*General Article*_____ *Chapter –29*

RENEWABLE ENERGY AND GREEN TECHNOLOGY FOR SUSTAINABLE DEVELOPMENT IN AGRICULTURE

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Abstract

Energy demand in the world is nowadays growing further out of limits of installable generation capacity. Therefore, future energy demands should be met and improved efficiently and securely. Energy solutions should be supported by utilizing renewable energy sources. At present, the contribution of renewable energy to the world primary energy is not high to meet the primary energy and electricity supplies. Both developed and developing nations will necessarily continue to rely on fossil fuels in the coming decades. In developing countries, the situation is more inconvenient than that for developed countries. Many developing countries have been apparently trying to restructure their energy sectors. It seems that it is difficult to realize innovations. Cost, market share and policy are the main barriers for the development of renewable energy.

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Introduction

Energy demand in the world is nowadays growing further out of limits of installable generation capacity. Therefore, future energy demands should be met and improved efficiently and securely. Energy solutions should be supported by utilizing renewable energy sources. At present, the contribution of renewable energy to the world primary energy is not high to meet the primary energy and electricity supplies. Both developed and developing nations will necessarily continue to rely on fossil fuels in the coming decades. In developing countries, the situation is more inconvenient than that for developed countries. Many developing countries have been apparently trying to restructure their energy sectors. It seems that it is difficult to realize innovations. Cost, market share and policy are the main barriers for the development of renewable energy. In the strategy plans of many countries, the sustainable development in relation to the parameters such as economic, social and industrial is supported by their energy policies. New enabling technologies related to renewable energies will also help to reduce environmental costs, and thus the energy systems will be operated as both securely and economically without environmental problems. New renewable energy markets are surely required in both the wholesale and retail markets.

Waste Management and Recycling

Due to industrialization, urbanization and increase in population density, there has been an increase in the accumulation of wastes. The wastes include radioactive substances, agricultural wastes, food wastes, industrial wastes, municipal wastes, garbage, paper waste etc. There has been decrease in the availability of open land space for the disposal of wastes due to intensive use of land for residential, industrial and commercial purposes. In order to reduce the load of wastes on earth, the collection, transport, recycling and disposal of wastes needs to be improvised .The process of collection, transport, disposal, recycling and monitoring of wastes is called as waste management. Waste management can be costly so it is important to understand the various effective, sustainable and safe means of its management .The three R`s "reduce, reuse, and recycle have become the basic tenet in waste management due increase in generation of wastes, increase in processing costs and decrease in available landfill space. There should be flexibility in waste management systems in light of changing environmental, social and economic conditions .To optimize, evaluate, adapt and define waste management systems, the information and feedback can be obtained from system analysis.The reduction of wastes is placed at the top of waste management hierarchies because the best means of waste management is to reduce waste by not creating it in first place. The reduction of wastes can also be achieved through the reuse of products. The reduction and reuse of wastes saves natural resources, reduces generation of wastes and reduces the costs associated with waste disposal .The waste management is undertaken to recycle the wastes so as to reduce the ill effects of wastes on environment, health and aesthetics. The wastes may be either in solid, liquid or gaseous form. The process of waste management varies for rural and urban areas, for municipal and industrial wastes, for developed and developing nations. The management of municipal wastes is the responsibility of local government while as the management of industrial waste is the responsibility of

generatorthe developed nations use various novel technologies to reduce the negative impacts of waste or use an effective management to exploit it.

Effect of Waste on Health and Environment

Wastes generated from industries and urban sources contain toxic substances which when disposed in open land, because health hazards like respiratory infections, intestinal disorders, cholera, typhoid, plague etc. These toxic substances get deposited in the soil; thereby reduce the fertility of land. There is an important need for the recycling of these wastes so as to prevent the deterioration of the soil and also to reduce the level of pollution caused by the disposal of these wastes. The wastes are either disposed in landfills or incinerated, which result in the loss of nutrients of soil and pollute environment. Landfill gas includes greenhouse gases such as carbon dioxide and methane which result in global climate change.

Waste Categories

There are several kinds of wastes produced; some are more hazardous such as medical wastes and nuclear wastes. Wastes are released into air, water or land. Following are the main categories of wastes:

Solid Waste

Solid wastes are the wastes that are that are deposited at the site where they are produced. They are further categorized into following types:

Agricultural Waste

It includes sugarcane trash, rice straw, leaves of trees and crops, rotten vegetables, fruits and flowers, animal wastes such as cattle dung, pig manure. Poultry manure etc.

