THE CONCEPT OF VALUE CHAINS IN AGRICULTURE, CLIMATE ACTION AND ENVIRONMENTAL RESOURCES

GLOBAL ISSUES & LOCAL PERSPECTIVES

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SAEREM BOOK CHAPTERS First Published 2025 ISBN 978-978-60709-7-1

TABLE OF CONTENTS

SAEREM BOOK CHAPTERS First Published 2025 ISBN 978-978-60709-7-1

The Impact of Agricultural Chemicals on Human Health: A Value Chain Analysis of Exposure Pathways

[1]Dr. Nwizia, Baribefii Paagolah & [2]Mbube, Baridanu Hope (Ph.D.)

Chapter Four

Potentials of Local /Scavenging Chicken for Sustainable Protein Production and Poverty Alleviation

Balogun, B.I. PhD

Chapter Five

An Appraisal of Women Participation in Cassava Production and Processing in Ogbia Local Government Area, Bayelsa State, Nigeria

Tasie, C.M. and Wilcox, G. I.

Chapter Six

Analysis of Cassava Value Addition and its Constraints in Emohua Local Government Area of Rivers State, Nigeria

G. I. Wilcox and C. M. Tasie

Chapter Seven

The Effects of Poultry Manure and NPK 15:15:15 Inorganic Fertilizer on the Growth of Maize (Zea *mays L.*) in Ibadan Oyo State

[1]Omidiran, M.O, [1]Adebisi, A.A, [2]Adedokun, D.O and [1]Geply, O.A

Chapter Eight

SAEREM BOOK CHAPTERS First Published 2025 ISBN 978-978-60709-7-1

Environmental Hygiene and Disease Management Along Beef Value Chain.

Azeez, Abdullahi Akinwale (DVM) and *Salawu, Mutiat Bukola (PhD)*

Chapter Nine

Food safety challenges of antibiotic-resistant foodborne pathogens in street vended foods and report on evolving remedies

[1,*]Clement Olusola Ogidi, [1]Oluwatoyin Ajoke Oladeji, [2]Olubukola Olayemi Olusola-Makinde, and [1]Adeyanmola Oluwaseyi Faturoti

Chapter Ten

The Role of Remittances on Economic Growth in Nigeria 1980-2022

Atiman Kasima Wilson PhD

Part two: THE CONCEPT OF CLIMATE ACTION

Chapter Eleven

Financing Climate-Smart Agriculture for Sustainable Food Security in Nigeria: Practices, Risks, Responses, and Enabling Policies

Odili, Okwuchukwu *Ph.D*[1]* and **Okoro Kelechi Okoro**[2]

Chapter Twelve

Climate Change and Pollution Appraisal: Scientific and Social Approaches

SAEREM BOOK CHAPTERS First Published 2025 ISBN 978-978-60709-7-1

[1]Salami, K. D., [2]Akinyele, A. O., [1]Muhammad, Y. K. and [1]Lukman, A. T.

Chapter Thirteen

Climate Change and Small Holder Agricultural Production in Nigeria

Ettah, O. I. and Edet, E. O.

Chapter Fourteen

Geese Production for Food Security

Balogun, B.I. PhD

Chapter Fifteen

Empirical Analysis Between Inflation and Poverty In Nigeria

Dr. Atiman Kasima Wilson PhD

Chapter Sixteen

Strengthening Climate Resilience and Adaptive Capacity in African Fisheries: Prioritizing Gender Transformation and Inclusive Approaches to Adaptation, Mitigation, and Risk Management

Victoria Folakemi AKINJOGUNLA, Mohammed Sani ISIYAKU and Emmanuel Anietie ESSIEN

Chapter Seventeen

SAEREM BOOK CHAPTERS First Published 2025 ISBN 978-978-60709-7-1

SAEREM BOOK CHAPTERS First Published 2025 ISBN 978-978-60709-7-1

SAEREM BOOK CHAPTERS First Published 2025 ISBN 978-978-60709-7-1

[1,4]Salami, K.D. [2]Akinyele, A.O. [1]Lawal, A. A. [3]Abubakar, A. W. [1]Jibo, A. U.
[3,4]Adeniyi, K. A.

Chapter Twenty Six

Effect of Tigernut on Reproductive Indices of *Clarias Gariepinus*

[1] Tusayi, B.W, [2]Onyia, L.U., [3]Musa, M., [4]Bello, H.A, and [5]Ndibrimta, N.

