ISSN 2656-8039 (online)
International Journal of Environment, Engineering & Education
Volume 6, Issue 1, April 2024
https://doi.org/10.55151/ijeedu.v6i1.128

Research Article

Impacts of Population Trends, Agricultural Supply Chains, and Environmental Decline in Otukpo LGA, Benue State, Nigeria

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Received: February 16, 2024; **Accepted:** March 28, 2024; **Published:** April 19, 2024

Abstract: This research delves into the intricate relationship between population dynamics, agricultural value chain, and environmental degradation in Otukpo Local Government Area (LGA), Benue State, Nigeria. The burgeoning population in the region has precipitated notable shifts in land use patterns, agricultural methodologies, and the overall environmental landscape. A robust research methodology was employed to explore this phenomenon comprehensively. Both primary and secondary data were collected, with a sample size of 400 determined using Taro Yamane's formula. This sample was then strategically distributed among the 13 clans within the LGA, yielding 380 returned samples for meticulous analysis. Statistical analysis, facilitated by tools such as standard deviation and mean, was conducted using SPSS software. Employing a mean criterion of 3.0, questionnaires were administered via survey techniques to discern respondents' perspectives. The research findings illuminate the multifaceted impacts of population dynamics in Otukpo LGA. Notably, these dynamics have instigated challenges within the agricultural value chain, manifesting as farmland degradation and pollution. These repercussions have reverberated throughout the environment, precipitating biodiversity loss, soil contamination, and rampant deforestation. The research also underscores the nuanced nature of these challenges. While population growth undeniably exacerbates these issues, it is crucial to acknowledge the contributory role of ineffective public policies in perpetuating environmental and agricultural dilemmas within the region. In light of these findings, the research advocates for formulating sustainable policies and evidence-based solutions. Addressing these issues holistically demands a concerted effort to mitigate the adverse impacts of population dynamics on agricultural practices and environmental sustainability.

Keywords: Deforestation; Farmland Degradation; Sustainable Policies; Soil Pollution; Natural Resources.

1. Introduction

Problems with population, natural resources, agriculture, and the environment have long been on people's minds. The extent and intensity of problems related to population, natural resources, agriculture, and the environment have intensified [1]–[3]. In order to support their quick population expansion, create foreign currency, and supply raw materials for industry, many emerging nations are depleting their natural resources at rates that exceed the natural replacement rate. Some of the most precious resources that humans have depleted include land, water, and forests.

In order to meet the food requirements of their families, communities, or nations, millions of impoverished farmers resort to clearing extensive areas of forest land [4], [5]. This reflects the formidable challenges agricultural communities face to ensure food security amidst limited resources and economic constraints. Many developing nations, including Nigeria, prioritize agriculture as a critical component of national development goals. While some countries have achieved significant improvements in their agricultural sectors following the implementation of new land policies and reforms, outcomes have been mixed. Despite significant reforms and substantial financial investments, agricultural output and traditional practices have not consistently improved across many nations. This highlights the complexities of promoting sustainable agricultural development and underscores the need for holistic approaches to address farming communities' multifaceted challenges [6]–[9].

This article citation (IEEE): N. Udoinyang, "Impacts of Population Trends, Agricultural Supply Chains, and Environmental Decline in Otukpo LGA, Benue State, Nigeria," Int. J. Environ. Eng. Educ., Vol. 6, No. 1, pp. 12-25, 2024.
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According to Drechsel, Kunze, and Vries [10], although agronomic modernizations have had short-term achievements, they have often resulted in long-term issues with natural resources and the ecosystem. Degradation of the environment is the most common and quickly worsening issue associated with farming. It is typical for agricultural programs to prioritize increasing productivity over managing and conserving resources. The social and environmental ramifications of heightened pressure on natural resources are frequently overlooked until substantial degradation occurs [11]. The loss of vegetative cover caused by deforestation and the conversion of savannah to cropland raises significant concern that a substantial portion of Sub-Saharan Africa's natural resource base and ecological environment is deteriorating [12]. For most of human history, population growth has been somewhat modest. Rapid worldwide population expansion has only happened in the last two centuries. While people have always been interested in population dynamics and how they affect the environment, Thomas Malthus's [13] Essay on the Principle of Population officially began the population and resource studies field. Malthus famously postulated that there would be natural "checks" (like famine) on future population increase since food supply rises at a linear rate compared to population growth.

Over the last twenty years, demography, geography, anthropology, economics, and ecological science researchers have attempted to address a more nuanced set of inquiries. These include how population density, composition, or number changes relate to desertification, climate change, or ambient air and water contaminant absorptions. Conversely, they investigate how changes and circumstances in the environment impact population dynamics [14], [15]. Additionally, they examine how intermediary factors, like markets or institutions, shape these connections and how they vary across different locations and eras. Researchers seek answers to these concerns with modern technologies such as GIS, remote sensing, computer-based models, statistical packages, and evolving ideas about the relationship between humans and their environments [16].

Demographers and other social scientists have long studied population dynamics to deduce the connections between environmental changes and various demographic variables. These variables include but are not limited to, vital rates, migratory patterns, urbanization, density, age and sex composition, and growth rates. Research at the micro and meso scales in underdeveloped regions is the primary emphasis, with the energy component as an exception [17], [18]. While much of the study has concentrated on the developed world, this does not mean these processes are irrelevant; per capita environmental effects are considerably higher in this area.