Most of the agricultural wastes are organic and hence can be converted to biofertilizer vermicompost through vermicomposting. Rest of the agricultural wastes can be incinerated or disposed in landfills. Air pollutants are released from incineration. Landfilling results in the emission of greenhouse gases such as carbon dioxide and methane which result in global climate change.

Food Waste

Food waste includes uneaten food and left-over food from residences, cafeteria and restaurants. These wastes are either disposed in landfills or incinerated, which result in the

loss of nutrients of soil and pollute environment. Recycling of food waste reduces the cost of waste treatments, air pollutants from incineration and refuses from landfills (Lai et.al. 2009). Landfill gas includes greenhouse gases such as carbon dioxide and methane which result in global climate change. Therefore, Vermicomposting of food wastes is an alternative for the management of food wastes as it is cost effective Eco-friendly and hygienic.

Industrial Waste

It includes the wastes from food industry, paper industry, herbal industry, pharmaceutical industry, agro industry etc. These wastes can be disposed in landfills, incinerated or composted. Various researchers have been successful on the conversion of wastes generated from above mentioned industries into vermicompost with the use of earthworm through vermicomposting.

Mining Waste

The mining operations release large quantity of waste in the form of rocks, tailings, chemicals involved in the processing of ore. These wastes are either dumped in the land or in a water body. This results in water pollution and soil pollution. The mining waste contains hazardous substances such as radioactive substances, arsenic, lead and asbestos. Mining disturbs the natural vegetation of an area and causes siltation in water bodies. Further large quantity of water is utilized for mining operations and makes it unsuitable for drinking, irrigation and recreation.

Bio Waste

It includes biodegradable green waste from parks and kitchen waste. It is regarded as wet waste because it contains 50-80% water. The management of bio-waste includes incineration, landfilling, anaerobic digestion and composting.

Hazardous Waste

It includes radioactive wastes, medical wastes, and explosives, volatile and flammable wastes. Special precautionary measures are adopted for the collection, storage, transport and disposal, of these wastes to avoid damage to life and property. Environment hazards may occur due to disposal of the hazardous wastes generated by industrial society.

Generating Energy from Waves

From decades, Earth is reminding humans to find better ways to produce power rather than burning fossil fuels which would result in the emission of harmful gases into the environment. The world energy consumption is expected to increase substantially in the next decade and if the same negligence towards the environment continues, there will be a day when no clean air would be available. Traditional practices of producing energy, regularly reminds us the serious threat they pose to the environment. Thus there is a need to produce independent and clean electricity. Wave energy can be observed as a possible clean energy resource which can be exploited for power generation purposes. While this method is relatively new and economically competitive, there is a growing trend towards it, which is gaining interest from government and industries. A vital feature of these waves is that they have the highest energy density when compared to other renewable energy resources.

Waves are formed when wind blows over the surface of water. Devices called wave energy converters capture the energy from waves and turn it into electricity.
Different approaches are used.
Some devices sit beneath the water's surface while others are anchored to the ocean floor. Another technique is to push the waves through a narrow channel, where they power a turbine.

Waves have the highest energy density of renewable energy sources, compared to others like wind, solar, biomass and geothermal. This means waves have the greatest potential to be an important contributor to the world's "energy mix resilience", say researchers at the University of Plymouth.

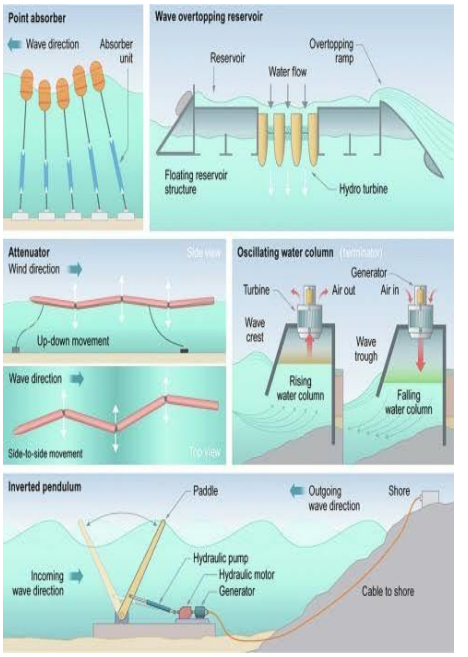
The challenge is that wave energy is far behind in its development compared to other renewable energies.

Benefits

The benefits of this technology are mentioned below:

- Wave energy has high power density compared to other renewable resources of energy.
- Wave energy is more regular and anticipated than other forms.
- Amongst the other resources, wave energy is the cleanest form and there is no impact on the environment.

