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The Vital Role of plants in meeting the Sustainable Development Goals: A. Comprehensive Review

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ABSTRACT

Plants are key to achieving the SDGs (sustainable development goals) of the United Nations through supporting food security, environmental quality, biodiversity conservation, and providing sustainable solutions to challenges faced by climate. Plants are not only a natural resource but also a strategic resource for constructing a more resilient and sustainable future through climate-smart practices, the conservation of ecosystems, and the development of sustainable agriculture systems. The main objective of this scientific review is to look at the connection and interaction between plant systems and the SDGs, promoted by examination of most recent regulations, policies, and scientific advancements, with it focusing on significant economic and environmental contributions from plant-based solutions for sustainable development goals.

INTRODUCTION

The existence of our world depends on plants; they are the cornerstone of all life on earth, providing 80% of the world's food and clothing, but they are also responsible for everybody's ability to breathe and function. Plants are the producers of life's food (almost all nutrients and calories necessary for human growth and health originated in them a well-known fact). The shift to more sustainable farming practices Farmers who move to sustainable farming methods tend to grow more diverse crops with more resilient plants, leading to better food systems and fighting against hunger and malnutrition. Besides, we can see that plants are important as well in meeting SDG 13 and mitigating climate change (Kabato et al., 2025).

Plants are themselves natural carbon sinks. They suck up CO_2 from the atmosphere and store it in their bodies, even as they help regulate temperature and levels of greenhouse gases while lowering both (Moore et al., 2021). Moreover, reforestation projects boost biodiversity and ecosystem services, as well as human health. This is a theme for the third Sustainable Development Goal (SDG) health, as they are plants that help to mitigate the risk of disease in the absence of specific diets and contribute to human health, as described by Savary et al. (2020).

Fifteenth is focused on life on Earth and seeks to protect the ecosystems of the planet, maintain biodiversity, and protect plant species necessary for human life and livelihood (Wang et al., 2025). This scientific article aims to highlight the role of plants, or the strong link between plants and the ecosystem, in achieving sustainable development goals. It will present a synthesis of studies and the multiple roles plants play in achieving development goals and seeks to build a more sustainable future by highlighting the importance of integrating sustainability practices and protecting plants.

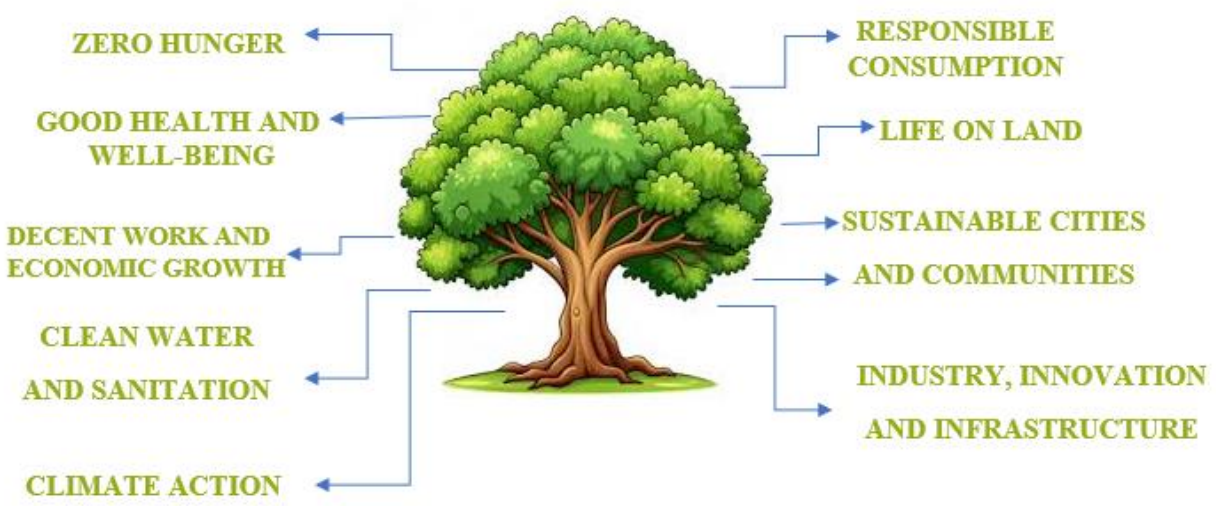

Figure 1. Illustrates the Role of Vegetation Cover in Achieving Sustainable Development Goals.

