The Impact of Agriculture Subsidies on Smallholder Farmers in Liberia

(Case Study Bong, Nimba and Lofa counties)

Prepared by

Liberia Macroeconomic Policy Analysis Center (LIMPAC)

Abstract

This study examines the impact of agricultural subsidies on the productivity of smallholder farmers in three Liberian counties: Bong, Lofa, and Nimba. The research addresses a key gap in the existing literature, which lacks a quantitative assessment of the direct causal effects of subsidy programs on productivity metrics in Liberia. Using a cross-sectional survey design, the study collected both primary quantitative and qualitative data from a sample size of 300 smallholder farmers using a mixed method analysis. The analytical framework included a Generalized Linear Models (GLMs) and thematic coding of interview and focus group discussion (FGD) transcripts. Various tests were conducted including Omnibus/ANOVA test to observe the validity of the model, and the results proved statistically significant.

The findings provided evidence that agricultural subsidies have a significant and positive effect on smallholder farmer productivity. The results indicate a strong positive link between a farmer's access to grants and their ability to adopt modern farming methods, with subsidies increasing productivity by 95.6% for every positive step taken toward these new practices. However, the study also confirms a significant negative relationship, showing that for every increase in challenges farmers face in obtaining a grant, the positive impact of the subsidy on their productivity decreases by 52.9%. This highlights how administrative and logistical obstacles, such as complex application processes and delayed delivery of inputs, undermine the program's effectiveness.

The findings concludes that agricultural subsidies are a powerful tool for improving productivity and food security in Liberia, but their full potential is not being realized due to significant implementation challenges. Based on these findings, the study recommends simplifying application processes, improving communication, ensuring timely delivery of inputs, and strengthening extension services to make these programs more effective, sustainable, and equitable for the country's smallholder farmers.

Contents

List of Tables

List of Figure

List of Acronyms

- **AfDB:** African Development Bank
- **AIC:** Akaike's Information Criterion
- **ASRP:** Agricultural Sector Rehabilitation Project
- **BIC:** Bayesian Information Criterion
- **FGDs:** Focus Group Discussions
- **GAFSP:** Global Agriculture and Food Security Program
- **GDP:** Gross Domestic Product
- **GLM:** Generalized Linear Models
- **IFAD:** International Fund for Agricultural Development
- **OLS:** Ordinary Least Squares
- **SAPEC:** Smallholder Agricultural Productivity Enhancement and Commercialization Project

- **STAR-P:** Smallholders Agriculture Transformation and Agribusiness Revitalization Project
- **USAID:** United States Agency for International Development
- **VIF:** Variance Inflation Factors

Chapter 1: Introduction

1.1 Background

Agriculture is a vital component of Liberia's economy. It contributes about 38.8% of its GDP and supports the livelihoods of 70%[1] of the population. Agriculture plays a significant role in employment and economic growth. Women are particularly important in this sector, as they produce more than 60%[2] of the agricultural output. Despite the sector's importance, approximately half of the population faces food insecurity. This food insecurity is primarily due to low productivity, which is a consequence of structural challenges, poor policies, and the lingering effects of past conflicts that have damaged resources and infrastructure (World Bank, Liberia Economic Update: Investing in Human Capital for Inclusive Growth, 2022).

Smallholder farmers are the majority of agricultural producers and provide most of the country's staple foods. However, they face numerous challenges, including limited access to credit, basic farming tools, and extension services. They are also susceptible to climate variability (FAO, 2020). In response, the Liberian government and various development partners have introduced agricultural subsidies, such as grants and inputs like seeds, fertilizers, and pesticides, to boost production.

The Smallholder Agricultural Productivity Enhancement and Commercialization (SAPEC) Project is a notable example. It was designed to reduce rural poverty and food insecurity by increasing the income of smallholder farmers and rural entrepreneurs, with a specific focus on women, youth, and people with disabilities. Funded by the Global Agriculture and Food Security Program (GAFSP), SAPEC was built on the existing Agricultural Sector Rehabilitation Project (ASRP) and had support from the African Development Bank (AfDB), the International Fund for Agricultural Development (IFAD), USAID, and the World Bank. The project's four main components were: Sustainable Crop Production Intensification, Value Addition and Marketing, Capacity Building and Institutional Strengthening, and Project Management. A

[1] Statistics drawn from the Global Agriculture and Food Security Program. Seen at: Smallholder Agricultural Productivity Enhancement and Commercialization Project (SAPEC) | Global Agriculture and Food Security Program

[2] Please refer to reference 1 above.

key finding from a survey was a reduction in severe food insecurity and an increase in household income for communities that received subsidized inputs, which highlights the positive impact of subsidies on rural well-being (GAFSP, 2019) (AfDB, 2018).

The Smallholders Agriculture Transformation and Agribusiness Revitalization Project (STAR-P), was another initiative created to address market failures in the rice, oil palm, and horticulture value chains. This project was managed by the Ministry of Agriculture and funded by the World Bank and IFAD, aimed to increase agricultural productivity and promote smallholder commercialization for 38,000 farmers, with at least 30% being women (International Fund for Agricultural Development, 2020). The STAR-P project also works to facilitate private sector investment, strengthen links between smallholders and agribusinesses, and incorporate climate resilience measures (World Bank, 2019).

Evaluating the impact of subsidies on smallholder farmer productivity is crucial for informed policy decision-making. This study focuses on smallholder farmers in Bong, Lofa, and Nimba counties, where agricultural activities are widespread and subsidy programs have been implemented. By assessing the relationship between subsidies and farmer productivity, the study aims to provide evidence-based recommendations to improve the design and implementation of agricultural subsidy programs.

