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AN EMPIRICAL STUDY OF SMALLHOLDER FARMING AND POVERTY REDUCTION: CASE OF SIERRA LEONE

[a]Mohamed Kargbo*, [b]Mnaranara E. Theresia, [c]Ebrahim Almekhlafi, [c]Alimamy A. Kargbo
[a] School of Management and Economics, Dalian University of Technology, China.
[b] School of Humanities & Social Science, Dalian University of Technology, China.
[c] School of Management, Science and Engineering, Dalian University of Technology, China.
[d] Department of Finance, School of Economics, Jilin University, China.

A B S T R A C T

The practice of smallholder farming for most Sub-Saharan African Countries is crude and traditional and has resulted in low agricultural output in the region. Present study is the case in Sierra Leone; where the agricultural system is primarily based on small-scale farming and farmers face low agricultural output and an increased risk exposure with high seasonal volatility. Given the welfare implication of agricultural development in poverty reduction. The present study investigated empirically the role of smallholder farming to poverty reduction in Sierra Leone using the production relations, combined with the Ordinary Least Squares (OLS) regression techniques from 2005-2012. The study reveal that the total supply of food crops has a positive impact on profitability and statistically significant at the 10% level and the export of food crops mixed though significant at the 5% level. Import is found to reduce profit at a smaller margin and insignificant. In general, import of food crops exceeds export and on average the return to profitability is 26.8% with export having relatively high volatility. On balance, the result indicates that smallholder farming contributes to the eradication of poverty. This understanding is important for academics, policy makers and development organizations in shaping future agricultural development.

Keywords: Food Security, Smallholder Farming, Poverty Reduction, Sub Saharan Africa, Profitability and Development Organizations.

INTRODUCTION

The relationship between smallholder farming and poverty is crucial in the understanding of agricultural development and growth of output. This study does not undermine the role of smallholder farming in poverty reduction and the consequences it may cause for the general population in countries that are faced with food insecurity coupled with environmental and institutional challenges that have impacted negatively on economic growth (World Bank, 2007).

In the recent past and to date, the food and agricultural organizations, including other world development organization such as the African Development Bank, World Bank etc, have placed high priority to agricultural productivity and development, with particular attention on smallholder farming. Acute poverty and chronic hunger have continued to inflict severe challenges and concerns on the population of most low-income countries. This has spurred governments and development organization to improve on the scope and development of agriculture to overcome the food threat and crisis situation via resource mobilization to support smallholder farmers, especially in Africa. In view of this initiative, international position in recent times has come up with the understanding that significant political support is required, coupled with international assistance to reviving agricultural livelihood with particular concern to smallholder farming in Africa (Dercon, 2009).

The success story of the Asia's Green Revolution in China provides evidence that smallholders are productive and contribute to poverty reduction (Wiggins, et al., 2010). Ghana is another mile stone in Africa relating to the contribution of agriculture, particularly smallholder

* Corresponding Author:
Email: mohamedkay17@yahoo.com

farming to poverty reduction and economic growth. The status of poverty in Ghana dropped to 28.5% in 2005 when compared to 51.7% level in 1991 mainly driven by smallholding farming based on cocoa and pineapples farming (World Bank, 2007).

Smallholder farming and smallholder farmers are however defined in different ways based on context, country and environmental condition. This however brings the interchanging usage of the term 'smallholder farming', "smallholder", "small-scale", and "resource poor farming". As Nagayets (2005) explained the word smallholder only points to their inadequate resource compared to other farmers in the sector. The subject of focus is mainly on constraints in land and labour.

In terms of the empirical evidence, several studies have demonstrated the critical role of small-scale farmers to poverty reduction. Ligon and Sadoulet (2007) have shown that small farmers income growth maximize the welfare of the poorest households than non-farms income growth, concluding that a 2% increase in growth of GDP driven from small scale-farm income will translate into more than 12% increase in the expenditure of the poorest deciles.

In Sub-Saharan Africa, the primary characteristics of smallholder farmers/ farming are straight forward, crude and traditional and has resulted in low output in the region. However, the majority of smallholder farmers in Sub-Saharan African are found in the rural areas, where poverty, chronic hunger and deprivation are more pervasive. Increase in agricultural infrastructure and outputs are therefore crucial and central to the wellbeing of the rural population in Africa and economic growth. About 70 percent of Sub-Saharan African population engages in agricultural activities with a view to reduce poverty. Examples of African countries that are agrarian in nature include, but not limited to Burundi, Rwanda, Bukinafaso, Uganda and South Africa (International Development Association, 2009).

In Sierra Leone, the agricultural system is done primarily on small-scale farming and farmers face with the problems of outdated technology, low agricultural output, high seasonal labour volatility and increase risk exposure, weak capital formation, low participation of the private sector. Additionally, poor credit facilities, limited microfinance institutions to assist the purchase of inputs and marketing, weak coordination of community based organizations and farmer's organization in terms of the delivery of information to the majority of rural farmers, and poor road infrastructure to market access. Despite these constraints the role of smallholders in agricultural production cannot be overlooked (Comprehensive Africa Agriculture Development Program, 2011).

In the early 1970s and late 1980s Sierra Leone was a net exporter of variety of agricultural produce such as rice, rubber, cocoa, coffee, palm-kernel and ginger. The economy experienced moderate growth in the 1970s and the growth performance of the 1990s spanning to early 2000s was mixed. The civil conflict that erupted in the economy has a devastating effect in terms of human capital loss, acute problems of unemployment, destruction of agricultural infrastructure coupled with poor structural adjustment programs that have resulted to low levels of agricultural productivity and given rise to more importation of rice and other food crops.

