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Vertical Farming: An agricultural revolution on the rise

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Abstract

Vertical farming in urban environments has sprung out of a need to find alternatives to common practice in industrial agriculture. The way in which industrial agriculture is being conducted today has a wide spread negative impact on the environment as well as being economically inefficient in a number of ways. This essay serves to investigate the concept of vertical farming, how it might potentially alleviate some of the problems brought on by current agricultural methods and whether it might serve as a viable alternative in future industrial farming. Vertical Farming is a promising concept that combines environmental considerations with sound economics. It puts the spotlight on the negative aspects of current agriculture and provides a solution in accord with future global societal structures. However, as with any novelty, improvements can be made, a lot of which comes with technological improvements of a concept in development.

Introduction

Modern day agriculture is a major contributor to the large range of environmental problems the world is facing at present. Agricultural run-off, ecosystem degradation and loss, use of fossil fuel, food wastage, artificial irrigation and use of the world´s freshwater supply are but a few in a long list of issues that needs to be addressed if current agricultural practice is to be made truly sustainable in the future.

Adding to this we have a world population growing at such a rapid pace that available space itself is quickly becoming a scarce resource. With current agricultural methods, it will not be long until the sheer land area required to feed the human population would be far too large to be sustainable in the long run (Despommier, 2010a).

In the light of this background, it becomes obvious that new methods need to be developed in how we conduct industrial agriculture. This is where vertical farming comes in.

Producing crops in multi-story buildings is an idea that originates as far back as half a century ago. In 1966, Othmar Ruthner presented "Apparatus for the Artificial Cultivation of Plants", the first detailed description of how to use a three dimensional space for the cultivation of plants independently of season and climate (Ruthner, 1966), and in 1970, Riethus and Bau conducted a vegetable production trial for 4 years in a 13 m high greenhouse (Riethus & Bau, 1970). Recently the concept has been reintroduced and developed further in the light of an ongoing debate on climate change and current environmental crisis. In 2009 the concept of vertical farming was introduced by Prof Dickson Despommier. Despommier takes indoor farming a step further and relocates it to the urban environment. By utilizing skyscrapers, buildings and other structures within our cities the ambition is to alleviate or even solve a lot of the negative effects that current agricultural practice has on the environment (Despommier, 2009). In 2010, his book entitled "The Vertical Farm: Feeding the world in the 21st century" was released. Currently constructions have begun and vertical farms are being built in Sweden, Singapore, Japan, Korea and U.S.A.

The aim of this article is to investigate the concept of vertical farming and how it might alleviate some of the problems we are facing as a consequence of current agricultural methods. Is this novel idea a viable alternative in future agricultural industry? Can vertical farming potentially replace current agricultural practice? Either completely or perhaps as a complementary method of feeding a rapidly growing population?

Material and method

Finding material and search terms

I mainly used the search terms, "vertical", "vertical farm", "urban farm", "urban agriculture", and also used various combinations of the search terms, agriculture, farm, localized, local, localization, skyfarming, vertical, and urban.

Search tools

My main search tools were Högskolan i Halmstads own database search engine www.hh.se/bibliotek/sokvarasamlingar/databaser and SUMMON, as these search engines scan several databases at once. I also utilized Google Scholar, JSTOR, Science Direct, ISI Web of Science, Springer Link, Academic Search Elite and AGRICOLA (AGRICultural Online Access).

Sorting out relevant material

As each search term or combination of words only yielded a max of 40 results and seeing as the area in question was new to the author, the decision was made not to refine the results further but to systematically go through all the results from start to finish. As the total amount of material amounted to several hundreds of hits, this turned out to be a quite time-consuming process. However, this was a necessary step as the process itself provided schooling on the subject at hand.

Fresh water, a resource not to be taken for granted

Fresh water suitable for drinking is scarce and one of the resources currently being wasted. It´s estimated that, by the year 2025, two thirds of the world will be facing water shortage with current agricultural practice being a major contributor to this depletion.

