

FLOATING HYDROPONIC CROPS PROPOSAL: TONLE SAP LAKE, CAMBODIA

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Abstract

The paper presents an innovation project elaborated by the authors as an entry for the Empowering People Award, an international competition launched by Siemens Company in 2013. The aim of the competition was to develop sustainable solutions in order to improve the quality of life in local communities from emerging countries. An important condition was the use of eco-friendly technologies, in order to solve supply problems considering financial constraints. The proposed solution represents a floating vegetables garden based on a simple hydroponics technology system which is powered by solar energy and is mostly made of recyclable and local materials. The location of the project is the area of Tonle Sap Lake (Kingdom of Cambodia), the largest freshwater lake in South-East Asia, a rural region with more than 1 million inhabitants. The aim of the design was to improve and to diversify food supply for the residents of the floating villages, considering the primary food resources are fish and rice. Thus, the main objectives of the solution were to enhance the life quality of the local communities in a sustainable manner, both at social, economic and ecological level. The results of the study include: target groups, technical feasibility and functionality, technical plans and illustrations of the proposed solution.

Key words: Cambodia, Floating villages, Hydroponics, Sustainability, Vegetables growing

INTRODUCTION

The proposed solution represents a floating vegetables garden based on a simple hydroponics technology system, using mostly recyclable and local materials. The location of the project is the area of Tonle Sap Lake (Kingdom of Cambodia), the largest freshwater lake in South-East Asia.

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MATERIALS AND METHODS

Following the competition launched by Siemens a study has been done for the implementation of a floating hydroponic

garden system for Tonle Sap Lake. The first phase included a theoretical research regarding local conditions. The results led us to analyze to what extent a sustainable solution to improve food security in the local communities can be implemented. The second phase of the study included the evaluation of the premises for making a product based on sustainable principles: renewable energy, using recycled materials, using local resources, minimal environmental impact and landscape integration. The costs to obtain a minimum budget were also taken into consideration. Following the two research stages a floating hydroponic culture system resulted, responding to the identified issues in the Tonle Sap Lake.

RESULTS

Tonle Sap is the largest freshwater lake in Southeast Asia, a generator of biodiversity and source of living for most of the population of Cambodia. The food is provided by fishing and

rice cultivation, while the shelters in the form of floating settlements are made of local materials. Intensive exploitation and lack of conservation strategies puts in danger the future of this area. Due to overfishing, of 500 species of fish existing initially, there are only 300 now. From an original area of 1 million ha of

forest there are only 20,000 ha remaining now due to the incontrollable expansion of agricultural area. While the resources are diminishing, the population grows and the need to find alternatives for providing food is only required.

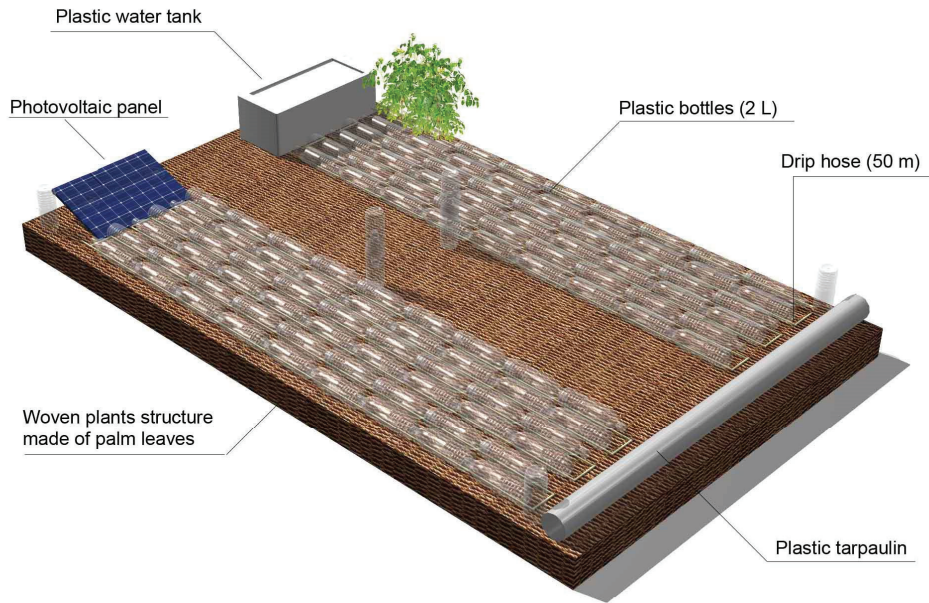


Figure 1. Floating hydroponic garden proposal - 3D image

Through this project we propose the development of low-cost floating gardens with important long-term benefits such as increasing crop areas without deforestation, balancing the population's diet that relies in present almost entirely on rice and fish, protection of the remaining species of fishes. The project aims primarily at people in lacustrine settlements. A floating garden can be attached to each house and it consists of one or more units based on the needs of each family and on the space available for configuration. The assembly can be easily accomplished both in terms of purchase of materials and their cost and the actual process of construction. Using the garden is also easy and can be done by any family member from kids to adults with minimal costs.