Plants and Food Security (SDG 2)

The second Sustainable Development Goal aims to achieve food self-sufficiency and eradicate hunger, that is, to achieve food security and develop sustainable agriculture, given its crucial importance in food production and in promoting health and the environment. To achieve this goal, plants are central, as their close link to food security is well-established (Mollier et al., 2017).

The Role of Plants in Food Production

Staple Crops

Plants provide about most of the calories needed by the majority of the world's population, meaning they provide most of their nutrients from staple crops such as rice, wheat, corn, barley, and many others. Therefore, they are essential and fundamental to food security. Thanks to the Green Revolution, food production has witnessed significant development and remarkable improvement in many countries that have introduced high-yield agricultural varieties and developed agricultural methods (Pingali, 2012).

Diversity in Crops

Plant species directly and definitively determine the nutritional value of a meal. This necessitates a varied diet rich in fruits, vegetables, legumes, and grains to avoid the risk of malnutrition. To

achieve this goal, it is needful to encourage plant-based diets so as to promote public health. (Hever & Cronise, 2017).

Quality of Nutrition

The nutritional value of meals is radically altered by the types of plants cultivated. A diverse diet that includes plenty of fruits, vegetables, legumes, and whole grains is necessary to prevent malnutrition. Plant-based diets are increasingly recognized to be beneficial for preventing undernutrition and improving overall health (Knez et al., 2024; Herpich et al., 2022; Tuso et al., 2013).

Challenges to Food Security

Climate Change

In 2018, Liu et al. pointed out that food security is sensitive to most conditions and climate. The production system is also climate-related: temperature, rainfall, etc. are all integral to the PPS so that if you cannot integrate, environmental factors in particular (constraints on it) cause a high level of hunger leading to malnutrition. At the bottom of all this are differences in food and crop prices.

Conflict and Economic Insecurity

The latest geopolitical conflicts and economic insecurities have ground their teeth into food security.

Resources

The accessibility of basic resources such as fertile land, water, and appropriate farming practices is a fundamental and indispensable requirement for achieving effective and sustainable food production. Lack of those resources or their imbalanced distribution is the reason for hunger and poverty and malnutrition. This undermines and complicates the second goal of the latter, namely equitable distribution of resources (Campbell et al., 2016)**.**

Strategies for Enhancing Food Security

Agroethics and integrated pest management are two agricultural practices that help temper the negative impact of agriculture on the environment. Utilizing the secondary crops, management of water resources can be more efficient, and growth is induced in the fertile grid age system, which enhances food technology under low-intensity water conditions. One study that demonstrated the sobering reality sustainable food systems face in ensuring that wise development and diversification of water use are available for the long-term sustainability of food production benefits from this (Dwivedi et al., 2017). Investment in Research and Development, the increase in food supply and securing long-term food security are closely followed by investment in agricultural research and development. By providing financial resources for scientific research and agricultural experimentation, we allow for the creation of new types of crops that are resistant to pests as well as extreme weather such as drought or high temperatures. According to research in 2024, the use of biotechnology and sustainable agricultural technologies helps increase production efficiency, reduce agro-waste, and improve crop quality, thus increasing the resilience of such agricultural systems to changes in the environment and guaranteeing long-term access to food supplies for mankind (Ngongolo & Mbandu, 2024). Three core pillars of the CSA model intensify productivity, enhance adaptation, and reduce adverse environmental impacts are shown in Figure 2.

