APQONIA

February 2012

ECONOMIC EXPANSION SERIES

Agriculture Expansion

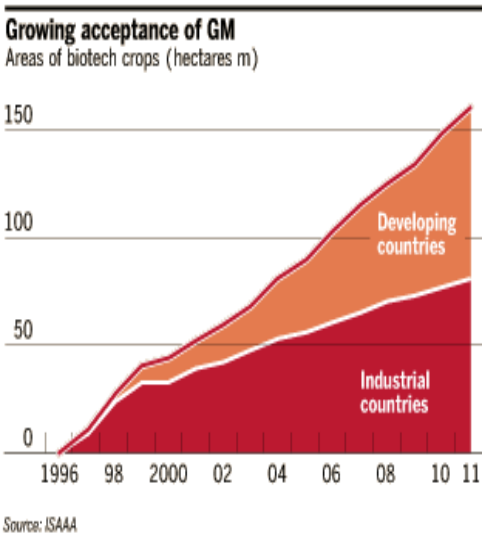
Agriculture represents 70% of freshwater use worldwide.
Cost per person per day $7.5, or approximately $18.25 trillion per year globally

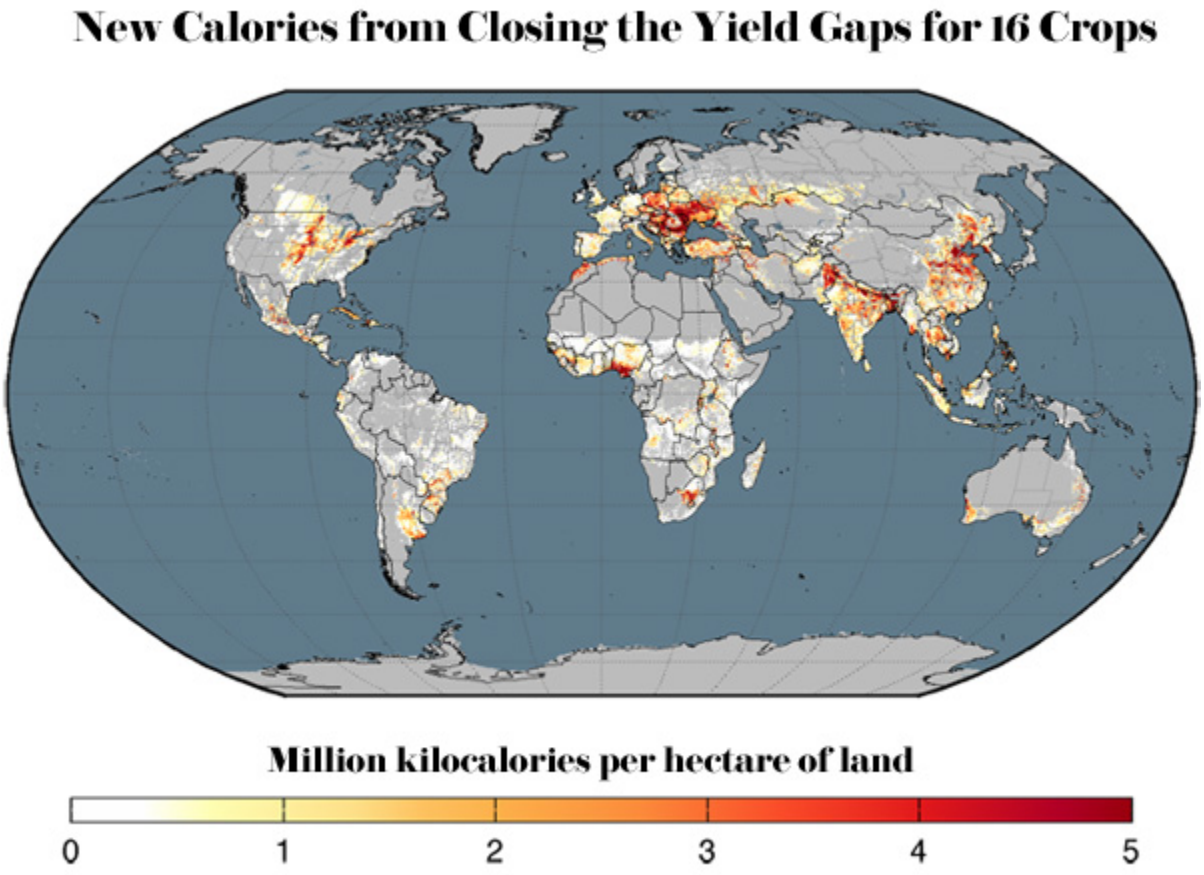
Climate change and agriculture are interrelated processes, both of which take place on a global scale. A rising unease about the future of the world's food supply came through during interviews this year with more than 50 agricultural experts working in nine countries. These experts say that in the next few decades farmers need to withstand whatever climate shocks come their way while roughly doubling the amount of food they produce to meet rising demand.

Stop-gaps aren't the answer. This is sensitive, the challenge is to base defense expenditure on an accurate assessment of threats and to develop effective defenses against those threats.
http://en.m.wikipedia.org/wiki/Global_warming_and_agriculture
Animals have adapted for millions of years. Ultimately little gets done unless somebody decides. Just about the time you think you know everything about climates they come up with something new. Finally, in poorer countries (not yet emerging markets) the control of financial markets and their capital flows became more effective. Italic: indicates comment by Artificial Intel Agent

The idea of supplemental food production beyond our rural farming operations and extensive long distant imports is not new, and has actually come in handy during war times and the Great Depression when food shortage issues arose. As early as 1893, citizens of a depression-struck Detroit were asked to use any vacant lots to grow vegetables. They were nicknamed Pingree's Potato Patches after the mayor, Haze S. Pingree, who came up with the idea to begin with. He intended for these gardens to produce income, food supply, and even boost self independence during times of hardship. During the first World War president Woodrow Wilson called upon all American citizens to utilize any available open space for food growth, he saw this as a way to pull us out of a potentially damaging situation. Because most of Europe was consumed with war, they were unable to produce sufficient food supplies to be shipped to the U.S. and a new plan was implemented with the intent to feed the U.S. and even supply a surplus to other countries in need. By the year 1919 over 5 million plots were growing food and over 500 million pounds of produce was harvested. A very similar practice came into use during the Great Depression that provided a purpose, a job, and food to those who would otherwise be without anything during such harsh times. In this case these efforts helped to raise spirits socially as well as boost economical growth. Over 2.8 million dollars worth of food was produced from the subsistence gardens during the Depression. By the time of the Second World War the War/Food Administration set up a National Victory Garden Program that set out to systematically establish functioning agriculture within cities. With this new plan in action, as many as 5.5 million Americans took part in the victory garden movement and over 9 million pounds of fruit/vegetables grown a year, accounting for 44% of U.S. grown produce throughout that time. With its past success in mind and with our modern technology, urban agriculture today can be something to help both developed and developing nations

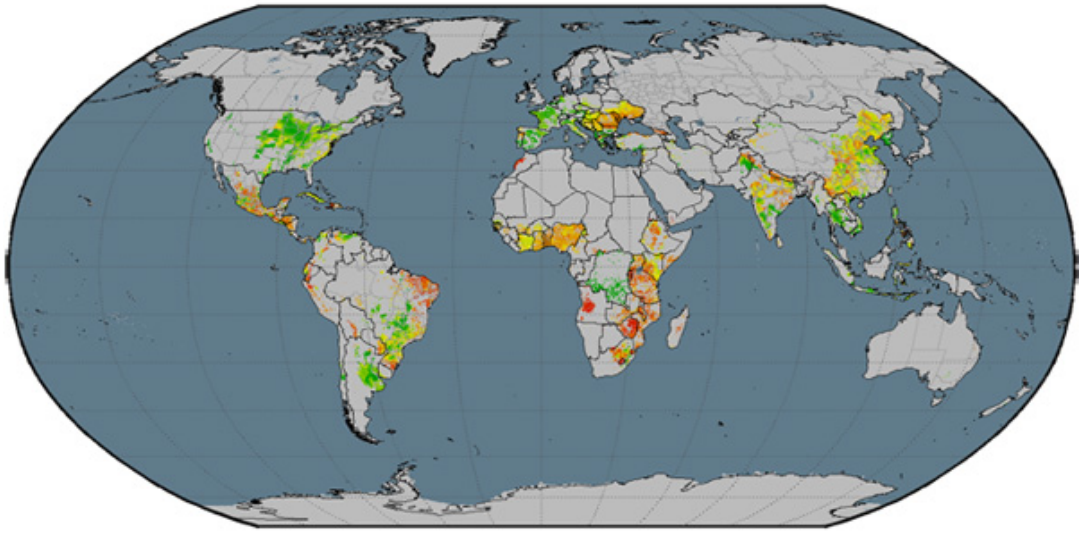
http://en.m.wikipedia.org/wiki/Urban_agriculture





