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Inequality and social welfare status of paddy rice processors in Nigeria's Jigawa state.

Desigualdad y situación de bienestar social de los procesadores de arroz con cáscara en el estado de Jigawa en Nigeria.

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ABSTRACT

This research empirically determined the social welfare status as well as factors causing income disparity among paddy rice processors in Jigawa State of Nigeria using a cross-sectional survey data obtained through a well-structured questionnaire coupled with interview schedule from a total of 200 processors (67 millers and 133 par-boilers) meticulously selected using a multi-stage sampling technique. Besides, the collected data were analyzed using both descriptive and inferential statistics. Empirically, it was established that income disparity across the target categories was low; however, market-wise, the market structure of the par-boilers and millers in the supply value chain was perfect and oligopolistic markets respectively. Nevertheless, based on the overall, the market structure of the processors in the supply value chain exhibited the characteristics of a perfect market. Furthermore, it was inferred that income disparity owes majorly to decline labour productivity across the target categories while poor social network and complacency attitude towards innovative marketing tools as a causal factor of income disparity are only common to the par-boilers. Moreover, it was established that macro-polices *viz*. food inflation and tax reforms negatively affected social welfare of the processors. Therefore, the study advice policy makers to provide social safety nets and adopt realistic economic barometers in order to ensure the sustainability of the rice supply value chain in the study area.

Keywords: Inequality; Social welfare; Rice; Processors; Supply value chain; Nigeria.

RESUMEN

Esta investigación determinó empíricamente el estado de bienestar social, así como los factores que causan la disparidad de ingresos entre los procesadores de arroz con cáscara en el estado de Jigawa de Nigeria, utilizando datos de una encuesta transversal obtenidos a través de un cuestionario bien estructurado junto con un programa de entrevistas de un total de 200 procesadores (67 molineros y 133 vaporizadores) meticulosamente

seleccionados utilizando una técnica de muestreo de múltiples etapas. Además, los datos recopilados se analizaron mediante estadística descriptiva e inferencial. Empíricamente, se estableció que la disparidad de ingresos entre las categorías objetivo era baja; sin embargo, en términos de mercado, la estructura de mercado de los vaporizadores y molineros en la cadena de valor de suministro era mercados perfectos y oligopólicos, respectivamente. Sin embargo, en términos generales, la estructura del mercado de los procesadores en la cadena de valor de suministro presentaba las características de un mercado perfecto. Además, se dedujo que la disparidad de ingresos se debe en gran medida a la disminución de la productividad laboral en las categorías objetivo, mientras que la mala red social y la actitud de complacencia hacia las herramientas de marketing innovadoras como factor causal de la disparidad de ingresos solo son comunes a los parboilers. Además, se estableció que las macropolíticas a saber. La inflación de los alimentos y las reformas fiscales afectaron negativamente el bienestar social de los procesadores. Por lo tanto, el estudio aconseja a los responsables de políticas que proporcionen redes de seguridad social y adopten barómetros económicos realistas para garantizar la sostenibilidad de la cadena de valor del suministro de arroz en el área de estudio.
Palabras clave: Desigualdad; Bienestar Social; Arroz; Procesadores; Cadena de valor de suministro; Nigeria.

INTRODUCTION

The market economy, which is made up of organizations and structures that serve as the primary sites of socio-economic integration, is logically bound to produce inequality (Saini and Kaur, 2022). Inequality may result from inequalities in access to social and economic goods and services as well as disproportionate ownership of the production resources (land and money) (Bathla and Kumar, 2019). In recent years, both macroeconomists and development economists have paid close attention to the impacts of economic inequality (Sadiq *et al*., 2021). This is a consequence of the rising inequality within and between nations, which has been present at least since the 1980s (Saini *et al*., 2022). Understanding its effects on growth and progress has been a focus for economists. Many countries in sub-Saharan Africa (SSA) have high levels of economic inequality (Odusola, 2017; Bigsten, 2018). The expanding scope of destitution and general economic issues in many of these countries can better support this. As a result, there is now a lot of interest in determining the degree of income inequality between various social categories (Omar and Inaba, 2020). The causes of income disparity in developing nations have drawn attention ever since Kuznets (1955) published his groundbreaking research on the link between economic growth and income inequality. As a result, new methods for breaking down the causes of income inequality have developed.