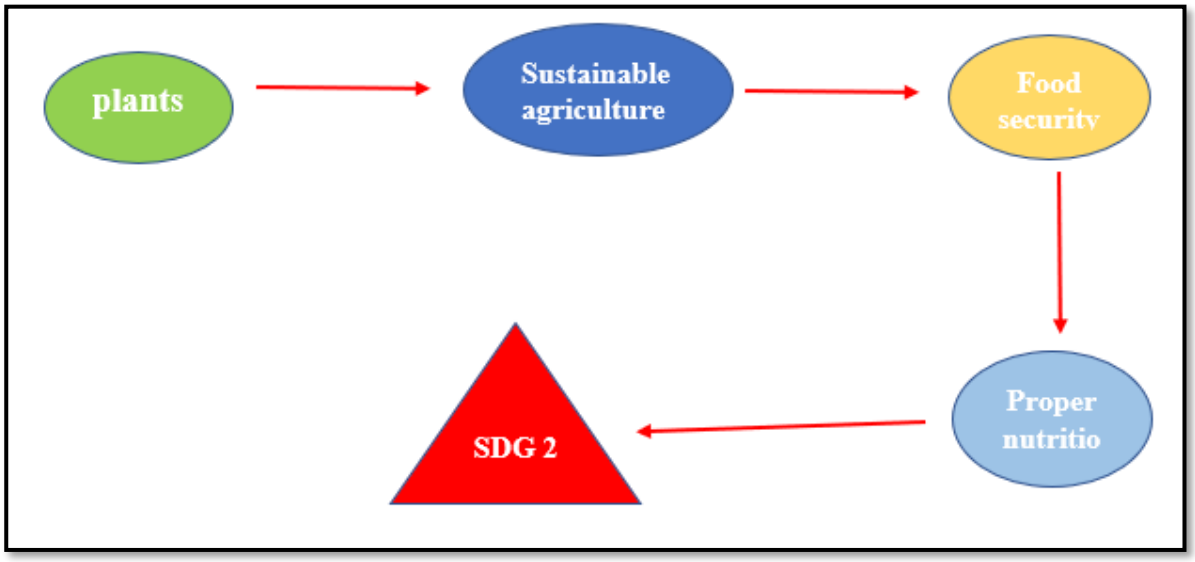

Figure 2. Conceptual Model of Sustainable Agriculture and Nutrition Outcomes within the CSA Framework

Plants and Health (SDG 3)

The third goal is in relation to good health. Plants are particularly important for this aim, both from a nutritional point of view (e.g., food source) and in traditional and modern medicine and for mental well-being. They help in the treatment and prevention of many diseases, provide foods and natural substances that bring nutritional benefit, reduce stress and promote psychological balance The body gets the vitamins, minerals, and dietary fiber it needs to support life processes while reducing the risk for chronic illness such as obesity, diabetes, and cardiovascular disease from a diet rich in fruits, vegetables, legumes, and whole grains. Eating patterns that include a variety of plant foods can lead to decreased mortality and better overall health. So, according to the study by Heidemann et al. (2008), phytochemicals, such as flavonoids, carotenoids, and polyphenols, are bioactive compounds that have anti-inflammatory, anti-cancer, and antioxidant effects in plants. When frequently ingested as part of a plant-based diet, these substances help strengthen the immune system and lower the risk of chronic diseases. Thus improving an individual's quality of life and contributing to SDG 3.as demonstrated by Satija & Hu (2018).