For example, on a global scale, modern agriculture uses 70% of available fresh water (Ellis, 2012). A lot of this water loss is due to artificial irrigation of farmlands. For the most part however, water used in outdoor farming is lost as it simply evaporates into the atmosphere (Ellis, 2012). This is however a natural phenomenon and the biggest problem is the water that leaves the fields as agricultural run-off. The run-off is unusable as drinking water due to contamination of fertilizers, pesticides, salts, silt and in some cases animal and human waste (Despommier, 2009). Translocation of agriculture to the controlled environment of a vertical farm would provide great water conservation potential, much of which is found in the choice of growing culture (Despommier, 2010a, Ellis, 2012).

Hydroponics and Aeroponics, benefits of a soilless culture

Hydroponics and Aeroponics are two technologies that revolutionized water use in agriculture. Combined in a "closed loop" system these two methods have the potential of conserving up to 95% of the water used as well as eliminating agricultural run-off and the negative repercussions it has on the environment and human health in general (Despommier, 2010a).

Hydroponics

Hydroponics is a soilless culture where plants are grown using a mineral nutrient solution instead of soil. Soil in itself is not essential for plant growth but has two main functions. First, it supplies physical support and second, soil acts as a mineral nutrient reservoir. When the nutrients found in the soil dissolves in water they become available for absorption by the plants rooting system. In hydroponics instead, plants are grown with their roots either directly in the nutrient solution or in a supporting medium such as sand, gravel, perlite or other. Soil is now no longer required for plants to grow and thrive (Statemaster.com). In fact, experience has proven that plants grown using hydroponics have shown to grow at a faster rate, ripen earlier and produce up to ten times the yield than that of soil-grown plants as well as providing a greater nutritional value (Ellis, 2012).

Aeroponics

Aeroponics, takes water conservation even further than hydroponics. The name is derived from the Latin meaning of air and essentially refers to plants grown in an air culture, compared to hydroponics which uses water as a growing medium. Aeroponics requires no substrate to operate. With this technology, plants are grown with their roots suspended in a deep air or growth chamber while periodically sprayed with a fine mist of nutrient solution (Statemaster.com). Aeroponics provides excellent aeration to the roots and takes water conservation even further than hydroponics as it can operate with up to 70% less water than hydroponic technologies (Despommier, 2010a).

Water Recovery by means of dehumidification

One of the biggest advantages of growing in controlled environments as in vertical farming compared to outdoor farming is that the water can be recovered. For example, water lost through transpiration and evaporation can be collected and thus reused (Ellis, 2012). Transpiration from plants occur mainly through the leaves where it leaves the plant in the form of water vapor. In a controlled growing environment, this water can be collected by means of dehumidification. By simply placing dehumidification devices on each floor, we can effectively collect and reuse all of the water in circulation (Despommier, 2010a). The soilless culture then, has the potential of saving incredible amounts of water compared to current outdoor agricultural techniques. Experience has shown that it can use as little as a 1/20 of the amount of water as a regular farm to produce the same amount of food (Statemaster.com). Other numbers tells us hydroponics use 70% less water than current agricultural practice and geoponics use 70% less water than hydroponics (Ellis, 2012, Despommier, 2010a).

By recycling the water in this fashion, one would also avoid any agricultural run-off and limit the negative impact farming has on the water table (Despommier, 2010a).

Pesticides, fertilizers and agricultural run-off

Closely related to the water aspect is the use of agro chemicals and agricultural run-off. The unpredictable nature of outdoor farming is a factor to consider when dealing with the problems of agricultural run-off as well. In an outdoor setting it is very difficult to provide the crops with the exact amount of nutrients they need. Fertilizers are often added to the irrigation water along with various pesticides in abundance. Excess irrigation water leaves the field as agricultural run-off, laden with fertilizers along with pesticides, herbicides and silt, creating a wide array of environmental and health problems (Despommier, 2012). Severe hypoxia and eutrophication, wetland degradation and ground water pollution are but a few on a long list of environmental problems that follows. It has been said that, agriculture is responsible for more ecosystem disruption than any other type of pollution with run-off being the most destructive source of pollution on the planet today (Ellis, 2012, Despommier, 2010a).

In a controlled growth setting designed for maximum efficiency the plants will grow in an environment optimized for their specific needs. This will generally produce plants that are healthier and stronger than those that are grown outdoors where conditions are highly variable. Stronger and healthier plants will have better resistance against pest attacks, bacteria, fungi or diseases thus reducing the need for pesticides (simplyhydro.com).