- With little energy loss wave can travel large distances.
- Reduction on the use of non-renewable energy resources.
- Cost effective way to produce electricity.



Solar Energy

Solar energy is defined as the transformation of energy that is present in the sun and is one of the renewable energies. Once the sunlight passes through the earth's atmosphere, most of it is in the form of visible light and infrared radiation. Plants use it to convert into sugar and starches; this conversion process is known as photosynthesis. Solar cell panels are used to convert this energy into electricity.

Advantages of Solar Energy

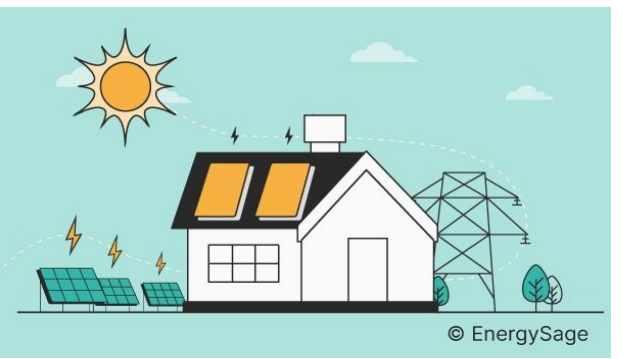
- Clean: It is considered to be the cleanest form of energy as there is no carbon dioxide emission like in the case of fossil fuels which is one of the causes of global warming.
- Renewable: There is ample energy available on earth as long as the sun exists.
- Reliable: The energy can be stored in the batteries, so there is no unreliability reduction in utility costs.
- Free energy because it can be trapped easily

Disadvantages of Solar Energy

- The production is low during winters and on cloudy days.
- Installation and the initial cost of the materials are expensive.
- Space consumption is more.

Types of Solar Energy

Solar energy can be classified into two categories depending upon the mode of conversion and type of energy it is converted into. Passive solar energy and active solar energy belong to the mode of conversion and solar thermal energy, photovoltaic solar power and concentrating solar power.



- Passive solar energy refers to trapping the sun's energy without

using mechanical devices.

- Active solar energy uses mechanical devices to collect, store, and distribute energy.
- Solar thermal energy: This energy is obtained by converting solar energy into heat.
- Photovoltaic solar power is the energy obtained by converting solar energy into electricity.
- Concentrating solar power: This is a type of thermal energy used to generate solar power electricity.

Uses of Solar Energy

- **Water heating:** Solar energy is used to replace electric heaters and gas as efficiency is more with 15-30%.
- **Heating of swimming pools:** Solar blankets are used to keep the pool warm. The other way is by using a solar water heater to keep the water warm.
- **Cooking purposes:** Solar cookers are used for cooking food. Solar energy is used to heat, cook and pasteurize food. A solar cooker consists of an elevated heat sink such that when food is placed in it, it gets cooked well.

Vertical Farms and Gardens

Introduction

The global population is expected to grow up to 9 billion by 2050. This population growth will cause immense pressure the available natural resources and create demand for more food production. On the other hand, it has been found that people's purchasing power is also growing, and at the same time, consumer preferences are changing. Forexample, demand for organic or pollution-free food is also increasing due to increased health concerns. So, new methods of crop production are essential to practice to meet global needs. The increased environmental pollution and degradation caused by traditional

farming methods from so many years also lead to identifying new and sustainable farming practices. These are much more environmentally friendly such as greenhouse/shade net farming, terrace farming, urban farming, and Vertical Farming. Among all these, Vertical Farming is one such alternative that promises to address environmental degradation and the rapidly growing demand for food. It can help to produce more crops with limited resources. It integrates building structure with farming, an alternative method where the food supply chain is shifted directly from the producer to the consumer. This system also generates a lower carbon footprint and is environmentally sustainable. Vertical Farming is a different concept of urban agriculture in which buildings and containers are used to cultivate plants that, in highly controlled environmental conditions. It has an advantage over the conventional method of farming that is listed below:

1. Saving land by stacked floors
2. All-year-round, high yield production
3. Protection from severe weather events enabling secured production
4. No use of pesticides or fertilizers
5. Saving water (using 70%-95% less water)
6. Saving financial and environmental logistic costs (fresh local production minimizing transportation)

As a result, in the past few years, Vertical Farms have drawn so much attention from various business communities. It has an immense opportunity to grow further because of its sustainability. Sustainable agriculture practices might help solve many global issues related to malnutrition, contamination-free food production, etc. In a sustainable farming method, there is a huge opportunity to increase agricultural production. This method encourages more crops in a smaller area than traditional farming methods like permaculture, biodynamic, and agroecological farming. This method recycles and reuses other natural resources such as water and nutrients and creates less waste as plants grow in a soilless medium. As a result, Vertical Farming leads to a smaller carbon footprint and causes much less pollution to the environment.

