VERTICAL FARMING: A FUTURE PERSPECTIVE OR A MERE CONCEPTUAL IDEA?

Population rise causes pressure on agricultural land and food production, as well as global warming and resource depletion. In order to mitigate all these problems, food production per unit area has to be maximized and be as efficient and non-polluting as possible. Revolutionary techniques such as technological advancements in rural agriculture, greenhouses and urban agriculture are being studied to find possible solutions to the major problems at hand. One of these techniques in urban agriculture is called Vertical Farming (VF) - the urban farming of edible crops inside buildings with an ideal climate regulated by (semi) closed loop systems – and is believed to be the perfect solution to both food supply and environmental problems. To test this hypothesis, this study creates and analyzes a fictive vertical farm in the state of Oklahoma USA, based on local climate characteristics and literature sources on vertical farming systems. With the use of a Life Cycle Analysis (LCA), environmental impacts of lettuce production in this farm are calculated and compared those of rural production of the same crop.

The LCA software program GaBi is used for LCA modelling of the fictive vertical farm and to perform the Life Cycle Inventory Analysis

This study shows that most of the claims made on vertical farming are confirmed. A vertical farm has a higher yield than rural agriculture, with more than 80 times the yield of open field agriculture, due to multiple harvests a year and a higher plant density, has a lower water footprint, with 18 times less water used, due to the semi-closed loop water system, has a lower freshwater pollution rate, with a eutrophication reduction of 70-90%, due to minor use of excessive fertilizers and has a major decrease in transport distance and thus a decrease CO_2 emissions during transport. However, due to the large electricity demand of all high-end systems, CO_2 emissions of a vertical farm are higher than that of rural agriculture. This high electricity use causes higher impacts in almost all impact category, especially in the Terrestrial Acidification and the Land Footprint. Contrary to common belief, the Vertical Farm actually has a massive Land Footprint, due to the fact that electricity production and other production steps in the production chain require land use.

Overall, results demonstrate that a Vertical Farm, as compared to other agriculture techniques, has its positives and negatives. Even though it can contribute to solving food supply and water scarcity problems, it has negative impacts on land scarcity, acidification of the ground and climate change.

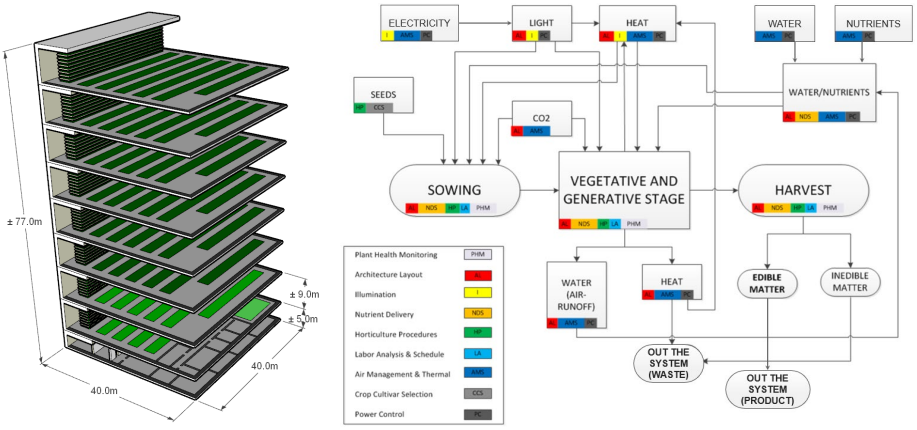

Figure 1: Physical layout and flowchart of functional subsystems in the fictional Vertical Farm

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