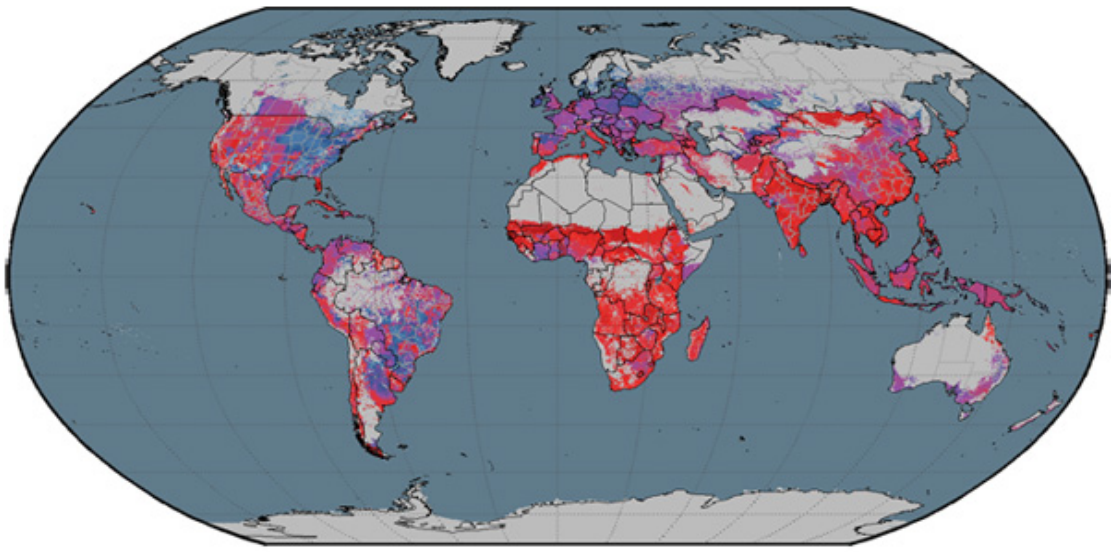
Africa, Western Europe, Asia, North America, South America all have potential for improved yields.

Widespread Improvement for Maize Is Possible



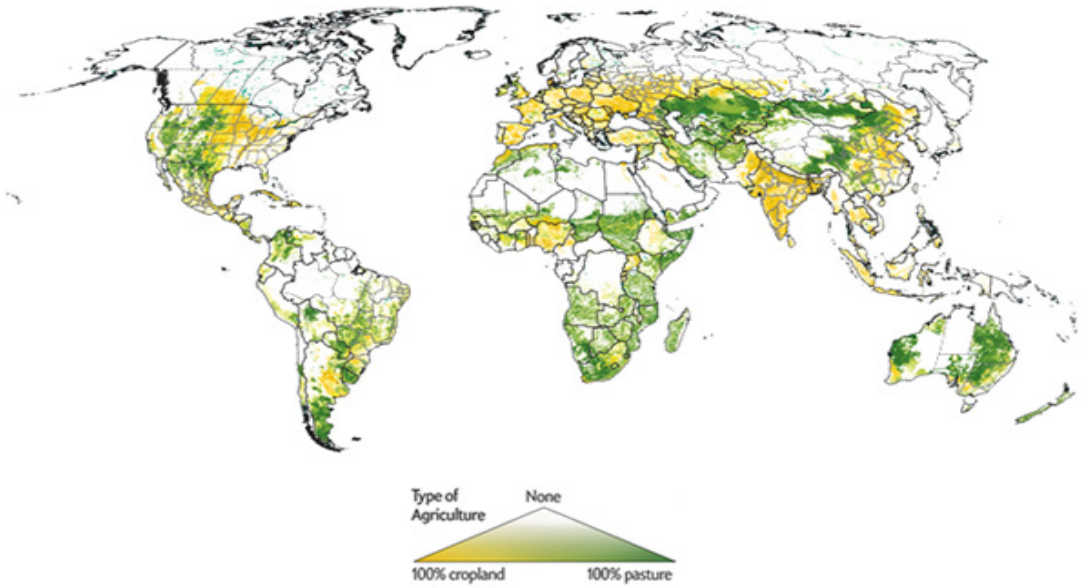
Percent of potential yield currently being achieved

Crops for People, Crops for Cows



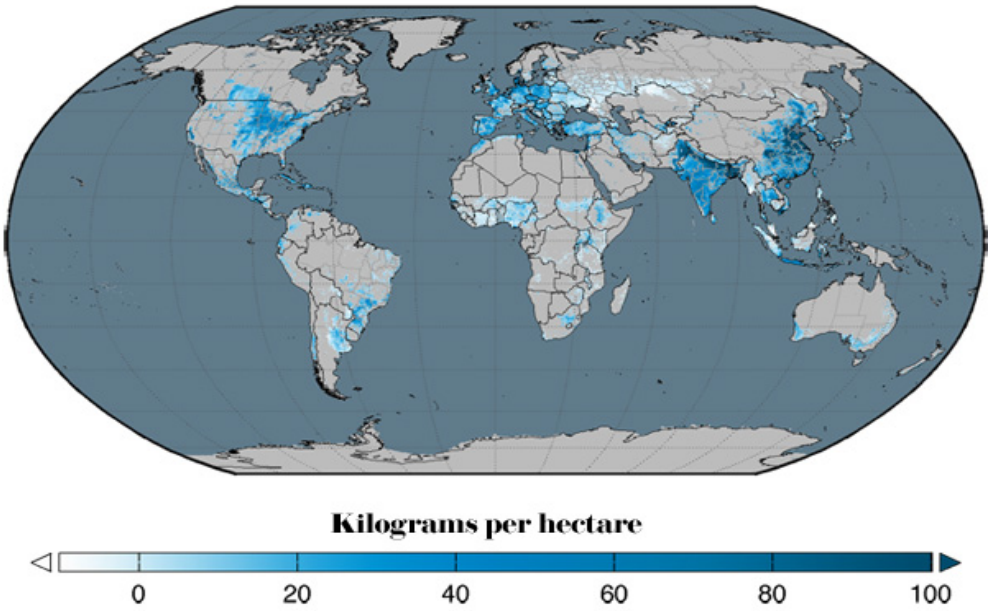
Human food production as a fraction of total cropland (1 = 100 percent)

Balance of Land Used for Agriculture



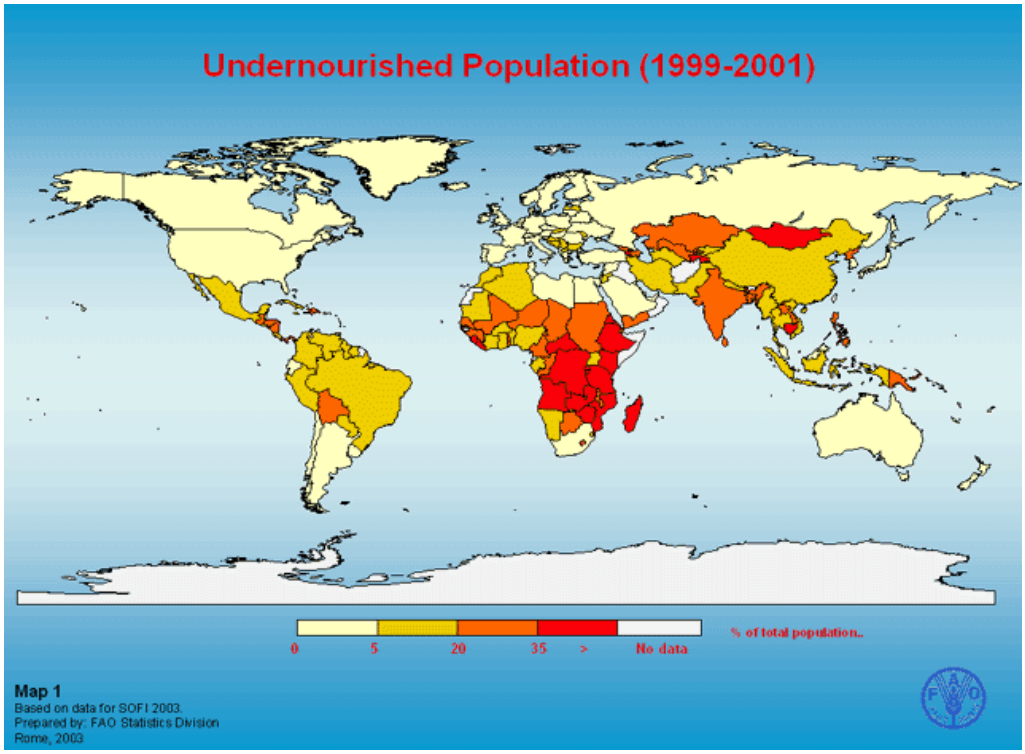
Available land is utilized, vertical farming offers an in crease in available agriculture.