Chapter Twenty Seven

Assessing Agroforestry Practices Impact on Environment, Income and Food Production In Southwest Nigeria.

Bolaji K.A., Jatto K.A and Adebayo D.O.

Chapter Twenty Eight

Breaking Barriers: Gender Dynamics and Opportunities for Women's Empowerment in Agricultural Value Chains

[1]Mbube, Baridanu Hope, [2]Odekunmi, Seyi Adeloba, [3]Utoko, Vincent Agu & Usman, Christiana Ilebaye

Chapter Twenty Nine

Ecological Perspectives on Reducing Post-Harvest Losses in Agricultural Value Chains: Implications for Climate Action and Environmental Sustainability

[1]Mbube, Baridanu Hope, [2]Abdulsalam, Rabiu Anate, [3]Ojumu Adedotun Omobayo & [4]Moses, Nueebu Mon

SAEREM BOOK CHAPTERS First Published 2025 ISBN 978-978-60709-7-1

Preface

This book adopts an exegetical approach as well as a pedagogic model, making it attractive agriculture and environmental economics teachers, professional practitioners and scholars. It is eschews pedantry and lays bars the issues in such clarity that conduces to learning. The book elaborates on contemporaneous ***The Concept of Value Chains in Agriculture, Climate Action and Environmental Resources*** issues of global significance and at the same time, is mindful of local or national perspectives making it appealing both to international and national interests. The book explores the ways in which climate change, food security, national security and environmental resources issues are and should be presented to increase the public's stock of knowledge, increase awareness about burning issues and empower the scholars and public to engage in the participatory dialogue climate change, food security, national security and environmental resources necessary in policy making process that will stimulate increase in food production and environmental sustainability.

The Concept of Value Chains in Agriculture, Climate Action and Environmental Resources: Global issues and Local Perspectives is organized in three parts. Part One deals with The Concept of Value Chains in Agriculture, Part Two is concerned with The Concept of Climate Actions and Part Three deals with the Concept of Value Chains and Environmental Resources.

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Chapter Twenty One

Forest Ecosystem Approach toward Food Security

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LIST OF TABLE CONTENTS

SAEREM BOOK CHAPTERS First Published 2025 ISBN 978-978-60709-7-1

- Biodiversity Preservation

CONTRIBUTIONS OF FOREST ECOSYSTEMS TO THE FOUR DIMENSIONS OF FOOD SECURITY

- Food Availability
- Food Accessibility
- Food Utilization
- Food Stability

CONCLUSION

INTRODUCTION

The global food system is not delivering sufficient, safe, and nutritious food to all (Ickowitz, McMullin, Rosenstock, Dawson, Rowland, Powell, Mausch, Djoudi, Sunderland, Nurhasan, Nowak, Gitz, Meybeck, Guariguata, Termote, Nasi,2022), with over 122 million people facing hunger in the world since 2019 due to the pandemic and repeated weather shocks and conflicts, including the war in Ukraine, according to the latest State of Food Security and Nutrition in the World (SOFI, 2023). If trends remain as they are, it is predicted that food prices will rise by another 30- 50% due to the inability of food production to keep up with growing demand (Kumara, Chhogyelb, Gopalakrishnanb, Hasanb, Jayasingheb, Kariyawasam, Kogob, and Ratnayakeb, 2022). The dominant discourse within the global agenda on food security has historically been characterized by the notion that undernourishment should be addressed by increased food production through agricultural intensification (Olesen, Hall, and Rasmussen, 2022). In parallel, there is considerable evidence that suggests that forests and tree-based systems can play an important role in complementing agricultural production in providing better and more nutritionally-balanced diets (Vinceti, Fremout, Termote, Conejo, Thomas, Lachat, Thiombiano,