The same precision can potentially eliminate the problems of excess run-off as well. Because, when using a mineral solution that precisely matches the needs of cultivated crops, plants will absorb all of the nutrients used (simplyhydro.com).

Fertilizers in developing countries, a global health hazard

As many developing countries simply cannot afford artificial fertilizers, instead they are forced to rely on feces, from humans as well as animals (Despommier 2010b).

Feces are not an ineffective fertilizer in terms of plant growth but it comes with a major side effect. It creates an expressway for the transmission of various parasites, infections and diseases (ibid.). Indoor farming utilizing vertical farms might potentially alleviate a lot of the sanitary health hazards seen in these regions (ibid.).

Municipal wastewater recycling and standalone vertical farms

Vertical farms are not simply restricted to food production. In the concept lies a novel approach to municipal water recycling. According to Despommier, cities are by far the biggest consumers of drinking water turning it into liquid municipal waste (Despommier, 2010a). This waste water is treated in a series of steps to remove solids and disarm it´s potential to cause diseases after which it is simply let out into the nearest body of water. US cities collectively spend billions of dollars each year disposing of liquid municipal waste. This linear way of using water is a waste of both economic and environmental resources. Despommier presents an idea (ibid.) where, instead of simply disposing of the treated water, Vertical farms could pose an additional step in the water purification process, restoring it back into drinking quality (ibid.). In this scenario, instead of discarding the treated waste water, it would be used as irrigation water in standalone vertical farms.

Plants absorb water along with any solutes (nutrients, pollutants etc) it may contain through their roots. Water and solutes will then travel up through the plant. Solutes and some water will be absorbed by the plant while the rest of the water will eventually evaporate off the leaves in the form of water vapor. The water vapor that evaporates off the plant has effectively been cleansed of any remaining pollutants it may have contained. By simply dehumidifying the indoor air one could recollect the massive amounts of water transpired by the plants inside a vertical farm, taking advantage of natural means of water purification (Despommier, 2010a).

Plants used in this purpose would not be suitable for eating. Therefore, these buildings would have to act as separate standalone vertical farms devoted entirely to the purpose of water purification. Instead, biomass produced in these buildings could be used in biofuel production adding an additional cost benefit to the solution. Resulting purified water would be drinking quality and could be used as irrigation water in food-producing vertical farms or simply be reused as drinking water (Despommier, 2010a). If this is a feasible option, it could mean "closing the loop" on our current way of using water, opening up the possibility of cities becoming more or less self-sufficient in terms of water supply, saving enormous amounts of both economic and environmental resources at the same time.

Ecosystem alteration, destruction and loss

Another major downside to our current agricultural practice is the sheer amount of land required for production. In order to support our current scale of agriculture, millions of hectares of natural land have been altered and the consequences it has had on our planets ecosystems and biodiversity are severe (Groom, Meffee & Carroll, 2005). Wetlands, estuaries, grasslands, temperate and tropical forests are but a few examples of the many biomes that have been severely affected, damaged or in many cases completely lost as a result of our practice (Despommier, 2012).

One of the major benefits of vertical farming in urban centers is the gradual repair of these ecosystems. Translocation of food production to vertical farms would relieve the land currently used for agricultural purposes allowing for large scale ecosystem restoration. In many cases all it would take is simply abandoning the land and given time, nature will repair itself (Groom, Meffee & Carroll, 2005, Despommier, 2012). Ecosystem regrowth will increase nature´s own buffering capacity, resilience and resistance to disturbance and pollution, increase biodiversity and carbon sequestration to name a few. Restoring ecosystem functions and services might very well be one of the most potent means we have to turn the negative spiral of climate change around, opening up the possibility of a brighter, cleaner and less polluted future (Groom, Meffee & Carroll, 2005, Despommier, 2010b).