The world's population experienced slow expansion for decades until reaching about 1 billion in 1800 [19]. It took another 150 years for the number to reach 2.5 billion. The population then doubled to 5 billion in less than 40 years due to significant growth acceleration after World War II [20]. Between 1950 and 1975, there was a swift annual increase in population of about 2%. With a population of 5 billion and a projected annual growth rate of 2%, some scholars and writers warn of the perils of exponential expansion throughout this period [21]. They suggest that at this rate, we will reach 40 billion in a little over a century and 20 billion in 70 years.

The worldwide population expansion, estimated to increase by approximately 83 million individuals annually, stands as the principal driver behind various socio-economic and environmental challenges. As of 2020, the global population reached 7.8 billion, a significant surge from merely 1 billion in 1800. Projections indicate a continued upward trajectory, with estimates forecasting 8.6 billion by mid-2030, 9.8 billion by mid-2050, and 11.2 billion by 2100.

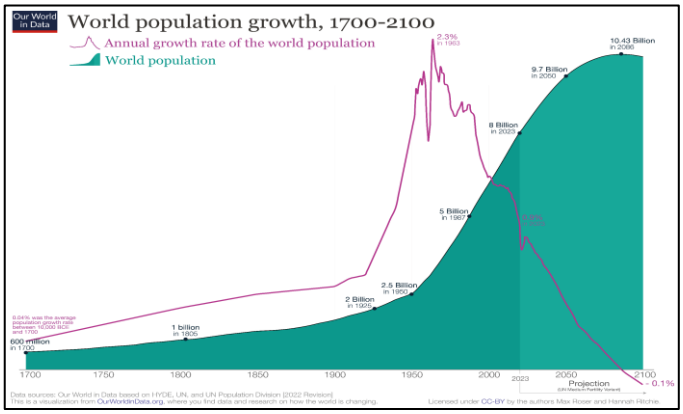

Figure 1. World Population Growth, 1700 – 2100 [22].

While affluent countries with moderate population growth typically enjoy a high standard of living, the scenario starkly differs in emerging nations like Nigeria, which are characterized by rapid population growth. The concomitant increase in population, without corresponding advancements in agricultural production, exacerbates the prevalent global food shortage crisis. Consequently, numerous governments, Nigeria included, have prioritized ensuring access to adequate food for their citizens. Such initiatives are imperative not only for averting social unrest during periods of food scarcity but also for fostering an environment conducive to strategic economic development by meeting the basic physiological needs of the workforce [23], [24].

The globalization of agricultural markets has catalyzed the emergence of novel consumer behaviors and distribution networks. In response, contemporary agricultural practices emphasize optimizing all facets of the value chain to mitigate agricultural losses, reduce wastage, and enhance production efficiency. Through collaborative efforts encompassing production, processing, and marketing activities, businesses within the value chain synergize to meet market demands effectively. This market-centric collaboration extends across various sectors, including production, processing, marketing, food service, retail, and ancillary entities such as suppliers, shippers, and research institutions. Together, these entities form an agri-food value chain to enhance competitive advantage through cooperative endeavors.

The agricultural value chain concept underscores the holistic optimization of the agro-system through the specialization of its constituent parts. Consequently, the degree of agricultural value chain development and environmental degradation within a community, region, or country correlates directly with the pace of population dynamics [25].

There is mounting demand on agricultural value chains to ensure the continued production, distribution, and consumption of food sustainably. This promotes human welfare in Otukpo LGA, Benue State, due to the growing and more well-off population. Consequently, private companies, government agencies, and non-governmental organizations (NGOs) have a resurgent interest in studying how agricultural and food markets might contribute to environmentally and socially responsible growth [26], [27]. Many social and environmental issues are plaguing agricultural value chains, which are also seeing significant changes. The condition of natural resources has been profoundly affected by population dynamics, particularly the annual absolute growth in human numbers due to natural increase and migration. The ever-increasing human population threatens the correct operation of the ecosystem and natural resource stocks. Rapid population increase is a direct cause of degraded soil, water, and forest resources and declining land holdings in many parts of the developing globe.

According to Drechsel, Kunze, and Vries [10], humans are fundamentally altering the diversity of life on Earth, and many of these alterations signify a substantial loss of biodiversity, often irreversible. This sentiment is echoed by the Millennium Ecosystem Assessment (MEA) [28], which emphasizes the substantial impact of human activities on Earth's biodiversity. Rees (2011) states that Rivers State is located in sub-Saharan Africa, home to a large portion of the world's population, and much of the projected population growth over the next four decades will occur in less developed countries [29]. This highlights the critical role of less developed regions, such as sub-Saharan Africa, in global population dynamics and their implications for biodiversity.

Politics, agriculture, sustainable development, the environment, food security, and migration are generally affected by the increasing population of Otukpo LGA, Benue State, and Nigeria. Modern studies in Nigeria have shown that the country's ever-increasing population is a significant contributor to many problems, including but not limited to traffic jams, low food production rates, high unemployment rates leading to social unrest, and a host of environmental hazards like deforestation, flooding, oil spills, desertification, logging, and soil degradation. Otukpo LGA's population grew from 190,457 in 1991 to 266,411 in the 2006 NPC census and is anticipated to reach 384,600 by 2022, according to the National Bureau of Statistics, an annual growth rate of 2.3%. Otukpo LGA, Benue State, is currently grappling with the issue of diverse environmental degradation caused by the state's obsession with increasing agricultural productivity and value chains at the expense of resource and environmental sustainability. This is all to feed the state's growing population.

The effect of population dynamics on the agricultural value chain in Otukpo LGA, Benue State, is exacerbated by shifting demographic trends. This intensifies pressure on limited resources and alters traditional farming practices, leading to increased environmental degradation. The changing demographic worsens environmental conditions by intensifying land use for agricultural purposes, resulting in deforestation, soil erosion, and loss of biodiversity. Additionally, in Otukpo LGA, Benue State, the agricultural value chain significantly contributes to environmental degradation through unsustainable farming practices. These include excessive chemical fertilizers and pesticides, improper waste disposal, and land degradation from continuous cultivation without adequate restorative measures.