While agricultural subsidies are generally expected to boost productivity by reducing production costs and encouraging technology adoption, the extent to which they actually improve smallholder farmer outputs in Liberia remains inadequately studied. Some farmers have benefited from these subsidies, while others still struggle to access essential inputs and services (USAID, 2018). Additionally, there can be unintended consequences, such as a dependency on external support and market distortions, which could undermine the long-term sustainability of these interventions (Jayne & Rashid, 2013). Given the scarcity of empirical data on how agricultural subsidies have influenced crop yields, farm incomes, and overall productivity in Liberia, a detailed analysis using a robust methodological approach is necessary. This study aims to determine if subsidies are meeting their goals of increasing smallholder production and ensuring food security.

The study is guided by the following research questions:

- How do agricultural subsidies impact farm-level productivity, measured by output per land size or yield?
- What factors, besides subsidies, influence smallholder farmer productivity?
- What challenges and opportunities exist in implementing agricultural subsidy programs that target smallholder farmers?

The main objectives of this study are:

- To assess the current productivity levels of smallholder farmers in Bong, Lofa, and Nimba counties.
- To examine the impact of agricultural subsidies on smallholder farmer productivity.
- To identify other socio-economic and farm-specific factors that influence farmer productivity.
- To recommend policy strategies for more effective agricultural subsidy programs in Liberia.

1.2 Hypotheses

The study proposes the following hypotheses:

Null Hypothesis (H_0): Agriculture subsidies have **no statistically significant impact** on smallholder farmers in Liberia.

Alternative Hypothesis (H_1): Agriculture subsidies **have a statistically significant impact** on smallholder farmers in Liberia.

The findings of this study are expected to provide vital empirical evidence that will inform policymakers at the Ministry of Agriculture, non-governmental organizations, and donor agencies about the effectiveness of agricultural subsidies. The results will also help in designing targeted interventions that enhance productivity, thereby contributing to national goals of food security and improved rural livelihoods. Furthermore, this research will fill a

knowledge gap by offering contemporary insights into the Liberian agricultural subsidy landscape.

1.3 Scope and Limitations of the Study

This section delineates the boundaries and focus of the research, defining what the study aims to achieve (Scope) and the inherent constraints or weaknesses that may affect the generalizability or interpretation of the findings (Limitations).

1.3.1. Scope of the Study

The scope of this research is defined across three key dimensions: geographical, thematic, and temporal.

1. Geographical Scope: The study is confined to three major agricultural counties in Liberia: Bong, Lofa, and Nimba. The findings and conclusions drawn are based exclusively on data collected from smallholder farmers operating within these three regions and may not be fully representative of the entire national smallholder farming population.
2. Thematic Scope: The research focuses specifically on the impact of agricultural subsidies (measured by access to grants and the resulting adoption of modern farming methods) on smallholder farmer productivity (measured by yield and output). While socio-economic variables are included as control factors, the study does not delve deeply into the macro-economic effects of subsidies, such as market price distortions, or the broader political economy of agricultural development in Liberia.
3. Temporal Scope: The study employed a cross-sectional research design, meaning data was collected at a single point in time. Therefore, the analysis captures the immediate or short-term impact of the subsidy programs. The temporal scope is limited to the period leading up to and including the time of data collection.

1.3.2 Limitations of the Study

While the methodology was designed for rigor, several limitations must be acknowledged:

1. Cross-Sectional Limitation (Causality): Due to the cross-sectional design, the study establishes correlation and statistical association, but it cannot definitively establish a dynamic, causal relationship over time. It is unable to track the sustainability of productivity gains or detect long-term behavioral changes (such as dependency on subsidies) that would require a longitudinal (time-series) study.
2. Reliance on Self-Reported Data: Productivity metrics (yield, output)[3] and socio-economic variables were gathered through farmer questionnaires, relying on the respondents' memory and reporting accuracy. This introduces the potential for recall bias or conscious over/under-reporting, which could affect the precision of the quantitative results.
3. Model Specificity (GLM): The Generalized Linear Model (GLM) is a powerful tool, but like all statistical models, it simplifies reality. While it effectively models the association between subsidies and productivity, it may not capture all complex, non-linear interactions or contextual nuances inherent in agricultural policy implementation, such as complex social networking effects or local political challenges.
4. Limited Generalizability: The purposive selection of only three counties, while strategic for relevance, means that findings may not be directly generalized to all smallholder farmers in other Liberian counties that may have different soil types, market access, or regional subsidy program variations.

[3] The output was not quantified or measured per se. The researchers relied on the respondents responses. Respondents asserted that there have been significant increase in their production and harvest/output since the institution of subsidies.

Chapter 2: Literature Review

2.1 Introduction

This chapter provides a comprehensive review of existing literature on agricultural subsidies and their impact on smallholder farmer productivity. It begins by exploring the theoretical frameworks of agricultural subsidies, followed by a discussion of empirical evidence on their effectiveness. The chapter also examines the specific context of smallholder farming in Liberia, including the challenges and opportunities that shape the policy environment.

2.2 Theoretical Perspectives on Agricultural Subsidies

Agricultural subsidies are analyzed through several theoretical frameworks. The **Neoclassical Economics Theory or market failure theory** views subsidies as a means to correct market failures, such as high transaction costs or information asymmetry, that prevent smallholder farmers from accessing critical inputs and technologies (Barrett, 2008). According to the **Theory of Production and Cost**, subsidies reduce the marginal cost of inputs, which can lead to output expansion. This can allow farmers to adopt improved seed varieties, fertilizers, and mechanized tools, ultimately raising productivity (Ellis, 1992). The **input subsidy theory** specifically suggests that providing subsidies for essential inputs can lower production costs and increase yields, which enhances the profitability and sustainability of farming operations (Timmer, 2010).

However, other theories present a more critical view. The **Political Economy Theory** suggests that subsidies often arise from political incentives, where policymakers aim to secure rural votes or appease influential groups (Anderson, Rausser, & Swinnen, 2013). The **Public Choice Theory** indicates that subsidies can introduce inefficiencies if not well-targeted, as they may distort market signals, favor specific groups, or lead to corruption in implementation (Krueger, 1992).