Excess Nitrogen on Landscape

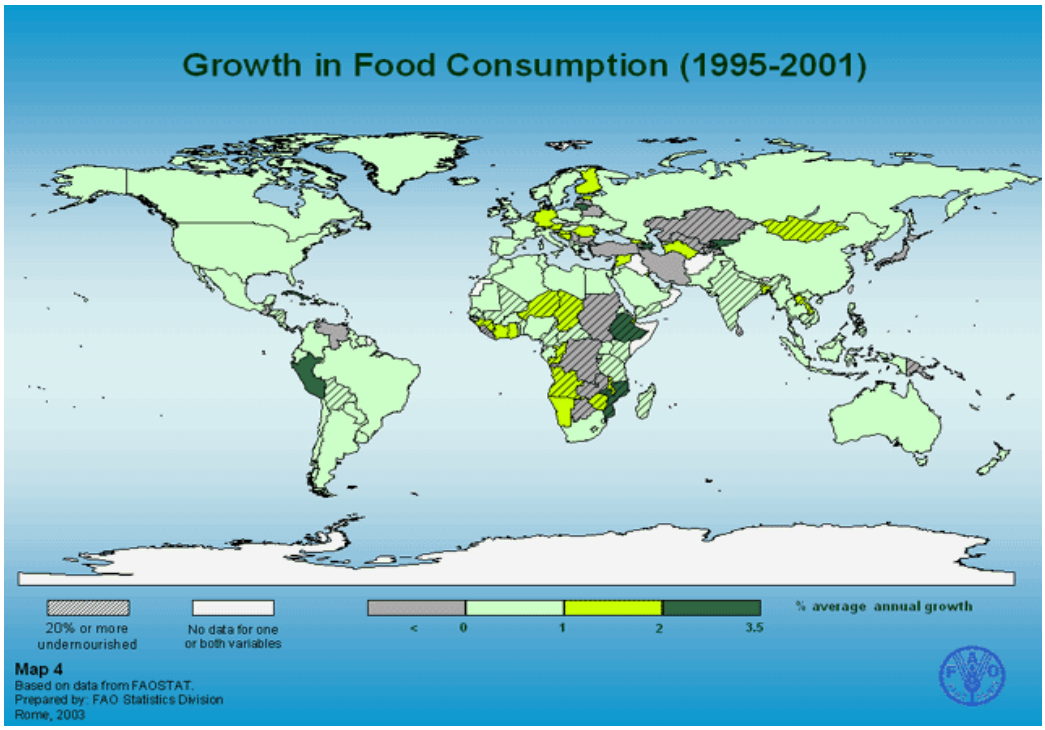


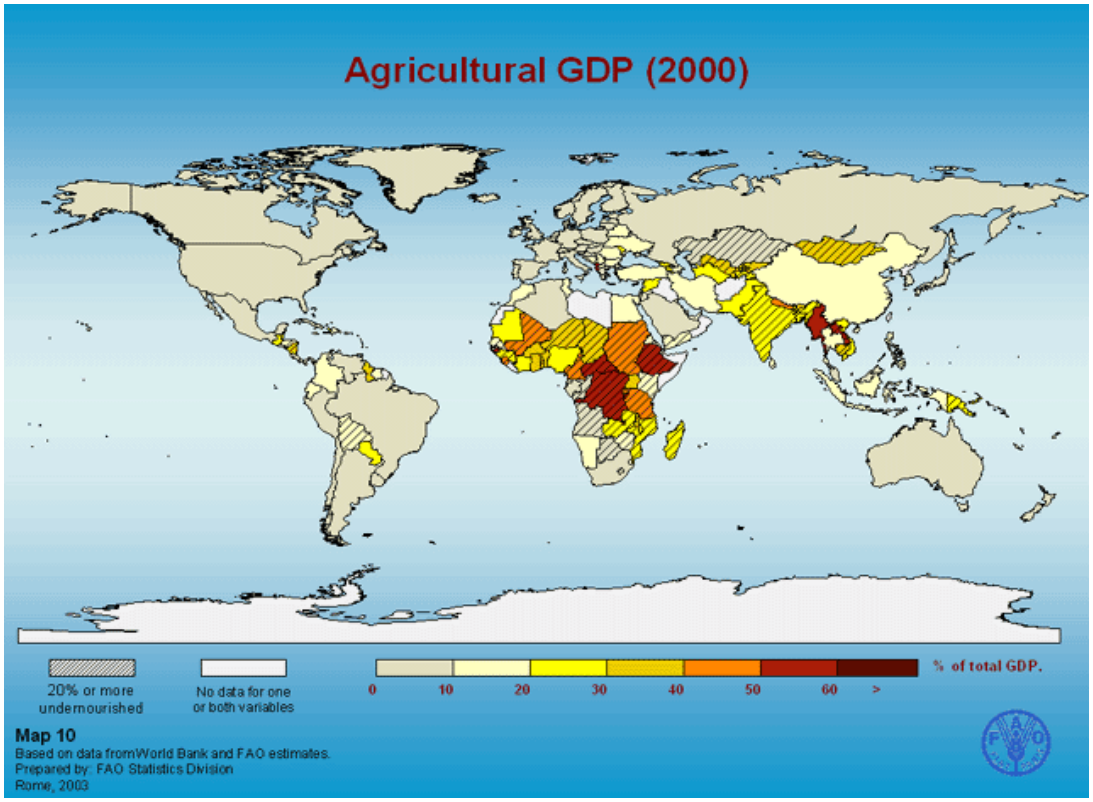
Credit: Maps pages 2,3,4: Scientific American, November 2011 page 60: ScientificAmerican.com/nov2011/foley

Existing agriculture is under maximum cultivation with excessive use of fertilizer.