2. Theoretical Review

2.1. Conceptual Clarifications

2.1.1. Population Dynamics

Population dynamics refers to the study of how many individuals constitute a population and how this number changes over time. It involves mathematical descriptions of fluctuations in population size and age distribution. According to Anyanwu [30], the population in Economics refers to the number of people residing in a specific location, such as Lagos, Abuja, Aba, Port Harcourt, or Uyo.

Population dynamics are influenced by migration, mortality, and births. The birth rate, representing the rate of new baby births, contributes to population growth and shrinkage when low [31], [32].

Conversely, the death rate (D) reflects a nation's mortality rate; high mortality rates lead to population decline, while low rates foster population growth. The natural growth rate, a sum of birth and mortality rates, determines population change. Anyaele [33] defines migration as the movement of people into and out of a country over time. Migration can be categorized into immigration, where individuals enter another nation, leading to population growth, and emigration, where individuals leave their home country to reside elsewhere, potentially decreasing the population of their country of origin.

2.1.2. Agricultural Value Chain

Since the turn of the century, those engaged in agricultural development in underdeveloped nations have mainly used the agricultural value chain idea. The phrase often denotes the whole spectrum of commodities and services required to transport an agricultural product from the farm to the end-user or consumer. At the same time, no such consensus has been reached on a precise definition. Interconnected actors producing and transporting commodities to consumers via a series of actions are central to the notion of the agricultural value chain. The value chain is defined by Evan Tarver [34] as the series of steps that businesses take in primary resources, transform them into a completed product by adding value via various processes, and then sell it to customers. The value chain is the series of steps in creating, distributing, and promoting a product or service.

The United Nations Food and Agriculture Organization (FAO) defined a value chain in agriculture in 2005 as A 'value chain' that identifies the set of actors and activities that bring an essential agricultural product from production in the field to final consumption, where value is added to the product at each stage [35]. This definition suggests that a value chain can involve input supply, manufacturing, processing, marketing/trade, and a vertical connection or a network of independent corporate organizations.

In contemporary agricultural value chains, standardization at every stage, agro-industrial processing, vertical coordination, and supply base consolidation are typical features [36]. Such value chains often involve various actors and activities that contribute to adding value to the agricultural product throughout its journey from production to consumption. The term "value chain" is frequently used alongside "supply chain." Traditional agricultural value chains, on the other hand, are often controlled by spot market transactions involving numerous small merchants and producers. However, in modern agricultural contexts, there is a shift towards more organized and coordinated value chains to enhance efficiency and maximize value addition at each stage.

2.1.3. Environmental Degradation

Environmental degradation, defined by the United Nations International Strategy for Disaster Reduction (UNISDR) [37], encompasses the decline in the environment's ability to meet societal and ecological needs. Tyagi et al. [38] argue that the depletion of natural resources like soil, water, and air contributes to ecosystem deterioration. Similarly, Chopra [39] posits that the consumption of assets such as air, water, and soil leads to environmental degradation, culminating in wildlife extinction and earth disintegration. Environmental degradation identifies urbanization, population growth, agricultural expansion, industrialization, transportation development, foreign indebtedness, and market failures [39]. Moreover, theoretical frameworks such as the Malthusian, Boserupian, and Demographic Transition Theories offer insights into the sustainability of human populations, agricultural practices, and natural ecosystems, thus providing valuable perspectives for addressing environmental challenges.

2.2. Theoretical Literature

2.2.1. Malthusian Theory

In his seminal work "Essay on Population 1798," Reverend Thomas Robert Malthus expressed concerns about Britain's politics and economy due to the expanding population's impact on food production. Malthus proposed a theory asserting that societal motivations and character traits evolve significantly over time and that complete equality within any community is unattainable. He argued that poverty, inherent to every community, cannot be eradicated solely through governance changes. Malthus contended that a shortage of resources would arise if population growth outpaced food production, foreseeing potential environmental degradation. He suggested measures to slow population growth, categorizing them as positive checks (war, disease) or preventative checks (abstinence, delayed marriage) [3].

Classical economics supports Malthus's view, positing that rapid population increase contributes to environmental deterioration. Economist Thomas Robert Malthus argued that the food supply grows slower than the population, advocating for actions to lower fertility rates. Neo-Malthusian scholars, such as Paul Ehrlich and Hardin [40], suggest fertility reduction to improve living

conditions and mitigate environmental harm. They believe current demographic trends validate Malthus's predictions.

Contrarily, neoclassical economists attribute environmental degradation to market inefficiencies and poor government policies. They propose measures to enhance market efficiency, such as cutting subsidies promoting resource overexploitation and ensuring individuals bear the total costs of resource use [41]. This perspective highlights the role of government policies in addressing environmental challenges.

2.2.2. Boserupian Theory

Boserup, a Danish economist, also established the Boserupian theoretical framework. This idea elucidates the connection between population shifts and agricultural technology advances. Her theory states that, rather than a barrier to agricultural development, people's increasing numbers stimulate new agricultural techniques through agricultural intensification, livelihood diversification, and stimulating out-migration to cope with the changing situation [4], [41]. For instance, the annual cropping system exemplifies how population pressure over time turns shifting cultivation, which requires more land to practice, into a land-saving and labor-intensive type of agriculture [42].

