UNDERSTANDING THE FOOD, WATER AND ENERGY NEXUS FOR SUSTAINABLE DEVELOPMENT

Abstract

For supporting growing population, population movement, rising standards of living, high incomes and disposal of income on various energy and water intensive activities, increasing urbanization and climate change have increased demand of food, water and energy to a great extent and this demand is still rising. Water, energy and food are interlinked, these interlinks have shown in the form of any action in one sector affect the other two these interactions have been termed as food, water and energy nexus. To obtain sustainable development the interconnection between renewable energy, food production, and water resources needs to be understood deeply. Integrated approach to resolve the issues regarding resource efficiency can lead to proper utilization and maintenance of natural resources and sustainable development. The concept of renewable energy emerges from change in form of energy that is recycling the energy and its best utilization for human activities and producing goods and services for supporting growing population. The renewable energy cannot be encouraged without understanding of this nexus. This chapter explores the intricate associations among renewable energy, food, and water, bringing the synergies, challenges, and opportunities presented by their interconnectedness. It also aims upon shed light on the prospective integrated solutions that can drive global efforts towards a more sustainable future.

Keywords: Interdependence of Food, Water And Energy Resources, FWE Nexus, Economic Activities

Authors

Dr. Ruchi Kalra
Assisstant Professor
Department of Home Science
Guru Nanak College
Sri Muktsar sahib
Punjab, India.

I. INTRODUCTION

The ultimate aim of science, the reason for which scientific communities are leaving no stone unturned is sustainable environment with economic development. For supporting growing population, population movement, rising standards of living, high incomes and disposal of income on various energy and water intensive activities, increasing urbanization and climate change have increased demand of food, water and energy to a great extent and this demand is still rising. It is seen that water, energy and food are interlinked, these interlinks have shown in the form of any action in one sector affect the other two these interactions have been termed as food, water and energy nexus. According to Food and Agriculture Organization food water and energy Nexus is the study of interlink ages of food security, water security and energy security. All of these are important for sustainable human development, reducing poverty and in human wellbeing. [1]

The poor and marginalized people are also a part of any civilized society; their energy requirements must be met through affordable energy solutions and reliable access to clean energy. The needs of all sectors of economy shall be equitably managed by access to renewable energy to achieve a secure environment.

The goal of sustainable development depends on the interconnection between renewable energy, food production, and water resources. Food, water and energy forms a complex and essential nexus as the world grapples with climate change, population growth, and resource scarcity, understanding and optimizing the interactions within this nexus have become paramount. This chapter explores the intricate associations among renewable energy, food, and water, bringing the synergies, challenges, and opportunities presented by their interconnectedness. It also aims upon shed light on the prospective integrated solutions that can drive global efforts towards a more sustainable future.

II. MOMENTOUS OF FOOD, WATER AND ENERGY NEXUS (FWE NEXUS)

1. **To Meet Ever-Growing Energy Demand:** The ever-growing energy, food and water demand of the world is expected to increase more than half by 2050. The economic growth has brought about high standards of living which depend on energy intensive activities like fuel for domestic and commercial consumption, electricity, food, water supply etc. to name a few. The growing world population has further put a pressure on existing resources which are depleting faster than ever in history. The pursuit of development has come on the cost of valuable food, water and energy becoming scarce day by day.

2. **Role in Curbing Poverty:** Food, water and energy management is important for reducing poverty levels of developing countries. All these three sectors are important for human race as these are basic necessities of human living. Access to clean food and water is crucial for healthy living which makes it necessary to spend most of our resources on production and maintenance of food and water resources for the country. The goal of sustainable development can't be thought achieved till a country meets its food and water requirements appropriately. The main aim of renewable energy is to provide never ending supply of food and water for the population. Only sustainable supply of food and water can help reduce poverty. [2]

3. **Meeting Water Requirements:** Defined as reliable availability of water, water is essential for agricultural activities, industries and household supplies maintenance of which remains at core of sustainable economic development. Increased use of surface water has left us on the brink of water deficit. It is seen that people have to migrate to other lands only for supply of water. Only using renewable energy for reclaiming wastewater or desalinating the sea water can ensure water security to growing population. [3]

4. **Meeting Food Requirements:** Food requirements of world have increased a lot not only in terms of requirement of quantity of food to meet world hunger but also food has now become a status symbol so more developed a country is more is its food requirement in terms of the variety, quality and quantity. Twenty five per cent world energy is used for production of food be it in form of agriculture, cooking fuel and for food transportation. The food procurement and production cycle is highly energy intensive. Renewable energy can make the food affordable and convenient to transport. Thus for achieving food security renewable energy development is highly important. [2]

5. **Sustain Various Economic Activities:** All the economic activities nowadays are energy intensive. High energy is required to maintain communications, run industries, travel, heating, lighting, and transportation of goods in the global world. These energy demands are traditionally met from fossil fuels making it very heavy on the environment. Getting energy from renewable resources will make it possible to run all these activities without causing environmental degradation. Only through study of the food, water and energy nexus can we ensure sustainable growth in various economic activities.

6. **Saving the Environment:** The link between renewable energy and food production is multifaceted, with potential benefits spanning from reduced greenhouse gas emissions to increased agricultural productivity. The integration of renewable energy sources, such as solar and wind power, into agricultural practices offers opportunities to enhance energy efficiency, reduce reliance on fossil fuels, and improve the resilience of food systems. For instance, solar-powered irrigation systems enable farmers to efficiently water their crops, mitigating water scarcity issues in arid regions while simultaneously reducing carbon emissions. Case studies from regions like India and sub-Saharan Africa demonstrate the positive impacts of such integration on crop yields and farmer livelihoods [1].

