estimated that adequately financing climate-proofing development investments and infrastructure will require \$44 billion per annum by 2015. A further \$40 billion a year will be needed to adapt poverty reduction programs to climate change. Climate-related disaster response could add another \$2 billion. This total of \$86 billion would require developed countries to mobilize just 0.2 percent of GDP in 2015—or roughly one-tenth of what they currently spend on defense.

Growing Green Professionals?

A concerted effort to adequately fund both adaptation and mitigation efforts would create career opportunities and employment for a new generation of “green” professionals. Not all of these positions will be tied to agriculture, but some will, and others will relate to agriculture in some way. The Perth Biodiversity Project in Western Australia is one example where a growth in green professionals has been documented. The project is a local government initiative to improve the conservation of biodiversity in the Perth Metropolitan region. It is largely funded by the Natural Heritage Trust and involves 29 participating local governments. Perth local governments spent a total of \$5.14 million on salaries and activities related to biodiversity conservation in the 2000–01 period, as well as an estimated \$21 million on other environmental protection and \$16 million on natural resource management activities. This created employment for environmental and biodiversity officers, and the local governments dedicate 41 full-time equivalent officers to on-the-ground bush regeneration.⁹⁰⁵

A 2002 survey, however, identified training needs and skills shortages in environmental occupations in Australia, particularly in bush regeneration, organic agriculture, environmental impact statement preparation, and environmental assessment and monitoring. If such shortages are evident in Australia, they are likely to be more evident in the developing world, where the resources to develop them are even scarcer.⁹⁰⁶ The study showed a marked increase in the number of “environmental workers” being hired, especially in the private sector. Among the occupations experiencing the highest growth were those concerned with “Earth repair” and “resource renewal.”

Along these lines, UNEP maintains that a prerequisite to achieving sustainable land use is adequate government support for national land resource institutions and for building up the capacities of land resource planners, farmers, and managers at local and national levels.⁹⁰⁷

Offsetting Trends?

Taken together, the above proposals are part of an effort to make existing agriculture more sustainable. Under this scenario, jobs may be gained, but they may also be lost—indicating that additional research into the employment implications is clearly necessary. Paradoxically, the projected increase in energy intensification in agriculture is such that it becomes possible to imagine a growth in green jobs within a system that actually becomes more environmentally unsustainable as time goes on. In its 2001 report on climate mitigation, the IPCC documents the global trend toward energy intensification in food produced on arable lands, projecting a “4 to 7 fold increase in current commercial energy inputs into agriculture, particularly in developing countries.”⁹⁰⁸

According to the IPCC, “The present challenge is to offset this trend by introducing more efficient production methods and greater adoption of new technologies and practices. Whilst reducing energy intensity, agriculture must also become more sustainable in terms of reduced nutrient inputs, lower environmental impacts, and with zero depletion of the world’s natural resources such as fish and topsoil.”⁹⁰⁹ In its *Fourth Assessment Report*, the IPCC sees the potential to reduce GHG emissions per unit of food production—provided the mitigation measures it proposes are implemented. But even then, absolute emissions in agriculture will continue to rise as global food demand grows.

Proposals to Green Retail, and a Civil Society Critique

Leaving aside their freight transport arrangements and the issue of “food miles,” today’s large retail establishments consume an estimated six times as much electricity as factories, largely for lighting and refrigeration.⁹¹⁰ Increasingly, supermarkets and superstores are proposing measures to limit their own environmental footprint and to promote sustainable practices, but this is no easy task. In 1999, Sainsbury’s built what it described as the most environmentally responsible supermarket in Britain. The 35,000 square foot (3,255 square meter) store was designed to reduce energy consumption by up to 50 percent compared to a standard store of similar size and operation. The store created 380 jobs, although it is not clear how this number would have changed had the store been constructed in a conventional way.⁹¹¹

In 2006, Tesco, the largest food retailer in the United Kingdom, generated 4.13 million tons of carbon dioxide equivalent (CO₂e) globally. The country’s food retail sector is estimated to emit 9.2 million tons CO₂e annually, plus approximately 2.4 million tons of CO₂e from associated distribution. Tesco is proud of its efforts to reduce its carbon intensity, noting that, “our footprint in tons of CO₂e has not changed materially since the 05/06 financial year despite a 10.9% increase in sales and a 17.2% increase in selling area.” Tesco has begun to build “environmental stores in which we test low-carbon technologies to establish their suitability for wider roll-out” and to “self-generate energy from renewable sources such as solar, wind, biomass and geothermal.”⁹¹² The employment implications of these early efforts to “green” food retail (and retail more generally) require further analysis.