2.2.3. Demographic Transition Theory

Warren Thompson's demographic history explanation, proposed in 1929, lays the foundation for the concept of "demographic transition." This phenomenon and theory delineate the historical shift from societies characterized by low levels of technology, education (especially among women), and economic development to societies marked by high levels of these factors, with various stages in between. Central to this transition is a pattern of declining birth and infant mortality rates. However, while this transition has occurred in many developed nations, its applicability to specific countries may vary due to the diverse social, political, and economic factors influencing different populations. Demographic transition theory discusses the transformation in a nation's population structure resulting from economic growth. Despite some disagreement among researchers regarding the causal relationship between declining birth rates and societal progress, there is consensus across the social sciences regarding the existence of demographic transition. The debate persists over whether lower populations precede industrialization and higher incomes or vice versa. Factors such as increasing demand for human capital, lower mortality rates, provision of old-age security, and higher per capita income are contested as to their roles in this process [43].

2.3. Empirical Literature

Udoinyang Nathan [44] investigates the relationship between the agricultural value chain and environmental deterioration in the state of Akwa Ibom. All of Akwa Ibom State's residents make up the study's population. A total of 400 samples were produced using the Taro Yamane formulas. The three senatorial districts that comprised Akwa Ibom State were arranged so that 400 questionnaires were deliberately allocated among two local government areas from each district. The study's research topics were examined utilizing the standard deviation and mean statistical tools in SPSS, using a 3.0 mean threshold. According to the results review, climate change, deforestation, ecosystem loss, soil nutrient contamination, water pollution, and inter-community road damage are all consequences of the agricultural value chain that contribute to environmental degradation in Akwa Ibom State. Based on the study's findings, sustainable agricultural development and an environment free of degradation are within reach in Akwa Ibom State if public policies address the issues plaguing the agricultural value chain. This chain is essential for citizens and industries, providing the raw materials for their products.

Population dynamics in Akwa Ibom State influence biodiversity loss, congestion, land pollution, increased greenhouse gas emissions, deforestation, and other environmental degradation. According to the research, inadequate public policy design to mitigate environmental degradation contributes to population dynamics. Environmental sustainability can shape the daily decisions made by residents, non-indigenous individuals, and the government of Akwa Ibom State [45]. This influence can pave the way for a sustainable environment, contingent upon implementing policies regulating birth rates and mitigating the environmental impacts of producing and consuming goods and services.

Majeed and Ozturk [46] analyzed panel data spanning 180 nations from 1990 to 2016 to examine the correlation between environmental degradation and population health. The analysis employed a fixed-effects technique following the Hausman test, two-stage least squares (2SLS), and system-generalized method of moments (SGMM) methodologies. The findings showed that environmental deterioration has a detrimental effect on people's health. Accordingly, the research finds that policies to reduce environmental deterioration should be coordinated with health-related changes.

Researchers examined the impact of carbon emissions on migration between Chinese provinces [47]–[49]. Their model estimates the inter-spatial transfer fluxes of household carbon emissions, split down into flows from

rural areas to urban centers, from urban centers to rural areas, and from urban centers to urban centers. This helps to capture the core purpose of the study. The research found that the overall national residential carbon emission was higher due to China's non-Hukou migration. The majority of the transfers occurred between eastern and central China. The northern provinces were likewise unique destinations because of the energy structure's significant carbon content. Among the most critical issues were differences in domestic energy consumption patterns between regions, imbalances in regional economic growth, and the connection between origin and destination.

Analyzed the magnitude of migration affected by climate change, particularly in Africa [50]. The research found that environmental change impacts African migration, based on qualitative and quantitative studies encompassing 53 nations. Consequently, the research deciphers the intricate interplay between the kind and length of environmental pressure and the people's means of subsistence.

Researchers Godson-Ibeji and Ubochioma [51] and Qadir et al. [52] examined how pollution affected crop yields in poor nations. Pollution is a global issue that has far-reaching consequences for human health and agricultural output, as shown in a case study of Nigeria. This has the potential to impede sustainable development. Soil fertility, crop growth, and crop production were the three variables that were measured using questionnaires in order to establish the study's goals and objectives. We used frequency tables and percentages to analyze data from 360 surveys distributed using a multistage sampling strategy. According to the results (82%), soil fertility and nutrient levels are diminished by environmental contamination. Pollution has a detrimental impact on agricultural production in Nigeria as it stunts crop growth and reduces crop output by 80%. Thus. It was suggested that in order to maintain any significant growth, the country's environmental concerns should be addressed right now. Lakshmana [53] stated that analyzed the impact of population shifts on pollution in India. In his pursuit of knowledge about how to lessen the environmental impact and make better use of our resources. Although shifting demographics affect the natural world, the research found that this issue is not worth much consideration.

According to Eshete et al. [54], in the multiple regression analysis, agricultural production and family well-being are significantly impacted by CO2 emissions. The no-CRGE scenario predicts a 4.5% decline in agricultural gross domestic output in the 2020s compared to the baseline. CO2 emissions reduce agricultural productivity (both traded and non-traded) but do not affect cattle. The relevant literature surveyed the opinions of several scholars. Three fundamental theories—the Malthusian, Boserupian, and Demography transition theory—formed the basis of the theoretical framework [55]. Population dynamics, the agricultural value chain, and environmental degradation were all topics in the literature review that were pertinent to the research. While conducting the literature analysis, the researcher found that only Mulatu et al. [56] looked at how population dynamics affected farming and were willing to accept the conclusion that CO2 emissions had a detrimental effect on crop yields and family income. The researcher also noted that most studies examining the impact of population dynamics on the environment concluded that an increase in population dynamics causes various environmental degradation, including air pollution, land pollution, biodiversity loss, land degradation, and freshwater loss. The effects of environmental degradation on agricultural sector productivity in Nigeria have been studied by Godson-Ibeji and Ubochioma [51] and Udoinyang Nathan [44], as noted by the researcher. Not only did not a single one of these studies take place in Otukpo LGA, Benue State, but not a single one of them addressed the combined effects of population dynamics, environmental degradation, and the agricultural value chain. Thus, this study differs from others in that it uses Otukpo LGA, Benue State, as a case study to investigate the effects of population dynamics on the agricultural value chain, the effects of population dynamics on environmental degradation, and the effects of the agricultural value chain on environmental degradation simultaneously.