The end of the war could not divert this trend; the economy still remains a net importer of rice and essential commodities. However, the restorations of peace, stability and growing confidence on security and governance have spurred rapid reconstruction and infrastructural development in the sector with active involvement of smallholder farmers. This has, however resulted to increase in domestic food production with an estimate of 56% in 2005 to 71% in 2007 as a share of household food consumption. The strong growth of the economy during the post conflict period translated into a reduction in the incidence of poverty in the country. The population of Sierra Leone currently stands at approximately 5.8 million people and growing at a rate of 2.1 percent (twice of the population size equivalently every 34 years). The country's population is set to double to 12.6 million people by 2050s. It can be seen that the growth in population will pose serious challenges to poverty reduction, food security and growth of output between the rural and the urban population (National Sustainable Agricultural Development Plan, 2010).

In order to alleviate rural poverty and freeing the masses from the vicious circles of poverty, the Government of Sierra Leone implemented a number of programs and projects in support of smallholder agriculture, which including but not limited to (i) West Africa Agricultural Productivity Program; (ii) Rural and Private Sector Development Project; (iii) Agriculture Sector Rehabilitation Project; (iv) NERICA Rice Dissemination Project; (v) Oil Palm Production and Marketing; (vi) Diversified Food Production and (vii) Smallholder Commercialization Program (SCP) etc. The aims of these Projects/programs

were to increase productivity, rural incomes and employment on a sustainable basis including economic, commercial and environmental through better access to technical skills, services and export markets. These are, however ongoing programs and its effects are still to be adequately felt on the poor (Sierra Leone Poverty Reduction Strategy Paper-Progress Report, 2010-12).

Now that development promotion in the agricultural sector is being actively supported by Governments, the World Bank and other International Financial Institutions including the Private Sector with particular focus on smallholder farming. All these efforts require research to find ways of increasing smallholder agricultural productivity. The Sierra Leone economy provides a good test laboratory. Given the poor infrastructural facilities of farmers in Sierra Leone, important and crucial empirical questions arise: (i) Can support to smallholder farmers maximize rural welfare and enhance agricultural growth in Sierra Leone? (ii) What are the agricultural growth policies frameworks conducive to sustain food security and poverty reduction in Sierra Leone? An investigation into these issues will help provide guidance and inform policy makers to design sound agricultural policy conducive for the growth of smallholder farmers and poverty reduction.

To this end, a country that has experienced conflict cannot secure long term returns for investments in both physical and human capital, resulting in low investment in health, education, agriculture and development and posing bottlenecks in improving institutions and heightens the risk of conflict re-occurrence. Hence, these specific characteristics of Sierra Leone's smallholder farming system offer us the test case to investigate the role of smallholder farming to poverty reduction and economic growth. These features of Sierra Leone's agricultural practice are one of the motivations of this current study. Therefore, the purpose of this paper is to investigate empirically the role of smallholder farming to poverty reduction in Sierra Leone within the framework of the production relation (Profit, Total Revenue and Total Cost) and the Ordinary Least Squares (OLS) regression techniques to determine empirically the impact of smallholder farming to poverty reduction and economic growth. Data on domestic supply, total supply, export and import of food production by smallholder farmers including the exchange rate and disbursements/cost of agricultural projects financed by government and donors in support of smallholder farming for the period 2005-2012 were collected from the Index Mundi Database, World Bank, Statistics Sierra Leone (SSL), the country's Ministry of Finance (MOF) and Ministry of Agriculture Forestry and Food Security (MAFFS).

The present study focused on the impact of smallholder farming on poverty reduction in Sierra Leone. It also provides an econometrics understanding of relationship between small-scale farming and poverty reduction. This understanding is important for International Development partners, academics, policy makers in shaping the future agricultural growth. Primary weakness of the study is the limited availability of data due from one source of data collection to other posed serious bottlenecks. Analysis is therefore, restricted to a smaller number of food crop productions than desired because of these restrictions. However, reasonable data is available for the purpose of this research.

MATERIAL AND METHOD

The study adopts a qualitative and quantitative approach in the analysis. It makes use of secondary data collected from the Government of Sierra Leone, donors and the World Bank, including other international financial institutions on the financial support in funding projects and programs for the activities of smallholder farmers, the total supply of food crops, the level of food export, import and domestic food supply including the exchange rate from 2005 to 2012.

We employed the notion of the production relation with particular focus on cost, revenue and profit to determine the impact of the output of smallholder farmers to poverty reduction and economic growth in Sierra Leone.

Hence, we denote Total Cost by (TCF), Total Revenue as (TRF) and Profit is symbolized by(PF). TCF is the cost involved in setting up projects and programs by the government and development partners in support of smallholder farmers' activities.TRF, is the revenue that is obtained from the export and domestic use of small holder output (i.e P multiplies Q), where P is sales price and Q is quantity. Therefore Profit (PF) = TRF-TCF which reflects the contribution of smallholder output to poverty reduction and economic growth. (The difference between the total revenue and the total cost).

We therefore employ the profit relation thus,

$$PF = TRF - TCF \text{ ----------} (1)$$

From equation (1), if Profit (PF) = 0 then TRF = TCF (Breakeven point). If Profit (PF) > 0 then TRF>TCF (profit is positive) if TRF<TCF profit is negative, which shows a loss.

To this end, we expect small-scale farming to contribute meaningfully to poverty reduction and economic growth in Sierra Leone if *TRF>TCF*. Hence, we pursue the profit relation combined with the Ordinary Least Squares (OLS) regression techniques to determine empirically the role of smallholding farming to poverty reduction.

It is the case that the movement of food prices has constantly been above that of imported prices, except for a few months in some case, on the other hand imported prices are above domestic prices and that imported prices are precursor in determining prices of locally produced food. Except in a few cases, particularly in the rural areas where domestic transportation cost affects imported prices. The price situation keeps on fluctuating year in, year out (Statistics Sierra Leone Data Base, 2010).