2.2.1 Factors Influencing the Effectiveness of Subsidies

Few studies have been conducted that label several factors that influence the effectiveness of subsidies. Researchers have found differing opinions on these factors.

The findings from (Pan Y. , 2013) shows that the effectiveness of subsidies is highly dependent on the quality of implementation. He showed that factors such as timely delivery, transparency, and accountability play crucial roles in determining the success of subsidy programs.

(Gautam, 2000) discovered that the level of awareness and knowledge among farmers about subsidy programs and their proper utilization significantly influences the effectiveness of these programs. Education and extension services are critical in this regard.

According to (Tadesse & Shively, 2014), subsidies alone may not be sufficient to enhance productivity. Access to complementary inputs such as irrigation, credit, and market access is essential for maximizing the benefits of subsidies.

Socio-economic factors, including gender, age, education level, and household size, also influence the effectiveness of subsidies. These factors determine the capacity of farmers to adopt and benefit from subsidy programs (Doss, 2001).

2.3 Empirical Studies on the Impact of Subsidies

2.3.1 Positive Impacts on Productivity

Several empirical studies show the positive effects of input subsidies on smallholder farmer productivity in Sub-Saharan Africa. For instance, (Chirwa & Dorward, 2013) found that Malawi's Farm Input Subsidy Program significantly boosted maize yields and improved household food security. Similarly, (Jayne, Mather, & Mghenyi, 2010) reported that fertilizer subsidies in Kenya contributed to an increase in smallholder agricultural productivity, although the benefits were sensitive to timeliness of input delivery.

In other studies, (Rutherford, Burke, Cheung, & Field, 2016) evaluated the impact of a rural agricultural value chain project in Liberia on smallholder farmers and their families, particularly focusing on child wellbeing. Using a longitudinal quasi-experimental design, the research examines changes in farming practices, household economic welfare, food security, child health, education, and nutrition. The findings reveal that participating farmers

adopted modern agricultural techniques more effectively, which led to increased production and improved food access. However, the project did not result in significant changes in child outcomes, although positive trends were noted. The study shows that while agricultural interventions can enhance farm productivity and household assets, they may not sufficiently improve children's lives. To effectively address the poverty cycle, it is crucial for economic programs to monitor their impacts on children, ensuring that both farmers' welfare and children's wellbeing are prioritized.

2.3.2 Mixed Outcomes and Challenges

Contrary to the above, some studies highlight that subsidies might not always yield the desired outcomes. (Jayne & Rashid, 2013) argue that subsidies can be economically inefficient if they displace commercial sales of inputs or are diverted to unintended beneficiaries. In Tanzania, (Pan & Christiaensen, 2012) found that while input vouchers facilitated improved maize yields, the program’s usefulness varied based on household characteristics, extension services, and market accessibility.

In developing countries, subsidies have been found to have varying impacts. For instance, in Sub-Saharan Africa, input subsidies have led to increased yields and improved food security in some cases but have also been criticized for creating dependency and inefficiencies (Ricker-Gilbert, Jayne, & Chirwa, 2011).

Available studies suggest that subsidies have the potential to improve productivity, but their effectiveness is contingent on factors such as implementation quality, farmer awareness, and access to complementary inputs (FAO, 2016).

2.3.3 Sustainability Issues

Sustainability concerns loom large over subsidy programs due to their fiscal burden and potential distortion of market dynamics (World Bank, Liberia Economic Update: Investing in Human Capital for Inclusive Growth, 2022). Over-reliance on subsidies can foster dependency, undermine private sector participation, and hamper the development of efficient input supply chains (Ellis, 1992). Furthermore, issues of targeting and leakage can erode the beneficial impact that subsidies aim to produce.

2.4 Smallholder Farmer Context in Liberia

2.4.1 Socio-Economic Profile

Liberia's smallholder farmers typically cultivate less than five hectares of land and rely on family labor (FAO, 2020). They often have limited formal education, and household incomes depend heavily on farming activities. Infrastructure constraints, including poor roads and inadequate storage facilities, also affect their market access and profitability (World Bank, Liberia Economic Update: Investing in Human Capital for Inclusive Growth, 2022).

The Liberian government, in collaboration with international donors, has implemented several policies to improve agricultural productivity. Among these are input subsidy programs designed to provide seeds and fertilizers at subsidized rates. However, the effectiveness of these policies is undermined by logistical challenges, corruption, and limited extension services (USAID, 2018).

2.4.2 Empirical Gap

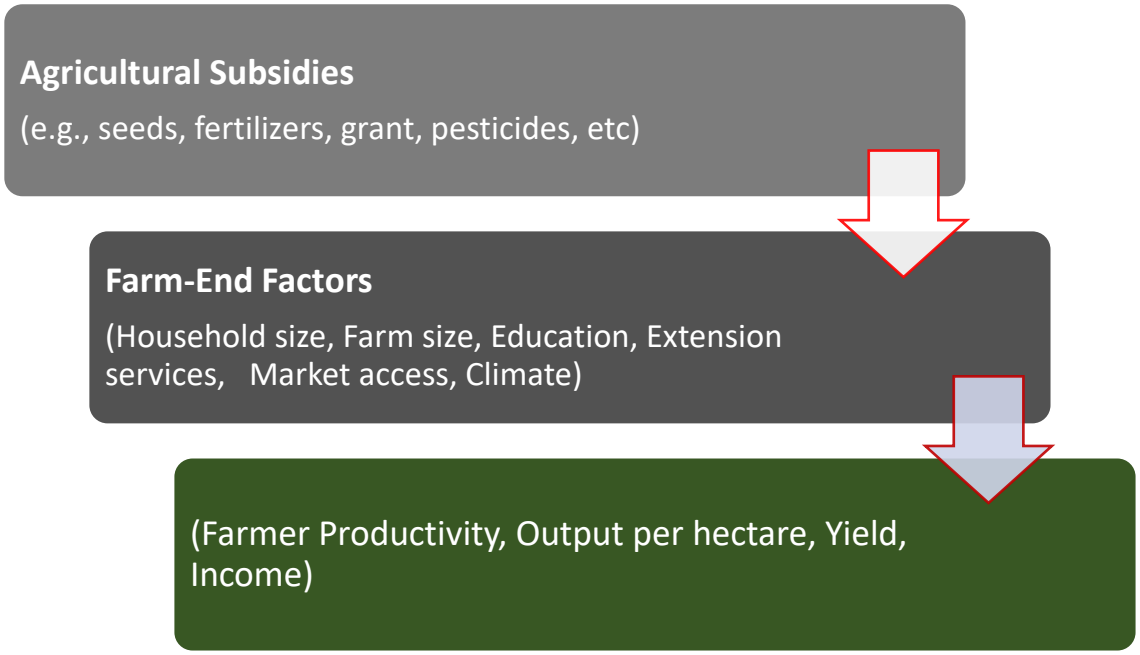
While several studies address the general constraints and opportunities in Liberian agriculture (FAO, 2020), few have quantitatively assessed the specific impact of subsidies on smallholder productivity. Most existing work takes a qualitative approach or focuses on broader rural development issues, leaving a gap in understanding the direct causal effects of subsidy programs on productivity metrics (World Bank, Liberia Economic Update: Investing in Human Capital for Inclusive Growth, 2022). There has been insufficient analysis of the interplay between subsidies and other factors influencing productivity in Liberia along with limited empirical evidence of the same.