In 2005, the world's largest retailer, Wal-Mart, unveiled a new store outside Dallas, Texas, that combined a host of renewable energy technologies, including solar PV arrays, two small wind turbines, a biofuel boiler to recycle and burn recovered oil from store operations, and a long list of energy-saving and sustainable design principles. The company announced that it would invest \$500 million to achieve a variety of goals, including: reducing its stores' GHGs by 20 percent in seven years; increasing its fleet's fuel efficiency by 25 percent in three years and doubling it in 10 years; designing a 25 percent more energy-efficient store within four years; reducing packaging; and pressuring its worldwide network of suppliers to follow its lead.⁹¹³ Wal-Mart's sustainability commitments include being supplied by 100 percent renewable energy, eliminating 30 percent of energy use in stores by roughly 2012, and selling more organic produce. The company also plans to reduce its CO₂ output by 20 million tons.

Wal-Mart's proposals have elicited a sharp reaction from many civil society organizations. According to one calculation, the company's GHG emissions through its supply chains and retail operations totaled 562 million tons—almost half the amount generated by France in 2004—thus putting into perspective the proposed emissions cuts. Wal-Mart's plan to sell more organics has also been attacked by watchdog organizations for pricing out other organic producers and for misrepresenting conventional food products as organic. Indeed, just about all of the company's sustainability commitments have been severely criticized. Given the potential implications for the retail sector, Wal-Mart's efforts to meet its targets will be monitored closely in the years ahead.

Overall, large retail companies can be expected to develop more systems for sustainability. Unilever, along with Danon and Nestlé, pioneered the Sustainable Agricultural Initiative (SAI) to promote the development of sustainable agricultural practices along the food chain. Organized around the slogan "People-Planet-Profit," the SAI Platform conducts various activities around knowledge building and management, awareness raising, stakeholder involvement, and giving support to the implementation of sustainable practices in agriculture both within the supply chain as well as in compliance with trade policies and regulations.⁹¹⁴ Unions are presently discussing a "social auditing" dimension to these initiatives, whereby civil society organizations such as unions and agricultural NGOs play a role as inspectors concerned with workers rights, health and safety, and living conditions.⁹¹⁵

Reducing Food Waste—Uncertain Employment Opportunities

Supermarkets could probably do more to prevent methane-generating food waste. It is unclear, however, just how many jobs this might create or preserve. In the U.S. state of New Jersey, 25 Shop Rite supermarkets together divert 3,000 tons of organic waste for off-site composting and rendering. Composting responsibilities are integrated into employee job descriptions, but the scheme does create jobs for employees of rendering companies.⁹¹⁶ On the West Coast, the California Integrated Waste Management Board employs around 400 workers to deal with 5.6 million tons of discarded food.⁹¹⁷ Over half of this waste—2.9 million tons—comes from commercial sources such as restaurants, hotels, and schools, and measures could be taken to manage and reduce this food waste in ways that could, in principle, create employment.

Landfill gas-to-energy (LFGTE) programs have been developed as a means of converting methane generated by decomposing organic materials such as food into useable energy, thus stopping the release of this powerful greenhouse gas. In principle, the widespread development of LFGTE could generate considerable employment. Of the estimated 2,500 landfills currently operating in the United States, approximately 340 have landfill gas projects and a further 60 of the projects are under construction.⁹¹⁸ The IPCC reported 1,150 such plants operating globally in 2003.⁹¹⁹

According to a U.S. Department of Energy survey, LFGTE projects currently utilize about 10 percent of the potential LFG available in the United States. The survey estimates that applying the controlled bioreactor technology to half of the waste currently being landfilled could provide more than 270 billion cubic feet of methane gas per year—meeting about 1 percent of the country's electricity needs.⁹²⁰ LFGTE is capital intensive and reduces emissions through engineered gas extraction and recovery systems consisting of vertical wells and/or horizontal collectors.⁹²¹ Nevertheless, its widespread deployment appears to have some employment potential.