Growing population, lack of arable land & Space Conservation

It´s estimated that, by the year 2050, global population will have increased to around 9.5 billion (Germer et al, 2011). If we continue our current soil based farming methods, we would need an additional land area equivalent to the size of Brazil to be able to produce enough crops. Considering that we already use a landmass equivalent to the size of South America for crop production it becomes obvious that space is quickly becoming a valuable resource not to be wasted (Despommier, 2010a). Translocation of agriculture to vertical farms will conserve space and would greatly increase food production and crop output for every acre used. By stacking floors on top of each other, we can utilize the vertical dimension as well, instead of considering only the horizontal space. A huge advantage compared to traditional outdoor agriculture that´s confined to a single plane (Ellis, 2012, Despommier, 2012).

Fossil Fuels, transport and wasting

Farming involves huge amounts of fossil fuels. It´s estimated that in America alone, 20% of fossil fuels is used in agriculture. Annually, every American consumes about four to eight barrels of oil used to produce the food they consume. In addition to all the environmental issues linked to fossil fuel consumption it greatly affects food prices as the price of food becomes linked to the price of oil. When the price of oil goes up, food prices will follow. With decreasing oil reserves and escalating oil prices this is bad news (Ellis, 2012, Despommier, 2009). Much of this fossil fuel consumption is due to transportation and storage but also machinery used in production. Transportation in agricultural industry operates mainly by fossil fuels and is a tremendous source of greenhouse gas emission and pollution (Sharanbir et al, 2011). Vast quantities of fuel is also required in the production process. For instance, plowing, seeding, harvesting, applying fertilizer etc, are all activities that require massive amounts of fossil fuels (Despommier, 2012). In a vertical farm, no heavy machinery will be needed in production as this process is largely automatized by robotics (Naoshi Kondo 2012). Transportation and storage is also a cause of food wasting and spoilage. Thirty percent of harvested crops is lost due to infestation and spoilage during storage and transport (Despommier, 2009).

In a world where urbanization is becoming more and more widespread, localizing the food production as with vertical farming would alleviate a lot of these problems.

Localizing food production to meet ongoing urbanization

On par with ongoing population explosion we also see a current global trend towards an increased urbanization. By 2050 80% of the world´s population will be residing in urban areas (Germer et al, 2011).

Vertical farming meets the needs of an increasing urbanization. Buildings used for farming can be placed anywhere while outdoor fields are static in location. By strategically placing vertical farms inside or in the near vicinity of urban centers and cities, we are able to meet the need for localization of food production. Foods can be harvested and sold in the same building immediately after harvest, eliminating the need for transportation and storage. Another benefit with foods produced in this manner is that they will be fresher when reaching the consumer and will thus have a superior nutritional profile (Despommier, 2010a). Eliminating or minimizing transportation and storage in food production will naturally eliminate the wastage and spoilage occurring in these stages as well. Meaning we might have to recalculate how much food needs to be produced in the first place, which in the long run will give an additional cost benefit to this method. Less food will have to be produced, even less area will be needed for food production, conserving space, as well as economic resources and environmental protection (Sharanbir et al, 2011).

Controlled environment and number of harvests

The controlled environment of Vertical Farming provides many advantages compared to outdoor agriculture.

In a closed environment a greater amount of control is possible making infestations and infections from pests, bacteria or other infectious agents easier to prevent, treat or control (Despommier, 2010a). A controlled environment is unaffected by seasonal variation, opening up the possibility of multiple harvests a year, compared to outdoor farming that´s typically restricted to a single harvest a year this is a dramatic increase of production output potential (Germer et al, 2011). In a controlled environment the grower will be unaffected by weather fluctuations, drought and floods, avoiding the frequent loss of crops due to these factors commonly seen in outdoor agriculture (Ellis, 2012).

Cons and Caveats

So is all good in the land of vertical farming? Not quite. As anything in this world it comes with cons and caveats. Most of which however is due to a concept under development. As with all new things one must keep in mind that development comes with errors, those errors then become corrected and with time the product improves. The first thing to fly by human inventions was hardly a Jumbo jet.

Affordable space in close proximity

A potential caveat to vertical farming that has been pointed out by others is finding available space inside our cities. If the idea of vertical farming is to work in terms of localization of food production, the location needs to be just that, local. Accounting for the sheer price of properties inside big cities and considering this price has to be accounted for with each building established, we might start seeing problems with economical viability. Despommiers argument to this is that, "every large city has plenty of less desirable sites that often go begging for projects that would bring in much needed revenue" (Despommier, 2009). In the authors opinion, this seems like a very loose response but an evaluation in each individual case would be necessary to calculate the possibilities and economical viability of establishing vertical farms.