Despite the significance of loans to small-scale rice paddy processors, the agricultural sector, and overall national economic development in Nigeria, studies done to date have not clearly focused on analyzing the determinant factors of income disparity among the operators - par-boilers and millers who use microfinance institutions credit facilities. Due to the size of their businesses and ease of credit application, small-scale rice paddy processors and entrepreneurs currently favor loans from cooperative societies and microfinance banks. Numerous studies on

income inequality have been conducted in Nigeria (e.g., Akin-Olagunju and Omonona, 2013; Ukoha *et al*., 2017; Ogundipe *et al*., 2019; Akpan *et al*., 2020), with the majority of these studies focusing on measuring the degree of income inequality in the primary production unit and making little to no effort to look at what transpired in the post-production unit's value chain. Additionally, there is no comprehensive research on the income differences among the country's agricultural businesses that benefited from credit facilities. In comparison to other growing economies and G20 countries, Africa and indeed Nigeria witnessed the lowest wage/income growth from 2006 to 2013, according to Ogundipe *et al*.(2019). It also discussed Nigeria's historically large wage inequalities and how these disparities are harming the nation's political and socioeconomic structures. Akpan *et al*.(2020), demonstrated how wage and income inequality impedes medium- and long-term economic development.

Nigeria is home to a large number of commercial rice mills, mostly in the north. The measures that aid in reducing poverty and reducing income inequality are not always the same (Akpan *et al*., 2020). For instance, improved productivity and high-quality education are effective instruments for reducing poverty, but without progressive taxation and focused safety nets, they could widen income gaps. Growth in agro enterprises is undoubtedly accompanied by high asset concentration, high capital consumption, and specialized labor intensity in industries like finance, production, insurance, and so forth, all of which contribute to an increase in overall inequality. Inequality and resource reliance, however, do not appear to be directly related. There are particular traits of resource-dependent growth that present clear inequality in risk, such as the peril for illegal outflows and frail governance organizations that could trigger a demographic shift. The connection between income inequality and small-scale rice processors is good, but the puzzle is how to reduce inequality while the population is growing. The factors that contribute to inequality among small-scale rice paddy processors are multifaceted and complex; as a result, numerous solutions are needed to handle the problem. Inequality in Nigeria & throughout Africa is largely a result of unequal national revenue and resource distribution. To resolve the income gaps between rice par-boilers and millers, it is necessary to guarantee an equal share of wealth, opportunities, and credit.

Small-scale rice paddy processors are viewed as the development engine for rice farmers, but there have been obstacles to the progress of SMEs in Nigeria. There aren't many studies on the topic of income disparity among small-scale rice paddy processors, sources of credit, and how it influences the amount of rice processed. If this category of small-scale processors is to significantly contribute to the process of the country's development, it would also be necessary from a policy perspective to integrate private and public strategies, taking into account the fact that credit access can only be accomplished when cheap, timely, and accessible financing options are present and used appropriately. To change the present pattern of diverging inequality into a merging trend of failing disparity throughout the region, it is essential to promote complementary policies that assist in addressing poverty and income inequality.

Much has been spent on reducing poverty in recent years, just as it was in the past. Despite the significant resources invested, it is clear that the effect was minimal and that the general public is still not in a better position. The growth region has seen the most success, while the distribution area has seen little to no success. The failure

of the government to effectively target the poor and the absence of a clearly defined income distribution policy are two factors impeding the success of the government's efforts to lower the level of poverty. Poverty, inequality, and economic growth have all been proven to be strongly correlated. Growing economic inequality has been a major factor in Nigeria's rise in poverty. Austerity measures have not encouraged income redistribution, and economic growth has a tendency to benefit those in managerial positions in the public sector. In reality, talks about reducing poverty have been focused on income growth while ignoring the importance of income redistribution. Income redistribution, however, makes a significant addition to the reduction of poverty in Nigeria. Therefore, in order to implement an effective and long-lasting policy to fight poverty and other character flaws associated with income inequality, it is necessary to handle the redistribution issue by understanding the variables that influence income disparity (and also measure inequality). Therefore, the research's results will be helpful to the government, non-governmental organizations (NGOs), policymakers, and others in identifying simpler, more affordable, and more readily accessible sources of credit as well as bridging income inequality nearby, among other fields. Additionally, this study will act as a turning point for policy options regarding the National Agricultural Agreement System, which is a magic bullet for reducing income disparity in Jigawa State specifically and Nigeria in general. Besides, it will provide details on relationships between rice processors and small-scale rice paddy processors or entrepreneurs who used banking institutions so that these traits and their inputs to income can be viewed in relation to one another. Consequently, this research aimed at determining social welfare status and income inequality determinants among paddy rice processors in Jigawa State of Nigeria. The specific objectives were to evaluate income distribution of the processors; determine the social welfare status of the processors; and, identify income inequality determinants among the processors in the study area.