Zerbo, Lompo, Sanou, Parkouda, Oumarou Ouédraogo, Ouoba, 2022); wood fuel for cooking, greater control over food consumption choices, particularly during lean seasons and periods of vulnerability; and deliver a broad set of ecosystem services which enhance and support crop production (Abanikannda, J.O., and Dantani, A., 2021). Based on nature, the ecosystem is wired to provide goods and services that make critical contributions to food security by supporting the availability, accessibility, and utility of foods, both farmed and wild, and by strengthening the stability of food systems (Ortiz, Chua, Salvador, Dyngeland, Albao, and Abesamis, 2022). The ecosystem has a community of plants, animals, and other organisms that live, feed, reproduce, and interact in an area or environment. Its services can be seen as the processes by which ecological systems supply human benefits (EPA, 2025). The ecosystem strengthens agricultural production by providing everything from water and soil resources to pollination and pest control services. An ecosystem is termed to be healthy if it can offer a diverse range of food sources and support the entire agricultural system. These systems are made up of complex interactions between biotic and abiotic components (Socorro, 2024). Meanwhile, the protection of these systems, such as forests, watersheds, and coastal environments, is a win-win for food security. The ecosystems support each of these systems directly and indirectly through the provision of critical ecosystem services that facilitate agricultural production, create income, generate opportunities, and provide energy for cooking (Grammatikopoulou, Chatzimichael, Sylla, La Notte, Zurbaran, and Paracchini, 2024).

FOOD SECURITY

According to Bahar, Lo, Sanjaya, Vianen, Alexander, Ickowitz, and Sunderland (2020), food security requires healthy, diverse ecosystems, forests, and trees, which have an important role to play in human survival. Meanwhile, food security is defined by Acheampong, Obeng, Opoku, Brobbey, and Sakyiamah, (2022) as “a situation in which all people at all times have physical and economic access to sufficient, safe and nutritious food which meets their dietary needs and food

preferences for an active and healthy life.'' This is because well-nourished individuals are healthier, can work harder, have greater physical reserves, and can withstand and recover from external shocks (Global Panel on Agriculture and Food Systems for Nutrition, 2020). Coupled with recent global food price spikes, anthropogenic climate change issues, and the challenge of a growing global human population, the roles of farms and forests in supporting food availability and nutritional security are becoming a concern and are back to the focus in politics and development (Malhi, Kaur and Kaushik, 2021). Food security in most developing countries depends on the sustainable use of natural resources and the provision of ecosystem services (Bakala and Asfaw,2020), while in most developed nations, there are diverse improvements in food production. However, statistics show that The number of people affected by hunger globally rose to as many as 828 million in 2021, an increase of about 46 million since 2020 and 150 million since the outbreak of the COVID-19 pandemic, according to a United Nations report that provides fresh evidence that the world is moving further away from its goal of ending hunger, food insecurity and malnutrition in all its forms by 2030 (WHO, 2022). Also, few people who are considered to be food secure are surprisingly combating "hidden hunger" which is a result of a lack of micronutrients richly deposited in forest foods, not knowing that tree foods are often rich sources of vitamins, minerals, proteins, fats and other nutrients (Beyene, 2023). These deficiencies are identified with poor growth and cognitive development in children and increased mortality and morbidity in both adults and children (Wanjiku, 2024). Omotayo, and Aremu, (2020) explained how African Indigenous fruit trees, for example, are rich in high nutritional value. Also, edible leaves of wild African trees such as baobab (*Adansonia digitata*) and tamarind (*Tamarindus indica*) are high in calcium and are sources of protein and iron (Asogwa, Ibrahim, and Agbaka, 2021). Another example is the dried seeds of the African locust bean (*Parkia biglobosa*) and raw cashew nut (*Anacardium occidentale*), which is rich in iron as well (Offiah, and Falade, 2023).

ECOSYSTEM SERVICES

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The term "ecosystem services" is borrowed from biodiversity conservation science and can be defined in multiple ways, which illustrates the complexity of the concept (Oguh, Obiwulu, Ogochukwu, Ameh, Ugwu, Sheshi, Oguh, 2021). Ecosystem services are all linked to human well-being either directly or indirectly (Kosanic& Petzold, 2020). Ecosystem services can be classified into those provided directly and those obtained indirectly. Direct services from forests and trees are represented by the provisioning of a wide range of products (wood and NWFPs) collected for food, feed, energy, construction, and other uses. Indirect services are largely biophysical environmental processes that support the production of food in the long term, including access to clean water and nutrients and enhanced quality of life (Dlamini, 2020). Ecosystem services are divided by the Millennium Ecosystem Assessment in Pearce (2023) into four groups: regulatory, supporting, provisioning, and cultural. As shown, regulatory services represent those ecosystem functions that provide environments conducive to human well-being and that ensure protection against natural disasters (Černecký, Špulerová, Ďuricová, Mederly, Jančovič, Hreško, Močko, 2020). They are realized over a global scale, encompassing substantial marine and terrestrial ecosystems, such services include clean air supply, groundwater purification, protection against runoff and erosion, and the global mobility of pollinators (both wind and animal pollinators) (Ye,Huang, & Xie, 2024). Supporting services are the crucial functions of soil and atmospheric stabilization that enable the production of crops and livestock. Such supporting services include photosynthesis, precipitation, and the bioavailability of soil nutrients for plant growth (Khan, 2021). Provisioning services, sometimes called "ecosystem goods," include the directly available food, medicines, building materials, and fuel that can be harvested from marine and terrestrial ecosystems (Geeks for Geeks, 2024). Cultural ecosystem services are described as the intangible values that society derives from the environment (Romanazzi, Koto, De Boni, Palmisano, Marilisa, Cioffi, Roma,2023).