Real-time examples have proved that Vertical Farming is a sustainable way to supply the best quality products while spending less energy. Countries like the United

States, Japan, and Singapore have shown significant results in applying Vertical Farming totheir buildings.

Need for Vertical Farming

World's population in mid-2017 was around 7.6 billion, and it is estimated to reach 11.2 billion by 2100 as per United Nations estimation. About 19.5 million hectares of agricultural land are currently converted into urban centers and industrial developments annually because cities are the center of ideas, science, jobs, productivity, social growth, and prosperity. Due to rapid urbanization, water supplies, sewage, biodiversity, land and soil resources, and public health are under pressure. The sustainable development of urban & rural areas requires addressing social, economic, and environmental land use in an integrated approach. Over two billion hectares of cultivable land got degraded, and more than 1.5 billion people live off the degraded land. Severe droughts have caused starvation and famine, affecting more than 25 million people in 2017.

Out of 130 million square kilometers of earth's surface, 46% is used for farming and forestry, and 7% is considered urban/pre-urban. FAO estimates that around 25% of the land is currently highly degraded and 36% is moderately degraded, while 10% is improving. Therefore, it is valuable to implement Vertical Farming techniques into our built environment to protect natural and economic resources.

Food and Nutrition Security

Around 8.7 million species live on the planet, out of which 8% are extinct, 22% are at risk of extinction due to distracted habitat. So sustainable management of land can reduce the impacts of conventional farming. By practicing Vertical Farming, external independents such as pesticides, heavy machinery, and other destructive elements to the environment can be minimized. It will also reduce the use of water and energy resources and help improve soil nutrient availability. The other benefits, such as afforestation, pest management, soil erosion control, vegetation management, etc., can be achieved.

Climate Change

The average global temperature has increased been by 0.85 C. For every increase in one degree, grain yield declines by about 5%. From 2000-2010 the emission of carbon increased. Food consumption with low energy profiles affected severe health issues such as obesity reduction and climate change mitigation. Also, the increase in greenhouse emissions is a significant contributor to climate change.

Water

Land development is related to a water decision, and water management is essential. Sustainable land practices must include cost-effectively improving water efficiency and quality and the restoration of ecosystems. In Vertical Farming, the issue of water scarcity is decreasing. It affects 40% of the global population, and with 1.7 billion people living on river basins where recharge is minimal compared to usage, it can be unsafe for survival. Additionally, the water discharge for irrigation peaks at 70% of the world's water consumption, and 80% of the wastewater is simultaneously put free into the environment.

Vertical Farming has immense potential to save energy regarding consumption and food production and saves water by reusing it.

Supply Chain Logistics

Industries and transportation also contribute to climate change. This energy use refers to the supply chain logistics of the food industry. It can be concluded that the Vertical Farming technique can save a large portion of fossil fuels and time. Many resources, such as varieties of machinery, labor, and money, are spent in the food industry. The most critical resource is time, which is heavily invested in providing food to the people. The fast depletion of fossil fuels and the development of new technology has led to rethinking food production and delivery processes. Vertical Farming can be promising for saving the precious resources of the planet and providing better health opportunities to the common man. The vertical farming concept enables minimal use of resources such as fossil fuels, fertilizers, workforce, and equipment, among others. The output of these farms can revolutionize the way we perceive agriculture.

Health

Conventional farming practices cause environmental issues like erosion, soil contamination, excessive wastewater generation. WHO also stated that animal waste as fertilizers in fields would attract flies and cause adverse health effects. Therefore growing crops in a controlled environment would provide the benefit of reducing the excessive use of fertilizers, pesticides, and herbicide.

The Ecosystem

Traditional agriculture is dominating the natural ecosystem. The indoor Vertical Farming method can reduce the agricultural impact on the world's ecosystems by restoring biodiversity and reducing environmental effects. Suppose cities employed Vertical Farms to produce at least 10% of the ground area they consume. In that case, this might help to reduce CO2 footprints and fertilizer runoff.

Economics

The increasing expense of traditional farming is quickly narrowing the cost gap. For example, when Vertical Farms are located strategically in urban areas, it would be possible to sell products directly to the consumer by reducing transportation costs. Vertical Farms uses advanced technologies that can increase production. Vertical Farming provides a huge opportunity to support the local economy. Unutilized urban buildings can be converted into Vertical Farms to offer healthy food in neighborhoods where fresh produce is less.