However, to minimize distortion in our estimate and analysis, we use imported food prices as a proxy to domestic food prices by providing a fair estimate of the level of domestic food supply in monetary terms. Import of food items is excluded from domestic supply level, as it does not constitute the efforts of smallholder farmers, but just to augment domestic output.

Therefore we calculate the domestic supply, cost of imports and disbursement/cost of projects financed by the government and donors, revenue from exports and total supply, including the profit to determine the impact of smallholder farmers' productivity to poverty reduction. Having obtained the values of the profit relation, we re-modeled it thus,

$PF = f\ (DSL, TSL, EX, IM, TCF, EXR)$ - - - - - - - - - - - - (2)

We transform equation (2) into natural logarithm yields

$\text{InPF} = \alpha_0 + \alpha_1 \text{In}\ DSL + \alpha_2 \text{In} TSL + \alpha_3 \text{InEX} + \alpha_4 \text{InIM} + \alpha_5 \text{InTCF} + \alpha_6 \text{InEXR} + \mu_t$ - - - - - - - - - - - - - - (3)

But $= DSL + IM$, and DSL contains a fraction of EX, μ_t is the error term

To avoid over parametrization/ potential multicollinearity, we drop DSL, IM and EX from equation (3), yields

$\text{InPF} = \alpha_0 + \alpha_1 \text{In}\ TSL + \alpha_2 \text{In} TCL + \alpha_3 \text{InEXR} + \mu_t$ - - (4)

If we want to determine the independent impact of DSL and IM on profit PF , we introduce

$DSL + IM = TSL$, in equation (4), to obtain

$\text{InPF} = \alpha_0 + \alpha_1 \text{In}\ DSL + \alpha_2 \text{InIM} + \alpha_3 \text{In} TCF + \alpha_4 \text{InEXR} + \mu_t$ - (5)

To capture, the impact of EX on (PF) , we drop DSL and replace it by EX , since DSL and EX have high potential of exhibiting multicollinearity, equation (5), now becomes

$\text{InPF} = \alpha_0 + \alpha_1 \text{In EX} + \alpha_2 \text{InIM} + \alpha_3 \text{In} TCF + \alpha_4 \text{InEXR} + \mu_t$ - (6)

We run the models of equations (4), (5) and (6) above to determine the impact of TSL, TCF, IM, EX, DSL *and* EXR on profit (PF) , using the descriptive statistics and the correlation by means of pair-wise correlation co-efficient. We are aware that M does not form part of the smallholder farmers profitability, but included in the model to capture its impact on farmers' profitability.

Data description and source

Table 1. presents the data description and source.

Variable	Symbol	Description	Source
Domestic Supply Level	DSL	Combined sum of food crop supplied for export and for domestic purpose by smallholder farmers	MAFFS[1]/SSL[2]/Index Mundi Data Base
Total Supply Level	TSL	Aggregate of domestic supply and import	Index Mundi Data Base
Export	EX	Amount of food items sent abroad for foreign currency earnings	Index Mundi Data[3] Base
Import	IM	Amount of food item brought into a country to augment domestic demand	SSL/ Index Mundi Data Base
Exchange Rate	EXR	Annual price of US dollar relative to the Leone	IMF[4]
Projects/Programmes Financed	TCF	Amount of funding of projects/ programmes in support of smallholder farming	MOF[5], MAFFS and World Bank
Profit	(*PF*)	Difference between total revenue and total cost	

[1] MAFFS, Ministry of Agriculture Forestry and Food Security in Sierra Leone
[2] SSL, Statistic Sierra Leone
[3] Index Mundi Data Base of international commodity of prices, and quantities
[4] IMF, International Monetary Fund
[5] MOF, Ministry of Finance in Sierra Leone

RESULTS AND DISCUSSIONS

Table 2. Result of the Production Relation (TRF, TCF and Profit (PF).

Year	Exchange Rate	Total Revenue(TRF/DSL)	Total Cost(Cost of projects financed)	Profit(Total Revenue-Total Cost)Le	Profit(Total Revenue-Total Cost) US$
2005	2889.59	346,634,280,790.8	753,780,585,334.3	-407,146,304,543.53	-140,901,185.56
2006	2961.91	627,387,956,535.1	616,678,301,839.0	10,709,654,696.06	3,615,794.44
2007	2985.19	488,533,930,589.8	247,307,505,664.2	241,226,424,925.60	80,807,841.92
2008	2981.51	619,977,738,256.6	229,460,927,697.1	390,516,810,559.51	130,979,336.11
2009	3385.65	887,162,792,817.0	119,165,438,155.0	767,997,354,662.03	226,838,968.78
2010	3978.09	1,630,751,760,757.7	99,528,880,983.8	1,531,222,879,773.85	384,914,326.18
2011	4349.16	1,857,352,942,281.2	63,280,423,483.5	1,794,072,518,797.72	412,509,918.69
2012	4344.04	2,148,175,896,928.2	41,138,660,472.7	2,107,037,236,455.50	485,041,201.35
Total	-	8,605,977,298,956.31	2,170,340,723,629.6	6,435,636,575,326.75	1,583,806,201.92