2.5 Conceptual Framework

Drawing from the reviewed literature, the conceptual framework for this study speculates that agricultural subsidies (the independent variable) directly influence smallholder farmer productivity (the dependent variable). This relationship is moderated or mediated by factors such as household characteristics, farm size, access to extension services, market

infrastructure, and climate variability. Figure 1 provides a simplified illustration of the conceptual framework.

Figure 1: Conceptual Framework for the Impact of Agricultural Subsidies



Source: LIMPAC

2.6 Summary of the Literature Review

The existing body of research suggests that agricultural subsidies can enhance smallholder productivity if well-targeted and effectively administered. However, issues such as poor targeting, corruption, and market distortions pose significant challenges. In the Liberian context, empirical gaps remain regarding the direct impact of subsidy programs on yield and farm income, necessitating further investigation. The subsequent chapter outlines the methodology employed to address these gaps and fill the knowledge void in current scholarship.

Chapter 3: Methodology

3.1 Introduction

This chapter outlines the systematic procedures and techniques employed to investigate the impact of agricultural subsidies on the productivity of smallholder farmers in Liberia. It details the research design, the selection of the study area and population, sampling techniques, data sources, and the statistical model used for quantitative analysis. The methodological choices are justified to ensure the rigor, validity, and reliability of the research findings.

3.2 Research Design and Unit of Analysis

3.2.1. Research Design

This study adopted a **mixed-methods research design**, primarily utilizing a **cross-sectional survey** approach. The cross-sectional survey design was adopted to collect both quantitative and qualitative data from a diverse group of smallholder farmers within a specific timeframe. This approach was chosen for its practical feasibility, allowing data collection within time and budget constraints. It also offers analytical robustness, as quantitative data from structured questionnaires can be statistically analyzed, while qualitative insights from interviews and focus group discussions (FGDs) can enrich the interpretation and provide contextual understanding.

- **Quantitative Component:** The cross-sectional survey collected numerical data at a single point in time from a large sample of smallholder farmers. This was necessary for the statistical analysis of the causal relationship between subsidies and productivity using the Generalized Linear Model (GLM).
- **Qualitative Component:** The study incorporated qualitative data gathered through Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs). This complementary component was essential for enriching the quantitative findings, providing context, and obtaining in-depth insights into the socio-economic factors and challenges in subsidy implementation.

3.2.2 Unit of Analysis

The **unit of analysis** for this study is the **individual smallholder farmer** operating within the three selected counties. Data on demographic profile, subsidy access, challenges faced, and farm productivity metrics were collected directly from these individuals to draw conclusions about the subsidy's impact.

3.3 Study Area and Population

3.3.1 Study Area

The research was conducted in three key agricultural counties in Liberia: Bong, Lofa, and Nimba. These counties were purposively selected because they are major crop-producing regions and have been focal points for government and donor-funded subsidy initiatives, making them ideal for evaluating policy impact. Bong County is known for its fertile land and production of upland rice, maize, cassava, and vegetables. Lofa County, known as the "breadbasket of the country," is located in northern Liberia and is a hub for rice, coffee, and cocoa farming. Nimba County, in northeastern Liberia, has both lowland and upland farming systems, and its proximity to regional West African markets provides interesting dynamics for market access and input use.

3.3.2 Target Population

The target population for this analysis is defined as All smallholder farmers operating in Bong, Lofa, and Nimba counties who are eligible for or targeted by government and donor-funded agricultural subsidy programs. These farmers typically operate on small plots of land and are the focus of national food security and poverty reduction strategies.

3.4 Sampling and Sample Size Determination

A multi-stage sampling technique was employed. Within each county, three districts with the highest concentration of farmers who received subsidies were identified based on advice from the Ministry of Agriculture. From each district, a random selection of communities was made to ensure a diverse representation of farmers' socio-economic status and agricultural

practices. A systematic random sampling method was then used to select the individual respondents.

The sample size was partly determined using the (Yamane, 1967) formula, but some complications arose due to the unavailability of a complete list of all subsidy recipients. The formula is as follows: n=N/(1+N(e)2),

Where:

n = the sample size,

N = the total number of smallholder farmers in the sampling frame, and

e = the margin of error, which was set at 5%.

For this study, a total sample size of 300 smallholder farmers was determined as appropriate to achieve statistical power and reliability for the intended analysis. This calculation is associated with a 95% Confidence Interval.