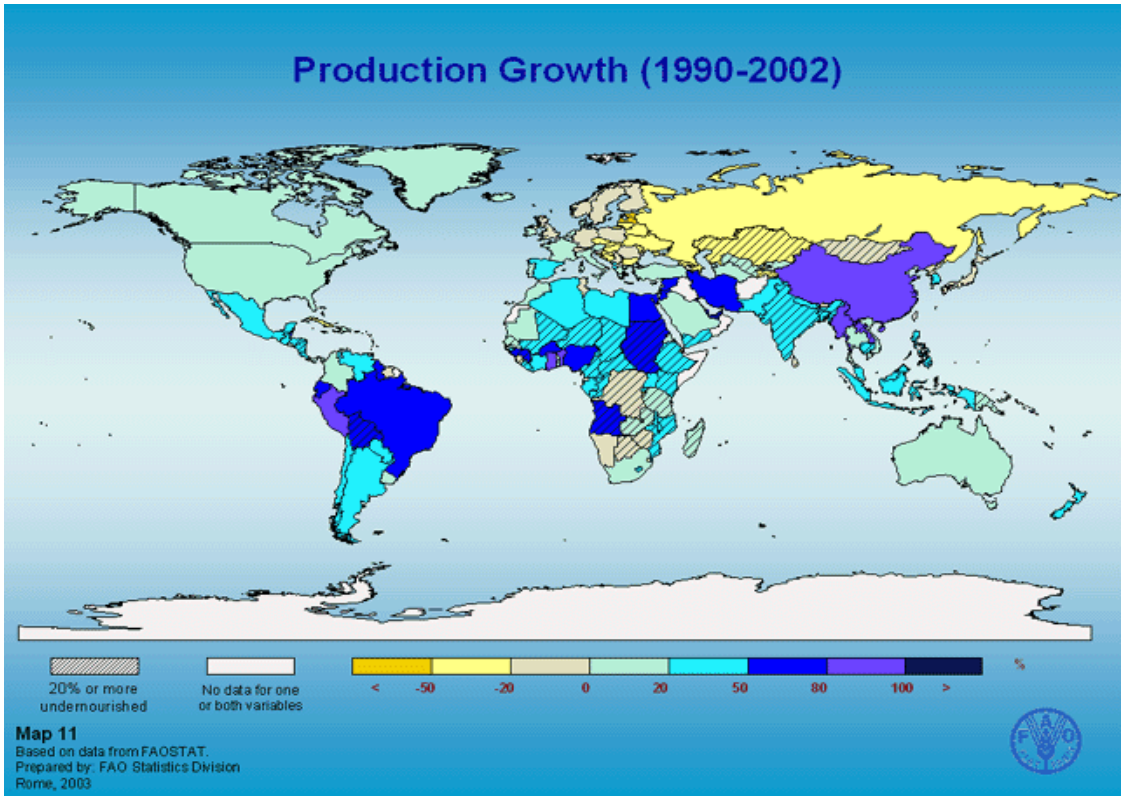


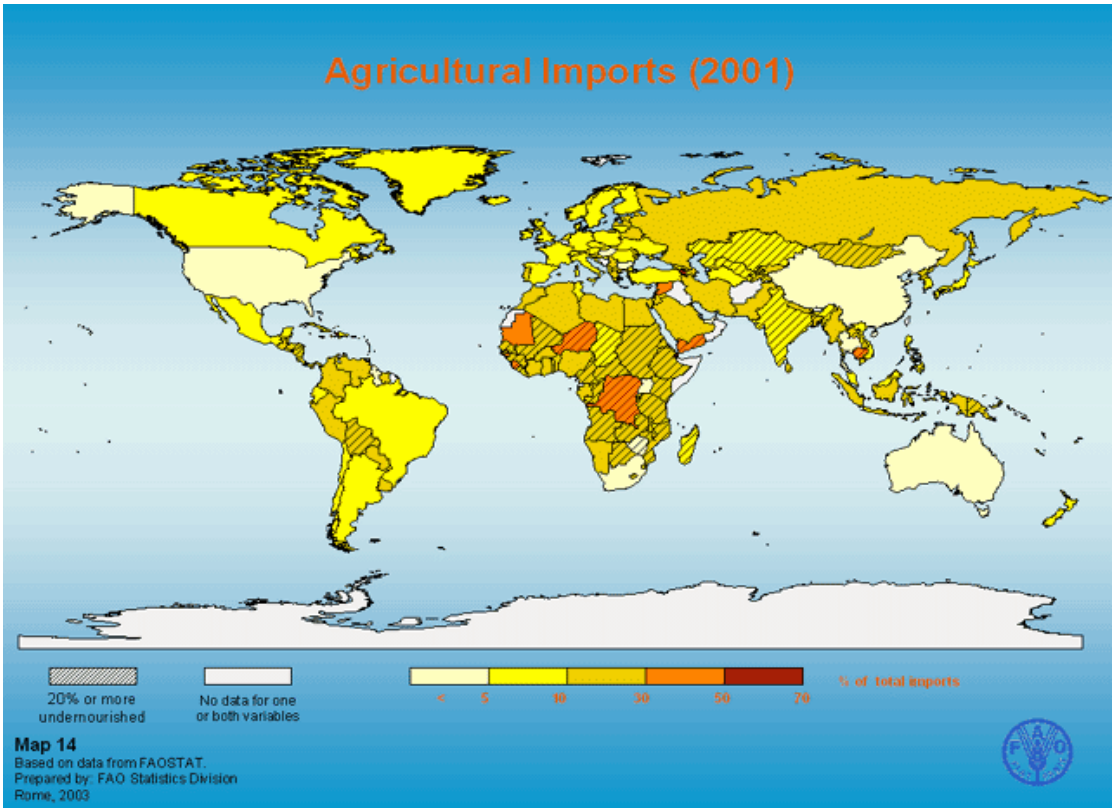
Red and dark green represent area for the introduction of vertical farming systems.



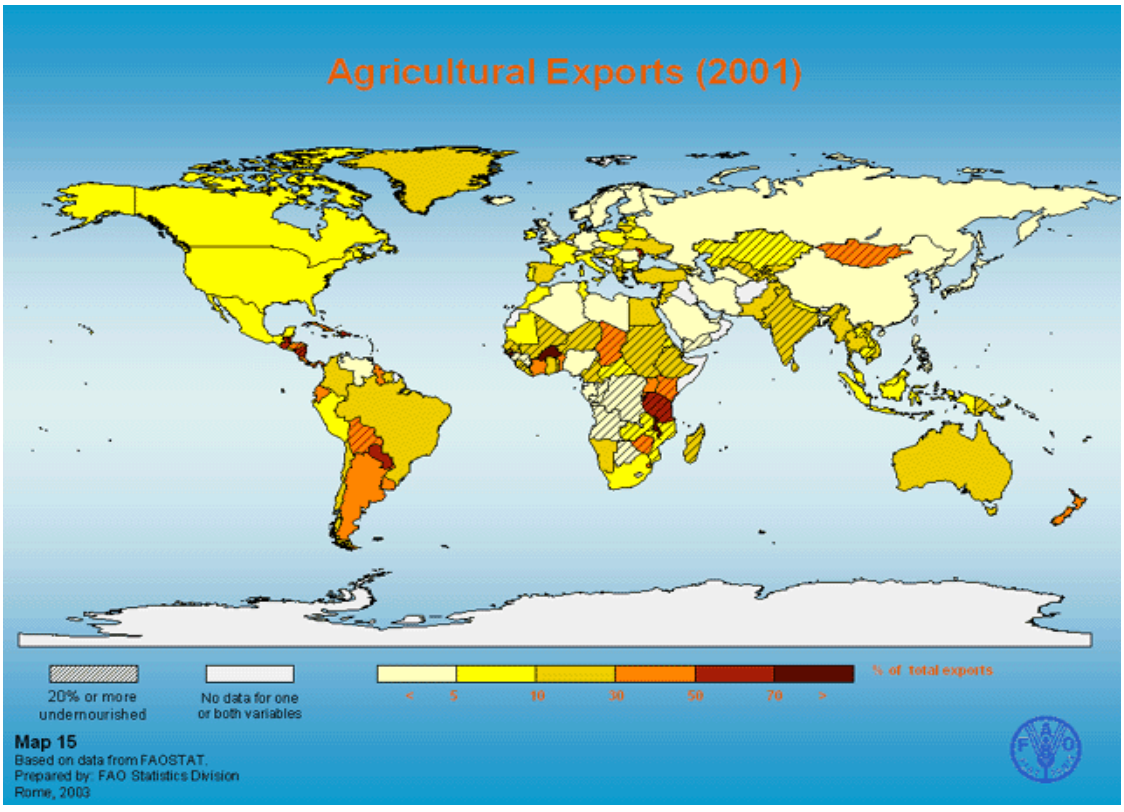


Blue areas indicate regions where new agricultural systems are accepted and implemented.

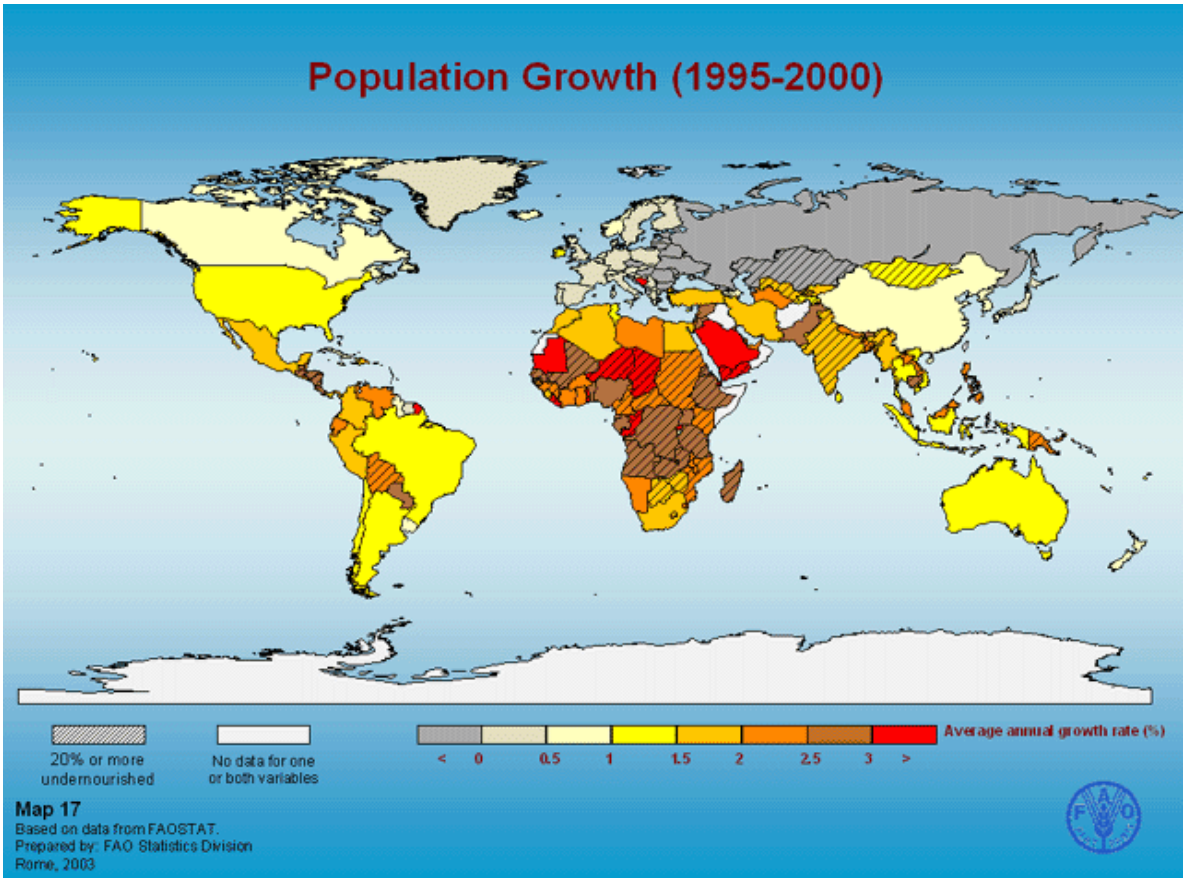




Map 14
Based on data from FAOSTAT.
Prepared by: FAO Statistics Division
Rome, 2003



Map 15
Based on data from FAOSTAT.
Prepared by: FAO Statistics Division
Rome, 2003



Red, orange and yellow regions in order of demand all represent future regions for the introduction of vertical farming.

By the year 2050, nearly 80% of the earth's population will reside in urban center. Further more in the same time frame there will be an additional 3 billion people requiring food. This represents a demand for 109 hectares of new agricultural production. Today 80% of all suitable crop land is in use, 95% of suitable land is utilized due to 15% becoming waste land due to poor farming management and climate shift. Source: www.verticalfarm.com

Advantages of Vertical Farming

1. Year round crop production; 1 indoor acre is equivalent to 4 to 6 outdoor acres or more, depending upon the crop. For example strawberries covering one vertical farm acre is equal to 30 natural acres.
2. No weather related crop failures due to droughts, floods or pest.
3. All Vertically Framed VF food is grown organically: no herbicides or pesticides.
4. Vertical Farming virtually eliminates agricultural runoff by recycling gray water.
5. Vertical Farming adds energy back to the grid via methane generation from composting non-edible parts of plants and animals.
6. Vertical Farming dramatically reduces fossil fuel use (no tractors, plows or shipping is necessary.)