THEORETICAL FRAMEWORK

Shorrocks (1983, 1999) is usually followed by conventional methods for income decomposition. These models allow either population sub-groups or factor components to perform the decomposition as both generate "within" and "between" elements. Adams (2001), Akin-Olagunju and Omonona (2013), Ouedraogo and Uoedraogo (2015) used source decomposition of the Gini statistic to divide factors (or sources of income) into smaller parts. Factor components have the drawback of only being able to attribute cumulative inequality to the sources of income, which prevents them from being broken down into components linked to each of the basic determinants. While managing the effects of other factors, the novel regression-based decomposition method enables quantification of each inequality factor's input. The technique can be applied to dissect any inequality index starting from an income-generating function, using any functional form of income-generating model. It also has the benefit of removing the "black box" that many conventional decomposition methods left unsolved. As a result, this study used regression-based decomposition with the Shapley’s framework to inequality decomposition and its benefits to analyze income data gathered from paddy rice producers in Jigawa State, Nigeria.

RESEARCH METHODOLOGY

The research region, which was separated from Kano State, has a total land area of about 22,410 square kilometers. Its boundaries on the west are Kano State, the east is Bauchi and Yobe States, the north is Katsina and Yobe States, and the south is the Republic of Niger. Generally flat in topography, the state's northern, central, & eastern regions are traversed by undulating sand dunes that stretch from southwest to northeast. The area around Dutse, the state seat, is rocky and hilly to a lesser extent. Hills in the region of Birnin Kudu and Kazaure, in the state's southern and western regions, attain heights of 600 meters above sea level. From west to east, the Hadejia River flows through the state, traversing the Hadejia-Nguru marshland before flowing into Lake Chad. With a tropical environment that changes with the seasons, the state is situated between latitudes 11˚00'N and 13˚00'N and longitudes 8˚00'E and 10˚35'E. April and September are typically the months with the highest reported temperatures. 15 degrees Celsius for the low & 35 degrees Celsius for the high are the monthly averages. The rainy season lasts from May to September, and rainfall amounts typically range between 600 and 1000 millimeters. More rain falls in the southern than in the northern parts of the province (www.jigawastate.gov.ng). Although Guinea savannah remnants can be found in the state's southernmost regions, the Sudan savannah flora zone dominates the region. The nation's total forest cover is only about 5% because of rainfall patterns and deforestation mainly brought on by the use of wood for cooking. The Hausa term "Jigawa" describes a sizable loamy soil that isn't marshy. Agriculture-cultivating crops, raising livestock, and other non-farm activities-is the main employment of the locals. Other occupations include hunting and artisanal work.

A multi-stage sampling technique was used to elicit information from a total of 200 actors of the processing chain of the rice value chain in Nigeria's Jigawa State. Based on high concentration of rice production, three out of the four stratified agricultural zones were purposively selected; and the chosen agricultural strata were Zones 1, 2 and 3. From each of the chosen agricultural strata, two Local Government Areas (LGAs) were randomly chosen. The chosen LGAs from Zones 1, 2 and 3 were Miga and Jahun; Ringim and Taura; and, Kafin-Hausa and Auyo respectively. From each of the selected LGAs, three villages were randomly selected, thus given a total of eighteen (18) villages. The random selection of the LGAs and villages were achieved by using an inbuilt Microsoft sampling tool. Afterward, on the basis of activities in the processing chain, the processing population was stratified into par-boilers and millers. Using Yammane formula, a total of 200 processors composed of 133 par-boilers and 63 millers were randomly drawn from the sampling frame obtained from the relevant agencies- Jigawa State Agricultural and Rural Development Authority (JARDA), Co-operative societies and Microfinance Banks in the State (Table 1). Data collection was done through a well-structured questionnaire complemented with interview schedule using an easy-route cost approach in the year 2022. Data syntheses were achieved using descriptive and inferential statistics. In order of arrangement, the first, second and third objectives respectively were achieved using Gini decomposition model, Social welfare model and Shapley's decomposition model.