LFGTE is not the only way of dealing with methane and food waste, and its use has been severely criticized in some quarters.⁹²² The IPCC has cited capture rates of just 20 percent in some cases, far lower than the 75 percent rate claimed by some waste management companies. Civil society groups have expressed concern that the often-subsidized waste industry has a monetary incentive to landfill as much garbage as possible, to decompose it as quickly as possible, and to claim that the capture of greenhouse gases from landfills is a sustainable way to create alternative energy sources. A more sustainable approach might be to ban the dumping of decomposable material into landfills, especially given the fact that capture rates will never be 100 percent and that accelerated decomposition may actually increase the release of methane into the atmosphere.

In the European Union, landfill gas recovery is mandated at existing sites, while the landfilling of organic wastes is being phased out via a recent directive. The IPCC notes that aerobic composting is probably more appropriate from a cost perspective and therefore might be a better option in the developing world. Even waste scavenging and informal recycling can make an important contribution to mitigation, the IPCC notes, since “low technology recycling activities can also generate significant employment through creative microfinancing and other measures to essentially pay people to sort through garbage.”⁹²³

In the United States, existing recycling and yard waste collection and composting programs could be expanded to include food scraps and soiled paper. Over 120 cities in North America are already in the process of diverting all organic material from landfills. In addition to preventing the creation of uncontrolled GHGs, these programs create their own benefits such as soil stabilization and improvement through composting. Recycling leads to indirect energy savings and reduced GHG emissions.

Consumers also waste a lot of food, and yet obesity has increased alongside the growth of entire industries around diet and exercise. In a sense, public education on food waste reduction and on better use of food in the homes could be a source of green employment in schools, government agencies, and NGOs.

Beyond the Agro-Industrial Model

In this final section, we examine the employment implications of a radically altered, “post-industrial” global food regime, based on “grow local” policies and practices and small farm production. We come at this question from two angles or perspectives. The first is in the developing world, where large numbers of small farming systems continue to grow food and raise animals for themselves and local communities. Here, the issue of green jobs revolves around securing local food economies, preserving what is already relatively green and perhaps making it greener still. According to the ILO, the evidence suggests that the development of rural small and medium enterprises is likely to be pro-poor, as these tend to be labor-intensive in nature—thus reducing unemployment, helping to smooth income seasonally, and bidding up local wages. These enterprises tend to generate more employment per unit of capital than big firms and typically produce goods and services that are affordable to the poor, thereby increasing their access to goods and services that otherwise might not be available to them.⁹²⁴

The second angle or perspective focuses on the developed countries, where today just a tiny fraction of the economically active population makes its living from farming, and where rural communities are often in an advanced state of disintegration.

Small Farming Systems

Small farm-based agriculture involves a qualitative shift in farming methods away from dependency on environmentally harmful inputs—such as fossil fuel-based energy, chemicals, and fertilizers—and toward methods that utilize more human labor, farmer expertise, and community experience. The system rests on the better use of locally available natural resources (such as water harvesting, irrigation scheduling, and reclamation of formerly unproductive land), the intensification of microenvironments in the farm system (such as gardens, orchards, and ponds), diversification through adding new regenerative components, and making better use of non-renewable inputs and technologies.

Of course, there exists no neat barrier between this model of agriculture and the agro-industrial model. Small farmers often use pesticides and fertilizers, just as large growers use traditional farming methods. But there is usually a huge political gulf between those who see small farming as a sustainable solution to most of the problems generated by agro-industrial model, and those who feel that small farmers have little choice but to adapt to the productive agro-industrial system or leave agriculture altogether.