SAEREM BOOK CHAPTERS First Published 2025 ISBN 978-978-60709-7-1

FOREST AS A RESERVOIR FOR FOOD SECURITY

Forests serve as a huge reserve landscape in which many agricultural systems exist, they cover around 31% of the earth's surface (FAO and UNEP, 2020). It serves as a huge reserve landscape in which many agricultural systems exist. Forests, as well as trees on farms, are a direct source of food and cash income for more than a billion of the world's poorest people, providing both staple foods and supplemental foods such as fruits, edible leaves, and nuts (Vansant, Mausch, Ickowitz, McMullin, Karanja, and Rasmussen, 2022). Forests, as well as trees on farms, are a direct source of food and cash income for more than a billion of the world's poorest people, providing both staple foods and supplemental foods such as fruits, edible leaves, and nuts (Olesen *et al*., 2022). Globally, forests and associated ecosystems have been managed to enhance their production of a vast array of wild, semi-domesticated, and domesticated foods, including fruits, nuts, tubers, leafy vegetables, mushrooms, honey, insects, game animals, fish, and other wildlife (Muir, Sorrenti, Vantomme, Vidale, and Masiero, 2020). Forests and trees contribute directly and indirectly to food security and nutrition in numerous ways. They are a source of wood, energy, food, and other products. They provide livelihoods for an important part of the worldwide population, often the most vulnerable (Olesen et al., 2022). Forests perform vital ecosystem services, including the regulation of the water and carbon cycles and protection of biodiversity, that are essential to food production and security in the long term (Machado, 2020). These contributions vary according to the types of forests, how they are managed, and the governance exerted.

In most parts of the developing world, forest products provide a large range of locally important goods and services and are widely consumed in most agrarian communities and even in many urban areas (Chamberlain, Darr, and Meinhold, 2020). Forest has a huge and vital role to play in improving current and impending food security (Sunderland and O'Connor, 2020). It is considered

a source of biodiversity and, as such, is inextricably linked to people's food security, nutrition, and health in several fundamental ways (Fichtner & Härdtle, 2021). Some health experts affirmed that it is not practical nor efficient to address human health and ecosystem health in isolation. Thus, there is a need to acknowledge the influence on human health and the environment (Lü, Lü, Gao, & Fu, 2021). The contribution of forests to food security is even more significant as they provide not only the staple foods that help to overcome food shortages but also several dietary elements through supplemental food (Olesen et al., 2022). Oftentimes, forest foods are consumed when arable food crops are out of season or during emergencies such as famines and wars. Although Lowe (2021) submits that forests may not directly contribute a significant percentage of calories in rural diets, new evidence suggests that they may play a role in preventing hidden hunger and micronutrient deficiencies that affect billions. From a food security perspective, these trends have important implications for the availability of, access to, and relative dependence on forest products for food and income. In their little way, they contribute to household food systems both directly and indirectly since they are the primary reservoir of food, fodder, farm inputs, medicines, and commercial forest products that better livelihood (Fanzo, Bellows, Spiker, Thorne-Lyman, and Bloem, 2021). The article's objective is to fully comprehend the roles forest ecosystems play and their contribution to ensuring our food and nutrition security.