Space required for production

Closely related is the argument of production output. Can the output of a vertical farm really match that of a traditional outdoor farm? To counter this argument one has to consider several factors, some of which have already been stated. For one, growing occurs year round in a vertical farm, resulting in multiple harvests a year depending on what crops are grown (Despommier, 2009). Second you have multiple stories, adding a multiplication factor for each floor. For example, a 30-story building covering only five acres will give us a total of 150 acres (Despommier, 2010a). In addition, strains developed for maximum yield in relation to size have already been developed and can thus be utilized in a vertical farm. For example, dwarf plant varieties of common crops developed for NASA take up less room and grow to a shorter stature. These dwarf varieties can then be stacked on top of each other giving each floor multiple layers of crops adding further multiplication factors to the equation (Despommier, 2009, Ellis, 2012). Combining these factors then, provides us with a production output far greater than that of a simple one dimensional field (Despommier, 2009). One acre of vertical farmland is thus equivalent to about 4-6 acres of outdoor agricultural farmland (Ellis, 2012).

Providing enough energy to operate a vertical farm in a sustainable way

Many have raised the point of providing enough energy to operate a vertical farm without breaking budget, while still keeping sustainability in mind, avoiding fossil fuel use. In the authors opinion this is where Despommiers concept provides "the most bang for the buck". Despommiers solution is as much a holistic solution as he points out. Municipal wastewater recycling can potentially make the farm self-sustainable in terms of water use (Despommier, 2010a). If that should be insufficient, rain water can be collected from rooftops and reused (Sharanbir et al, 2011). Further, biomass from vertical farms used in water purification as well as plant waste left over from food crops can be incinerated and converted to biofuel that in turn can be used to fuel additional farms (Despommier, 2009). And finally, Despommier points to the obvious, that "location is everything" (Despommier, 2012). Wind and wave energy can be harnessed in regions that provide strong winds and water motion. Sun energy can be captured in other locations and geothermal energy in locations where that is a viable option (Despommier, 2009).

Resource distribution

An obvious thought that comes to mind is that the world´s problem is not lack of food but rather the distribution is skewed (Germer et al, 2011). Fact is, we have enough crops to meet the nutritional needs of the human population but starvation is still a worldwide problem, right alongside a bolting obesity epidemic (Children´s Rights Portal, 2012). No secret then that delivering resources to markets are driven largely by economics and not biological need (Despommier, 2012). In the authors opinion this argument falls beyond the realm of vertical farming. Factors determining resource distribution will be unaffected by what means we choose to conduct agriculture. Still, Despommier argues that, locating vertical farms near these "human hot spots" might alleviate the problems of starvation and hunger (Despommier, 2012).

Vertical farming in developing countries

As previously stated, Despommier claims locating vertical farms near human hot spots can alleviate hunger and starvation as well as a lot of the sanitary issues seen in developing countries due to human feces being used as fertilizers (Despommier, 2010b). However if someone cannot pay for artificial fertilizers and is suffering starvation and disease because they cannot afford proper nutrition and health care, how are they going to pay for vertical farms, a single building of which is probably worth millions of dollars in construction and operational costs?

Unless extensive financial aid was given to the establishment of vertical farms in developing countries and "human hot spots" it´s unlikely that we will see any of these in the aforementioned regions in the near future. Although vertical farms might initially only be available to people with a strong economy, technology gets cheaper. The IPhone might not initially have been developed with third world markets in mind but eventually it reaches these areas as well. So maybe we just have to withstand that vertical farms, initially become the toys of the richer westernized world, keeping in mind that eventually the technology will be available in the countries where it will benefit the most.

Economics, is vertical farming viable?

One might argue that vertical farms are simply too expensive and non-profitable in the long run. Does the economical benefit of vertical farming like resource sparing and minimizing waste, mentioned previously in the article outweigh the costs of constructing, operating and maintaining these buildings?