3. Material and Methods

3.1. Research Design

The study adopts a survey research design to thoroughly examine the impact of population dynamics on both the agricultural value chain and environmental degradation within Otukpo LGA of Benue State, Nigeria. This design enables comprehensive data collection to effectively address the research objectives, combining primary and secondary data sources for a comprehensive analysis.

3.2. Population and Sample

The study population comprises all 13 clans/wards within Otukpo LGA. According to the 2006 census, the total population was estimated at 266,411, and a projection by the National Bureau of Statistics anticipated a figure of 384,600 for 2022. Using Taro Yamane's formula [57], the population size was pragmatically reduced to 400 for the study. The entire 13 clans/wards in Otukpo LGA were purposively selected as the sample, ensuring

representation across the diverse demographics of the region.

3.3. Sampling Technique

Purposive sampling techniques were strategically employed to select the sample population. This approach ensures the inclusion of diverse perspectives across Otukpo LGA's 13 clans/wards, enabling a comprehensive exploration of population dynamics and their effects on agricultural practices and environmental conditions. By purposively selecting all 13 clans/wards, the study aims to capture a broad spectrum of viewpoints and experiences, facilitating a thorough understanding of the research phenomena.

3.4. Research Instrument

A meticulously crafted self-structured questionnaire titled Population Dynamics, Agricultural Value Chain, and Environmental Degradation (PDAVCED) serves as the primary tool for data collection. This questionnaire, divided into four sections comprising 33 parts, was methodically designed to elicit responses relevant to the study's objectives. It encompasses inquiries regarding population dynamics, agricultural practices, and environmental issues specific to Otukpo LGA, ensuring a comprehensive exploration of the research themes.

3.5. Data Collection and Analysis

Data presentation employs descriptive statistical tools, including tables, percentages, and averages, to depict the collected data. The Likert scale, encompassing responses ranging from "Strongly agreed" to "Strongly disagree," facilitates nuanced data collection, capturing varying degrees of respondents' perspectives. The Statistical Package for Social Science (SPSS) is utilized for data analysis, employing Mean and Standard Deviation to ascertain the magnitude of agreement or disagreement with the research questions. A mean criterion of 3.0 delineates agreement or disagreement, ensuring a rigorous analysis of the findings.

4. Result and Discussion

4.1. Respondents' Characteristics and Classification

Respondents' socio-demographic characteristics are analyzed, providing insights into their backgrounds and profiles. The information collected includes respondents' place of birth, sex, age, residence area, education level, and profession. This data allows for a comprehensive understanding of the diverse perspectives and experiences of the participants in the study.

Table 1. The Breakdown of Questionnaires Administered and Returned

Clans/Wards	Distribute	Returned	Percent (%)
Allan	30	29	7.25
Adoka-Icho	30	28	7.00
Adoka Ehaji	30	26	6.50
Entekpa	30	28	7.00
Ewulo	30	29	7.25
Okete	30	26	6.50
Otobi	30	29	7.25
Otukpo Town Central	40	40	10.00
Otukpo Town East	30	30	7.50
Otukpo Town West	30	29	7.25
Ugboju-Ehaje	30	29	7.25
Ugboju-Icho	30	28	7.00
Ugboju-Otahe	30	29	7.25
Total	400	380	95.00

The distribution and return rates of the questionnaire are shown in Table 1. 400 questionnaires were issued to thirteen (13) clans or wards of Otukpo LGA, Benue State, and 380 were returned, accounting for 95% of the total.

Table 2. Genders of the Respondents

Genders	Frequency	Percent (%)
Male	175	43.70
Female	225	56.30
Total	400	100.00

According to Table 2 above, out of 400 respondents, 175 were male (or 43.7% of the total), while 225 were female (or 56.3%). This means that there were more female replies than male ones.

Table 3. Age of the Respondents

Age	Frequency	Percent (%)
18 – 30 years	60	15.00
31 – 45 years	55	13.70
46 – 60 years	100	25.00
61 and above	185	46.20
Total	400	100.00

According to Table 3, most respondents (185 people, or 46.2%) fell into the age bracket of 61 and higher. Sixty people, or around 15%, were in the 18–30 age bracket. One hundred people, or 25% of the population, are in the 46–

60 age bracket, while the smallest age bracket, 31–45, accounts for 13.7% of the total. This indicated that the age brackets 46–60 and 61 and above comprised most responders.

Table 4. Occupation of the Respondents

Occupation	Frequency	Percent (%)
Retired Civil Servants	70	17.50
Farmers	195	48.80
Students	55	13.70
Traders	80	20.00
Total	400	100.00

Table 4 displays the results for all six LGAs, showing that 70 respondents, or 17.50% of the interviewees, are retired civil personnel. Are 195 farmers among the total responses, making up as much as 48.80 percent. Once again, 55 people, or 13.70% of the total, are students, while 80 people, or 20%, are traders.