III. THE INTERDEPENDENCE OF FOOD, WATER AND ENERGY RESOURCES

The term food water and energy nexus ascends from the inherent interdependence of all these resources on each other. Water is crucial for generation of electricity; the generation of electricity from fossil fuel involves water usage for extraction, mining, cooling and refining of fossil fuels. When we shift from use of fossil fuel to bio-fuels, the bio-fuel production needs much more water than the production of fossil fuels. Moreover the land used for growing raw material for production of bio-fuels is also the same land used for production of food. Mankind does not afford using of land for the purpose other than production of food. More dependence on bio fuels for meeting the energy demand will scare the food production and might lead to food insecurity. The water intensive extraction of Tar sands and shale using hydraulic fracturing lead to water pollution and making this water

reusable again requires a lot of energy. Thus, we can say that clean energy comes on cost of water and reclaiming water requires energy again.

Another water intensive activity is agriculture. Agriculture requires freshwater supplies for irrigation. Food production and distribution consumes seventy per cent of global freshwater. [1] Energy is required for fertilizer production, tilling, sowing, harvesting and transportation of crops. Food security is the pillar of sustainable development to support ever-growing population food generation has to be increased. Food production has to be done in such a manner that there is excess of food available to meet conditions like drought and other emergencies. The use of water and energy for food production can't be compromised as food is basic amenity for human survival.

Interdisciplinary study of food, water and energy is crucial to make policies for sustainable development and environmental conservation. Integrated management of important factors which influence the production and sustainability of all the resources, maintaining global supply and optimal distribution is the aim of maintaining Synergy among food, water and energy nexus. [4]

The environment, economic and social sustainability can only resource from the nexus of water energy and food. This nexus studies the resource management as a whole and supports the policy making process where the harmony is established between optimum use of natural resources for meeting economic development goals and fulfilling global demands.

IV. PUNJAB: A CASE STUDY

Green revolution introduced during 1960s led to ensure food security for India. Because of this policy, Punjab state in India having only 1.5 per cent land, produces one fifth of countries' wheat, almost one tenth of rice and also utilizes twenty percent of pesticide. The area irrigated by groundwater was almost doubled to support this production. Such humongous food production came on the cost of depletion in groundwater. Approximately 80 percent of groundwater has been used up. The government provided subsidies for fertilizers, pesticides and power which led to drying up of aquifers. The provisions of minimum support prices for these water intensive crops fuelled over production which led to depletion in soil quality. The ground and river waters became polluted with over usage of pesticides and fertilizers. There has been rapid increase in cancer among farmers of the state. The shift of Indian people from consuming varied millets to wheat and rice led to various micro nutrient deficiencies and lifestyle diseases among the population. Implementing policies without considering their consequences on food, water, energy, health and environment can play havoc and state of Punjab is perfect example of such a disaster. [5, 7]

V. SUGGESTIONS FOR SUSTAINABLE PATHWAYS

A multifaceted strategy and well informed policy decision mechanism is requisite for addressing the challenges presented by the FWE nexus. To achieve sustainable development goals it is highly recommended that all the three resources that is the food, water and the energy are considered as a whole and planned in such a way that there is harmony in development as well as conservation of nature. Here are a few suggestions for policy makers to study implications of this nexus on environment and human development to consider:

1. **Increasing Efficiency and Innovation in Approach:** The resources are limited and that is the only reason they need to be used efficiently there is a dire need to innovate and adopt policies such as drip and precision irrigation, which have potential to reduce wastage of water in agriculture activities and also usage of renewable energy resources for minimizing the environment impact of conventional energy systems.

2. **Recycle to Produce a Circular Economy:** The concept of circular economy lies in the prospect of sustainability. The organic waste of agriculture and food production can be converted to clean energy like producing biogas. Recycling the waste water can reduce the demand for freshwater and energy.

3. **Planning Water and Energy in Synergy:** As the water and energy go hand in hand to meet the developmental goals, also these are interlinked in such a manner that they can be a strategically planned relocated to create such a infrastructure where water and energy both are optimally produced and used for example Integrated water treatment facilities having solar panels where there is a sharing among the production and utilization of resources.

4. **Using Ancient Wisdom to Introduce Climate Based Agriculture:** Modernization has led us far away from our ancient wisdom where climate resilient agriculture practices were common and ensured food security as well as provided best nutrition for generations to survive. Such practices were inherent in our traditional system like crop rotation, agro-forestry and adopting drought resistant crops these can be utilized to minimize the cost of food production and implication of these techniques also minimizes the energy and water demand.

5. **Creating Cordial Systems among Various Sectors:** It is not possible to improve food energy and water nexus without support from Government and International organizations. These institutions must work in synergy to prevent negative consequences of modern development.

6. **Creating Awareness:** The only way to change the behavior is to educate, creating awareness is crucial to reduce the water and energy footprint and making informed choices for food consumption and energy usage.

VI. CONCLUSION

The food water and energy nexus is at the axle of human well being and environment sustainability. Only a deep understanding of this nexus and an integrated approach to resolve the issues regarding resource efficiency can lead to proper utilization and maintenance of natural resources and sustainable development. The concept of renewable energy emerges from change in form of energy that is recycling the energy and its best utilization for human activities and producing goods and services for supporting growing population. The renewable energy cannot be encouraged without understanding of this nexus. Further study in this area is direly needed to find out solutions which can support our economic and development aspirations without compromising our valuable natural resources.

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