THE ROLE OF THE FOREST ECOSYSTEM IN FOOD SECURITY

Provision of Food and fodder

The forests deliver other ecosystem services as well, such as the provision of timber and non-timber forest products (NTFPs) to tribal people as tangible benefits and maintaining soil, food, and environmental security (Raj, Jhariya, & Khan, 2022). Globally, food products account for the greatest share of NTFPs harvested, with millions of people depending on NTFPs for their food security and nutrition, either directly or indirectly, which underscores the importance of forests for

sustaining access to food (Shackleton, Garekae, Sardeshpande, Sanni, & Twine, 2024). The most direct way in which forests and trees contribute to food security is through contributions to diets and nutrition (Gitz *et al*., 2021). Plants and animals found in forests provide important nutrient-rich supplements for rural households. They add variety to diets and improve the taste and palatability of staples. For instance, Forest resources play a vital role in the livelihoods of rural communities living in forest-fringe areas, serving as an integral part of their economic framework (Bisui, & Shit, 2023). In addition, countless forest resources (high-protein fodder trees and shrubs) are used as a reserve of fodder, can support livestock production, and increase animal-sourced food consumption among poor rural communities living in or near forests (Abraham, Kechero, Andualem, Dingamo, 2022). It serves as a protein bank through bush meat, milk, and aquatic resources (fish), providing rich diets to forest-dependent communities. Fodder trees contribute in several ways to the overall food security of households. More broadly, they contribute to meeting the diversifying culinary demands in nutritional gaps. Wild edible plants from the forest, either fresh or dried, are extensively used worldwide to supplement food, nutrition, and medicine. Exploration of ethnic traditional food recipes has an immense contribution to the preservation and sustainability of traditional food habits and culture (Gajurel, Singh, Kashung, Adhikary, Nopi, Barman, Yakang, Doni, &Gogoi,2022). For instance, integrating a variety of forest foods, such as edible plants, fungi, and insects, into food value chains widens the consumption pattern and preferences of food, which could contribute to reducing malnutrition (Wells, Sawaya, Wibaek, Mwangome, Poullas, Yajnik, Demaio, 2020). Forest-based edible seeds and nuts are those forest products that can be used as a staple or main dish, minor food supplements, thickening agents, condiments, and food flavors. (Godeto, Bachheti, Husen, Pandey,& Bachheti, 2021). In this regard, food from forests and tree-based systems is likely to continue to form an essential part of household strategies to eliminate hunger and achieve nutritionally balanced diets.

Provision of energy

Forests are not only known for food items; they are also known for providing fuel for cooking. In many local communities, especially in Africa, 90 percent of rural households depend solely on forest ecosystems for bioenergy because they cannot afford alternative energy (Gebru and Elofsson, 2023). The most common biofuel used as rural domestic fuel is firewood, and the number of people who depend on it is expected to increase over time (Benti, Gurmesa, Argaw, Aneseyee, Gunta, Kassahun, Aga,& Asfaw, 2021). Access to cooking fuel provides people with more flexibility in what they can eat because it enables them to process foods (Chamberlain, 2020). However, fuelwood supplies thus indirectly affect the stability, quality, and even quantity of food consumed. Studies from Waswa, Mcharo &Mworia (2020) revealed that the scarcity of wood fuel resulted in changes in cooking habits whereby households opted to cook composite meals as opposed to single meals. Households also reduced their cooking frequencies from the conventional three meals per day to two or sometimes only one meal per day. Foods with shorter cooking times were preferred to those that took longer to cook as an indirect response to firewood scarcity. This compromised the nutritional status of especially the children under five and also the elderly. Also, food processed using fuelwood (traditionally smoking and drying) is of central importance to food security, as it extends the supply of food resources into non-productive periods (Recipes and Roots, 2024).

Economic support

Food insecurity is generally related to poverty and limited opportunities for employment or income generation (Okpala, Manning, & Baines, 2021). Through income, it is believed that the global rate of undernutrition falls because of its potential to enhance access, through purchase, to a wide range of healthy foods (Seferidi, Hone, Duran, Bernabe-Ortiz, &Millett, 2022). Forest income can make

a significant contribution to rural households and their food security from the sale of wood and NWFPs in local, national, and international markets and forest-related employment (Begazo-Curie & Vranken, 2025). Among low-income households, extracting more environmental resources, most of which are from forests, is an important income-generating coping strategy during times of hardship (Ickowitz, McMullin, Dawson, Sunderland, Powell, Nurhasan, Vinceti, Jamnadass, Meybeck, & Gitz, 2024). Padhi (2022) revealed that the forest serves as a source of livelihood for rural women as they sell forest products in the market, which acts as a source of income for the family. This is important for their income and forest food and helps increase the purchasing power of forest-dependent communities. They collect various kinds of NTFPs from the forest they sell them in the market to make their living. For them, the forest is the central resource through which they can generate their income. They can generate more income with proper training and skill on value addition and marketing opportunities of their forest products. Income generated from such activities is often an important means of providing food for the family, ensuring food security at the household level in many parts of the world (Soh Wenda, 2024).