3.4.2 Sampling Technique

A **Stratified Random Sampling** technique was employed to ensure that each of the three study counties was proportionally represented in the final sample. The total sample size (N=300) was allocated to the counties based on their size and significance in the agricultural sector, leading to the following distribution:

Table 1: Geographic Distribution of Respondents

County	Frequency	Percentage
Bong	156	52.00%
Lofa	105	35.00%
Nimba	39	13.00%
Total	100	100%

Source: LIMPAC

The data show that a majority of respondents (52%) reside in Bong County, followed by Lofa (35%) and Nimba (13%). This distribution reflects the availability of farmers during data collection, population density of farming households, and accessibility of farming communities.

3.5 Data Collection Methods

Primary data were collected through structured questionnaires administered to 300 smallholder farmers. These questionnaires covered demographic information, the types and levels of subsidies received, farming practices, and productivity outcomes.

Key informant interviews were conducted with program administrators from the Ministry of Agriculture and local extension officers to provide contextual information on policy frameworks, implementation processes, and challenges. Focus group discussions (FGDs) were also organized in selected communities to capture communal perspectives on subsidies. We conducted five (5) FGD and each FGD included 6-10 participants and elicited insights on collective experiences, perceived benefits, and adaptations resulting from the subsidy programs.

3.5 Data Sources and Instruments

3.5.1 Data Sources

The study relied on **primary data** collected directly from the field. This includes quantitative responses from structured questionnaires and qualitative insights from Focus Group Discussions and Key Informant Interviews.

3.5.2 Research Instrument

A structured, closed-ended questionnaire was the main instrument for quantitative data collection. It was designed to capture:

1. **Demographic and Socio-economic data** (age, gender, education, household size).
2. **Productivity metrics** (yield/output per land size).

3. **Subsidy access and type** (e.g., received grants, type of farming).
4. **Challenges** encountered during the subsidy application and implementation process.

The qualitative data was collected using open-ended discussion guides for FGDs and KIIs with farmers, local agricultural officials, and community leaders to probe the 'why' behind the quantitative findings.

Table 2: Age Distribution of Farmers

Age Range	Frequency	Percentage
18–24	10	3.30%
25–34	55	18.30%
35–44	87	29.00%
45–54	93	31.00%
55+	55	18.30%

Source: LIMPAC

The data reveal that farming in these counties is dominated by middle-aged adults. Farmers aged 35–54 constitute approximately 60% of respondents. This implies:

- The sector relies heavily on experienced, mature farmers, which may positively influence the efficient use of subsidies.
- Youth participation (18–24) is extremely low at 3.3%, signaling a potentially aging farming population and challenges in attracting young people to agriculture.
- The significant presence of older farmers (55+) underscores the need for subsidies and interventions that reduce physical labor burdens and support mechanization.

Table 3: Gender Distribution of Farmers

Gender	Frequency	Percentage
Male	65	21.70%
Female	235	78.30%

Source: LIMPAC

The findings demonstrate a female-dominated agricultural workforce, with 78.3% of respondents being women. This suggests:

- Women are the primary agricultural labor force in the surveyed counties.
- Policy interventions must consider gender-sensitive approaches, ensuring that women have equitable access to subsidies, training, and extension services.

Table 4: Educational Attainment of Respondents

Education Level	Frequency	Percentage
No formal education	169	56.30%
Primary education	49	16.30%
Secondary education	37	12.30%
Tertiary education	45	15.00%
Other	0	0%

Source: LIMPAC

Over 56% of respondents have no formal education, while a combined 28.6% have only primary or secondary education. This means:

- Most farmers possess limited literacy, which may affect their ability to understand subsidy application procedures, use improved technologies, or interpret extension instructions.

- Effective agricultural subsidy programs must therefore:

Simplify communication materials, Use local languages, Support visual and demonstration-based training.

Interestingly, 15% have tertiary education, which indicates a small but significant number of highly educated individuals engaged in farming, possibly due to agriculture being a major livelihood source.

Table 5: Household Size

Household Size	Frequency	Percentage
Below 5	27	9.00%
5–8	142	47.30%
9–12	82	27.30%
13+	49	16.30%

Source: LIMPAC

The data show that most farming households are large, with nearly 90% reporting household sizes above five members. This has several implications:

- Larger households may provide more family labor, which can enhance farming productivity if properly supported with inputs and subsidies.
- However, large households also imply more consumption needs, which may reduce the proportion of produce available for the market.
- Subsidies targeted at inputs (e.g., seeds, fertilizer, tools) may significantly reduce the burden on large families and improve agricultural output.

The demographic of this study indicates that:

1. Women and middle-aged adults dominate smallholder farming, positioning them as key beneficiaries and targets for agricultural subsidies.
2. Low literacy levels among farmers mean subsidy programs must be communicated in accessible ways.

3. Large household sizes indicate both higher labor capacity and higher consumption needs.
4. Geographical differences—with Bong heavily represented—should be considered when analyzing county-level variations in subsidy impact.

3.6 Variables and Measurement

The study investigates the relationship between agricultural subsidies and farmer productivity through the following defined variables:

3.6.1 Dependent Variable (Y)

- **Smallholder Farmer Productivity (IMP_Pro):** This is the outcome variable, measuring the increase in farm output. It was operationalized and measured by objective metrics such as **yield per acre/hectare** (e.g., bushels of rice per unit of land) or **total output** attributed to the subsidy program, converted into an appropriate scale for modeling.

3.6.2 Independent Variables (X_i)

- **Agricultural Subsidies/Grants (T_frm):** The main explanatory variable. This was measured as a proxy for the adoption of modern farming methods and inputs secured through subsidy or grant programs (e.g., use of improved seeds, fertilizer, or mechanization).
- **Challenges in Obtaining Subsidies (Chal_gr):** This variable measures the severity of implementation issues faced by farmers (e.g., corruption, delays, lack of awareness, transport costs). It is expected to have a negative relationship with productivity.
- **Socio-economic Factors:** These are control variables (e.g., farmer education, household size, access to extension services) included in the model to account for their influence on productivity independent of the subsidy.