Table 5. Academic Level of the Respondents

Academic Level	Frequency	Percent (%)
FSLC	50	12.50
WAEC	185	46.20
B.SC	120	30.00
Postgraduate	45	11.20
Total	400	100.00

Table 5 reveals that out of the total population considered for this research, 185 people (or 46.2%) have a WAEC, and 120 people (or 30%) have a B.SC. Fifty people, or 12.5% of the total, have an FSLC, while forty-five people, or 11.2%, have a postgraduate degree. According to these results, most respondents in the six local governments must have a WAEC or B.SC.

4.2. Research Question One.

This section explores the effects of population dynamics on the agricultural value chain within Otukpo Local Government Area (LGA) of Benue State, Nigeria. Population dynamics encompass population growth, migration patterns, and demographic changes, which can significantly influence agricultural activities and the associated value chain processes. Understanding the implications of population dynamics on the agricultural value chain is crucial for devising effective strategies to address challenges and leverage opportunities for sustainable agricultural development in the region.

Q1: What is the impact of population dynamics on the agricultural value chain in Otukpo LGA in Benue State?

Table 6. Respondents' Perceptions on the Impact of Population Dynamics on Agricultural Value Chain.

S/N	Factors	Mean	Std Dev.	Decision
1	An increase in population increases Labor/human resources available to work in agricultural farmland, thereby increasing agricultural product production.	2.92	1.14	Disagreed
2	Population dynamics increase the demand for agricultural products.	3.59	0.78	Agreed
3	An increase in the demand for agricultural products leads to an increase in farmers' revenue.	3.59	0.73	Agreed
4	Farmers apply modern means of technology in order to meet their demands.	2.89	1.15	Disagreed
5	An increase in population brings about an increase in the application of storage facilities.	3.11	0.82	Agreed
6	Population increase brings about a decrease in the availability of agricultural farmlands.	3.46	0.59	Agreed
7	The increase in population led to the destruction of farmlands.	3.53	0.55	Agreed
8	The activities of industries and residents pollute most farmlands.	3.42	0.64	Agreed
9	Most of the rivers are being polluted by the activities of industries and residents in the state	3.47	0.53	Agreed
10	Soil nutrients and crops planted on farmlands close to houses are washed away by water that rushes from these houses' roofs, compounds, and gutters.	2.99	0.94	Disagreed
11	An increase in population leads to using artificial nutrients such as fertilizers and chemicals to fasten the crop maturity rate and meet its demand.	3.20	0.83	Agreed
12	Population growth brings about pollution, such as air pollution and climate change, which sometimes affect the planting season.	3.10	0.81	Agreed
	Total	3.27	0.75	Agreed

The influence of population dynamics on the agricultural value chain in Otukpo LGA, Benue State, was the first study topic, and Table 6 shows the respondents' replies to this issue. The highlighted challenges in Otukpo LGA, Benue State, such as population rise, pollution, artificial agricultural nutrients, and climate change, are addressed in twelve (12) solution items in Table 7. From items 1 to 12, the table displays the average and standard deviation of how respondents in Otukpo LGA, Benue State, saw the influence of population dynamics on the agricultural value/food chain. Most items have a mean higher than the 3.0 mean criteria, as seen in Table 7. With a standard deviation of 0.75 and an aggregate mean of 3.27, the results surpass the mean criteria of 3.0. The respondents in Otukpo LGA, Benue State, seem to agree about the effect of population dynamics on the agricultural value chain.

4.3. Research Question Two.

This section examines the effects of population dynamics on environmental degradation within Otukpo Local Government Area (LGA) of Benue State, Nigeria. Population dynamics, including population growth, urbanization, and migration, can exert significant pressure on natural resources and ecosystems, leading to environmental degradation. Understanding the linkages between population dynamics and environmental degradation is essential for devising sustainable management strategies and mitigating adverse impacts on ecosystems and biodiversity.

Q2: How does population dynamics impact environmental degradation in Otukpo LGA, Benue State?

Table 7. The Perceptions of Respondents Regarding the Influence of Population Dynamics on Environmental Degradation

S/N	Factors	Mean	Std Dev.	Decision
1	Due to an increased population, more waste is being dumped in the environs.	3.44	0.67	Agreed
2	One by-product of population growth is the stress on freshwater, leading to its shortage.	3.31	0.74	Agreed
3	The population increase led to biodiversity loss.	3.63	0.64	Agreed
4	Population growth leads to congestion in the environs.	3.35	0.74	Agreed
5	The establishment of industries has led to environmental degradation.	3.11	0.91	Agreed
6	Population growth increases land degradation through land pollution.	3.43	0.73	Agreed
7	The expansion of transportation options emits significant amounts of harmful gases like carbon monoxide, nitrogen oxides, and hydrocarbons, which result from population growth.	3.53	0.55	Agreed
8	Population growth is directly linked to the escalation of greenhouse gas emissions.	3.14	0.91	Agreed
9	The surge in population results in heightened levels of water and land pollution, consequently diminishing overall productivity.	3.27	0.80	Agreed
10	Using outdated technology such as vehicles, generators, and motor vehicles has contributed to noise and air pollution, disrupting the natural environment.	3.48	0.55	Agreed
11	Deforestation, driven by population growth, has resulted in the depletion of vital plant and animal habitats.	3.53	0.63	Agreed
12	Many trees, essential for providing shelter and oxygen to the environment, are being felled to construct residences for the expanding population.	3.42	0.65	Agreed
13	Numerous creeks and waterways are being filled to construct residences, commercial establishments, educational institutions, and places of worship, leading to floods and erosion.	3.48	0.57	Agreed
14	The increase in human and industrial activities has resulted in various spills and floods, adversely impacting the environment.	3.31	0.74	Agreed
	Total	3.39	0.70	Agreed

Table 7 shows the answers to study question two (2 to find out how population dynamics affect environmental degradation). Waste management concerns, water scarcity, biodiversity loss, traffic, environmental deterioration, greenhouse gas emissions, pollution, deforestation, flooding, and spills are addressed in fourteen (14) solution items in Table 8.