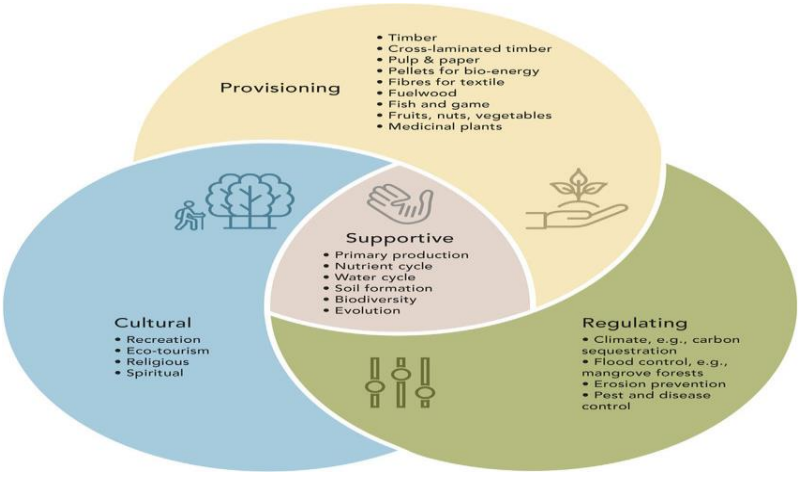

Figure 3. Ecosystem Services Framework and Its Contribution to Quality of Life and SDG 3

sustainable Agriculture and Climate Action (SDG 12 and 13)

Goals 12 and 13 relate to consumption and production, and this highlights the importance of plants in implementing effective measures to enhance food security and reduce the negative impacts of climate change. Plants play the most prominent and significant role in this context because they are the largest and primary consumers of carbon and are responsible for returning it to the soil. If biomass is physical, then it contributes to reducing and mitigating global warming Here the reciprocal relationship between agriculture and climate becomes clear.as illustrated in Figure 4 and Figure 5.