3.7 Analytical Framework and Model Specification

3.7.1 Generalized Linear Model (GLM)

The **Generalized Linear Model (GLM)** was adopted as the primary analytical framework for testing the study's hypotheses.

Traditional Ordinary Least Squares (OLS) regression relies on the assumption that the dependent variable (Productivity) follows a normal distribution and that the error terms are homoscedastic. Since agricultural productivity data often involves counts, proportions, or non-normal distributions, GLM provides a more robust and flexible framework. It allows the researcher to specify an appropriate error distribution (e.g., Gamma, Poisson, or Binomial) and a link function that relates the linear predictor to the mean of the dependent variable.

3.7.2 Model Specification

The relationship between smallholder farmer productivity and the key independent variables is formally expressed by the GLM equation below:

$$\mathbf{GLM:}\ \mathbf{g(E[IMP_{\_Pro}])} = \boldsymbol{\beta 0} + \boldsymbol{\beta 1}\left(\boldsymbol{T_{\_frm}}\right) + \ \boldsymbol{\beta 2}\left(\boldsymbol{Chal_{\_gr}}\right) + \ \sum_{i=3}^{k} \boldsymbol{\beta i}(\boldsymbol{Control_{\_i}}) + \epsilon$$

Where:

Term	Definition
$\mathbf{g(E[IMP_{\_Pro}])}$	The link function (e.g., identity or log) applied to the expected value of the Dependent Variable (Farmer Productivity).
$\boldsymbol{\beta 0}$	The intercept of the model.
$\boldsymbol{\beta 1}$	The coefficient measuring the impact of T_frm (Subsidy-driven Adoption of Modern Methods) on productivity. **(Hypothesis H_1 & H_0 test)**
$\boldsymbol{\beta 2}$	The coefficient measuring the impact of Chal_gr (Implementation Challenges) on productivity.
$\boldsymbol{Control_{\_i}}$	A set of control variables (e.g., education, extension services).
ϵ	The error term, assumed to be independent and follow a specific distribution.

Source: LIMPAC

3.7.3 Statistical Tests

The following statistical tests, generated through the GLM analysis, were used to validate the model and test the hypotheses:

1. **Omnibus Test (or ANOVA Test):** This served as the overall test of the model's validity. A statistically significant result (p-value < 0.05) confirms that the independent variables, taken together, contribute significantly to explaining the variation in the dependent variable (Productivity). The standard statistical significance level used in this study (implied by the rejection rule) is $\alpha = 0.05$, which corresponds to a 95% Confidence Interval (CI). This level means the study is 95% confident that the true population value lies within the estimated range. The result of **p-value = 0.000** for this test led to the correct decision to **Reject the overall Null Hypothesis (H_0)**.

2. **Tests of Model Effects (Parameter Estimates):** These tests assess the individual statistical significance of each independent variable β1, β2, etc.). The p-value for each coefficient determined whether the specific variable had a significant relationship with productivity. The coefficients (β) indicated the direction and magnitude of the impact.

3. **Goodness of Fit:** Tests such as the Deviance, Chi-Square, Akaike Information Criterion (AIC), and Bayesian Information Criterion (BIC) were used to confirm that the selected GLM was an appropriate fit for the collected sample data.

3.8 Ethical Considerations

All research procedures adhered to the highest ethical standards. Participation was entirely voluntary, with informed consent obtained from all smallholder farmers before data collection began. Confidentiality and anonymity were maintained throughout the process by ensuring that no personally identifiable information was recorded alongside the survey data.

Chapter 4: Results and Discussion

4.1 Introduction

This chapter presents the findings from the data analysis, offering an in-depth discussion of the results in relation to the study's research questions and hypotheses. The results are presented in a clear, understandable way, connecting the statistical findings to the real-world experiences of the farmers surveyed.

4.2 Goodness of Fit Analysis

The statistical models used in this study were carefully evaluated to ensure they accurately represent the data. The Pearson Chi-Square and Deviance tests were used, and both produced p-values below 0.05. This result indicates that the model is a good fit for the data, meaning it can reliably be used to draw conclusions about the relationship between agricultural subsidies and smallholder farmer productivity. This conclusion is further supported by the Akaike's Information Criterion (AIC) and Bayesian Information Criterion (BIC), which both showed negative values, indicating a strong fit.

Table 6: Goodness of Fit Summary

	Value	DF	Value/df
Deviance	.994	288	.003
Scaled Deviance	300.166	288	
Pearson Chi-Square	1.032	288	.004
Scaled Pearson Chi-Square	311.649	288	
Log Likelihood[b]	288.899		
Akaike's Information Criterion (AIC)	-551.799		
Finite Sample Corrected	-550.526		
AIC (AICC), Bayesian Information	-503.650		
Criterion (BIC), Consistent AIC (CAIC)	-490.650		

Source: LIMPAC

4.3 Omnibus Tests (GLM) Analysis

The omnibus tests were conducted to determine the overall significance of the model, essentially asking if all the variables together had a meaningful impact. The results showed a likelihood ratio Chi-Square value of 1222.408 with a p-value of 0.000. Since this p-value is less than 0.05, we can confidently say that the overall model is statistically significant. This means that the variables we chose to analyze (such as the type of farming and challenges in getting grants) are indeed useful for predicting the impact of agricultural subsidies on smallholder farmers.

Table 7: Omnibus Tests (GLM) Analysis

Likelihood Ratio Chi-Square	**df**	**Sig.**
1222.408	11	.000
Dependent Variable: IMP_Pro		
Model: (Intercept), T_frm, Chal_gr		
Compares the fitted model against the intercept-only model		

Source: LIMPAC

4.4 Tests of Model Effects

To understand which specific factors were most influential, we examined the "Tests of Model Effects." This analysis focused on two key variables: "Type of farming" (T_frm) and "Challenges in obtaining the grant" (Chal_gr).