Small farmers’ organizations and agricultural workers’ unions stress that land reform, access to markets, affordable finance, and other resources are all essential to sustainability.⁹²⁵ They also emphasize the need for a new and fairer set of rules to govern international trade and to control the market power of the large growers and retailers. In any discussion on employment, environment, and sustainability generally, these questions are seldom far from view even if, for the purposes of this report, they have been left aside. Questions have been raised regarding the productive

potential of small farming systems. Some studies show that small farm productivity can rise dramatically in the case of rain-fed crops, and significantly in the case of irrigated crops. With the latter, farmer experimentation with redesign of nutrient, water, and soil management can improve per-hectare food production levels still further. In addition, farmers have shown their capacity to increase total farm production by bringing formerly unproductive lands into cultivation, by using intercropping and manuring, biopesticides and biofertilizers, as well as harvesting enough water for an extra irrigated crop during formerly unproductive seasons.

The small-farm model entails a shift toward biodiversity farming that uses the complementarities and synergies that result from the right combinations of crops, trees, and animals in integrated agricultural systems.⁹²⁶ According to WWF, the contribution of small farming to environmental sustainability will be invaluable: “Highly diverse systems, as opposed to commercial monocultures, have repeatedly been shown to be more resilient—and more productive. Farming based on expensive energy-intensive artificial inputs will be both vulnerable to fuel price rises and will further add to the problems of climate change and environmental vulnerability.”⁹²⁷ Overall, this kind of sustainable agriculture is based on a far more careful use of natural resources in a way that is regenerative—restoring water tables, maintaining soil fertility, and fostering biodiversity. It also makes use of the knowledge and skills of farmers.⁹²⁸

The Developing World

Small farmers play a critically important role in the developing world. In Brazil, for example, more than 70 percent of the food consumed is produced by small farmers, and small properties with less than 200 hectares generate more than 14.4 million jobs in the countryside, or 86 percent of rural employment. Meanwhile, in Cuba, economic circumstances following the collapse of the Soviet Union necessitated a return to small-scale agriculture, which proved to be quite successful.⁹²⁹ (See Box II.5-3.)

The 1996 Brazilian agricultural census showed that, using the average productive strategies of small-scale agriculture, every eight hectares cultivated produces one rural job, whereas large-scale mechanized farms require an average of 67 hectares per unit of rural employment.⁹³⁰ In banana production, an IUF study shows that 2,000 workers are employed for every 1,000 hectares dedicated



to bananas; however, in Columbia, where palm oil production has grown dramatically and displaced banana plantations, 1,000 hectares employs just 100 workers.⁹³¹

© Mark Edwards / Still Pictures

Man watering crops with a hose. 30% of Havana's vegetables are grown on waste land in the city. All produce is grown organically, the government cannot afford to impose fertilizer and pesticides, Havana, Cuba.

Box II.5-3. The Cuban Experience

The Cuban experience perhaps best illustrates the possibilities of both urban agriculture and small farm production systems. In 1989, Cuba's agriculture was totally dependent on oil, fertilizers and pesticides from the Soviet Union and its allies; an estimated 57 percent of the island's caloric intake was imported, as was 80 percent of all protein and fat. The collapse of the Soviet Union brought this system to an abrupt halt, forcing Cuba to transition from a conventional high-input, monocrop-intensive agricultural system to smaller organic and semi-organic farms.

To respond to the changing food supply, an Urban Agriculture Department was established in Havana to develop urban growing in a city that had relied on imports or rural production for decades. At first, per capita daily caloric intake dropped from 2,908 calories in 1989 to 1,863 calories in 1995, a decline of 36 percent. But by mid-2006, caloric intake had rebounded to 2,473—a recovery due almost entirely to the changes in Cuban agricultural methods. Today, urban agriculture provides 50 percent of the caloric intake for Havana's 2.5 million people.

Source: See Endnote 929 for this section.

Local Production and Climate Change

The impact of climate change on agriculture in the poorer regions of the world is already obvious, as worsening droughts, rising sea levels, and more-intense storms affect people's ability to grow food. However, the adaptation potential of local food systems has not always been recognized. According to WWF, "the conservation and development of local agricultural biodiversity is crucial in the face of climate change. In Andean communities, farmers help each other where government support is missing."⁹³²

Despite scarce resources and underfunding, farmers and communities are taking adaptation measures into their own hands. The UNDP documents numerous cases where local populations in different parts of the developing world are strengthening dykes and embankments, and where farmers and growers operating in water-stressed rained environments already invest their labor in small-scale water harvesting.⁹³³ Women farmers in Bangladesh are building "floating gardens" to grow vegetables in flood-prone areas.