Table 1: Sampling frame of rice processors in Jigawa State

Zone	LGA	Village	Sampling frame		Sample size	
			Par-boiler	Miller	Par-boiler	Miller
Zone 1	Miga	Sakuwa	15	7	8	4
		Hantsu	10	11	5	5
		Gwari	8	9	4	5
	Jahun	Harbosabuwa	13	6	7	3
		Harbutsohuwa	18	10	9	5
		Agufa	15	8	8	4
Zone 2	Ringim	Sintimawa	21	9	11	4
		Yan-Dutse	18	8	9	4
		Yakasawa	19	6	10	3
	Taura	Maje	11	10	6	5
		Gilma	10	6	5	3
		Majiya	12	4	6	2
Zone 3	Kafin-Hausa	Bulangu	11	7	5	4
		Kafin-Hausa	13	6	6	3
		Baushe	19	5	9	2
	Auyo	Arawa	21	5	10	2
		Gatafawa	17	10	8	5
		Ayama	14	7	7	4
Total	6	18	265	134	133	67

Source: JARDA, Co-operative Society and Micro Finance Bank, 2019.

$n = N/1 + N(e)^2$ ……..(1)

Where, n is the finite sample size, N is the population size and e is the error gap at 5%.

Model specification

1. Gini decomposition model

The Gini index was revised to read as follows to emphasize the gross disparities between and within groups (Ouedraogo and Uoedraogo, 2015):

$$G = \frac{\sum_{j=1}^{k}\sum_{i=1}^{n_i}\sum_{r=1}^{n_i}|x_{Q,i}-x_{Q,r}|}{2n^2\mu} + \frac{2\sum_{j=2}^{k}\sum_{h=1}^{j-1}\sum_{i=1}^{n_i}\sum_{r=1}^{n_h}|x_{Q,i}-x_{Q,r}|}{2n^2\mu} = G_w + G_{gb} \text{ ……. (2)}$$

The term $x_{j,i}$ refers to the person i's income level within group Q_j. G_{gb} is the gross contribution of the Gini between-group index, which allows one to measure the income gaps between each peer group and sub-group. G_w

is the Gini within-group index of inequality, which reflects the contribution of inequalities from each category to the overall inequality.

The sub-population Gini values $Q_j(G_{ij})$ and the sub-populations Q_j and Gini indicators$Q_h(Q_{jh})$, respectively, are provided by:

$$G_{jj} = \frac{\sum_{i=1}^{n_i}\sum_{r=1}^{n_i}|x_{Q,i}-x_{Q,r}|}{2n_j^2\mu_j} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(3)}$$

$$G_{jh} = \frac{\sum_{i=1}^{n_i}\sum_{r=1}^{n_h}|x_{Q,i}-x_{Q,r}|}{2n_jn_h(\mu_j+\mu_h)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(4)}$$

The revenue distribution between groups Q_j and Q_h is uneven when G_{jh} tends toward the value 1; the even distribution is represented by a value of zero.

The net intergroup Gini index of inequality G_{nb}, which tracks differences in mean income between groups, is the first component of the between-group index of inequality. The second assesses the degree to which income distributional overlaps are responsible for disparities between groups G_t. The economic distance, D_{jh}, is used in this analysis. When the mean of the sets Q_j and Q_h are equal, it is null. It gauges the degree to which two groups overlap:

$$D_{jh} = \frac{\sum_{xi,j<xh,r}(x_{h,r}-x_{i,j})-\sum_{xi,j>xh,r}(x_{i,j}-x_{h,r})}{\sum_{i=1}^{n_i}\sum_{r=1}^{n_h}|x_{j,i}-x_{h,r}|} \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(5)}$$

$\forall \mu_j < \mu_h$

The Gini index breakdown can then be expressed as:

$$G = G_w + G_{nb} + G_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(6)}$$

With $G_{nb} = \sum_{j=2}^{k}\sum_{h=1}^{j-1} G_{jh}D_{jh}(P_jS_h + P_hS_j)$ ……. (7)

And $G_t = \sum_{j=2}^{k}\sum_{h=1}^{j-1} G_{jh}(1 - D_{jh})(P_jS_h + P_hS_j)$ ……. (8)

$$P_j = \frac{n_j}{n} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(9)}$$

$$S_j = \frac{n_j\mu_j}{n\mu} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(10)}$$

2. Social welfare model

The Atkinson social welfare indicator is as follows:

$$\xi(k;\varepsilon) = \begin{cases} \left|\frac{1}{\sum_{i=1}^{n} w_i^k}\sum_{i=1}^{n} w_i^k (y_i)^{1-\varepsilon}\right|^{\frac{1}{1-\varepsilon}} \rightarrow if\ \varepsilon \neq 1\ and\ \varepsilon \geq 0 \\ Exp\left|\frac{1}{\sum_{i=1}^{n} w_i^k}\sum_{i=1}^{n} w_i^k ln(y_i)^{1-\varepsilon}\right| \rightarrow \varepsilon = 1 \end{cases} \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(11)}$$