The "Type of farming" variable had a coefficient of 0.956 and a statistically significant p-value of 0.000. This is an important finding, as it suggests a very strong positive link between a farmer's access to grants and their ability to transition from traditional to more modern farming methods. Essentially, for every positive step a farmer takes in adopting modern farming practices (e.g., using better tools or methods), the impact of subsidies on their productivity increases by 95.6%. This highlights how financial assistance, such as grants, can help farmers overcome the initial costs and risks associated with new farming techniques, ultimately leading to higher yields and more resilient agricultural practices.

The "Challenges in obtaining the grant" variable had a coefficient of -0.529 and a statistically significant p-value of 0.000. This result is equally important, as it shows a strong negative relationship. It indicates that for every increase in the challenges farmers face in getting a grant, the positive impact of those subsidies on their productivity decreases by 52.9%. This underscores a critical issue: even when subsidy programs are available, obstacles like poor communication, complex application processes, a lack of awareness, and delays in receiving funds can severely limit their effectiveness. These challenges prevent the intended beneficiaries from fully capitalizing on the support, leading to a loss of potential benefits.

Table 8: Tests of Model Effects

Source	Type III		
	Wald Chi-Square	**Df**	**Sig.**
(Intercept)	77.531	1	.000
T_frm	0.956	10	.000
Chal_gr	-0.529	1	.000
Dependent Variable: IMP_Pro			
Model: (Intercept), T_frm, Chal_gr			

Source: LIMPAC

4.5 Qualitative Insights from Interviews and FGDs

The qualitative data from interviews and focus group discussions provided deeper context to these statistical findings. Farmers repeatedly mentioned how grants enabled them to purchase improved seeds and fertilizers they couldn't otherwise afford. An elderly farmer in Bong County noted, "Before the grant, I was just planting what I knew. But with the new seeds, my harvest is bigger, and my family has more food." This sentiment aligns with the positive coefficient for the "Type of farming" variable.

However, the qualitative data also reinforced the negative findings about challenges. Many farmers spoke of the long and confusing application processes. "The forms are too complicated, and sometimes you wait for months without any news," one farmer from Lofa County shared. Another farmer lamented about the timing of the assistance: "We need the

fertilizer at the start of the planting season, but sometimes it arrives too late, so we can't use it effectively." These firsthand accounts directly support the quantitative finding that challenges in the process significantly reduce the benefits of the subsidies.

The qualitative analysis also revealed a strong desire for more education and training on how to use new inputs. Farmers expressed a need for consistent visits from agricultural extension workers to help them get the most out of the subsidized materials, which is a key factor for maximizing productivity. This highlights that subsidies are most effective when paired with other forms of support.

Chapter 5: Conclusion and Recommendations

5.1 Summary of Findings

This study set out to examine the impact of agricultural subsidies on smallholder farmer productivity in Bong, Lofa, and Nimba counties in Liberia. The findings provide clear evidence that agricultural subsidies have a significant and positive effect on productivity. The study's statistical model was confirmed to be reliable, and the overall model was shown to be statistically significant, demonstrating that subsidies, along with other key factors, are effective predictors of farmer productivity.

Specifically, the results strongly support the hypothesis that subsidies have a positive effect. A significant finding was the positive relationship between the "type of farming" (T_frm) and the impact of subsidies. This suggests that grants and other forms of financial assistance are critical for helping smallholder farmers move from traditional farming methods to more productive, modern techniques.

However, the study also confirmed a second crucial hypothesis: that challenges in the implementation of these programs significantly undermine their effectiveness. The negative relationship between "challenges in obtaining the grant" (Chal_gr) and the impact of subsidies highlights that administrative and logistical obstacles can severely reduce the positive outcomes. These findings were further corroborated by qualitative data from farmers, who shared their frustrations with complicated processes and delayed assistance.

5.2 Conclusion

In conclusion, agricultural subsidies in Liberia, particularly in Bong, Lofa, and Nimba counties, are a powerful tool for improving smallholder farmer productivity. They provide the necessary capital for farmers to adopt new technologies and practices that leads to higher yields and better food security. However, the potential of these programs is not being fully realized due to significant implementation challenges. Without addressing issues related to access, transparency, and timely delivery, a large portion of the subsidies' intended benefits are lost. The study makes it clear that for subsidies to truly transform the agricultural sector

in Liberia, they must be part of a broader, more accessible, and well-managed support system.

5.3 Recommendations

Based on these findings, the following recommendations are proposed to enhance the effectiveness of agricultural subsidy programs in Liberia:

1. **Simplify and Streamline Application Processes:** The Ministry of Agriculture and its partners should work to simplify the grant application process. This could involve creating user-friendly forms, offering assistance in completing them, and using a mobile-based system to reach farmers in remote areas.

2. **Improve Communication and Awareness:** Implement a robust communication strategy to inform farmers about available subsidies. This should include using local community leaders, radio broadcasts, and extension workers to spread information about eligibility criteria, application deadlines, and program details.

3. **Ensure Timely Delivery of Inputs:** The logistical challenges of delivering inputs (seeds, fertilizers) must be addressed. Programs should be designed to ensure that materials arrive at the beginning of the planting season, when they are most needed. This may require better coordination with suppliers and the establishment of local distribution centers.

4. **Strengthen Extension Services:** Pair subsidies with robust and regular extension services. Training farmers on how to properly use new inputs and technologies is essential to maximize their impact. The government should invest in training and deploying more extension workers, especially in the most remote areas.

5. **Increase Transparency and Accountability:** To combat potential corruption and leakage, a more transparent system for tracking the disbursement of grants and inputs is needed. This could include publicizing the list of recipients and creating a feedback mechanism for farmers to report issues.

By adopting these recommendations, policymakers can ensure that agricultural subsidies in Liberia are not only effective but also sustainable and equitable, paving the way for a more food-secure and prosperous future for the country's smallholder farmers.