Paying farmers to keep rainforests intact also helps the fight against climate change. According to the Working Group on Climate Change and Development, "Every hectare contains about 200 tons of carbon, and developing countries could be granted carbon credits for those rainforests that they save from destruction. These credits can be traded on the international market under the Kyoto protocol, giving tropical countries and local landowners an incentive to keep their forests. A hectare of rainforest might cost \$300 to clear for pasture, and then be worth only \$500 to its owner. At current market values for carbon, the same hectare of rainforest, if left intact, could be worth thousands of dollars."⁹³⁴

Urban Agriculture and Cooperatives

Urban agriculture is an important expression of sustainable methods. As the Cuban experience illustrates, the expansion of urban farming could generate much-needed employment, particularly

in cities with high levels of underemployment and informal labor. Already, urban agriculture has been expanding “more rapidly than urban populations, and in many countries more rapidly than their economies.”⁹³⁵

Urban agriculture takes place on both public and private land, and in 1993 it involved more than 800 million urban dwellers. In São Paulo, Brazil, agriculture is a major planned land use in the city’s metropolitan master plan, adopted in the 1990s. Urban agriculture is not, however, unambiguously green. The improper use of chemicals has contributed to land, air, and water pollution. However, the activity recycles organic matter, and solid wastes can be composted and used to fertilize soils. A 1996 study in Zimbabwe found that the expansion of urban agriculture reduced municipal costs for landscape maintenance and waste management, and created hundreds of jobs.⁹³⁶

Cooperatives are also very important to any model of sustainability. Globally, cooperatives employ around 100 million people, many in rural areas. More than 50 percent of global agricultural output is marketed through cooperatives.⁹³⁷

Green Job Potential in Organic Farming and Local Food Systems

The global market for organic products reached \$38.6 billion in 2006, with the vast majority of products being consumed in North America and Europe, according to the International Federation of Organic Agricultural Movements.⁹³⁸ Research cases provide some evidence that organic farming and local food systems generate positive-sum employment gains while also protecting the environment. For example:

- ❑ A study of 900 food businesses in Devon in the United Kingdom showed that producers involved in the local economy hired more workers on average than those not involved locally. The study found that 38 percent of producers have created new jobs, at an average of 0.5 per farm, with 3.4 full-time equivalents (FTE) per farm compared to 2.34 regionally.⁹³⁹
- ❑ A study of 1,144 organic farms in the United Kingdom and the Republic of Ireland showed that organic farms employed one-third more FTEs per farm than conventional farms. In these countries, organic agricultural land amounts to 4.3 percent and 1 percent of the total farm area, respectively. If 20 percent of farmland became organic in both countries, this would bring 73,200 new jobs in the United Kingdom and 9,200 in Ireland, according to the study.⁹⁴⁰
- ❑ An input-output analysis of organic apple production in the U.S. state of Washington found that, for every \$1 million in sales, organic apples generated 29.4 FTEs, whereas conventional farms generated 25.9 FTEs.⁹⁴¹

Other studies show that purchases from local growers through such means as organic box schemes (where organic food is delivered to individual doorsteps) generate considerably more income for local economies than does food purchased from supermarkets. The studies detail how the multiplier effects of extra income sustain and expand a range of employment in the local areas. A study in the U.S. state of Iowa claims that if people living in the state purchased 10 percent more of their food from local growers, they would cut the state’s CO₂ emissions by 3,590 tons per year and

generate much-needed income for farmers. Another study showed that consuming domestically grown food in Japan would be equivalent to a 20 percent energy savings per household.⁹⁴²

Similarly, a U.K. study on Queens Market, a local food market in East London, found that “the Market provides twice as many jobs per square foot of retail as supermarkets...[and] delivers twice as many jobs per square metre as a food superstore.” It reported that the market provides 581 jobs, with 308 of the people employed living in the immediate local area. Jobs at the market were also “more varied than those at a food superstore, involving a richer skill set and greater opportunities to start a business and to acquire business knowledge.”⁹⁴³