Authors' computation

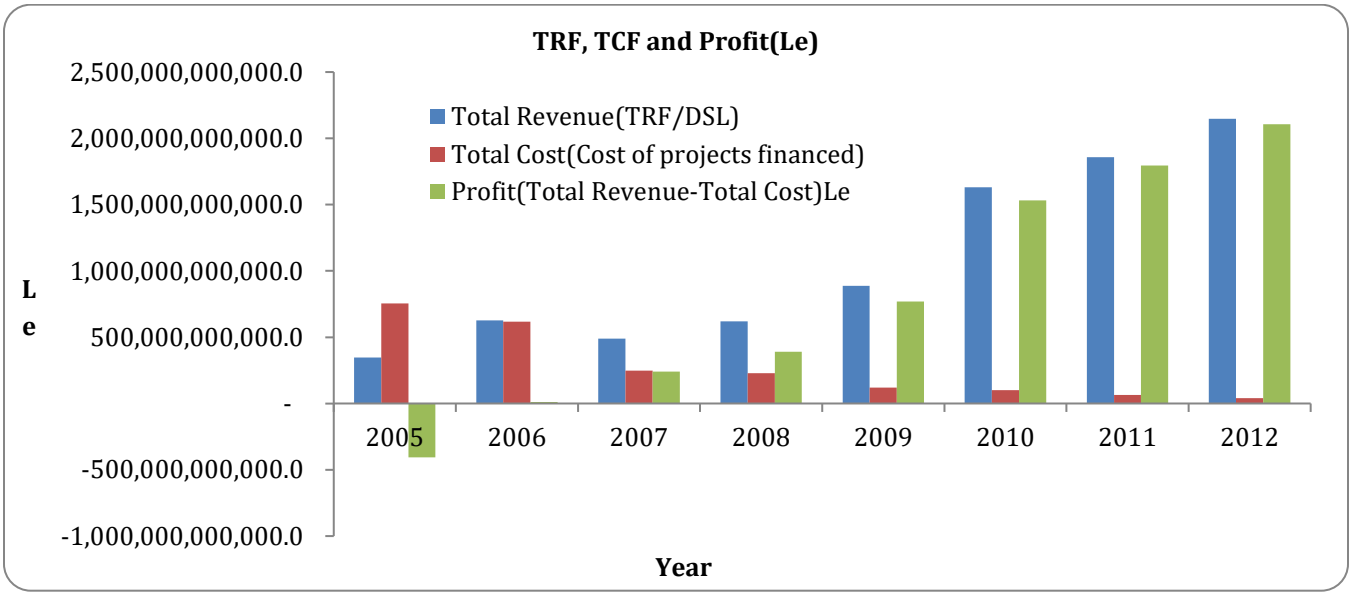

Figure 1. Trend of TRF, TCF and Profit (PF).

Total cost for the period 2005 is higher than revenue from domestic supply, resulting to negative profit (-407, 146,304,543.53 Leones) in 2005. This is not surprising, possibly the initial cost outlay including fixed cost in the first year of operation is higher than initial output or could be attributed to fall in international and or domestic agricultural commodity prices and low output. The result in table 3 also indicates that total supply of food items is the sum of domestic supply and import, this suggest that domestic supply provides the basis to determine the contribution of smallholder farmers on the economy. For this reason domestic supply is taken as the total revenue obtained from the sales of the food items for domestic use and for export. The cost of financing the project is the total disbursements in support of the projects and programs for the operation of smallholder farmers in the country from 2005 to 2012. However, for the period 2006-2012 productivity increased yields significant gains in revenue. In general, for the entire study period the total profit, which is the economic benefit derived from the contribution of smallholder farmers is 6,435,636,575,326.73 Leones, equivalent 1,583, 806,201.92 US dollars and hence, the aim of production.

Table 3. Total supply, domestic supply and imports in Local currency.

Year	Exchange Rate	Total Supply(Le)	Domestic Supply(Le)	Import(Le)
2005	2889.59	410,180,124,171.3	346,634,280,790.8	63,545,843,380.50
2006	2961.91	736,358,520,017.7	627,387,956,535.1	108,970,563,482.63
2007	2985.19	652,621,386,587.0	488,533,930,589.8	164,087,455,997.29
2008	2981.51	723,580,602,210.2	619,977,738,256.6	103,602,863,953.63
2009	3385.65	988,308,951,141.0	887,162,792,817.0	101,146,158,324.00
2010	3978.09	1,841,726,171,791.3	1,630,751,760,757.7	210,974,411,033.59
2011	4349.16	2,357,125,862,183.1	1,857,352,942,281.2	499,772,919,901.86
2012	4344.04	2,968,408,135,716.7	2,148,175,896,928.2	820,232,238,788.46
Total	-	10,678,309,753,818.30	8,605,977,298,956.3	2,072,332,454,861.95