5.4 Suggestions for Further Research

Based on the findings and limitations of this study, several avenues for future research are recommended to deepen the understanding of agricultural subsidies in Liberia:

- Future research should employ a time-series or longitudinal design to track smallholder farmers over several planting seasons to assess the long-term sustainability of the productivity gains and to detect potential issues of dependency on external support.
- A dedicated qualitative and quantitative study is needed to specifically investigate the administrative and logistical challenges (e.g., corruption, delayed delivery, awareness) and their precise economic cost, providing actionable data for policy streamlining.
- Given the very low rate of youth participation observed in the survey, research should explore specific policies and interventions (e.g., mechanization, financing) that can successfully attract and retain young people in the agricultural sector.
- Future work should conduct a formal cost-benefit analysis to determine the fiscal efficiency of the different subsidy programs, comparing the government's investment against the socio-economic returns in productivity and food security.

References

AfDB. (2018). *Liberia Smallholder Agricultural Productivity Enhancement and Commercialization (SAPEC) Project. Project Completion Report.* OSAN. Abidjan: African Development Bank. Retrieved from https://www.afdb.org/en/documents/document/liberia-smallholder-agricultural-productivity-enhancement-and-commercialization-project-sapec-esmp-summary-26406

Anderson, K., Rausser, G., & Swinnen, J. (2013). Political economy of public policies: Insights from distortions to agricultural and food markets. *Journal of Economic Literature*, 51(2), 423-477. doi:10.1257/jel.51.2.423.

Barrett, C. B. (2008). Smallholder market participation: Concepts and evidence from eastern and southern Africa. . *Food Policy*, 33(4), 299-317. doi:10.1016/j.foodpol.2007.10.005

Chirwa, A., & Dorward, A. (2013). Agricultural input subsidies: The recent Malawi experience. *Oxford University Press*. doi:10.1093/acprof:oso/9780199683529.003.0003

Doss, C. R. (2001). ning agricultural technology for African women farmers: Lessons from 25 years of experience. *World Development*, 29(12), 2075-2092.

Ellis, F. (1992). Agricultural policies in developing countries. *Cambridge University Press*.

FAO. (2016). *The State of Food and Agriculture 2016: Climate Change, Agriculture and Food Security.* Rome: Food and Agriculture Organization of the United Nations.

FAO. (2020). *Country Programming Framework for Liberia (2019-2023).* Food and Agriculture Organization of the United Nations.

GAFSP. (2019). *Impact Evaluation of Smallholders Agriculture Productivity Enhancement and Commercialization (SAPEC), ENDLINE SURVEY REPORT.* Global Agricultural and Food Security Program. GAFSP. Retrieved February 26, 2025, from https://www.gafspfund.org/sites/default/files/inline-files/Liberia%20Endline%20Report.pdf

Gautam, M. (2000). *Agricultural Extension : The Kenya experience - An Impact Evaluation: A World Bank operations evaluation study*. Retrieved February 16, 2025, from http://documents.worldbank.org/curated/en/753941468254951667

International Fund for Agricultural Development. (2020). *Republic of Liberia: Smallholder Agriculture Transformation and Agribusiness Revitalization Project (STAR-P).* Rome:

IFAD. Retrieved from https://ifad-cofinancing.org/project/smallholder-agriculture-transformation-and-agribusiness-revitalization-project/

Jayne, T. S., & Rashid, S. (2013). *Input subsidy programs in sub-saharan Africa: A synthesis of recent evidence.* Agricultural Economics. doi:doi:10.1111/agec.12073

Jayne, T. S., Mather, D., & Mghenyi, E. (2010). Principal challenges confronting Smallholder Agriculture in Sub-saharan Africa. *World Development, 38(10)*, 1384–1398. doi:doi:10.1016/j.worlddev.2010.06.002

Krueger, A. O. (1992). *Economic policy reform in developing countries* . Blackwell.

Pan, L., & Christiaensen, L. (2012). Who is vouching for the input voucher? Decentralized targeting and elite capture in Tanzania. *World Development, 40(8)*, 1619-1633.

Pan, Y. (2013). Agricultural Subsidies in Developing Countries: What Works and What Doesn't. *Journal of Agricultural Economics*, 64(3), 541-561.

Ricker-Gilbert, J., Jayne, T., & Chirwa, E. (2011). Subsidies and crowding out: A double-hurdle model of fertilizer demand in Malawi. *American Journal of Agricultural Economics*, 93(1), 26-42.

Rutherford, D. D., Burke, H. M., Cheung, K. K., & Field, S. H. (2016). Impact of an Agricultural Value Chain Project on Smallholder Farmers, Households, and Children in Liberia. *World Development, 83*, 70-83. doi:10.1016/j.worlddev.2016.03.004

Tadesse, G., & Shively, G. (2014). Input subsidies, productivity change, and food security in Ethiopia. *Food Policy*, 49, 128-138.

Timmer, C. P. (2010). Agriculture's role in economic development: Past debates and new understandings. *Elsevier, Vol. 4*, 3635-3696. Retrieved February 2025

USAID. (2018). *Liberia Agricultural Sector Assessment.* United States Agency for International Development.

World Bank. (2019). *Smallholder Agriculture Transformation and Agribusiness Revitalization Project (STAR-P).* Washington, D.C.: World Bank. Retrieved from https://www.worldbank.org/en/news/loans-credits/2019/01/15/liberia-smallholder-agriculture-transformation-and-agribusiness-revitalization-project-star-p

World Bank. (2022, September 27). *Liberia Economic Update: Investing in Human Capital for Inclusive Growth.* PRESS RELEASE NO: 2023/009/AFR: World Bank Publication. Retrieved January 25, 2025, from World Bank Group:

https://www.worldbank.org/en/news/press-release/2022/09/27/liberia-economic-update-prospects-for-inclusive-and-sustainable-growth

Yamane, T. (1967). *Statistics: An Introductory Analysis. 2nd edition.* Harper and row, New York: references - scientific research publishing. Retrieved from https://www.scirp.org/(S(i43dyn45teexjx455qlt3d2q))/reference/ReferencesPapers.aspx?Refere