While the studies of organic farms and local food systems do not always deal with the quality of the work created, the farms employing the most workers above the average were mixed farms, suggesting that workers would perform a variety of tasks in these establishments. This is in contrast to livestock and dairy farms, where the jobs dividend between organic and conventional farms is almost zero and the work would probably be less varied. In general, more sustainable farming practices tend to be knowledge-intensive. While this would appear to raise demand for adequately trained workers, it also raises the need for, in the words of the World Bank, “research and extension systems that can generate and transfer knowledge and decision-making skills to farmers.” There is a need for the requisite levels of ecological literacy to better understand interactions in complex ecosystems.⁹⁴⁴

The U.K.-Ireland study also suggested that, in the case of organic farms, the larger number of workers per farm might also yield social benefits by helping to break down the social isolation felt by sole farmers and sole employees.⁹⁴⁵ And farmers’ markets have community-building value as well. One study estimated that people have 10 times as many conversations at farmers’ markets than at supermarkets—to the benefit, presumably, of both workers and consumers alike.⁹⁴⁶ A pilot survey by the California Institute of Rural Studies on job benefits and conditions most appreciated by workers on small-scale farms found that “respectful treatment” was the most important feature, and year-round employment also ranked highly.⁹⁴⁷

While these findings suggest employment and other social gains generated by organic farming, sometimes the differences between organic and conventional farms are harder to detect. A 2005 survey of organic farmers in California attempted to establish whether or not “certified organic” incorporated a conception or practice of sustainability that extended to hired farm labor. The survey found that organic farmers operate on razor-thin margins and often pay as poorly as conventional farmers. These organic producers felt so squeezed by cheap imports on the one hand and large wholesale operations on the other, that they complained that their own wages and benefits were also extremely low. Fully two-thirds of these farmers opposed guaranteed collective bargaining rights for waged employees.⁹⁴⁸

U.S. organic soybean producers have been subjected to the same downward pressures on prices as have the producers of non-organic produce. In 2000, however, several organic farmers formed an organization (OFARM) that, among other things, substitutes collective actions for one-on-one negotiations with large buyers. Organic milk producers in the United States have organized themselves along similar lines. Organic certification remains critical to these producers, and

without it they are subject to the pressures leading to consolidation and lower prices faced by conventional producers.

If the social benefits of organic production are not always clearcut, the same is sometimes true of the environmental benefits. Organic produce, for example, is not necessarily synonymous with local food production and a reduction of food miles. The global trade in organics is on the increase, with Chinese exports reaching \$350 million in 2005. Mexico produces organic cherry tomatoes for the U.S. market. However, China also produces organic food for its own consumption, as Chinese urban dwellers become more interested in healthier and safer food options.⁹⁴⁹ The growing market for organic produce provides an incentive for Chinese farmers to convert their farmland from chemical-dependent techniques back to traditional, pesticide-free, sustainable farming methods. If the consumption of organic produce continues to grow worldwide, then employment growth in this area could become a more generalized and global phenomenon.⁹⁵⁰ The United Kingdom, for example, imports 70 percent of its organic produce—along with 50 percent of its conventionally-grown vegetables, 90 percent of its fruit, and 70 percent of its meat.⁹⁵¹

Organic Production and Developing Countries

While the demand for organic produce is growing in industrial countries, organic methods of farming are also visible in the developing world. At the 2007 “International Conference on Organic Agriculture and Food Security,” organized by the FAO, a number of submissions made note of the social benefits of organic production.⁹⁵² One study described how, in the Dominican Republic, the establishment and maintenance of organic crops such as cocoa, coffee, and bananas requires intense use of hand labor, as mechanization is still not available for the majority of farm operations. As a result, “the movement from rural to metropolitan areas is reduced by the availability of local employment opportunities.”⁹⁵³ Another study noted that, since 1990, employment in the agricultural sector of northeastern Germany, in the former East Germany, has been reduced by 80 percent; however, larger organic farms developing there are generating employment and other social benefits.⁹⁵⁴ And in India, “organic farming is spreading fast to many agro-ecological zones.... Small farmers are showing preference for organic farming practices because it reduces their cost of cultivation, in several cases bringing down to little cash input costs, [and it] provides more employment to members of the farming families”⁹⁵⁵

The growth in organics is to some extent contingent on labeling. As government regulation in agriculture has retreated, the large retailers have filled the vacuum with their own systems of certification, standards, and labeling—usually in partnership with food services companies, manufacturers, and other agrifood interests. Organic producers are organizing in ways that not only challenge this kind of private certification system, but they are also redefining the product being certified as something representative of community, diversity, and local power.