Authors' calculation

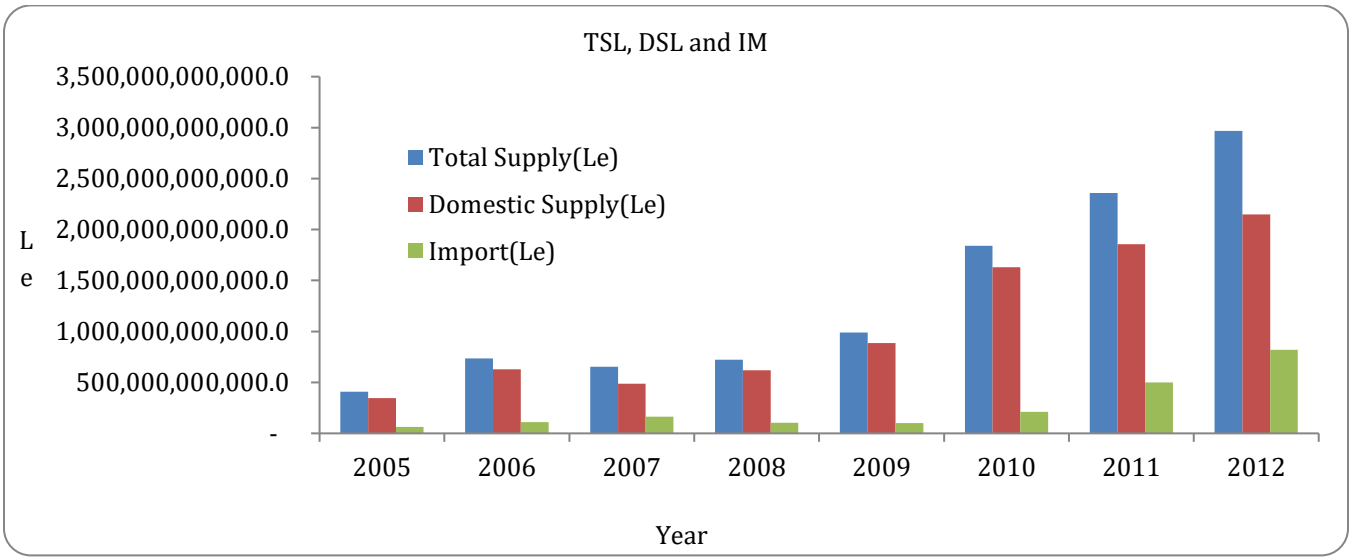

Figure 2. shows the trend in total supply, domestic supply and imports in Local currency.

The total supply, domestic supply and imports of food items are calculated in local currency terms, this is because an estimate of total supply should be reflected in the local unit of currency. The total supply is the aggregate of domestic supply and import as confirmed in table 3. The result indicates that prices of export of the food items are highly volatile, implying that even if a country exports more in quantity terms, if export prices in the international markets are not to her advantage it can have negative consequences on revenue and hence profit. This understanding is described as a commodity crisis or the fallacy of composition, meaning that more export in volume terms does not necessarily imply more revenue due to lower international prices or fluctuation in prices. This scenario may make a country's debt becomes unsustainable and ultimately result to debt burden and debt overhang. The result also indicates that entire production may not mean total supply, what is produced might not be the supply for that particular period, for instance, if a farmer is able to produce 50Kg of 1000 bags of rice and decides to supply 50Kg of 700 bags the entire production is 1000 bags but the total supply for the period is 700bags, meaning that the 300 bags is left for household use or otherwise.

To this end, the data captured in this study is for total supply and not the entire production. It is the case that the gap between production level and supply level is reserved for smallholder farmers' household consumption and livelihood for welfare increasing effect. Hence, the activity of small holder farming no doubt impacts positively on the poverty reduction thorough food available, affordable and accessible for domestic consumption and export of foreign currency, which is need of import essential product and improves the budget and balance of payment. Otherwise, deficit in the budget and deficit in the balance of payment may result to twin deficit and to come out of this situation can pose severe difficulty on the economy in the short, medium and even in the long run.

Table 4. Export and Import in US$/Le.

Year	Exchange Rate	Export(US$)	Import(US$)	Export(Le)	Import(Le)
2005	2,889.59	4,673,046.20	21,991,320.00	13,503,175,886.44	63,545,843,380.50
2006	2,961.91	7,239,355.56	36,790,650.00	21,442,313,580.76	108,970,563,482.63
2007	2,985.19	14,708,320.52	54,967,250.00	43,907,070,055.06	164,087,455,997.29
2008	2,981.51	18,563,888.60	34,748,400.00	55,348,505,976.57	103,602,863,953.63
2009	3,385.65	84,132,355.40	29,874,960.00	284,842,709,060.01	101,146,158,324.00
2010	3,978.09	24,742,436.87	53,034,130.00	98,427,579,475.35	210,974,411,033.59
2011	4,349.16	142,385,818.07	114,912,460.00	619,259,008,533.91	499,772,919,901.86
2012	4,344.04	140,297,539.33	188,817,940.00	609,457,791,902.04	820,232,238,788.46
Total	-	436,742,760.54	535,137,110.00	1,746,188,154,470.13	2,072,332,454,861.95