When the concept arose anew in 2010 with Despommier´s book "The Vertical Farm: Feeding the world in the 21st century". One of the major potential downsides was providing enough light for the vertical farm to be productive yet economically viable in the long run (Despommier, 2010a). Closely related to this are the expenses of constructing and providing optimal climate control. Being the multidisciplinary concept that is vertical farming, it is beyond the scope of this article to go into details in these areas. A lot of this can be solved in construction. The architecture of the building is key as it can be constructed to optimize light input according to seasonal and daytime variation as well as taking advantage of the simple laws of physics to maximize climate control and ventilation without the use of external power sources needed. However, regardless of how optimal the architecture is fitted, extra lighting and climate control will most likely be needed (Ellis, 2012, Despommier, 2010a, Germer et al, 2011). This is where technological improvements and economics comes in to play. We have seen the phenomenon many times in history. As soon as an area becomes financially lucrative for investors, science and research tends to put in a fifth gear and technological improvements gallops. It´s a personal opinion of the author therefore, that once the concept of vertical farming acquires global attention, lighting and climate control technology will soon be highly developed and available at a cost that is viable in the long run. In fact, this technological evolution has already begun (ibid.).

When it comes to determining if total gains and benefits outweigh the costs, this has to be determined in each specific case as there are too many individual factors to consider. However, any cost calculation will have to include all the environmental, as well as health benefits vertical farming can potentially bring to mankind. Benefits that are hard to value in any financial currency.

A theoretical construct of a vertical farm

So if one were to build a vertical farm, how would it look? When designing a vertical farm, individual factors have to be considered. Geography, surroundings and budget are but a few examples. Provided here is the authors theoretical construct and simply one way to design the farm.

Fueling the farm and water supply

Sticking with the theme of sustainability and avoiding linear use of resources, the farm would be for the most part powered by wind, wave, solar energy or another sustainable fuel. For example, left over plant mass from crop production or biomass from wastewater treatment vertical farms would be incinerated and converted to biofuel, and reused to help power our farm. Any water needed for our farm would come from recycled municipal waste water from a nearby standalone waste water treatment vertical farm. The water could then be recycled within our crop farm as transpired water could be recollected by placing dehumidification devices on each floor, recollecting the water and putting it back in to circulation. Additional water needed for the farm could possibly come from rain water collected from the roof top.

Growing floors, form and function

Technology within the vertical farm would be similar to the principles of Maximum yield and High rise crops (Despommier, 2010a). For example, an automated conveyor would be used to move the plants from one end of the floor to the other while the plants grow from seedling to mature and reach the harvester at the opposite side. Along the way, water and lighting could be optimized for each growth stage. To add additional efficiency, plants could be stacked in layers on each floor, using existing hydroponic growing technology (Despommier, 2009).

Building designed for maximum light efficiency

The building architecture itself would be optimized for maximum light efficiency. Windows and rooftops could be designed to get the most out of the sun according to seasonal variation, summer, winter, spring and fall in temperate regions (Despommier 2010a). However, additional lighting would be required, preferably some form of LED lighting as this technology is advancing rapidly. With superior lamp life and a strong declining cost function, LED lighting seems to be the most economically viable alternative (Germer et al, 2011, verticalfarm.com, Despommier, 2010a).

Bottom floor

To take adhere fully to the principle of localized food production, the bottom floor of our vertical farm would include some form of grocery store or even a restaurant where crops and produce are sold. The freshness of the produce would be hard to match as it can be sold immediately after harvest, and the price could even be lower than "standard" as the expense of transportation and storage was removed (Ellis, 2012, Sharanbir et al, 2011).

Plantagon, Sweden

A glimpse into the future of agriculture?

Providing a case study at this moment is difficult to say the least. So far, buildings are under construction, far from complete and on top of that most Vertical Farming companies are very silent and protective of their techniques and projects (agri-techture.com). However a preview of the ongoing construction and plans of Plantagon in Linköping, Sweden is provided. Scheduled for completion in 2015, the company plans on using an unconventional helix design, a globular structure where the main focus is on constructing automated systems that move crops upwards as they mature from infancy to harvest to optimize light penetration and distribution (ibid.)

The rotating design and automated system aims to minimize or even eliminate the need for artificial lighting (ibid.).