In Mexico, for example, *Coyote Rojo* (“Red Coyote”) is an organic bioregional label that began certifying producers in August 2007. Its purposes are to safeguard and promote biodiversity, uphold cultural practices of seed saving, protect methods of crop production and typical foods, and conserve natural resources and sustainable means of harvesting them. According to one study,

Coyote Rojo's "bioregionalism" focuses on satisfying basic needs in the local area, taking advantage of renewable energy sources, promoting and preserving organic agriculture, and developing local businesses based in local skill, knowledge, and capacity. As the quality of the product is the result of the entire production process, evaluation must encompass the entire process in order to guarantee specified qualities.

The politics behind the *Coyote Rojo* has a bearing on the green jobs discussion. According to one study, the label "is one way of confronting many of the challenges facing this region. It capitalizes on the niche value of maize varieties specific to localities within the bioregion, thus confronting the looming threats to Mexico's single greatest cultural symbol." The hope is that people will be less forced to migrate, taking with them precious knowledge of how to work the traditional and labor-intensive crop growing system known as *milpas*. It is anticipated that the commercialization of local varieties can sustain rural livelihoods and contribute to agronomic diversity at the same time. Bioregionalism and the *Coyote Rojo* project thus offer an alternative to nearby farmers embracing standard production systems defined by transnational supply chains.

These studies suggest that the organic sector may offer a development path that is sustainable at the global level and that organics provide what FAO describes as "alternative employment opportunities for educated young people in rural areas with decreasing chances to make a living in the cities. Rural community development is also a highly valued advantage achieved through collective learning processes fostered by organic agriculture's principles and practices."⁹⁵⁶

Fair Trade Coffee

The demand for "fair-trade" products—particularly tea, coffee, cocoa, and bananas—has grown dramatically in recent years. Fair Trade Organizations promote sustainable methods and also work to ensure that small producers in developing countries receive a fair price for their goods. In 2003, 8,400 tons of green coffee was "Fair Trade" certified, with a retail value of \$208 million. It comprised roughly 15 percent of the \$1.7 billion specialty coffee market in the United States.



© iyers
Fair trade coffee stand.
www.flickr.com/photo/i_y_e_r_s/500869859

As a result of this certification, workers and farmers in fair-trade production systems generally have better rights and protections than is the case in conventional industries, and the production methods are usually also environmentally sustainable. Typically, fair-trade farmers each cultivate less than 3 hectares of coffee and harvest 1,000–3,000 pounds of unroasted coffee a year. Small farmers are perhaps more aptly defined as those farmers who rely principally on their own families' labor. This makes fair trade potentially representative of an estimated 75 percent of all coffee farmers.

A look at one large company involved in fair trade, Equal Exchange, shows an average annual growth of 32.5 percent between 1986 and 2006. In 2006, the company's sales were approximately \$23.6 million, and it employed 94 full-time employees.⁹⁵⁷ The combined efforts of the fair trade movement have generated significant numbers of green jobs. While the numbers of such jobs may typically be only a few dozen in each cooperative, they add up. The National Cooperative Business Association reports that in Indonesia, 12,000 jobs have been created as a result of fair-trade exports to the United States.⁹⁵⁸

Proponents of fair trade often view it as a way of challenging the dominant economic concept underlying today's globalization, which touts competitiveness and efficiency above social and environmental concerns.⁹⁵⁹ Recently, proposals have been developed to expand fair-trade initiatives to include hard-pressed farmers in the global North. If fair trade coffee is a good thing for farmers in Central America, why not market "fair trade carrots" as a means to help farmers in central England? While considerable economic differences exist between farmers in the North and South, many of the economic dynamics are nonetheless very similar.⁹⁶⁰

Meanwhile, agricultural certification of varying types is well established in Europe and the United States and is expanding rapidly in terms of sales volume and market share. In theory, certification should enable consumers to use their purchasing power to support sustainable products, and so drive social and environmental improvements along the value chain. However, certification faces several problems. It is typically associated with niche markets and, at least in some sectors, may face limited prospects for market expansion. Certification may also become another requirement for market access and a barrier for small producers rather than an opportunity.