Authors' computation

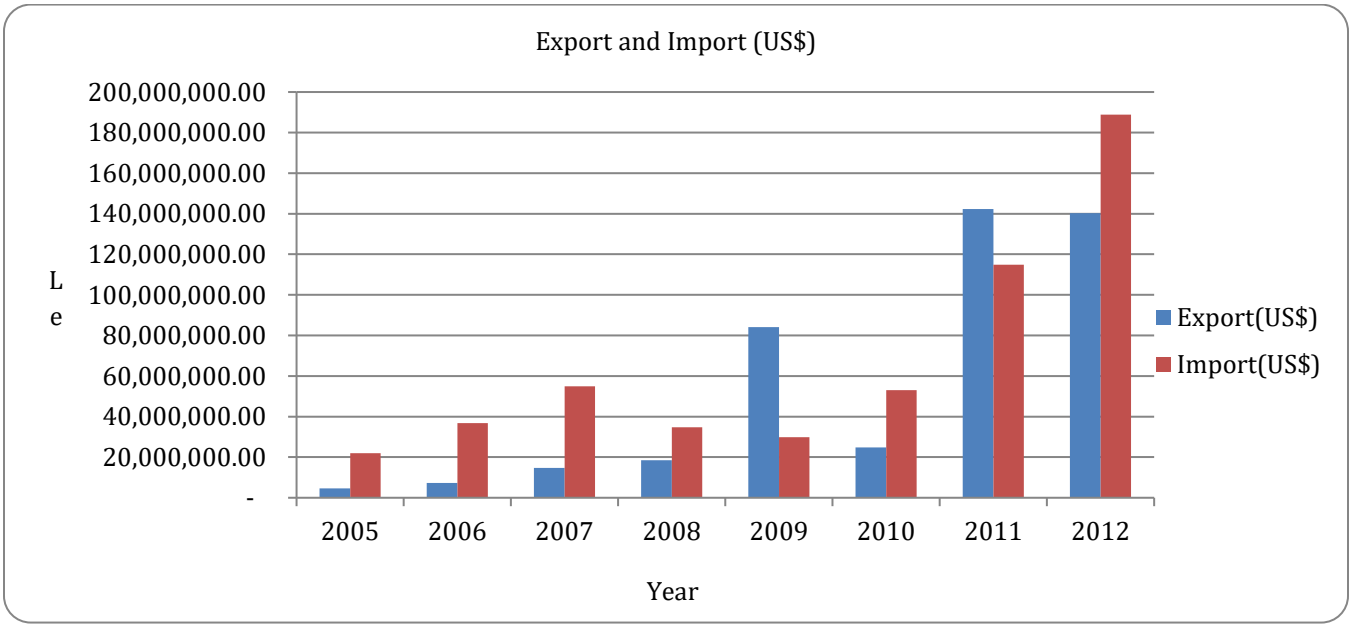

Figure 3. shows the trend of export and import in US$.

The export revenues and import costs are graduated in foreign currency terms; this is because export and import transaction requires the use of foreign currency, which contextually is international trade. However, the average annual exchange rate for the period 2005 to 2012 is used to obtain the local currency, the Leone relative to the dollar. From figure 3, it can be observed that import cost is higher export revenue.

When import is greater than export, the effect will be a balance of payments disequilibrium (deficit in the balance of payment) driven largely by the agricultural sector through the importation of rice; this implies that the country is still a net importer of rice even though rice is produced within the domestic economy. This implies that the profit is realized from the domestic output of smallholder farmers and domestic sales and not from export, due to price volatility or unfavorable prices from export. Despite unfavorable export prices, however, export is still relevant on the grounds of foreign currency provision and earning, which is critical for the importation of essential goods and services. Otherwise surplus, (i.e. export exceeds import) or balance of payment is the balance (import equals export).

The combination of the food measures/variables does not contradict the trends obtained previously as evinced in table 5, figure 4 below.

Table 5. (EX, IM, TSL, DSL, PF and TCL).

Year	EX	IM	TSL	DSL	PF	TCF	EXR
2005	13,503,175,886.44	63,545,843,380.5	410,180,124,171.3	346,634,280,790.8	-407,146,304,543.53	753,780,585,334.3	2889.59
2006	21,442,313,580.76	108,970,563,482.6	736,358,520,017.7	627,387,956,535.1	10,709,654,696.06	616,678,301,839.0	2961.91
2007	43,907,070,055.06	164,087,455,997.3	652,621,386,587.0	488,533,930,589.8	241,226,424,925.60	247,307,505,664.2	2985.19
2008	55,348,505,976.57	103,602,863,953.6	723,580,602,210.2	619,977,738,256.6	390,516,810,559.51	229,460,927,697.1	2981.51
2009	284,842,709,060.01	101,146,158,324.0	988,308,951,141.0	887,162,792,817.0	767,997,354,662.03	119,165,438,155.0	3385.65
2010	98,427,579,475.35	210,974,411,033.6	1,841,726,171,791.3	1,630,751,760,757.7	1,531,222,879,773.85	99,528,880,983.8	3978.09
2011	619,259,008,533.91	499,772,919,901.9	2,357,125,862,183.1	1,857,352,942,281.2	1,794,072,518,797.72	63,280,423,483.5	4349.16
2012	609,457,791,902.04	820,232,238,788.5	2,968,408,135,716.7	2,148,175,896,928.2	2,107,037,236,455.50	41,138,660,472.7	4344.04
Total	1,746,188,154,470.13	2,072,332,454,862.0	10,678,309,753,818.3	8,605,977,298,956.3	6,435,636,575,326.74	2,170,340,723,629.6	-

Table 5, above confirms the following identity, as obtained inter alia.

TSL = DSL+ IM, implying that IM =TSL-DSL

PF=DSL (PRF) –TCF

In terms of the econometrics transformation $PF = PF = \int(DSL, TSL, EX, IM, TCF, EXR)$

In PF $= \propto_0 + \propto_1$ In $DSL + \propto_2$ In $TSL + \propto_3$ In$EX + \propto_4$ In$IM + \propto_5$ In $TCF + \propto_6$ In$EXR + \mu_t$, from equations, (2) and (3)

But *TSL = DSL + IM,* and *DSL* contains a fraction of *EX*, μ_t is the error term. We maintain the model up to equation (6), to be able to come up with the descriptive statistics, correlation matrix and regression output as shown below:

Table 6. Descriptive Statistics (Model 4).

Variable	LNPF	LNTSF	LNTCF	LNEXR
Mean	26.84282	27.70564	25.87843	8.141777
Median	27.04975	27.47212	25.83139	8.064359
Maximum	28.37630	28.71905	27.34837	8.377738
Minimum	23.09441	26.73986	24.44021	7.968869
Std. Dev.	1.710168	0.699203	1.035677	0.178949
Observations	8	8	8	8

Table 7. Descriptive Statistics (Model 5).

Variable	LNPF	LNDSL	LNIM	LNTCF	LNEXR
Mean	26.84282	27.51015	25.90775	25.87843	8.141777
Median	27.04975	27.33806	25.61900	25.83139	8.064359
Maximum	28.37630	28.39564	27.43285	27.34837	8.377738
Minimum	23.09441	26.57154	24.87503	24.44021	7.968869
Std. Dev.	1.710168	0.674658	0.874197	1.035677	0.178949
Observations	8	8	8	8	8

Table8. Descriptive Statistics (Model 6).