Commercial Development

Valcent Products: www.valcent.net and www.valcent.eu

Imagine producing in a 50' x 75' area as much food as a 16 acre farm.

This patented technology was developed to grow food naturally in bustling urban environments and represents a paradigm shift in farming and food production. Providing up to 20 times the yield of normal field crops, while using only 8% of the water typically required for soil farming.

Utilizing a unique, suspended tray configuration on a moving conveyor system, VertiCrop™ provides optimal exposure to either natural or artificial light along with precisely measured nutrients for each plant. Designed to grow healthy, leafy green vegetables in closed loop and controlled environments, VertiCrop™ eliminates the need for harmful herbicides and pesticides, while maximizing taste, nutrition and food value.

Yields are approximately 20 times higher than the normal production volume of field crops.

VertiCrop™ requires only 8% of the normal water consumption used to irrigate field crops.

Works on non-arable lands and close to major markets or urban centers Does not require the use of harmful herbicides or pesticides.

Able to grow over 50 varieties of leafy green vegetables

Significantly reduces transportation distance, thereby reducing cost and carbon foot print.

Provides higher quality produce with greater nutritional value and a longer shelf life High levels of food security due to the enclosed growing process Scalable from small to very large food production operation.

BrightFarm Systems: http://brightfarmsystems.com

City produce markets that produce all their own perishable produce are typical market cost.

http://inspirationgreen.com/vertical-farms.html

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PEPPERS
CHIVES
LETTUCE
CHERRIES
APPLES
CABBAGE
STRAWBERRIES
THYME
TOMATOES
PEAS
MINT
SPINACH
PEACHES
BRUSSEL SPROUTS
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GRAY WATER COLLECTION & SAND FILTRATION SYSTEM
-USED TO IRRIGATE SOIL CROPS AND FLUSH TOILETS
BLACK WATER COLLECTION
-FROM BUILDING SEWAGE
BLACKWATER LIQUID AND SOLID SEPARATION TANKS
-SOLID WASTE DRIED IN KILN FOR FERTILIZER
-LIQUID SEPARATE SENT TO HYDROPONIC FILTRATION LOOP
BLACK WATER GRAVITY FED FILTRATION SYSTEM THROUGH PERIMETER HYDROPONICS
-NUTRIENTS REMOVED BY PLANTS AS SOURCE OF FERTILIZER
-BY-PRODUCT OF FRESH WATER USED IN GRAY WATER COLLECTION OR SAFELY RETURNED TO LAKE MICHIGAN
BUILDING SEWAGE
GRAY WATER DISTRIBUTION
FRESH WATER MAKEUP FROM LAKE MICHIGAN
FILTERED WATER RETURN TO LAKE MICHIGAN
METHANE SUPPLY
BUILDING SEWAGE
BIOGAS DIGESTER
-METHANE AND CARBON DIOXIDE BY-PRODUCTS
METHANE & CO2 TANKS
-METHANE USED FOR HEATING BIOGAS DIGESTER, APARTMENT COOKING AND HEATING.
BLACK WATER GRAVITY FILTRATION SYSTEM THROUGH PERIMETER HYDROPONICS
© 2009 BLAKE KURASEK

50% of the world's population lives in cities.

800 million people are involved in urban agriculture world-wide and contribute to feeding urban residents.

Low income urban dwellers spend between 40% and 60% of their income on food each year.

By 2015 about 26 cities in the world are expected to have a population of 10 million or more. To feed a city of this size at least 6,000 tonnes (6,600 tons) of food must be imported each day.

250 million hungry people in the world live in cities

The benefits that UPA brings along to cities that implement this practice are numerous. The transformation of cities from only consumers of food to generators of agricultural products contributes to sustainability, improved health, and poverty alleviation.

UPA assists to close the open loop system in urban areas characterized by the importation of food from rural zones and the exportation of waste to regions outside the city or town.

Wastewater and organic solid waste can be transformed into resources for growing agriculture products: the former can be used for irrigation, the latter as fertilizer.

Vacant urban areas can be used for agriculture production.

Other natural resources can be conserved. The use of wastewater for irrigation improves ·water management and increases the availability of freshwater for drinking and household consumption.

UPA can help to preserve bioregional ecologies from being transformed into cropland. Urban agriculture saves energy (e.g. energy consumed in transporting food from rural to urban areas).

Local production of food also allows savings in transportation costs, storage, and in product loss, what results in food cost reduction.

UPA improves the quality of the urban environment through greening and thus, a reduction in pollution.

Urban agriculture also makes of the city a healthier place to live by improving the quality of the environment.

UPA is a very efficient tool to fight against hunger and malnutrition since it facilitates the access to food by an impoverished sector of the urban population.

Poverty alleviation: It is known that a large part of the people involved in urban agriculture is the urban poor. In developing countries, the majority of urban agricultural production is for

self-consumption, with surpluses being sold in the market. According to the FAO (Food and Agriculture Organization of the United Nations), urban poor consumers spend between 60 and 80 percent of their income on food, making them very vulnerable to higher food prices.

UPA provides food and creates savings in household expenditure on consumables, thus increasing the amount of income allocated to other uses.

UPA surpluses can be sold in local markets, generating more income for the urban poor.

Secondly, urban agriculture may also positively impact upon the greening and cleaning of the city by turning derelict open spaces into green zones and maintaining buffer and reserve zones free of housing, with positive impacts on the micro-climate (shade, temperature, sequestration of CO2).

Degraded open spaces and vacant land are often used as informal waste dump sites and are a source of crime and health problems. When such zones are turned into productive green spaces, not only an unhealthy situation is cleared, but also the neighbors will passively or actively enjoy the green area. Such activities may also enhance community self-esteem in the neighborhood and stimulate other actions for improving the community's livelihood

Types of actors involved

Large part of the people involved in urban agriculture is the urban poor. Contrary to general belief they are often not recent immigrants from rural areas (since the urban farmer needs time to get access to urban land, water and other productive resources). In many cities, one will often also find lower and mid-level government officials, school teachers and the like involved in agriculture, as well as richer people who are seeking a good investment for their capital.

Women constitute an important part of urban farmers, since agriculture and related processing and selling activities, among others, can often be more easily combined with their other tasks in the household. It is however more difficult to combine it with urban jobs that require travelling to the town centre, industrial areas or to the houses of the rich. Types of location

Urban agriculture may take place in locations inside the cities (intra-urban) or in the peri-urban areas. The activities may take place on the homestead (on-plot) or on land away from the residence (off-plot), on private land (owned, leased) or on public land (parks, conservation areas, along roads, streams and railways), or semi-public land (schoolyards, grounds of schools and hospitals).

Types of products grown
Urban agriculture includes food products, from different types of crops (grains, root crops, vegetables, mushrooms, fruits) and animals (poultry, rabbits, goats, sheep, cattle, pigs, guinea pigs, fish, etc.) as well as non-food products (like aromatic and medicinal herbs, ornamental plants, tree products, etc.). or combinations of these. Often the more perishable

and relatively high-valued vegetables and animal products and by-products are favored. Production units in urban agriculture in general tend to be more specialized than rural enterprises, and exchanges are taking place across production units. Types of economic activities

Urban agriculture includes agricultural production activities as well as related processing and marketing activities as well as inputs (e.g. compost) and services delivery (e.g. animal health services) by specialized micro-enterprises or NGOs, etc.

In urban agriculture, production and marketing tend to be more closely interrelated in terms of time and space than for rural agriculture, thanks to greater geographic proximity and quicker resource flow. Product destination / degree of market orientation
In most cities in developing countries, an important part of urban agricultural production is for self-consumption, with surpluses being traded. However, the importance of the market-oriented urban agriculture, both in volume and economic value, should not be underestimated (as will be shown later). Products are sold at the farm gate, by cart in the same or other neighborhoods, in local shops, on local (farmers) markets or to intermediaries and supermarkets. Mainly fresh products are sold, but part of it is processed for own use, cooked and sold on the streets, or processed and packaged for sale to one of the outlets mentioned above.

Scales of production and technology used
In the city, we may encounter individual or family farms, group or cooperative farms and commercial enterprises at various scales ranging from micro- and small farms (the majority) to medium-sized and some large-scale enterprises.

The technological level of the majority of urban agriculture enterprises in developing countries is still rather low. However, the tendency is towards more technically advanced and intensive agriculture and various examples of such can be found in all cities.

http://www.ruaf.org/node/512

Difficulties
Space is at a premium in cities and is accordingly expensive and difficult to secure.

The use of waste water for irrigation without careful treatment and monitoring can result in the spread of diseases among the population.

Cultivation on contaminated land also represents a health hazard for the consumers.

The practice of cultivating along roadsides facilitates the distribution of products to local markets, but it is also a risky practice since it exposes food to ·motor vehicle emissions.