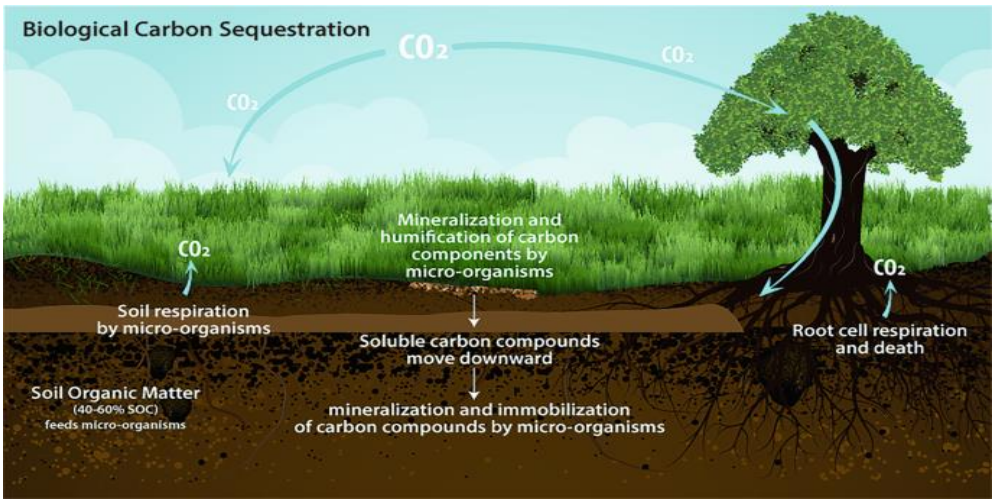

Figure 4. Biological Carbon Sequestration

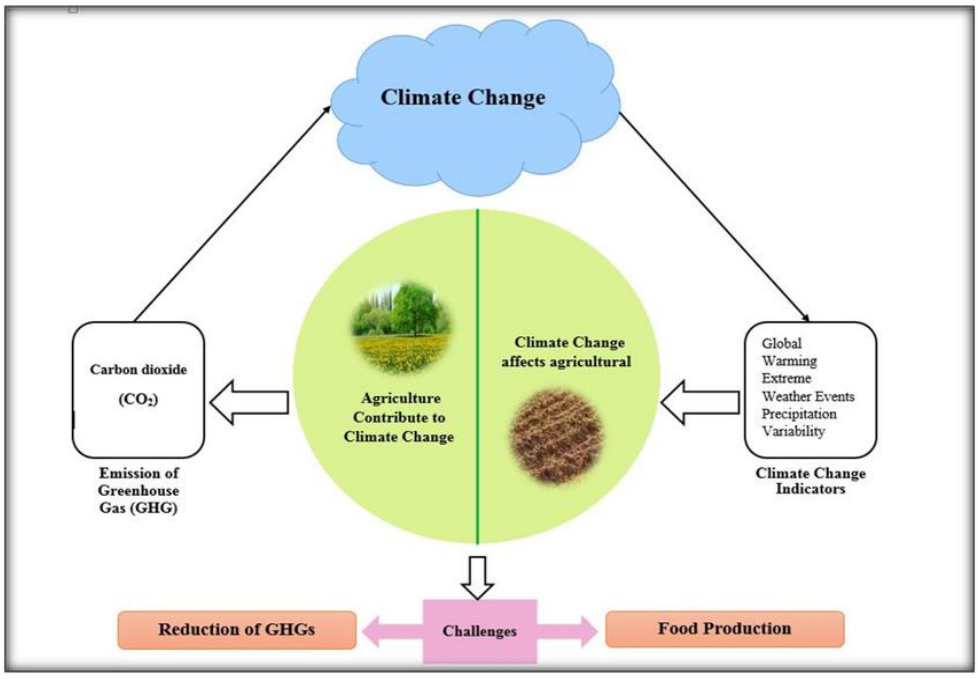

Figure 5. Bidirectional Relationship between Agriculture and Climate Change: Implications for GHG Reduction and Food Production

Interconnection of SDG 12 and SDG 13

The sustainability of agriculture depends primarily on maintaining soil health. Healthy soil is fundamental to the long-term success of agricultural production. as Smith et al. (2020) demonstrated also the achieving efficient and sustainable food production depends largely on the ecological services provided by natural systems, such as pollination by insects and birds, and the role of organisms in naturally controlling agricultural pests.as confirmed by the Altieri study (2021).

Reducing the impact of climate change as early as possible needs to involve a variety of strategies and a range of measures, with particular attention paid to the agricultural sector that both contributes to and feels the effect of climate change (Thornton et al., 2020). Strong enabling legal and policy frameworks, a key element of successful climate action in agriculture because they pave the way for government policies that reward good environmental stewardship, fund scientific research, and support farmer training programs, should be supported (Godfray et al., 2010).

SDG 15

Goal 15 is about "Life on Land." One of 17 development goals established by the United Nations in 2015, its formal wording reads: "Protect, restore, and promote sustainable use of terrestrial ecosystems; sustainably manage forests; combat desertification; and halt and reverse land degradation and halt biodiversity loss."

Importance of Forests

An essential element for life on Earth, plants exist at the base of the food chain in nearly all ecosystems. Every plant species provides a home to many organisms such as insects, birds, animals, and microorganisms. More than 80% of all terrestrial species, including plant, animal, and fungal species, are native to the one-third of Earth's surface where forests grow. This preference, according to the UN (2021), underscores the significance of biodiversity in maintaining the stability and resilience of ecosystems and their ability to resist or adjust to changes in their environment.

Forests are represented as the key element for many countries of the world, in terms of keeping cultural traditions as well as securing basic needs (food and shelter). They are also crucial in economic terms, being of value not only for timber but also as sources of non-timber forest products such as fruits, honey, and medicinal plants, among other natural resources. According to Cox & Mair, (1988), these goods support the local economy and give locals steady sources of income. However, a variety of environmental challenges to forests and their biodiversity have an impact on ecosystem balance and sustainability.

Economie Verte ET Travail Decent (ODDs 8 et 9)

The green economy It is among goals 8 and 9 that the key element of sustainable development, the green economy, falls. This "greening of the economy" improves the balance between economic growth (Goal 8) and environmental protection (Goal 9). As shown in the figure 6.

The Green Economy

A "green" economy is one that reduces environmental risks and sins and sacrifices natural resources rather than increasing their degradation, according to the International Labour Organization (ILO) (2018). Based on social inclusion, resource efficiency, and carbon reduction, this paradigm is built up. Also, this change will force us to reimagine how we make and use things. The green economy could be the basis for a massive job boom, generating entirely new sectors of employment in fields such as waste management, sustainable agriculture, energy conservation,

and renewable power. The ILO projects that the flow could create around 24 million new jobs globally by 2030 (Baker et al., 2020). Quality job creation is another key green aspect of the economy. This is an investment in the longer-term stability of our society and a large part of the solution to our economic downturn. For people, good work means fairness, respect at work, social protection for families, and an opportunity for both men and women to contribute meaningfully to societies and economies.

