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URBAN ROOFTOP HYDROPONICS FOR DIVERSIFIED AGRICULTURE: PILOT PROJECT

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THE POLICY SITUATION

The Philippines is rapidly urbanizing. In 1980 only 39% of the population lived in urban areas. By 2020 this is projected to increase to 73%. Much of this urbanization occurs in largest cities. Metro Manila, for instance, contains close to 12 million people. Many live in dense communities with large building stock. Traffic congestion, rising fuel prices, and poor road infrastructure has produced problems in transporting agriculture from rural areas to urban markets, where people reside and food is consumed. Increase in rates of spoilage of perishable vegetables and transportation costs constitute a food security issue that needs to be addressed. This project sought one solution - utilizing the rooftops of buildings to grow vegetables. A number of cities are already exploring this option. Singapore calculated that they have 212 hectares of available building rooftops that are underutilized. They have the capacity of producing 39,000 tons of vegetables annually. Cities like Montreal, Toronto and New York are exploring the possibilities of urban rooftop agriculture as well.

This pilot project developed a hydroponics installation on the rooftop of Saint Joseph Hall at De La Salle University that cultivated lettuce consumed by the community on-site. The following research questions were addressed:

1. IS THE PRACTICE Of SUSTAINABLE AGRICULTURE IN OPEN SPACE OF URBAN AREAS FEASIBLE? IS URBAN AGRICULTURE DOABLE IN ROOFTOPS?

A hydroponics set up was installed at the northern end of the roof top of St Joseph Hall at De La Salle University, Manila. This building is 6 stories high with no neighbouring taller structures. The location of the set up was a vacant space, directly exposed to the elements. To protect the plants from direct sunlight, heavy rainfall and strong winds, a shed with steel pipes as framework was constructed. Nets wrapped around the whole structure served as protection from the elements. Three layers of nets protected the plants against gusty winds and very heavy rainfall, without lessening the sunlight penetrating the shed. However, we have apprehensions that the plants might be destroyed by strong winds and heavy rains caused by typhoons. To address such natural occurrence, water proof canvas sheets are on hand. The whole set up only occupied 18.5 square meters. It is lightweight, and does not add weight burden to the building.

To save on water by, a closed hydroponics system was devised using PVC pipes. The water is bubbled and circulated for 1 hour every 6 hours using submersible pumps and aerators. The whole system is powered by a solar panel. The mini-weather station installed recently to monitor air temperature & relative humidity, and predict rainfall is powered by rechargeable batteries. The environmental foot print of this set up is minimal.

2. CONSIDERING THAT AGRICULTURE IS A MAJOR USER OF WATER, WILL AGRICULTURE PRACTICE NOT COMPROMISE WATER SECURITY IN URBAN AREAS?

Results of the experiment indicate that 140 liters of nutrient solution is enough to support 50 lettuce plants to maturity (around two weeks after germination). On extremely warm and dry days, there might be the need to replenish evaporated water. Nevertheless, the nutrient solution after two weeks is still able to grow a second batch of lettuce before more nutrient solution needs to be added. When we consider that 140 liters can support 100 plants using our methods and that our average yield per plant harvested is 25 grams for green wave and 50 grams for fanfare, then 140 liters nutrient solution is required to grow 2.5 kg and 5 kg of lettuce respectively or 56 liters of nutrient solution is needed by green wave and 28 liters is needed by fanfare to grow to 1 kg. The global average water footprint of 1 kg of lettuce is equivalent to 130 liters. The water footprint of our methods is less than half of the global estimates.

3. WHAT ARE THE COSTS OF URBAN HYDROPONICS LETTUCE PRODUCTION BASED ON THE MODEL OF ON-SITE PRODUCTION AND ON-SITE CONSUMPTION AND COMPARE THIS PRICE OF THE PRICE OF LETTUCE PURCHASED IN MARKETS?

The average national wholesale price of lettuce has more than tripled from PhP 12 in 1990 to PhP43 in 2010. Metro Manila prices are higher by PhP 2 in 1990, now it rose to at least PhP 10. The retail prices are much higher. The retail prices vary, depending on whether the lettuce is imported or locally grown. Currently there are only four lettuce markets found in major urban centers. These are Manila, Cebu, Iloilo City and Cagayan de Oro City. Two of the more popular varieties are Iceberg and Romaine. Locally grown Iceberg can sell at a price as low as PhP 75 and the imported kind can be sold at PhP 280. Hydroponically grown lettuce is sold at PhP 30 per pot, by RFM Hydroponics. Based on our computations, the hydroponically grown lettuce is being sold commercially at around PhP 600 per kg.

With the inclusion of the cost of electricity for sterilizing the water used for preparing the nutrient solution, the total cost of materials per 100 plants is less than PhP 500 or approximately PhP 100 per kilogram.

If we are to sell the lettuce at PhP 30 per pot, a total of PhP 3,000 will be earned per harvest or a gained profit of PhP 2,500. If we are to recover the cost of the whole set up of PhP 100,000, with one cycle of germination and growth period of a month, then at least 40 months or 3.3 years is needed. The main profit however is the reduction in the ecological foot print brought about by our method.

POLICY ISSUES ADDRESSED

This pilot project addressed the following issues: First, it addressed the need for agriculture products to be grown locally and consumed on site. This is coined by co-author Taylor as "diversified agriculture." This type of agriculture emphasizes the following characteristics: 1. It is grown on site, therefore reducing the cost of transportation and spoilage; 2. It meets the demand for on-site food supply, i.e. the immediate deployment of food through an existing food delivery infrastructure (canteens). Second, the project utilized an underdeveloped and vacant urban space resource - building rooftops - and transforms them for productive use. Third, it employed a type of agriculture, hydroponics, that does not use soil but, in this case, a continuous flow of water to grow food. This type of agriculture uses only 10% of the water requirements for traditionally grown agriculture, thus, saving a valuable resource – water.

Fourth, it used a nutrient base this is recycled and controlled so that surplus nutrients are not emitted into the environment as pollutants, i.e. the wastewater runoff of nitrates for agriculture into streams and rivers. The amount of nutrients applied was professionally managed. This saved cost through a more efficient application regime. And fifth, through hydroponics, a controlled environment was maintained in order to reduce diseases, pest infestation, sunlight application and shading, and temperature, all factors that can contribute to crop loss, but through scientific management is likely to produce greater yield.

POLICY RECOMMENDATION

The results of this pilot study show that urban farming in open areas such as rooftops is not only feasible but is also productive. The growing time is not only shorter and the yield, higher, but the set up can also be designed so that ecological foot print of the methods used is drastically reduced. It is not because the lettuce need not be transported from distant places, but energy is saved by using alternative sources of power supplies such as solar powered pumps and aerators.

Furthermore, water conservation is also enhanced by the hydroponic method adopted in this study. It has been shown that urban farming does not only address food security issues but also proves to be environment friendly. Hence, the practice should therefore be encouraged.

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