Subtitle

Vertical Agriculture

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**Why agriculture ?**

# .  the development of agriculture is one of the most important factors to the development of human life. So, many studies for the recent agricultural environments focus on the ITagricultural convergence to aim for smart and ubiquitous agricultural services. However, most of existing IT-agricultural technologies for smart services in agricultural environments are less flexible or less real time because they tend to be dependent on particular systems and use a few of fixed environmental data. And also they always need a human intervention about a variety of exceptional situations. To resolve the limitations and disadvantages, this paper designs the vertical farm ontology that is defined as the environmental, control factors and relationship between each factor for the crop growth using OWL based on RDF. The defined factors in the vertical farm ontology can be extended continuously, and its knowledge can be shared and reused in a various domains of agricultural environment.

What is vertical agriculture ?

**Vertical agriculture**  is the practice of growing crops in vertically stacked layers. It often incorporates Controlled -environment agriculture , which aims to optimize plant growth, and soilless farming techniques such as hydroponics , aquaponics, and aeroponics. Some common choices of structures to house vertical farming systems include buildings, shipping containers, tunnels, and abandoned mine shafts.

The modern concept of vertical farming was proposed in 1999 by Dickson Despommier, professor of Public and Environmental Health at Columbia University. Despommier and his students came up with a design of a skyscraper farm that could feed 50,000 people. Although the design has not yet been built, it successfully popularized the idea of vertical farming. Current applications of vertical farming coupled with other state-of-the-art technologies, such as specialized LED lights, have resulted in over 10 times the crop yield than would receive through traditional farming methods.There have been several different means of implementing vertical farming systems into communities such as: Painting, Singapore , Chicago,  Munich,  London,  Japan, and Lincolnshire .

The main advantage of utilizing vertical farming technologies is the increased crop yield that comes with a smaller unit area of land requirement. The increased ability to cultivate a larger variety of crops at once because crops do not share the same plots of land while growing is another sought-after advantage. Additionally, crops are resistant to weather disruptions because of their placement indoors, meaning less crops lost to extreme or unexpected weather occurrences. Lastly, because of its limited land usage, vertical farming is less disruptive to the native plants and animals, leading to further conservation of the local flora and fauna.

Vertical farming technologies face economic challenges with large start-up costs compared to traditional farms. In Victoria , Australia, a “hypothetical 10 level vertical farm” would cost over 850 times more per cubic meter of arable land than a traditional farm in rural Victoria. Vertical farms also face large energy demands due to the use of supplementary light like LEDs. Moreover, if non-renewable energy  is used to meet these energy demands, vertical farms could produce more pollution than traditional farms or Greenhouses .

Why vertical agricultural?

The human population has reached some 6.4 billion individuals. Over 800 million hectares (i.e., nearly 38% of the total landmass of the earth) is committed to producing crops to support this still growing population. Farming has dramatically transformed the landscape, replacing and redefining functional ecosystems. Undeniably, a reliable food supply has allowed for the evolution of culturally robust societies. Ironically, farming has created a set of new hazards unique to activities involved with the production of food, and has exacerbated many older ones. Exposure to toxic levels of agrochemicals (pesticides, fungicides) and a wide spectrum of geohelminths are transmitted with regularity at the tropical and sub-tropical agricultural interface. Emerging infections, many of which are viral zoonoses (e.g., Ebola, Lassa fever) have adapted to the human host following our encroachment into their environments. In 50 years, the human population is expected to increase to some 8.3 billion individuals. Feeding these new arrivals will require an additional 109 hectares of farmland; land that does not exist. Vertical, urban farming in tall buildings involves fully sustainable energy use and creation in a new and literal organic relationship between engineering, architecture, technology, and global agricultural imperatives in local based community solutions.

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