Sustainable Industrialization

For instance, as an exemplar, recent research highlights SDG 9, innovation and sustainable production, is important to support economic growth with environmental conservation (Khan et al., 2021). A robust infrastructure is also an ingredient for sustaining green manufacturing. According to Zhang et al. (2021), the investment in green infrastructure (e.g., energy-efficient buildings and clean public transportation) promotes economic development, mitigates CO 2 emissions, and improves quality of life.

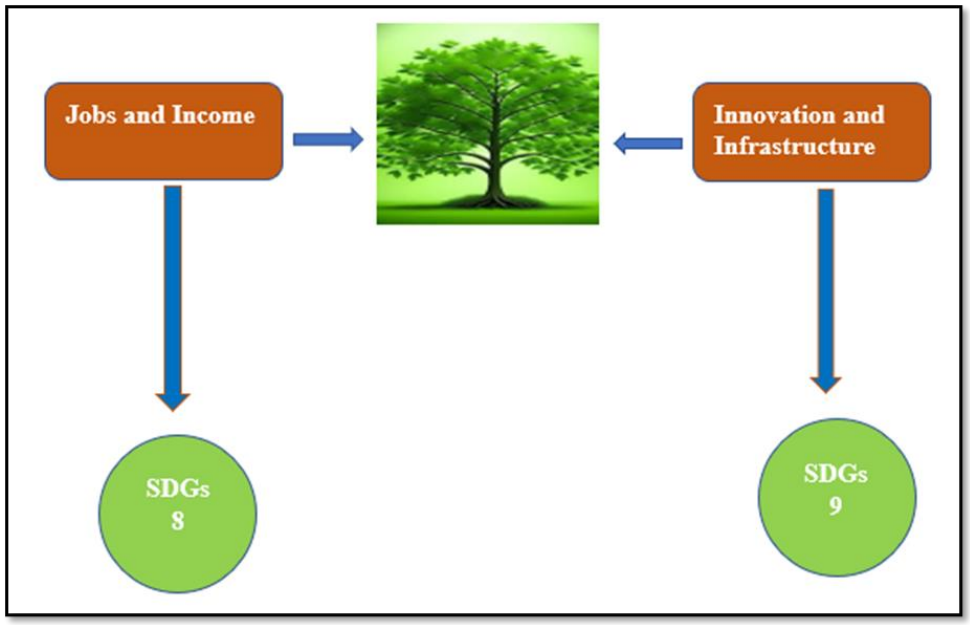

Figure 6. Linkages between Economic Growth, Innovation, and Sustainable Development Goals (SDGs 8 and 9)

Clean Water and Sanitation (SDG 6)

Natural water treatment: These simple ways to treat water are inexpensive and convenient, and they work. However, there are some issues needing to be addressed before those systems can be implemented, including financial limitations and management and operational concerns (Brockwell et al., 2021; Cheng et al., 2021). A significant problem is the discharge of new contaminants that might affect water quality, such as pesticides and microplastics, which are a growing threat to ecosystems and human health. According to some experts, complete multilevel management should be put into place in order to effectively address these issues (Shore et al., 2017; Rolf et al., 2018). Also, the treatment of wastewater plays a critical role in improving the quality of water. According to Lin & Chen (2021), new technologies and innovations have evolved and developed, such as anaerobic membrane bioreactors (AnMBR), which could be a bridge between energy-recovering systems and high-effluent-quality pollution removal systems. Figure 7 shows a sketch of the objective's plan section.