Variable	LNPF	LNEX	LNIM	LNTCF	LNEXR
Mean	26.84282	25.29156	25.90775	25.87843	8.141777
Median	27.04975	25.02475	25.61900	25.83139	8.064359
Maximum	28.37630	27.15179	27.43285	27.34837	8.377738
Minimum	23.09441	23.32619	24.87503	24.44021	7.968869
Std. Dev.	1.710168	1.467932	0.874197	1.035677	0.178949
Observations	8	8	8	8	8

The results in tables 6, 7 and 8 on average have the same mean return to profitability of 26.8%, the EXR is relatively stable with a standard deviation of 0.178949. However, profit (PF) has a high dispersion with a standard deviation of 1.710168which is more risky and unpredictable; this could be attributed to the exports of agricultural commodity prices that are volatile in nature in the international market. Table 8, is consistent with this notion, export (EX) has a relatively higher dispersion with a standard deviation of 1.467932.

Table 9: Correlation Co-efficient (model 4).

Variable	LNPF	LNTSF	LNTCF	LNEXR
LNPF	1.000000	0.614804	-0.778028	0.718702
LNTSL	0.614804	1.000000	-0.927980	0.973601
LNTCF	-0.778028	-0.927980	1.000000	-0.912083
LNEXR	0.718702	0.973601	-0.912083	1.000000

Table 10. Correlation Co-efficient (Model 4a).

Variable	LNPF	LNTSL	LNTCF
LNPF	1.000000	0.614804	-0.778028
LNTSL	0.614804	1.000000	-0.927980
LNTCF	-0.778028	-0.927980	1.000000

Multicollinearity is detected in table 9, between TSL and EXR, and between EXR and PF, with a correlation coefficient of 0.973601 and 0.718702 respectively. To correct for this, we drop EXR from model 4, and obtains model 4a, which correlation coefficient is provided in table 10. TS positively related with Profit (PF), and TCF is negatively correlated with Profit with a correlation of 0.614804 and -0.778028 respectively. This is not surprising as productivity increases, profit is highly likely to increase and cost is falling. This result does not contradict the aim of production, which is profit maximization and cost minimization.

Table 11: Correlation Co-efficient (Model 5)

Variable	LNPF	LNDSL	LNIM	LNTCF	LNEXR
LNPF	1.000000	0.612231	0.550111	-0.778028	0.718702
LNDSL	0.612231	1.000000	0.871474	-0.917543	0.969869
LNIM	0.550111	0.871474	1.000000	-0.857988	0.889723
LNTCF	-0.778028	-0.917543	-0.857988	1.000000	-0.912083
LNEXR	0.718702	0.969869	0.889723	-0.912083	1.000000

Table 12. Correlation Co-efficient (Model 5a).

Variable	LNPF	LNDSL	LNIM	LNTCF
LNPF	1.000000	0.612231	0.550111	-0.778028
LNDSL	0.612231	1.000000	0.871474	-0.917543
LNIM	0.550111	0.871474	1.000000	-0.857988
LNTCF	-0.778028	-0.917543	-0.857988	1.000000

Table 13. Correlation Co-efficient (Model 5b).

Variable	LNPF	LNIM	LNTCF
LNPF	1.000000	0.550111	-0.778028
LNIM	0.550111	1.000000	-0.857988
LNTCF	-0.778028	-0.857988	1.000000

Table 14. Correlation Co-efficient (Model 6).

Variable	LNPF	LNEX	LNIM	LNTCF	LNEXR
LNPF	1.000000	0.706117	0.550111	-0.778028	0.718702
LNEX	0.706117	1.000000	0.807680	-0.956201	0.875994
LNIM	0.550111	0.807680	1.000000	-0.857988	0.889723
LNTCF	-0.778028	-0.956201	-0.857988	1.000000	-0.912083
LNEXR	0.718702	0.875994	0.889723	-0.912083	1.000000

Table 15. Correlation Co-efficient (Model 6a).

Variable	LNPF	LNEX	LNIM	LNTCF
LNPF	1.000000	0.706117	0.550111	-0.778028
LNEX	0.706117	1.000000	0.807680	-0.956201
LNIM	0.550111	0.807680	1.000000	-0.857988
LNTCF	-0.778028	-0.956201	-0.857988	1.000000

Table 16. Correlation Co-efficient (Model 6b).

Variable	LNPF	LNEX	LNTCF
LNPF	1.000000	0.706117	-0.778028
LNEX	0.706117	1.000000	-0.956201
LNTCF	-0.778028	-0.956201	1.000000

Table 17. Correlation Co-efficient (Model 6c).

Variable	LNPF	LNTCF
LNPF	1.000000	-0.778028
LNTCF	-0.778028	1.000000

Despite correcting for multicollinearity, the results of the summary statistics and correlation matrices are unaffected. TSL, DSL and IM are positively related with Profit (PF), since the EX and EXR are found to be multi-collinear with PF, with a correlation of 0.706117 and 0.718702 respectively. But DSL is the sum of EX and domestic use, it can thus be inferred that the EX is positively related with profit. However, as observed in tables 6, 7 and 8, earlier, EX has relatively high volatility, characterizing upturn and downturn movement, favourable export prices increase profitability and vice versa. Therefore, the direction of export is likely to be mixed. The negative correlation of TCF with profit is still observed as evidenced in table 17 above. Therefore, interpretations made earlier are valid and consistent.

In terms of the regression result, after correcting for multicollinearity, the correlation and summary statistics remain unchanged. On average the return to profitability is 26.8% with export relatively volatile and thus affects profitability, which also shows a very high dispersion. However, import is positively correlated with profitability indicating that imported prices influence domestic prices and vice versa. Importation is driven largely by rice and that both import and domestic rice supply does not match with domestic demand for rice (demand exceeds supply) and prices are expected to rise. Therefore, importation does not reduce smallholder farmers' profitability. Hence the positive correlation between import and profitability as observed in the study.