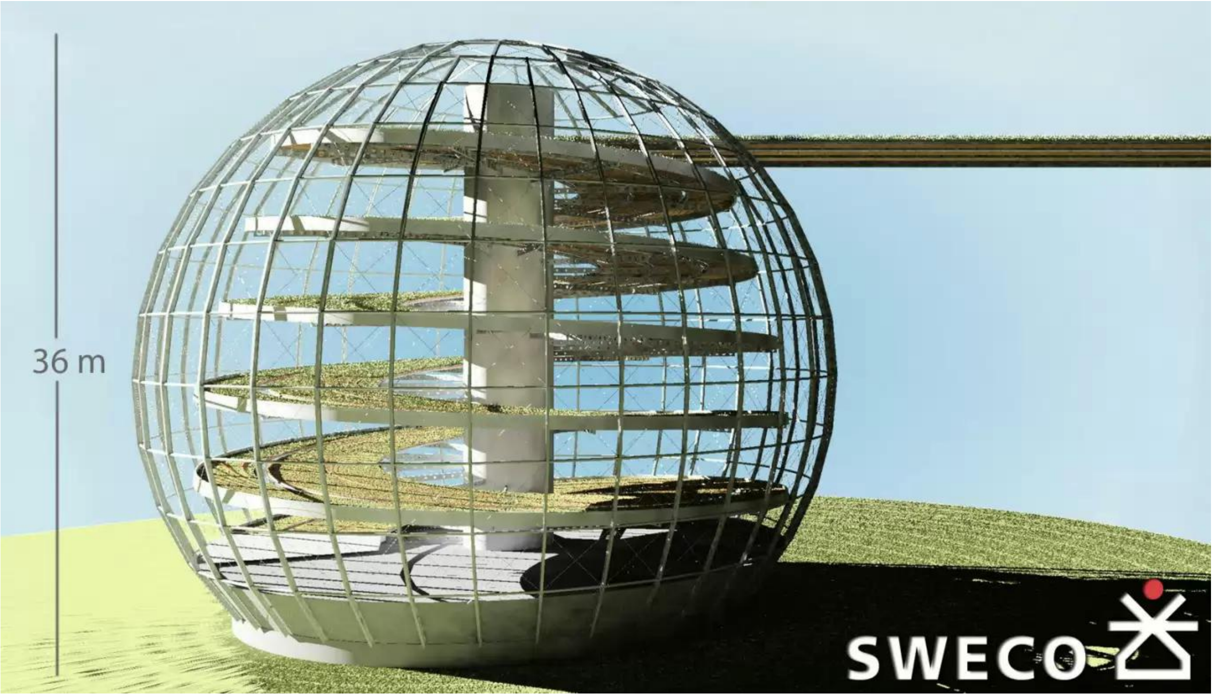

Fig 1: Illustration of Plantagon, Linköping. Globular helix design with internal rotating structure

Final words

The concept of Vertical farming is undoubtedly a promising one. It successfully combines the needs for an environmentally sustainable way of conducting agriculture with economic and resource efficient means of production. Human industries have long been characterized by a linear use of our natural resources, an open loop, in which resources move through the system only to become waste in the end (Petersson, 2006). Vertical farming instead, emphasizes a nonlinear use of resources, successfully integrating the principles of closed loop systems where waste become inputs for new processes (ibid.), to create a futuristic and truly sustainable method to conduct industrial agriculture. Much of the technology required already exists, but simply needs to be combined the right way (Despommier, 2010a). Other areas need improvement, further research and development to be successful (Despommier, 2012, Ellis, 2012). Being the novel concept that is Vertical farming, it´s best viewed as a work in progress.

Can it provide an alternative to current agricultural methods? Absolutely. Is it a better alternative? It´s this writers firm belief that Vertical farming is in fact a better alternative from both an economical as well as an environmental point of view. As to what degree it can replace our current methods, only time can tell.

So what news does this article contribute to the subject? It would no doubt be a pleasure to provide a significant contribution to the concept of Vertical farming that would forever be remembered in history. But for now it might be best to settle for mere attention. Every article written on the subject will in it´s own way be a contribution as it directs the attention to the promising concept of Vertical farming and thus, opening up the eyes of the public to the subject at hand.

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Cover Image

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