Agriculture and urbanization are considered to be incompatible activities, competing for the access and use of limited land. In reality, in urban areas there is important available space for agriculture use such as public and private vacant lots, and areas not suited for built-up uses (steep slopes and flood plains).

Legal restrictions and economic impediments to accessing land and resources (such as reasonably priced water) are among the most common problems confronted by urban agriculture.

Lack of security of tenure also acts as a preventive for farming due to the uncertainty in the use length of the land.

Urban agriculture has been criticized by those who believe that industrial farm production can produce food at larger volumes more efficiently.

A major argument is whether urban farming alone—farming very intensively on small land areas—could replace land extensive production in rural areas which produce the bulk of our food products. Yet hunger persists in both urban and rural areas, despite a subsidized industrial agriculture. The degree to which urban agriculture can address these food needs systemically is undetermined, though there are indications in some communities that it is an important source of food.

Other opponents argue that localized food production and the introduction of common resources and common lands into the urban areas would produce a tragedy of the commons, though many urban farms and community gardens are managed privately or through other civil society organizations.

Municipal greening policy goals can pose conflicts. For example, policies promoting urban tree canopy are not sympathetic to vegetable gardening because of the deep shade cast by trees. However, some municipalities like Portland, Oregon, and Davenport, Iowa are encouraging the implementation of fruit bearing trees (as street trees or as park orchards) to meet both greening and food production goals.

The Power Problem

Despite these promising calculations, such high-rise farms still only exist as small-scale models. Critics don't expect this to change anytime soon. Agricultural researcher Stan Cox of the Kansas-based Land Institute sees vertical farming as more of a project for dreamy young architecture students than a practical solution to potential shortages in the global food supply.

The main problem is light -- in particular, the fact that sunlight has to be replaced by LEDs. According to Cox's calculations, if you wanted to replace all of the wheat cultivation in the US for an entire year using vertical farming, you would need eight times the amount of electricity generated by all the power plants in the US over a single year -- and that's just for powering the lighting.

It gets even more difficult if you intend to rely exclusively on renewable energies to supply this power, as Despommier hopes to do. At the moment, renewable energy sources only generate about 2 percent of all power in the US. Accordingly, the sector would have to be expanded 400-fold to create enough energy to illuminate indoor wheat crops for an entire year. Despommier seems to have fallen in love with an idea, Cox says, without considering the difficulties of its actual implementation.

Getting Closer to Reality

Even so, Despommier still believes in his vision of urban agriculture. And recent developments, like the ones in South Korea, might mean his dream is not as remote as critics say. Ten years ago, vertical farming was only an idea. Today, it has developed into a concrete model. About two years ago, the first prototypes were created.

In fact, the concept seems to be working already, at least on a small scale. In the Netherlands, the first foods from a vertical farm are already stocking supermarket shelves. The PlantLab, a 10-year-old company based three floors underground in the southern city of Den Bosch, has cultivated everything from ornamental shrubs and roses to nearly every crop imaginable, including strawberries, beans, cucumbers and corn. "We manage completely without sunlight," says PlantLab's Gertjan Meeuws. "But we still manage to achieve a yield three times the size of an average greenhouse's." What's more, PlantLab uses almost 90 percent less water than a conventional farm.

As a country which has limited land resources but which possesses much of the necessary technology, the Netherlands seems to be an ideal place to develop vertical farming. This is especially true now that its residents are increasingly demanding organic, pesticide-free foods -- and are prepared to pay more for it.

'The Next Agricultural Revolution'

Despommier believes that entire countries will soon be able to use vertical farming to feed their populations. The South Korean government, at least, is interested in exploring the possibility. At the moment, the country is forced to import a large share of its food. Indeed, according to a 2005 OECD report, South Korea places fifth-to-last in a global ranking on food security. Increasing food prices, climate change and the possibility of natural disasters can compound the problem.

These facts are not lost on the researchers in the vertical farming laboratory in Suwon. "We must be prepared to avert a catastrophe," Choi says.

Still, it will be some time before vertical farming is implemented on a commercial scale in South Korea. Choi's colleague Lee Hye Jin thinks that five more years of research are needed. "Only then will our vertical farm be ready for the free market," he says.

http://www.spiegel.de/international/zeitgeist/0,1518,775754,00.html

Pollution — Large quantities and concentrations of waste are produced. Lakes, rivers, and groundwater are at risk when animal waste is improperly recycled. Pollutant gases are also emitted. Concentrations of animals can produce unacceptable levels of foul smells as opposed to the tolerable odors of the countryside. In less intensive conditions, natural processes can break down potential pollutants. Large farms can maintain and operate sophisticated systems to control waste products. Smaller farms may or may not be less able to invest in the same standards of pollution control.

Beijing, China

Beijing's increase in land area from 4,822 square kilometres (1,862 sq mi) in 1956 to 16,808

square kilometres (6,490 sq mi) in 1958 led to the increased adoption of peri-urban agriculture. Such "suburban agriculture" led to more than 70% of non-staple food in Beijing, mainly consisting of vegetables and milk, to be produced by the city itself in the 1960s and 1970s. Recently, with relative food security in China, periurban agriculture has led to improvements in the quality of the food available, as opposed to quantity. One of the more recent experiments in urban agriculture is the Modern Agricultural Science Demonstration Park in Xiaotangshan.

But many potential pitfalls juxtapose its great promise, including threats to human health, biodiversity and, perhaps most significantly, increased inequality of income and wealth between industrial and developing country agricultural production

Characteristics of urban agricultural activities in Mexico City

Urban agriculture can be defined as all forms of agricultural production that benefit from the infrastructure provided by human concentrations in towns or cities (Ellis & Sumberg 1998). The productive urban agricultural process can be defined by attributes, activities and an identity which are distinct from traditional rural agriculture:

- small agricultural properties predominate;
- animal husbandry uses little area;
- recycled materials are used to construct animal sheds;
- food industry and household wastes are fed to animals;
- cow dung is intensively used as a source of manure, macronutrients (NPK), water and heat;
- the use of local knowledge and technology predominates, and the transfer of local knowledge is by word of mouth;
- products are sold in local markets and/or to neighbours;
- urban and agricultural activities co-exit within family units;
- urban and rural cultures co-exist; and
- production is for both home consumption and sale; urban farming often complements urban subsistence strategies through the generation of income and/or the consumption of self-produced products.

The urban agricultural systems perform a gamut of functions and go beyond simply producing foodstuffs. Typical, for example for backyard animal rearing, is that this is not

Economic contribution — The high input costs of agricultural operations result in a large influx and distribution of capital to a rural area from distant buyers rather than simply recirculating existing capital. A single dairy cow contributes over US$1,300 to a local rural economy each year, each beef cow over US$800, meat turkey US$14, and so on. As Pennsylvania Secretary of Agriculture Dennis Wolff states, "Research estimates that the annual economic impact per cow is US$13,737. In addition, each US$1 million increase in Pennsylvania milk sales creates 23 new jobs. This tells us that

dairy farms are good for the state's economy.

Growing your own food saves household expenditures on food; poor people in poor countries generally spend a substantial part of their income (50 – 70%) on food. Growing the relatively expensive vegetables therefore saves money as well as on bartering of produce. Selling produce (fresh or processed) brings in cash

Food security and nutrition

The contribution of urban agriculture to food security and healthy nutrition is probably its most important asset. Food production in the city is in many cases a response of the urban poor to inadequate, unreliable and irregular access to food, and the lack of purchasing power. Most cities in developing countries are not able to generate sufficient (formal or informal) income opportunities for the rapidly growing population. The World Bank (2000) estimates that approximately 50% of the poor live in urban areas (25% in 1988). In urban settings, lack of income translates more directly into lack of food than in a rural setting (cash is needed). The costs of supplying and distributing food from rural areas to the urban areas or to import food for the cities are rising continuously, and it is expected that urban food insecurity will increase (Argenti 2000).

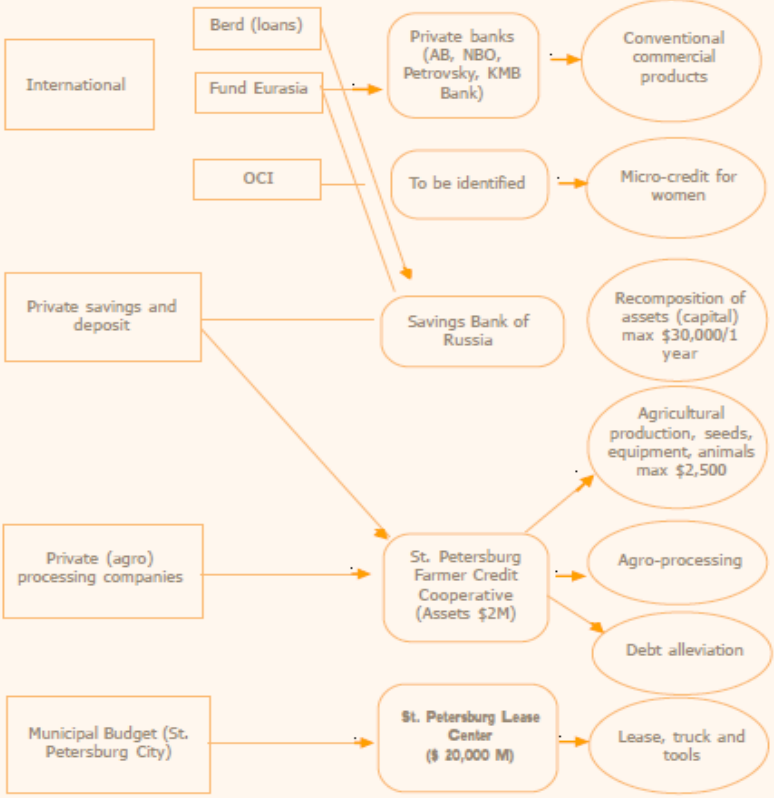
Food prices in Harare, for example, rose 534 percent between 1991 and 1992 due to the removal of subsidies and price controls, spurring poor urban consumers to get access to food outside of market channels through home production or bartering (Tevera 1996).
Urban agriculture may improve both food intake (improved access to a cheap source of proteins) and the quality of the food may improve (poor urban families involved in farming eat more fresh vegetables than other families in the same income category).

http://www.ruaf.org/node/513

Source: Survey of city experiences with credit and investment for Urban Agriculture Interventions, IPES/UMP-LAC/IDRC.

