Artificial Farming – The Need of Near Future

[1]Dr. Madhukar S. Chavan, [2]Mulla Jasmin Khalil

[1] Professor, [2] Research Scholar,

[1, 2]Department of Electronics & Telecommunication Engineering

[1] Padmabhooshan Vasantraodada Patil Institute of Technology, Budhgaon Tal - Miraj, Dist –Sangli, Pin – 416304

[1] Padmabhooshan Vasantraodada Patil Institute of Technology, Budhgaon Tal - Miraj, Dist –Sangli, Pin – 416304.

Abstract : Food, water and shelter are the basic needs of mankind. A man has travelled in all directions in search of food and a better quality food. For travelling we use various modes of transport these days. This includes travelling by foot, vehicle, railway, airplane etc. The vice versa is also true. Now the food has started traveling towards a human being. During this travelling we burn a large quantity of fossil fuels. Burning fossils cause pollution, especially air pollution. The green house gases are responsible for increases temperature of the earth. That's the whole world is talking about.But has anybody given a thought that, "Agricultural sector also causes a significant pollution"! Although it sounds weird, it is true. Every farmer used chemical fertilizers, insecticides, pesticides to protect his crop. While spraying insecticides, large quantity of insecticides and pesticides dissolves in air causing air pollution. Fertilizers used for assisting growth of plants are not completely absorbed by plants. Some traces of these fertilizers are left in the soil. They mix with water and percolate through the layers of soil and make the soil infertile. Isn't it a kind of soil pollution? Fertilizers dissolve in water and through various water streams it reaches to the river and thus pollutes water in rivers. Although the efforts are being made to use organic fertilizers, but their use is limited. Also majority of water supplied to crops either percolates in the earth or evaporates. The artificial farming is an approach to grow crops in a controlled indoor environment. As the environment is indoor it will not have any insects, and pests affecting the crops, hence no insecticides and pesticides will be required. The indoor environment will neither evaporate water nor will percolate it in to the earth hence water requirements be very small. The indoor environment is equipped with artificial lightening. So crops can be grown independent of season.

Keywords: Photosynthesis, wavelength, soil moisture, temperature, humidity.

I. INTRODUCTION

Traditional farming methods cannot produce enough food to feed the world's population. There is insufficient land and labor for traditional farming. The number of people living in towns and cities is increasing day by day. This is a vicious cycle. With growing population in cities, more agricultural land will be sacrificed to accommodate urbanization. With limited farmland and fewer farmers, the farming trade is not thriving. Very few people have the aspirations to be or stay on as farmers.

Vertical farming is the solution for urban, land-scarce cities, and countries like Singapore. But the concept of vertical farming is not new. Farmers in East Asia have been growing rice in vertical tiers (terraces) to conserve space and water. "Vertical Farming" was coined in 1915 by American geologist Gilbert Ellis Bailey. In 1950s, an attempt to integrate agriculture into the built-up environment was made in Denmark when a farmer grew cress in a factory on a mass scale. Since then, vertical farming has evolved into growing crops in a fully-controlled, indoor urban environment.

II. VERTICAL FARMING

Plants require water, soil and sunlight to grow with the process of photosynthesis. Traditional farming has always been resource-intensive. Agriculture uses 70 per cent and wastes about 60 per cent of the worlds freshwater due to inefficient or defective irrigation methods, and the cultivation of water-thirsty crops such as cotton, rice, sugar cane, and wheat. In addition, anthropogenic water pollution causes water to be unfit for drinking and also leads to the extinction of flora and fauna [1].

Vertical farms in urban areas are a relatively new phenomenon, but interest in this approach is growing and expanding every year. There are several variations of vertical farms being tested throughout the world, and new innovations and technology will increase the energy efficiency and profit margins of these farms in the future. In the near term, most vertical farms will focus on high-return and short-rotation crops intended for fixed consumer. Whether vertical farms will become more widespread is uncertain, but the innovative vertical farms currently under construction or already in production are being closely observed by urban planners and the sustainable agriculture community [2].

Rooftop vegetable gardens are in place for houses, buildings and commercial complex. Some environmental groups are creating awareness about the importance of self-reliance and responsibility for the environment and are gaining popularity. Such rooftop vegetable gardens in are capable of reducing food transportation costs and promoting self-reliance.The concept of vertical

farming in buildings is new and its cost of implementation is still too high. This further requires advances in engineering & technology as well as building design [3].

Achieving sufficiency in food production along with the conservation of the environment are the major objectives of the agriculture presently. The constraints in achieving this task are: limiting land and water resources along with the degradation of the environmental health due to excessive use of chemicals for nutrition and pest management in agriculture. Sustainability, biodiversity and better Ecological services are attracting features of organic farming. As emerging technologies are catering the growing demand, adapting the vertical & organic farming will become efficient and cost effective. [4] Vertical farming will thus enable re growth of forests and reduce carbon dioxide contents of the air [5].