Green Employment in Food and Agriculture: Challenges and Opportunities

From the above overview, it is possible to identify several key challenges to the development of green jobs in agriculture. These include:

- ❑ In the developing world in particular, the shrinking proportion of smallholders amounts to a decline in small farming that is green or relatively green, to the extent that smaller farms generally use less energy and chemical inputs than larger scale livestock-intensive or plantation systems.
- ❑ Some smallholders and entrepreneurs are moving into higher-value, "new agriculture" products, such as cut flowers, that generally require more environmentally damaging inputs and often create low-quality and precarious employment.

- ❑ Poverty contributes to land degradation as the poor, due to lack of alternative employment, are forced onto marginal lands with fragile ecosystems and into areas where land is increasingly exploited to meet food needs. They typically lack adequate economic and political support to adopt appropriate agricultural practices.⁹⁶¹
- ❑ Rising income in some parts of the developing world is raising the demand for meat and therefore for intensive livestock production and feed for the animals. This trend is driving up GHG emissions and broadening the environmental footprint of agriculture considerably.
- ❑ The globalization of food is increasing the distance from farm to fork, making food more carbon-intensive and lowering air quality as it helps generate “non-green” employment in transportation and other logistics.
- ❑ The vertical and horizontal integration of the food industry has raised productivity and lowered employment levels in some sectors of the global food system. Any growth in green employment must therefore confront or adapt to powerful trends to reduce labor inputs in the name of efficiency, productivity, and profitability.
- ❑ The spread of superstores and supermarkets is generating employment in facilities that consume large amounts of energy. Serious efforts to make food retail more environmentally sustainable will therefore have employment implications.
- ❑ Organic agriculture is growing, is more labor intensive, and brings environmental benefits. For these reasons, policies must be put in place that can help organics scale up dramatically.

Presently much of the employment in the existing global food system cannot be categorized as green. On the contrary, much of this employment is environmentally damaging, and the trends are moving away from green jobs rather than toward them. It is also very difficult for producers, both small and large, to disentangle themselves from these trends and build sustainable alternatives. However, opportunities for green employment have been identified both within the context of the existing global food system and also by way of small farming systems, local food, and organic produce. These opportunities exist in both industrialized and developing countries.

It would appear that the challenges to green employment are more formidable than the opportunities are promising. But much will depend on the policy and institutional frameworks established in the years ahead, from the international down to the local levels. If present trends, driven by market forces, continue, then any growth in green jobs will probably run counter to much stronger trends in the other direction. Only a decisive policy shift, driven by mass political pressure from civil society, and perhaps aided here and there by shifting consumer preferences for healthier and/or local food, has the power to intercept and reverse the trend toward more unsustainable practices.

Postscript: The Rising Cost of Food

It is necessary to note that, as this report was being prepared, the cost of food has risen sharply on world markets. According to the World Bank, global wheat prices increased 181 percent over the 36

months leading up to February 2008, and overall global food prices jumped 83 percent. The FAO's food price index rose by 40 percent in 2007, and the poorest countries spent 25 percent more on imported food. The soaring prices for staple crops, including wheat, rice, corn, and soybeans, have pushed up prices for grain-fed meat, eggs, and dairy products, spurring inflation throughout the consumer food market.

According to the FAO, these changes represent an “unforeseen and unprecedented” shift in the global food system, threatening billions of people with hunger and decreased access to food.⁹⁶² In 2008, rising food costs have led to violent protests in Cameroon, Egypt, Ethiopia, Indonesia, Ivory Coast, Madagascar, Mauritania, the Philippines, and other countries. Responding to the price increases, in April 2008 the World Bank called for a “New Deal for Global Food Policy” and emphasized the recommendations of its 2008 *World Development Report*, discussed above. The new policy would “contribute to inclusive and sustainable development” that would benefit all countries—poor, middle-income, and developed.⁹⁶³

The present crisis will give further impetus to demands for a more sustainable, stable, and just global food system. This will open the door to further opportunities for green employment and decent work. However, the situation requires action that goes beyond emergency aid and temporary support.