Existing demand for urban agriculture is proven, with possible high end developments to be realized in high income food exporting regions.

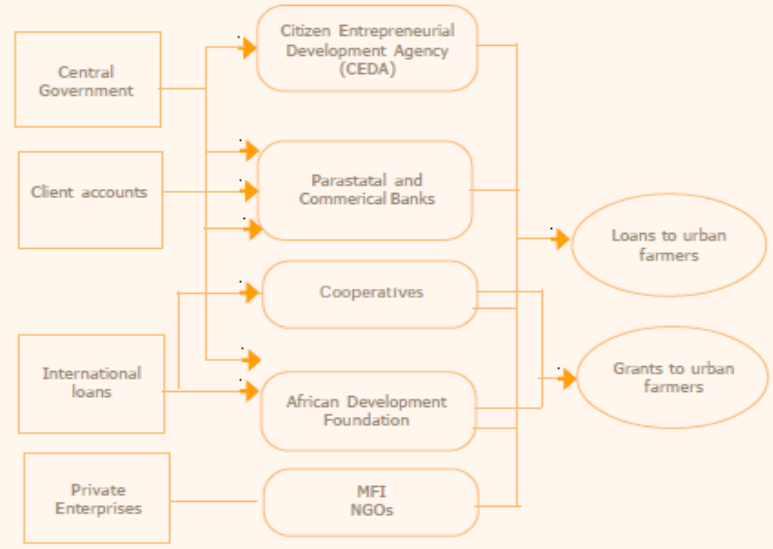
Figure 4.3 *Financial flows and financial products for urban farmers in St Petersburg, Russia*



Source: Moldakov, O. "Saint Petersburg Urban Gardening and Farming. Micro credit and Investment for Urban Agriculture in Russia, St. Petersburg Urban Gardening Club," St. Petersburg, Russia 2002 Cabannes, Y 2004a.

http://www.ruaf.org/node/969

Figure 4.4 *Financing of urban agriculture in Botswana*



Source: Mosha, A.C. "Credit an Investment for Urban Agricultural Interventions: Case Study: Gaborone City, Botswana," University of Bostwana, Gaborone, July 2002 & Keboneilwe, D.L. "Credit and Investment schemes for urban agriculture". Power Point presented for the International Panel Microcredit and Investment for Urban Agriculture, Barcelona, 2004. Cabannes, Y 2004a.

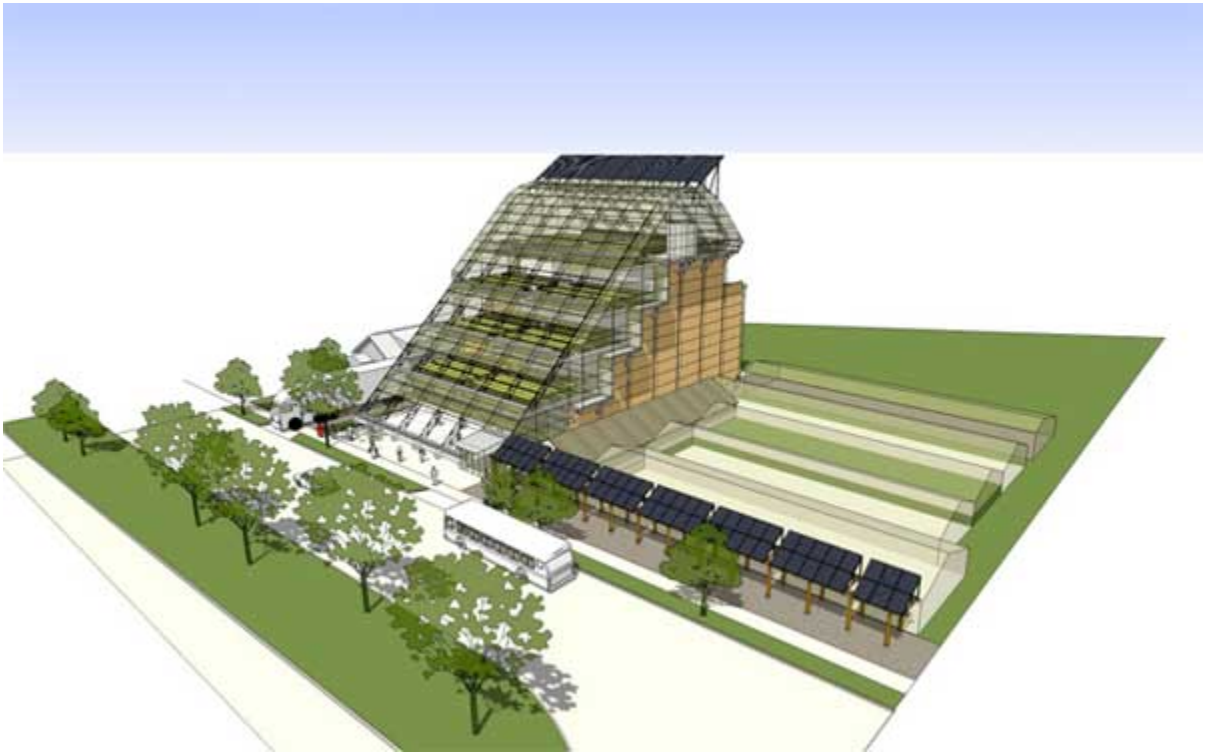
It should also turn a handsome profit. Despommier's calculations peg the construction cost of a 21-story vertical farm at about $84 million, operating costs at $5 million a year, and revenue at $18 million a year, based on the price of produce at upscale Manhattan delis.

Getting product to market is one of the most expensive parts of traditional agriculture, but with a vertical farm, your retailers are just down the block. Despommier has been talking to VCs in both the United States and Europe.

The Sustainable Agriculture Initiative, a group of 20 food companies including Coca-Cola (Charts, Fortune 500), Kraft (Charts), McDonald's (Charts, Fortune 500), and Nestlé, has expressed interest, as has IBM (Charts, Fortune 500). Kristin Reynolds, program representative at the University of California's Small Farms Program, says her only concern is that vertical farming could grow too big too fast: "It needs to be developed cautiously, so it doesn't take markets away from small-scale farmers."

http://money.cnn.com/2007/09/10/technology/farming_vertical.biz2/index.htm?postversion=2007091105

http://en.m.wikipedia.org/wiki/Urban_agriculture



http://www.triplepundit.com/2010/11/vertical-farms-realized-growing-power-launches-5-story-expansion/

"Feeding 50,000 People, Anisa Buck, Stacy Goldberg and others conclude that a single building covering one city block, and up to 48 stories high depending on the design, can grow enough food to sustain 50,000 people. This calculation doesn't require any magical

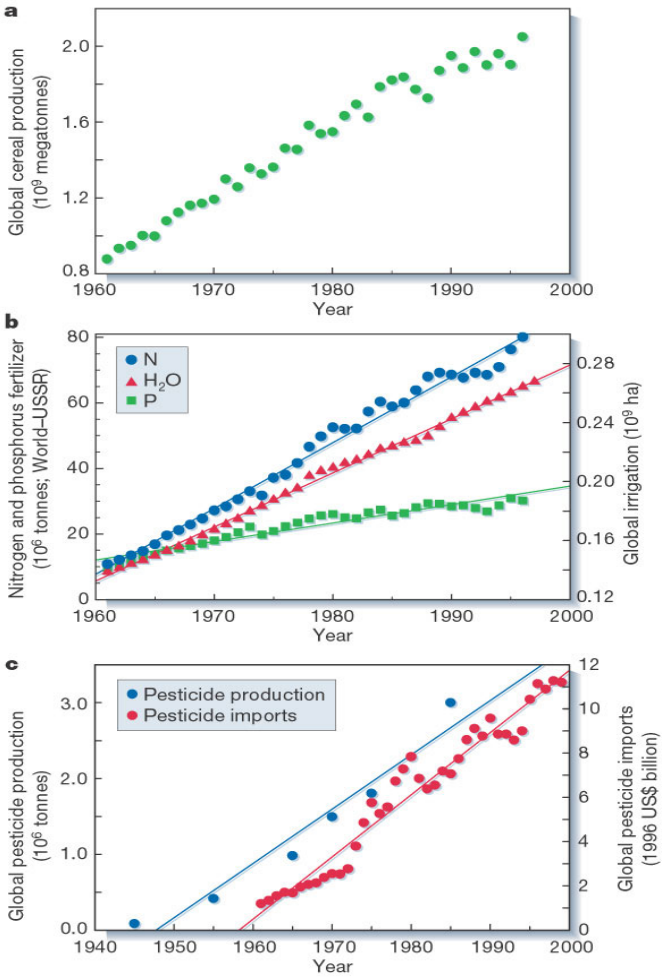
technology; there's no fairy-dust being evoked here, we could build such a structure now.