Prototype implementation of Vertical Farms reveals it financial and economical feasibility. Streamlining of this technology is expected to further reduce the cost. The cost of the building structure, transport and power requirements are serious issues to be addressed. Optimal growing conditions in the agricultural system & labor requirement need to be worked out. Artificial lightening LED can be used to accelerate plant growth. [6, 7]

III. ARTIFICIAL FARMING

Photosynthesis is mainly a light wavelength dependant phenomenon. It is more dominant at a wavelength between 450NM to 690NM. [7] It can be summarized by following chemical reaction in presence of sunlight

$$6\,CO_2 + 6H_2O \rightarrow C_6H_{12}O_2 + 6\,O_2$$

The artificial farming is an approach to grow crops in a controlled indoor environment. The artificial environment supplies light with required wavelength using LEDs. Watering of plants is assisted with solenoid vales and soil moisture sensor that gives required quantum of water to plants. Exhaust fan, temperature & humidity sensor control temperature of indoor environment. The electrical power requirement is taken care by Solar PV system.

IV. AUTOMATED ARTIFICIAL FARMING SYSTEM

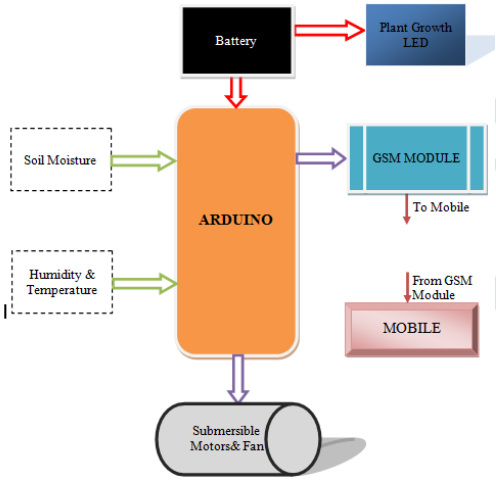

Fig.1: Proposed artificial farming system

Green house automations are often seen, studied, implemented and monitored. The purpose of this proposed automated artificial farming system is to create an artificial environment required for growth of plants. A plant grows with the process of photosynthesis wherein it consumes water and CO2 in presence of sunlight and emits O2 with carbohydrates as by the product. The sunlight consists of wide range of wavelengths. The studies [7] have shown that photosynthesis is at peak at wavelengths between 450NM to 690NM. This corresponds to purple – pink color. The plant grow LED provide the wavelength for accelerating the photosynthesis process. The system is aided with soil moisture sensor and solenoid valve & pump motors which helps in controlling water supply to the plant. The temperature - humidity sensor and exhaust fan control temperature of the closed environment.

The entire system being enclosed, it can be considered to be isolated from the outer environment. Due to this, plant diseases spreading from the environment does not enter. This helps growing plant without using insecticides and pesticides. Also use of non GMO seeds is recommended along with organic fertilizers.

V. CONCLUSION

The system is expected to reduce possible pollutions occurring in conventional farming. Vertical farming would assist in increasing floor area for farming in folds. Thus more crops can be grown in less area. This can be constructed anywhere i.e. in busy cities, in an apartment, in home also. Hence the transportation of farm good can be reduced which will also reduce pollution. Thus artificial vertical farming will be future of Agriculture sector.

VI. ACKNOWLEDGMENT

Authors would like to acknowledge department of Electronics of Telecommunication Engineering, PVPIT, Budhagaon for offering laboratory facilities for conduction of research work.

REFERENCES

[1] Parry, M., Rosenzweig, C., & Livermore, M. "Climate change, global food supplyand risk of hunger", Philos Trans on Biological Sci. 2005 Nov 29; 360(1463): 2125–2138

[2] Jeff Birkby, "Vertical Farming", NCAT Smart Growth Specialist Jan. 2016 pp. 1-12

[3] Kor Kamonpatana & Pongpun Anuntavoranich, "Vertical Farming Concept in Thailand: Important Decision Variables", International Journal of Innovative Research in Science, Engineering and Technology, Volume 2, Issue 12, December 2013, pp. 7851 – 7860

[4] Anirudh Garg and Rekha Balodi, " Recent Trends in Agriculture: Vertical Farming and Organic Farming", Advances in Plants & Agriculture Research, Volume 1 Issue 4 – 2014

[5] Eric Ellingsen, Dickson Desopmmier, "Vertical Farming – The Origin of 21st Century Agriculture Topology" , CTBUH Journal, 2008, issue III pp. 26 – 34

[6] Chirantan Banerjee, "Up, Up and Away! The Economics of Vertical Farming", Journal of Agricultural Studies, 2014, Vol. 2, No. 1, pp. 40-60

[7] David Latchman, "Vertical Farming: Does it Latch Up", ChemMatters | OCTOBER/NOVEMBER 2016, pp. 8 – 9

[8] OpenStax-CNX module: m44448 "The Light Dependant Reactions of Photosynthesis" Version 1.11, Oct 9, 2013