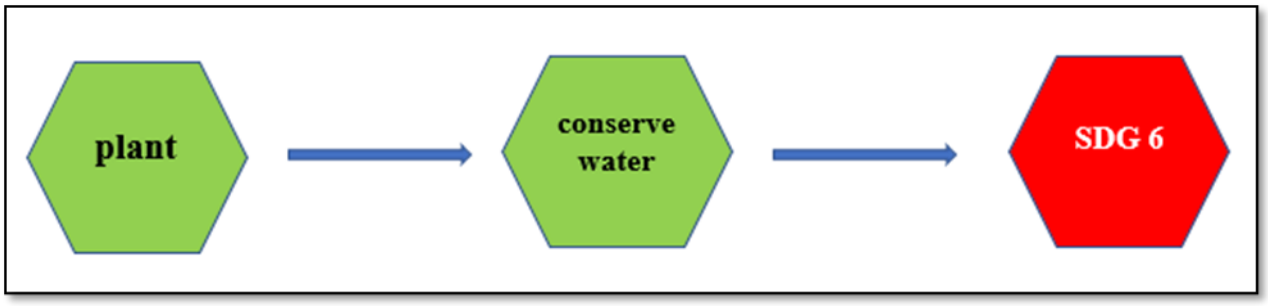

Figure 7. Sketch of the Objective's Plan Section

Sustainable Development Goal 11

The great question of air pollution and urban human life is mainly brought about by the emission from industrial and transportation systems. These factors aggravate urban air quality problems and their potential consequences for human health (World Bank, 2020). That's why increasing public green space and improving public transportation are such cost-effective ways to reduce pollution and improve air quality. Developing sustainable cities Building communities that are resilient to environmental challenges also necessitates the development of sustainable cities and infrastructure, making investment in public transport systems and other energy-efficient buildings that can help mitigate the urban heat island effect and improve people's lives in cities (Kumar et al., 2025). Involving local communities in urban planning procedures is also essential to ensuring that people' needs are satisfied and to improve cities' resilience to future problems and climate change. (Figure 8), According to Rezende et al. (2025) and Eisenberg et al. (2021), the relationship between Sustainable Development Goal 6 (clean water) and Goal 11 (sustainable cities) emphasizes the necessity of integrated approaches that combine better green infrastructure with efficient water resource management.

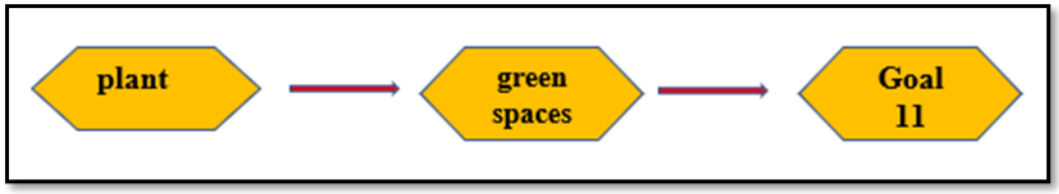

Figure 8. Role of Urban Green Spaces in Achieving SDG 11 (Sustainable Cities and Communities)

CONCLUSION

Through their direct contributions to food security, public health, environmental protection, and climate change mitigation, plants are essential to fulfilling the Sustainable Development Goals (SDGs). They provide the majority of the world's food and help end hunger by promoting crop variety, sustainable agriculture, and increased food production. Because of their high nutritional content, bioactive substances, and beneficial effects on mental health, they also contribute to health and well-being (SDG 3). By absorbing carbon, controlling the climate, and lowering greenhouse gas emissions, plants and forests are essential to climate action (SDG 13). In SDG 15 concept, they turn the tide on desertification as well as promote biodiversity through ecosystem conservation. Apart from the optimal utilization of resources such as soil, water, and energy in farming, climate-smart agriculture and sustainable resource management also help enhance the resilience of farming systems to climatic challenges. The green economy promotes decent work and economic growth (eight and nine of SDGs) through the promotion of innovation, green technologies, and sustainable infrastructure. Such a development approach, focusing on community participation and the

conservation of wildlife areas, is also realistic. In order to ensure a future for the next generation that is sustainable and fair, facilitated planning in the cross-section is called for, from urban development over agricultural policy through healthcare to environmental protection

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