Provision of water supply

Trees help to mitigate climate change impacts through carbon storage, protect agricultural systems from climate-related risks, provide support for agriculture through contributing to regulating surface and groundwater flows, mitigating flood risk, reducing water runoff by facilitating water infiltration in soils, and enhancing water quality (Lock, 2021) as well as the provision of essential habitat for wildlife to survive. Furthermore, research discovered that forests and planted trees regulate water availability and climate on micro to macro scales because at the micro end of the spectrum, evapotranspiration from trees reduces the temperature in the immediate vicinity, supporting crop production in agroforestry systems under stressful conditions (Ickowitz *et al*., 2022). At the macro scale, trees and forests facilitate water infiltration into soils and can improve

groundwater recharge locally to enhance crop production (Miller, Ordoñez, & Brown, 2020). Trees can also protect against flooding through water infiltration and interception (Muchane, Sileshi, Gripenberg, Jonsson, Pumariño, & Barrios, 2020). The forest ecosystem also plays a critical role in the provision of adequate water supply, both in quantity and quality, for human consumption, agriculture irrigation, or the alimentation of lakes and rivers on which inland fisheries depend. These are essential for food security (Ringler, Agbonlahor, Mekonnen, Barron, Uhlenbrook, Baye, & Meenakshi, 2022).

Provision of soil fertility and microbial activities

Across the tropics, trees are integrated into agricultural systems in a variety of ways, providing a range of benefits in terms of restoring or sustaining soil fertility and boosting food production (Mahmud, Raj, & Jhariya, 2020). Trees hold fertile soil in the fields against wind and rainfall to prevent rapid water runoff, thus preventing the loss of valuable soil and water resources (Sufiyan, 2022). Over the years, farmlands have been protected and managed by planting trees when forests recede or are degraded from overharvesting (Bezu & Abera, 2021). When trees are integrated into the crop system, they not only protect the environment but also make it more productive. For example, leguminous trees are established with crops to support yields and fix nitrogen and other nutrients in the soil, thereby reducing dependence on inorganic fertilizers and helping smallholder farmers in the tropics who cannot afford such inputs (Lebrazi & Benbrahim, 2022). Bankefa, Oladeji, Ayilara-Akande, and Lasisi, (2021)explained that microbial biodiversity is important in improving global food security via (i) reduction of food spoilage/wastage (as in food preservation), (ii) microbial protein production for addressing malnutrition, (iii) generation of alternative source of energy (as in the case of bio-fuel production); (iv) enhancement of food production (as in, the exploitation of microbes as bio-control agents, bio-fertilizer and bio-pesticides).

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Biodiversity Preservation

Biodiversity at all levels, including the diversity of genes, species, and ecosystems, is lost at alarming rates (Sufiyan, 2022). However, it is important because it provides humans with many resources. Without biodiversity, we would not have food or shelter. Other resources provided by biodiversity include clean air and water, medicines to treat disease, clothing fibers, fuel sources such as biofuels and biomass energy, and more (GeoPard Agriculture,2025). Rich biodiversity is harbored in the forest, including wild relatives of crops, which are critical for breeding programs to develop more resilient and productive crop varieties (Maxted &Brehm, 2023). That is where genetic diversity may play a key role in allowing trees and forests to adapt to future uncertainties. Genetic diversity is the raw material and main mechanism trees have in which to adapt and evolve in response to climate change disturbances (TEAGASC, 2024). Biodiversity plays a crucial role in maintaining ecosystem functions and services such as pollination, pest control, and soil formation (Diyaolu and Idris, 2024). In addition to this, biodiversity also helps in improving the quality of food products by providing resistance to diseases and pests for crops (Renard & Tilman, 2021). Biodiversity can be found everywhere in nature, including plants, animals, and microorganisms (WHO, 2025). Conversely, the loss of biodiversity could have serious implications for human health, food security, economies, livelihoods, cultures, and much more.