The proposed floating crops garden represents a horizontal hydroponic system, adapted to the natural conditions and social needs of Tonle Sap Lake area, Cambodia. So, a large part of the construction materials are of local origin, eco-friendly and recyclable. In order to minimize the costs, to reduce the environmental impact and to benefit from the natural local resources, the floating crops contain a simple self-sustaining solar energy generator. Also, all the materials, excepting the solar pump, doesn't require major investments. According to organic farming principles, the nutrients used for the crops would be made of local fish emulsion. Thus, the proposed technology is based on sustainability principles in terms of environment, energy, agriculture and economy. The components of the floating

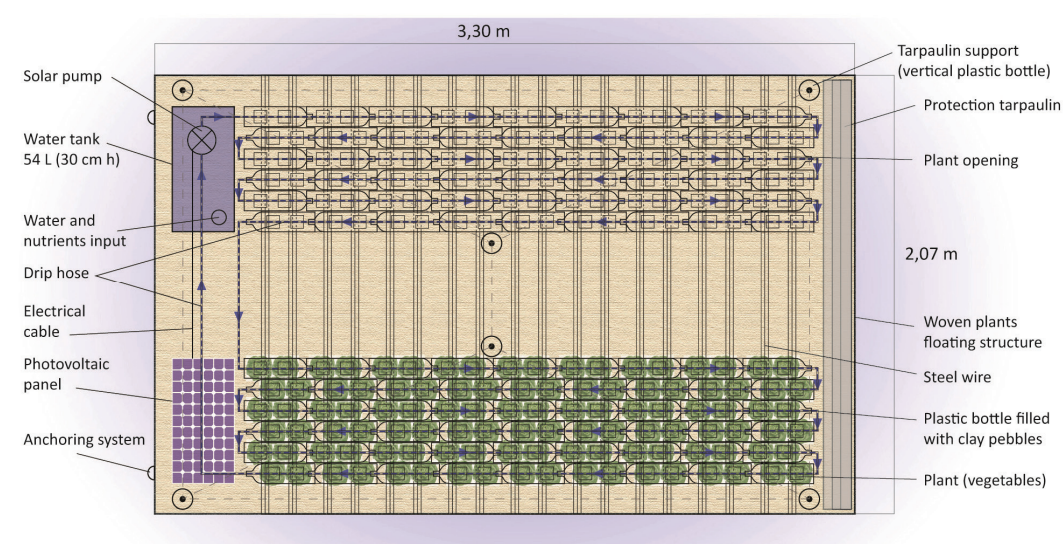


Figure 2. Floating Hydroponic Crops – Plan view

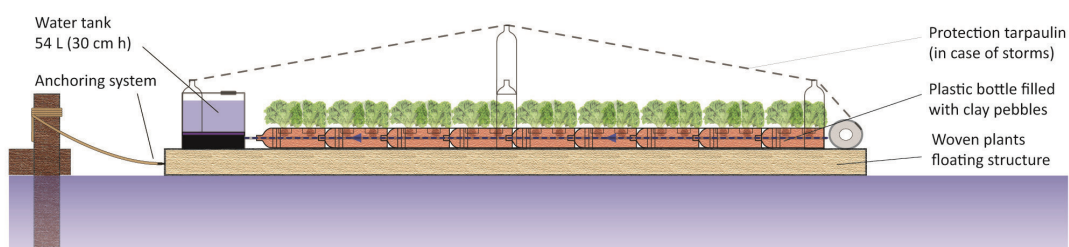


Figure 3. Floating Hydroponic Crops – Longitudinal section view

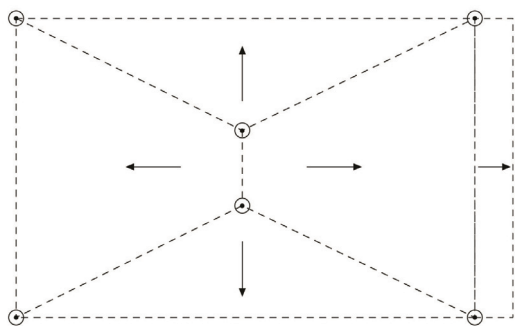


Figure 4. Tarpaulin structure made of vertical plastic bottle



Figure 5 Floating garden proposal for local households

garden include: a simple solar pump (photovoltaic panel included), a drip hose (50 m), a plastic water tank (50 L), steel wire (100 m), a plastic tarpaulin (for protection in case of storms), a rope (15 m), clay pebbles (40 L), nutrients (natural fish emulsion), 50 plastic

bottles (2 L), woven plants structure made of palm leaves.

Vegetables species that can be cultivated on the floating garden include: lettuce, Chinese cabbage, tomatoes, basil, spinach, etc. The constructing process of the floating garden is not complicated, so that it can be built without

requiring the presence of a specialist. Thus, the plastic bottles filled with clay pebbles are installed on the woven plants structure and fixed on it with steel wire (as shown in the flowing diagram). A solar pump placed inside the water tank activates the irrigation system, by a drip hose which connects all the plastic bottles. Water and nutrients should be inserted manually into the water tank, depending on the needs of the plants. Considering the variable level of Tonle Sap Lake, the floating garden has to be anchored to a close built structure by a rope.

CONCLUSIONS

The functionality of the floating garden relies on sustainable development principles in terms of health, social, economic, financial and environmental issues. The main task of the project was to solve the basic supply problems in Tonle Sap Lake Area.

Thus, the proposed solution would improve the quality of life for the local communities by increasing and diversifying the food supply, in a healthy manner, without any use of harmful substances. The system has a very low impact on the local environment taking into account the use of biological nutrients. Regarding the economic and financial issues, the concept

could be developed as a family business or used just for self-consumption. In the second case, it would contribute to local job creation, depending on the size of the business. After the initial investment, the costs would be very low on long term considering that all the resources can be found in the area. These include: fresh water (for irrigation), solar energy (for water recirculation pump), fish emulsion (for nutrients), seeds (from the plants cultivated on the floating gardens).

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