Table 18: Regression Output

Variable	Model 4 (M*) LNPF	Model 4a (NM*) LNPF	Model 5 (M*) LNPF	Model 5a (M*) LNPF	Model 5b (NM*) LNPF	Model 6 (M*) LNPF	Model 6a (M*) LNPF	Model 6b (M*) LNPF	Model 6c (NM*) LNPF
Constant	104.7887 (2.325824)***	143.0136 $(1.964757)^{NS}$	96.14337 $(1.84794)^{NS}$	138.5919 $(1.748289)^{NS}$	98.96238 (2.156782)***	100.6335 $(0.866647)^{NS}$	137.0804 $(1.563318)^{NS}$	91.14474 $(1.358449)^{NS}$	60.08945 (5.478977)*
LNTSL	6.549479 (3.709945)**	2.122611 (3.342674)**	-	-	-	-	-	-	-
LNTCF	-2. 254863 (-3.398370)**	-2.467637 (-2.229492)***	-2.161606 (-2.822890)***	-2.434854 $(-2.006232)^{NS}$	-1.915245 (-2.276696)***	-2.382312 $(-1.120009)^{NS}$	-2.757634 $(-1.499858)^{NS}$	-1.981971 $(-1.277848)^{NS}$	-1.284724 (-3.033563)**
LNEXR	19.88066 (3.171240)**	-	19.99436 (2.688523)***	-	-	4.745645 $(-0.561863)^{NS}$	-	-	-
LNDSL	-	-	5.231536 (2.721926)***	5.214763 (2.29048)***	-	-	-	-	-
LNIM	-	-	-1.244066 $(-1.612539)^{NS}$	-0.565303 $(-0.484926)^{NS}$	-0.870629 $(-0.873573)^{NS}$	-1.318421 $(-0.952414)^{NS}$	-0.918892 $(-0.849767)^{NS}$	-	-
LNEX	-	-	-	-	-	-0.657172 $(-0.527404)^{NS}$	-2.456934 (-2.302050)***	-2.161606 (-2.822890)***	-
R^2	0.91139	0.688076	0.908768	0.688955	0.657589	0.710317	0.679834	0.622036	0.605328
Adjusted R^2	0.844668	0.563306	0.787125	0.455671	0.520625	0.324074	0.439710	0.470850	0.539550
Durbin Watson	2.085633	1.990804	2.354859	2.014371	2.221532	2.185836	2.245046	2.333262	2.433713
Prob (F-statistic)	0.014328	0.054340	0.065120	0.068399	0.068607	0.019249	0.065949	0.087827	0.022992

Note: The figures in parentheses are t-Statistics, * means significant at 1%, ** significant at 5%, *** significant at 10% and *NS* not significant. M* means model with multi-collinearity,and NM* means model with no multi –collinearity.

After correcting also for multicollinearity TSL is found to impact positively on profitability and statistically significant at 10%. TCF, IM and EX have a negative impact on the profitability with TCF and EX statistically significant at 5% and 10% respectively, and IM is not significant. This is evidenced in models 4a, 5b and 6c. However, for imperfect multicollinearity, the OLS estimator still has desirable properties; they are still linear and unbiased. The t-test, F-test, the estimators and R-squared are still unaffected. To this end, we may infer that EXR, DSL, impact positively on profitability and are statistically significant at 5% and 10% respectively as observed in models 5 and 5a. Multicolliearity is a sample problem; it may mean that the data for the study has limited independent variation, hence, the data limitation problem as mentioned previously. In general, the result of regression equation does not contradict the correlation result and it further confirms the result of the profit relation obtained earlier. The R-squared is reasonable indicating that the model best fit the data (Coefficient of determination) and the Durbin Watson (DW) values suggests no autocorrelation as the values are around 2 (two).

CONCLUSIONS

The study investigates the role of smallholder farmers to poverty reduction in Sierra Leone from 2005-2012. Data is collected from the World Bank, Index Mundi Data Base, IMF, Government of Sierra Leone Policy documents and the International Financial Institutions on total supply, domestic supply, export, import and exchange rate collected from. The production relationship combined with the OLS regression techniques is applied in the study.

The result reveals that revenue outweighs the cost of funding the projects and programs specifically meant to boast small holding farming. The result indicates that small-scale farming contribution towards poverty reduction is apparent to increasing food production, increasing welfare livelihood and improving the economy. To maintain this scenario, policy makers including the government and donors should pursued policies geared towards scaling-up smallholder agricultural production by creating the enabling environment to attract agricultural investments in the sector.

The result further indicates that even if contingency financing and loans are provided by the international financial institutions to countries, by the IMF and World Bank. As long as the revenue obtained from exports are low, countries may not be able to sustain debt servicing mechanism. Therefore, development partners including the government should strive to stabilize prices of export for agricultural primary commodities. Therefore, effective and well-coordinated operational planning with implementing partners that requires robust engagement of smallholder farmers in Agricultural policy formulation and export price stabilization.

Our findings have an important implication not only for policy makers in Sierra Leone but, also for development organizations that are assisting in the agricultural growth process of Sierra Leone and other Sub-Saharan African countries.

The regression result shows that TSL, EXR, and DSL have a positive impact on profitability, and statistically significant. While, TCF and EX impact negatively on profit but significant. IM is however found to impact negatively on profitability with small margin and insignificant. The policy implication is that smallholder farmers operations should be promoted to expand output while maintaining a stable exchange rate and stable export prices. However, in order to fully understand the complexities surrounding the role of smallholder farming to poverty reduction requires a more robust future study to further provoke policy discourse. Such study could be the nexus between the commercialization of agriculture and economic growth. Despite data limitations, our findings are relevant and provide a foundation for understanding the relationship between agricultural growth via small holder farming and poverty reduction especially in the case of Sierra Leone.

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