Otukpo LGA, Benue State residents' views on how population dynamics contribute to environmental deterioration are shown in Table 7, along with their standard deviations. All items have higher than the 3.0

mean criteria, as shown in Table 7 above. In addition, the mean criteria are 3.0, and the average obtained from the participants' responses is 3.39, with a standard deviation of 0.70. It is clear that the respondents in Otukpo LGA, Benue State, believe that population dynamics contribute to environmental deterioration.

4.4. Research Question Three.

This section focuses on exploring the viewpoints and opinions of respondents regarding the relationship between the agricultural value chain and environmental degradation within Otukpo Local Government Area (LGA) of Benue State, Nigeria. The agricultural value chain encompasses various stages of production, processing, distribution, and consumption of agricultural products, which can positively and negatively affect the environment. Understanding respondents' perceptions of this relationship is essential for identifying key issues, challenges, and opportunities for promoting sustainable agricultural practices and environmental conservation.

Q3: What do respondents believe about how the agricultural value chain affects environmental degradation in Otukpo LGA, Benue State?

Table 8. The Opinions of Respondents Regarding the Effects of Population Dynamics on Environmental Degradation.

S/N	Factors	Mean	Std Dev.	Decision
1	Expanding agricultural practices contributes to climate change as it disrupts the natural environment.	3.44	0.68	Agreed
2	Forest reserves are being depleted to make way for agricultural expansion, driven by the demand for agricultural products.	3.14	0.85	Agreed
3	The success of the agricultural value chain poses a threat to bush animals and the entire ecosystem.	3.31	0.68	Agreed
4	Agricultural activities, whether manual or mechanized, lead to the degradation of natural soil nutrients and pollution of water bodies by using chemicals and other substances, impacting soil texture.	3.46	0.61	Agreed
5	Unrecycled agricultural by-products contribute to an increase in waste production, elevating the state's overall waste levels.	3.10	0.81	Agreed
6	The growth of agricultural value chain activities results in the deterioration of inter-communal and state roads.	3.44	0.67	Agreed
	Total	3.32	0.72	Agreed

The results of research question three (3), which aimed to determine the effect of the agricultural value chain on environmental deterioration, are shown in Table 8. In Otukpo LGA, Benue State, six (6) questions in Table 8 ask about the effects of the agricultural value chain on environmental degradation. From Otukpo LGA, Benue State, we can see the average and standard deviation of the respondents' perceptions of how the agricultural value chain contributes to environmental degradation in Table 8. According to the data in Table 8, all items have a mean higher than the 3.0 threshold. Additionally, the standard deviation of 0.72 and the aggregate mean of 3.32 obtained from the respondents' responses are higher than the mean threshold of 3.0. Based on the responses, it seems that everyone in Otukpo LGA, Benue State, agrees that the agricultural value chain is to blame for the state of the environment.

The impacts of population dynamics on the agricultural value chain in Otukpo, LGA, Benue State, were uncovered by the results of the first research question. Table 6 shows the following effects of population dynamics on the value chain in agriculture: In Otukpo LGA Benue State, an increase in the population means more people working the land for agriculture, which means more food for the farmers. Demand for food also rises due to population growth, so farmers make more money. To keep up with demand, farmers are turning to modern technology. Otukpo LGA Benue State is experiencing an increase in the use of storage facilities for agricultural product preservation. This is due to several factors, including a decrease in available farmlands, destruction of farmlands, pollution of farmlands and rivers caused by industrial activities, runoff from nearby houses washing away soil nutrients and crops, and the artificial use of fertilizers and chemicals to speed up crop maturity to meet demand. Lastly, air pollution and climate change are two significant pollutants caused by population growth.

Research question one's results are consistent with those of Mulatu et al. [56] and Elahi et al. [58] in that improperly handled inputs like chemical fertilizers and pesticides can cause a host of environmental problems, including water pollution, the loss of beneficial insects, and a decline in soil fertility, as well as human health hazards. As a result, this study has accomplished its specific objective of demonstrating the impact of population dynamics on the agricultural value chain in Otukpo LGA,

Benue State, through the findings of research question one and the associated empirical literature evidence.

Otukpo LGA, Benue State, was the site of environmental deterioration, as shown by the results of the second study question. Table 7 shows the effects of population dynamics on environmental degradation in Otukpo LGA, Benue State. These include an increase in waste dumping, a decrease in biodiversity, increased congestion, and more environmental degradation due to industrialization. A shortage of fresh water is also a consequence of population growth. The population growth in Otukpo Local Government Area (LGA), Benue State, has spurred the adoption of various transportation modes, resulting in the emission of significant quantities of harmful gases such as carbon monoxide, nitrogen oxides, and hydrocarbons. This surge in population has also led to a rise in greenhouse gas emissions, exacerbating environmental challenges. Furthermore, the increasing population has increased water and land pollution levels, diminishing the area's productivity.

The utilization of outdated technology, including vehicles, generators, and motor vehicles, has contributed to noise and air pollution, disrupting the natural equilibrium of Otukpo LGA. Deforestation, driven by the need for housing to accommodate the expanding population, has resulted in the loss of crucial habitats for plants and animals. This includes the felling of trees that serve as vital sources of shelter and oxygen in the region.