CONTRIBUTIONS OF FOREST ECOSYSTEMS TO THE FOUR DIMENSIONS OF FOOD SECURITY

Since forests have served as a huge source for securing food production, it has also sustained humanity through the four dimensions classified under availability, accessibility, utilization, and stability (Gitz *et al*., 2021). At both the local and national levels, food availability refers to the supply of food through production, distribution, and exchange. Access defines the proximity, social access, economic access (affordability), and consequent allocation of food. Utilization refers

to the metabolism of food by individuals and the factors needed for individuals to make use of the foods they have access to (including, for instance, energy for cooking, clean water, sanitation, and health care). Stability refers to the constancy and resilience of the three previous pillars over time.

Food Availability

One dimension of food security is food availability. Approximately one billion people depend to some extent on wild foods such as game meat, edible insects, edible plant products, mushrooms, and fish (Farmers' Weekly, 2021). This dimension refers to the amount of food in a country or region. It can be provided through domestic production, food imports, and food aid (Sarkar, 2022). There are direct and indirect contributions of forest and tree resources to food security availability. Forest foods vary in fruits, vegetables, protein foods, and mushrooms, they represent an essential part of the diet for many people living in or near forests and, more broadly, in rural areas and contribute to balanced diets for the global population (Gitz *et al*., 2021) which are most consumed and are all of particular importance to nutrition. These foods are rated high in local, national, and international markets because of their contribution to the worldwide food web, feeding both the rural and urban populace (Maziya-Dixon, Achterbosch, Adelekan, Adeyemi, Ajieroh, Akerele, Akinola, Alamu, Van Berkum, Byrd, Nijhuis, Ojide, Onabolu, Onyibe, Raaijmakers, Samuel, Snoek, Yusuf,& Brouwer, 2021). Interestingly, the varieties of plant species with their differences in fruiting phenology ensure year-round food availability with diverse nutrients in various seasons (Vinceti, 2022). Although foods from forests have been estimated to represent less than 0.6% of global consumption, they are key to ensuring the availability of nutrient-dense foods, proteins, and micronutrients, including vitamin A, calcium, and iron, and much of the folic acid comes from crops pollinated by animals important vitamins and trace elements in many communities (Farmers' Weekly, 2021). On the other hand, the indirect pathway to availability results from the fact that forests and trees provide ecosystem services that critically support food production (Gitz *et al*.,

2021). Forest ecosystems enhance agricultural productivity by transporting deeper water and nutrient resources close to the soil surface and making them accessible for other crops (Olaniyan, Ujah, Ogunsola, & Afanwoubo, 2024). Forests contribute to food availability through the provision of adequate water supply (quantity and quality) for human consumption, agriculture irrigation, and the alimentation of lakes and rivers, which fisheries depend on (Chamberlain, Darr, & Meinhold, 2020). Forests and trees outside forests also support food availability by providing fodder for livestock. Fodder thus contributes to food availability in two ways: Livestock are a source of meat and milk, and they support agricultural production by providing draught power and manure, which can increase farm productivity (Farmers' Weekly, 2021).

Food Accessibility

Food access refers to economic, social, and physical access to food by all people. Physical accessibility refers to regular and timely access to food trading places, while affordability relates to household purchasing power (Gitz *et al*., 2021). In other words, Pinerua (2023) further explained that physical access refers to one's proximity to food sources because economic access does not guarantee food access. Another factor that contributes to physical access to food is mobility and access to transportation. If individuals or families have mobility issues and/or a lack of access to transportation, they may not be able to access food assets, even if they are spatially proximate. In terms of mobility, research indicates that having a disability, including those that do not relate to mobility, often results in decreased access to food and an increased chance of food insecurity (Rajasooriar & Soma, 2022).

Meanwhile, economic access to food implies that people have sufficient financial means to purchase food products in a formal or informal food economy (Pinerua, 2023). The availability of an adequate amount of food at the regional, national, or international level does not imply it is accessible at the household level (Olurinola & Osabuohien, 2021). It must be locally accessible

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and affordable, suggesting that every individual should have sufficient access to sufficient resources to have appropriate food to live a healthy life (Page & Marshall, 2023). High food prices or insufficient income can reduce economic access, while higher earnings or safety nets and other social protection programs can improve economic access (Pinerua, 2023).