So, let's do the math. If the population of the Toronto area is, say, 3 million people (it's more or less depending on where you draw your lines) then 3,000,000/50,000=60. Sixty large buildings could feed the entire city. It's a big effort, but not much bigger than the current condo boom happening down by the waterfront, where literally dozens of projects are planned. Certainly there's room; the city could feed itself without importing anything (except we'd want cow's milk and beef and mustard and luxury foods--which I'll get to in a minute).

To continue with the math: if the population of Canada as a whole is around 30 million, then 10x60=600 buildings will feed the entire country. Yes, you're seeing that right. An area 25 city blocks on a side could feed Canada. An area the size of a small town can displace the entire Canadian agricultural sector and much of its aquaculture as well. It's hugely energy-intensive, and labour-intensive too; but the buildings recycle their own water, produce much of their own power, and with the right economies of scale, could run at a profit.

http://www.worldchanging.com/archives/007000.html

http://en.m.wikipedia.org/wiki/Vertical_farming



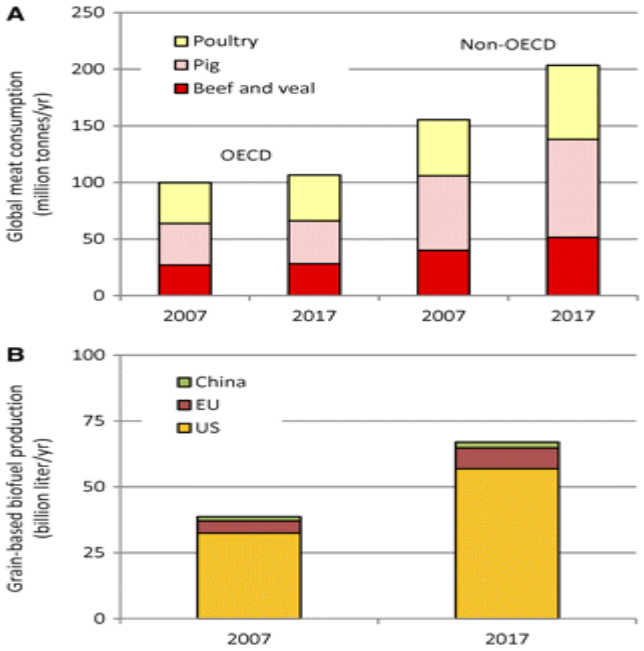
Sustainability and net benefits

Agricultural practices determine the level of food production and, to a great extent, the state of the global environment. Agriculturists are the chief managers of terrestrial 'useable' lands, which we broadly define as all land that is not desert, tundra, rock or boreal. About half of global usable land is already in pastoral or intensive agriculture[4]. In addition to causing the loss of natural ecosystems, agriculture adds globally significant and environmentally detrimental amounts of nitrogen and phosphorus to terrestrial ecosystems[12, 13], at rates that may triple if past practices are used to achieve another doubling in food production[4, 16]. The detrimental environmental impacts of agricultural practices are costs that are typically unmeasured and often do not influence farmer or societal choices about production methods.

Such costs raise questions about the sustainability of current practices. We define sustainable agriculture as practices that meet current and future societal needs for food and fibre, for ecosystem services, and for healthy lives, and that do so by maximizing the net benefit to society when all costs and benefits of the practices are considered. If society is to maximize the net benefits of agriculture, there must be a fuller accounting of both the costs and the benefits of alternative agricultural practices, and such an accounting must become the basis of policy, ethics and action. Additionally, the development of sustainable agriculture must accompany advances in the sustainability of energy use, manufacturing, transportation and other economic sectors that also have significant environmental impacts.

Agriculturalists are the *de facto* managers of the most productive lands on Earth. Sustainable agriculture will require that society appropriately rewards ranchers, farmers and other agriculturalists for the production of both food and ecosystem services. One major step would be achieved were agricultural subsidies in the United States, EU and Japan redirected to reward sustainable practices. Ultimately, sustainable agriculture must be a broadly based effort that helps assure equitable, secure, sufficient and stable flows of both food and ecosystem services for the 9,000 million or so people likely to inhabit the Earth.

http://www.nature.com/nature/journal/v418/n6898/full/nature01014.html



Increasing Crop Productivity to Meet Global Needs for Feed, Food, and Fuel

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Global demand and consumption of agricultural crops for food, feed, and fuel is increasing at a rapid pace. This demand for plant materials has been expanding for many years. However, recent increases in meat consumption in emerging economies together with accelerating use of grain for biofuel production in developed countries have placed new pressures on global grain supplies. To satisfy the growing, worldwide demand for grain, two broad options are available: The area under production can be increased or productivity can be improved on existing farmland. These two options are not mutually exclusive and both will be employed to produce the additional 200 million tonnes/year of corn (Zea mays) and wheat (Triticum aestivum) estimated to be needed by 2017. Both options will alter the environmental footprint of farming. Of the two options, increasing productivity on existing agricultural land is preferable as it avoids greenhouse gas emissions and the large-scale disruption of existing ecosystems associated with bringing new land into production. In the United States, breeders, agronomists, and farmers have a documented history of increasing yield. U.S. average corn yields have increased from approximately 1.6 tonnes/ha in the first third of the 20th century to today's approximately 9.5 tonnes/ha. This dramatic yield improvement is due to the development and widespread use of new farming technologies such as hybrid corn, synthetic fertilizers, and farm machinery. The introduction of biotechnology traits and development of new breeding methodology using DNA-based markers are further improving yields. Outside the United States, similar farming practices have been adopted in some agricultural nations, but in many major grain-producing countries, yields still lag well behind world averages. By continuing to develop new farming technologies and deploying of them on a global basis, demand for feed, fuel, and food can be met without the commitment of large land areas to new production.

Global demand for corn and wheat is growing at a rapid pace. As disposable incomes have risen in developing countries, meat consumption has increased. Among urban Chinese, meat consumption rose from 25 kg person–1 year–1 to 32 kg person–1 year–1 between 1996 and 2006 (von Braun, 2007). It is anticipated that meat consumption will continue to grow in developing countries because global consumption levels remain far below the approximately 100 kg person–1 year–1 meat consumption rate of the United States and many western European countries. Globally, meat consumption is expected to grow by 55 million tonnes to 310 million tonnes/year over the next decade (OECD-FAO, 2008). During this same period, biofuel production from corn and, to a lesser extent, wheat is expected to grow by 28 billion liters to 67 billion liters/year (Fig. 1). Meeting the expected demand for meat will require feed grain usage to increase by about 50 million tonnes to about 640 million tonnes/year. Concomitantly, grain consumption for biofuel production is likely to increase by about 60 million tonnes to about 145 million tonnes/year. When food use for corn and wheat is added to the calculation, total demand for corn and wheat over the next decade is expected to increase by about 15% or about 200 million tonnes/year to a total of approximately 1.5 billion tonnes/year.

http://m.plantphysiol.org/content/149/1/7.full

CONCLUSION:

Global economic expansion is necessary for maintenance of agricultural production. Demand for sustainability of an increasing population, and or for replacement of degraded and wasted agricultural land, demand for various alternative forms of production presents massive economic expansion potential.

This data was assembled by Joseph C. Piskac in support of APQONIA 2011 2012 Global Assessment.

URL LINKS TO ORINIGINAL CONTENT AND CREDITS:

Page One: http://en.m.wikipedia.org/wiki/Global_warming_and_agriculture

http://en.m.wikipedia.org/wiki/Urban_agriculture

Page Two: Financial Times, Reuters Data Base

Scientific American, November 2011 page 60: ScientificAmerican.com/nov2011/foley

Page Three: Scientific American, November 2011 page 60: ScientificAmerican.com/nov2011/foley

Page Four: Scientific American, November 2011 page 60: ScientificAmerican.com/nov2011/foley

Page Five, Six, Seven: http://www.fao.org/countryprofiles/default.asp?lang=en

Page Eight: www.verticalfarm.com www.valcent.eu

Page Nine: Valcent Products: www.valcent.net and www.valcent.eu

Page Ten, Eleven: BrightFarm Systems: http://brightfarmsystems.com

http://inspirationgreen.com/vertical-farms.html

Page Twelve, Thirteen, Fourteen: http://www.ruaf.org/node/512

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Page Eighteen, Nineteen: http://www.ruaf.org/node/513

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