Moreover, filling waterways for urban development, such as residential buildings, commercial establishments, schools, and places of worship, has led to flooding and erosion issues within Otukpo LGA. The escalation of human and industrial activities has further exacerbated environmental degradation, with various spills adversely impacting the area's ecosystem.

Consistent with previous studies, the second research question strengthens the assertion that increasing human populations cause deforestation [2], [50], [53], [59]–[63]. This is because, among other things, a growing human population clears forests for use as farms or construction materials, and soil erosion reduces ground cover and fuel wood supplies. As a result, this study has achieved objective two by demonstrating the impact of population dynamics on environmental degradation in Otukpo LGA, Benue State, through the findings of research question two and the associated empirical literature evidence.

The results of the third research question showed that the agricultural value chain contributes to environmental degradation in Otukpo LGA, Benue State. This is because increased farming practices cause climate change; deforestation happens because forest reserves are cleared to make way for farms and agricultural products; the success of the agricultural value chain, from seedling to consumer, puts the entire ecosystem and wildlife at risk; the use of chemicals and other substances to alter soil texture destroys natural soil nutrients; and the inability to recycle agricultural by-products leads to their disposal in landfills.

The results of this study's third research question corroborate those of Godson-Ibeji & Ubochioma [51] and Udoinyang et al. [44] in showing that, if not handled correctly, the increased use of chemical pesticides and fertilizers in agriculture can cause a host of environmental problems, including water pollution, the loss of beneficial insects, and a decline in soil fertility, among other things. According to our third specific objective, this study has shown how the agricultural value chain contributes to environmental degradation in Otukpo LGA, Benue State, based on the results of research question three and the relevant empirical literature.

5. Conclusion and Recommendations

Without a doubt, any given state or country's population, agriculture, and environment dictate its development and economy coupled with good government policies. There are a lot of environmental problems in Otukpo LGA, Benue State since the population is growing faster than the land can provide food. This is especially true in urban and semi-urban regions. Population dynamics are not the only thing causing issues in the agricultural value chain and environmental degradation; ineffective public policy design is also a significant contributor. Population, agricultural value chain, and environmental preservation are all compatible so long as rules are put in place to limit the birth rate and the environmental implications of our goods and services. Implementing these policies will ensure that all residents, including indigenous and non-indigenous people, as well as the council boss of Otukpo LGA and the government of Benue State, make decisions with an eye toward environmental sustainability. This, in turn, will benefit the entire population of Otukpo LGA and Benue State.

In light of the pressing need to address population dynamics and environmental sustainability in Otukpo Local Government Area (LGA), Benue State, several measures are proposed to mitigate the adverse impacts of population growth and promote ecologically sustainable practices. These recommendations, if implemented by the Benue State government and the local administration of Otukpo LGA, could significantly contribute to achieving a balance between population growth and environmental conservation:

Implementation of Family Planning Legislation: The government of Benue State and the head of Otukpo LGA should consider enacting legislation to limit family sizes to

two children per household. This measure aims to regulate population growth by promoting family planning practices and empowering individuals to make informed choices regarding reproductive health and family size. By encouraging smaller family sizes, this policy can help alleviate pressure on natural resources and mitigate the environmental impacts of population growth.

Introduction of Pigovian Taxation for Environmental Conservation: To deter environmentally harmful activities and incentivize sustainable practices, the Benue State government and the council boss of Otukpo LGA should introduce Pigovian taxation. This taxation system imposes levies on private individuals, businesses, and enterprises engaged in activities detrimental to the environment. These taxes can be reinvested in environmental conservation efforts, such as reforestation initiatives, pollution control measures, and ecosystem restoration projects. By internalizing the environmental costs of economic activities, this policy promotes responsible behavior and fosters a culture of environmental stewardship.

Support for Adoption of Modern Agricultural Practices: To enhance agricultural productivity while minimizing environmental degradation, the head of Otukpo LGA council, the Benue State government, and non-governmental organizations (NGOs) should collaborate to support farmers and businesses in adopting contemporary production methods and technology. This support can be provided by providing necessary tools, training programs, and financial assistance, including low-interest loans, to enable farmers to invest in sustainable agricultural practices. By promoting the adoption of efficient and environmentally friendly farming techniques, such as agroecology and precision agriculture, this initiative aims to increase yields, conserve natural resources, and reduce the ecological footprint of agricultural activities.

Improvement of Transportation Infrastructure: To facilitate the transportation of agricultural surplus from agriculturally rich areas to regions with high demand, both within and outside of Benue State, it is imperative to invest in the construction of high-quality highways in urban, semi-urban, and rural parts of Otukpo LGA. Improved transportation infrastructure will enhance market access for farmers, promote trade, and stimulate economic growth while reducing post-harvest losses and food waste. Furthermore, efficient transportation networks can contribute to regional development and alleviate pressure on local ecosystems by reducing the need for expansion into environmentally sensitive areas.

Implementing these policy recommendations holds the potential to foster ecologically sustainable population levels in Otukpo LGA, Benue State. Addressing the complex interplay between population dynamics, environmental degradation, and socio-economic development contributes to achieving a harmonious balance between human activities and the natural environment, ensuring the well-being of present and future generations.

Acknowledgments

I want to express my sincere appreciation to all those who contributed to completing this paper. Special thanks to my lovely and wonderful wife, Mrs Veronica Nathan Udoinyang and all the family members of Pastor Testimony Matthias Agada, whose insightful guidance and expertise greatly enriched the content and their invaluable support and encouragement throughout the research process. Their contributions and guidance have been instrumental in shaping the outcome of this work, and I extend my heartfelt thanks to each of them.

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