Social access to food is based on the social, cultural, and political factors that influence the ability to acquire food. Food is the most fundamental and oldest part of any culture (Bikesh, Suraj, & Arun 2020). Culture, to a great extent, influences people to participate in food production, marketing, and distribution (Nyambura, Muiruri, & Mbuthia, 2023). For instance, cultural norms may dictate that only certain individuals are expected or allowed to acquire and prepare food, which may limit access. Geopolitics and domestic policies also play a role in social access. Policies may limit individuals from accessing food or social protection programs based on certain demographics, such as ethnicity or political affiliation (Pinerua, 2023).

Food Utilization

The use of food products refers to the nutritional aspect of the food that households consume. Thus, household food products must meet their preferences and individuals' needs for protein-energy elements and micronutrients (Michel, Eldridge, Hartmann, Klassen, Ingram, & Meijer 2024). The utilization of forest resources exposes people to a balanced diet and improves food production, as some forest resources improve crop yields. Most of these forest resources are NTFPs and contribute to human livelihoods and household income (Derebe, Alemu, & Asfaw, 2023). These forest resources supply green social security to the largest portion of the world population through the provision of edible fruits, honey, minerals, vegetables, pastures for animals, building materials, fuel wood, other food resources, and medicines (Kugedera, Kokerai, Sakadzo, Chivhenge, & Museva, 2024). In the 20th century, the contribution of forest resources to food security has been reported to be increasing due to the value addition made on most harvested

NTFPs (Kugedera *et al*., 2024). NTFPs are major resources extracted cheaply from forests that generate employment and a lot of income for both rural and urban dwellers, particularly women. For example, traditional healers in Southern Africa charge a cattle or cow to cure some ailments using medicines harvested from forests, such as tree roots, bark, and leaves (Cock, Luwaca, & Van Vuuren 2023).

Food Stability

Stability is a particular dimension of food security as long as it concerns the stability of the other three components/pillars (availability, utilization, and access) (Gitz *et al*., 2021). The stability of food supplies refers to the regularity of food availability in space and time (Sawadogo, 2023). Income and wild foods from forests provide a safety net during seasonal food shortages and in times of famine, crop failure, and economic, social, and political shocks (Farmers' Weekly, 2021). Forests also became safety nets by providing households with forest food and income to purchase food during lean seasons (Ntiyakunze, and Stage, 2024). In addition to providing measures for coping with short-term instability in food supplies, forests and forest diversity provide ecosystem services for ensuring medium- to long-term stability of food supplies, which can prevent chronic food insecurity (Farmers' Weekly, 2021).

Forests provide many ecosystem services able to enhance food systems' resilience and support the stability of food production by protecting the soils against erosion from wind and water, particularly in areas of steep slopes and heavy rainfall, and against desertification (Gitz *et al*. 2021). They also play a key role in climate (temperature, wind, and rainfall) regulation, in flood control and water supply regulation (quantity and quality), in coastal protection against sea level rise, as well as in pest control. All these functions will be essential for increasing the resilience of food production systems to increased climate variability and intensified extreme climatic events (Kumar, 2022). Lastly, forests and biodiversity are vital components of our planet’s health and

sustainability. They not only provide essential resources, such as clean air and water, but also support diverse ecosystems that are crucial for the survival of countless species, including humans. Understanding the importance of these natural treasures is essential for fostering a deeper appreciation and commitment to their conservation. (Hayes, 2025).

CONCLUSION

The forest ecosystem approach to food security recognizes the essential role that forests play in our everyday lives. Due to the recent hikes in food prices, it is imperative to consider our forest as a reservoir for food security. Forest ecosystems are rich in influencing food availability, accessibility, stabilization, and utilization both now and in the future. Forest foods are not just complementary but are essential sources of nutrient-dense diets that sustain many rural and forest-dependent communities, enhancing overall well-being. The forest ecologies contribute to increased crop yields and protect plants' gene pool, ensuring a more robust and resilient food system for both man and animals. The consumption of forest products is essential as they provide the necessary proteins, vitamins, and minerals for a balanced diet. The sustainable management of these resources is not merely beneficial; it is vital for securing food for vulnerable communities and strengthening global food systems. To maximize the benefits of our forest ecosystem, policymakers, communities, and stakeholders must facilitate the implementation of sustainable management practices, prevent deforestation, and promote agroforestry systems. By doing so, forests will continue to serve as a vital source of food, nutrition, and income while safeguarding ecosystems for future generations.

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