Limitations

- High initial investment. It also includes automation and computerization cost.
- Huge energy cost as a growing plant is entire with artificial lights.
- LED lighting systems that emit heat can create the problem of maintaining the temperatures.

- A proper waste management system is required.
- It is challenging to get a skilled workforce with proper training.

Green Architecture

Green architecture is a method of minimizing the negative effects built structures have on their surrounding environment. It's a philosophy that draws on the environment as inspiration to deliver low-impact, adaptable, and healthy spaces.

Green buildings are made in accordance with this thinking. They are designed, constructed, and operated with a focus on conserving energy, sourcing eco-friendly/recycled materials, and preserving the biodiversity of the area.

Think solar panels, and rainwater harvesting. Also, consider things like improved resiliency guidelines that account for natural disasters to create longer-lasting buildings. These initiatives are becoming more commonplace, and they all represent ways that infrastructure can minimize its environmental footprint.

Certified groups and individuals come together to make green buildings a reality. The process begins even before breaking ground with site surveys for topography, drainage/soil samples, and sun patterns. The role of architects and engineers might be to design a natural ventilation system to offset air conditioning use, then to work with builders and local organizations to source sustainable materials.

Once constructed, building tenants play their part to minimize their own energy, water, and general resource use within the structure. Each group fulfills an important role in making the building more environmentally friendly.

What Does Green Building Looks Like

There's no one way to make a green building. Any building, whether it's a home, office, school, or other structure, can be a green building if it is made with these features:

- Efficient use of energy, water, space, and other resources
- Use of renewable energy, such as solar energy
- Pollution and waste reduction measures, and the enabling of re-use and recycling
- Good indoor environmental air quality
- Use of materials that are non-toxic, ethical and sustainable
- Consideration of the environment in design, construction and operation
- Consideration of the quality of life of occupants in design, construction, and operation
- A design that enables adaptation to a changing environment

Green buildings differ from each other across regions and countries to account for unique variations in climate, cultures, and economic priorities. No two will be exactly alike.

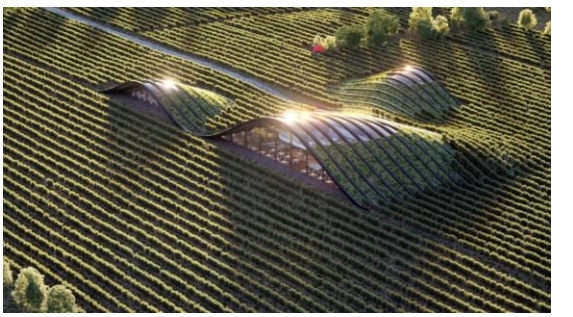
But one thing holds true: effective green architecture is notan add-on. Green buildings must be designed and executed with the environment in mind, from start to finish.

Examples of Impressive Green Buildings Initiatives

1. The Vertical Forest in Milan : A Residential Building Designed By Boeri Studio

The Vertical Forest in Milan is a model for regenerating urban environmental diversity without expanding city limits. The building is home to thousands of planted shrubs that absorb CO2 and produce oxygen.

2. The Edge in Amsterdam : An Office Building by PLP Architecture



This worker-friendly building is covered in solar panels and powered by a digital LED ceiling that anticipates and adjusts lighting needs, rather than running at a steady rate. The architects estimate anover traditional lighting.

3. The Shilda Complex in Georgia : A Winery concept from X – Architecture

This structure is literally embedded within the landscape. It faces north to avoid overheating, and the thermal mass of the soil also optimizes the cooling of the building. These details minimize the building's energy consumption, instead allowing the environment to regulate internal temperature.

4. The Bahrain World Trade Complex from Atkins

Built by architecture firm, this 50-floor skyscraper incorporates wind turbines into the blueprint. The turbines of the complex's energy needs, and they represent a bold step toward a more innovative green design.

Conclusion

Climate changes, global warming, energy depletion and other environmental concerns have led to the emergence of green technologies in recent years. Researchers believe the increase of sustainable development will contribute to sustainable economies and communities. It will also have a very positive impact in the future on the sustainability. Technical advances mark human creativity and innovations in modern society. However, those technologies, have led to ecological disruption from local to global level. Green technologies involve: energy efficiency, recycling, safety and health concerns, renewable resources, and lots of more. Green technologies have a promising future when it comes to meeting economic sustainability needs. However, factors relating to environmental and social sustainability need to be reinforced mutually. Before technology implementation, both the environmental and economic impact and efficiency of a technology should be analyzed. It should be a win-win situation when high accent is placed on economic and sustainable growth.

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