Using the symbol $\xi(k;\rho)$ to denote the S-Gini social welfare indicator, we have:

$$\xi(k;\rho) = \sum_{i=1}^{n}\left[\frac{(V_i)^\rho-(V_{i+1})^\rho}{[V_1]^\rho}\right] y_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(12)}$$

$$V_i = \sum_{h=i}^{n} w_h^k \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(13)}$$

Using the notation $\xi(k;\varepsilon,\rho)$ to denote the Atkinson-Gini social well-being index, we have:

$$\xi(k;\varepsilon,\rho)=\begin{cases}\left[\sum_{i=1}^{n}\left[\frac{(V_i)^{\rho}-(V_{i+1})^{\rho}}{[V_1]^{\rho}}\right](y_i)^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}} & \rightarrow if\ \varepsilon\neq 1,\varepsilon\geq 0\ and\ \rho\geq 1\\ Exp\left[\sum_{i=1}^{n}\left[\frac{(V_i)^{\rho}-(V_{i+1})^{\rho}}{[V_1]^{\rho}}\right]lny_i\right] & \rightarrow \varepsilon=1\ and\ \rho\geq 1\end{cases}$$

…… (14)

$V_i=\sum_{h=i}^{n}w_h^k$ …… (15)

Impact of a price change on the Atkinson social welfare index

The effect of a good's marginal price shift (abbreviated IMPW) on the Atkinson Social Welfare index $\xi(\varepsilon)$ is as follows:

$IMPW=\frac{\partial\xi(\varepsilon)}{\partial p_i}*pc$ …… (16)

$$IMPW=\begin{cases}-(s1)^{\frac{1}{\varepsilon-1}^{*}}(s2)^{\frac{1}{1-\varepsilon}^{*}}(s3)^{*}pc\ \ if\ \ \varepsilon\neq 1\\ -exp(\frac{s2}{s1})^{*}(\frac{s3}{s1})^{*}pc\ \ if\ \ \varepsilon\neq 1\end{cases}$$ …… (17)

$$\begin{cases}s1=\sum_i w_i\quad s2=\sum_i w_i y_i^{1-\varepsilon}\quad s3=\sum_i w_i y_i^{-\varepsilon}x_i & if\ \ \varepsilon\neq 1\\ s1=\sum_i w_i\quad s2=\sum_i w_i\log(y_i)\quad s3=\sum_i w_i\,{}^{x_i}/_{y_i} & if\ \ \varepsilon\neq 1\end{cases}$$ …… (18)

Where y_i is the standard of living, *PC* is the percentage price change for the product 1, and x_i^1 is the amount of money spent by individual i on commodity 1.

Tax reform's effect on the Atkinson social welfare index

Under the condition that total government income remains constant, this tax reform involves changing the prices of two commodities, 1 and 2. The marginal cost of public funds (MCPF) from a tax on two over the MCPF from a tax on one determines the impact of this constraint, and it is measured by an efficiency parameter called "gamma" (γ).

The Atkinson Social Welfare indicator $\xi(\varepsilon)$ (referred to as IMWTR) has the following effects as a result of this tax reform:

$IMWTR=\left[\frac{\partial\xi(\varepsilon)}{\partial p_1}-\gamma\frac{\bar{X}_1\partial\xi(\varepsilon)}{\bar{X}_2\partial p_2}\right]*pc$ …… (19)

Where $\bar{X}_g$ represents the overall cost associated with the good *g* and *PC* represents the percentage change in price of commodity 1. Given the government's revenue restrictions, commodity 1's percentage price shift is given by $\gamma\frac{\bar{X}_1}{\bar{X}_2}pc$.

Impact of income-component growth on the Atkinson social welfare index

Following are the effects of the j[th] component's increase on the Atkinson Social Welfare index $\xi(\varepsilon)$:

$$\frac{\partial\xi(\varepsilon)}{\partial x_j}*pc=\begin{cases}(s1)^{\frac{1}{\varepsilon-1}^{*}}(s2)^{\frac{1}{1-\varepsilon}^{*}}(s3)^{*}pc & if\ \ \varepsilon\neq 1\\ exp(\frac{s2}{s1})^{*}(\frac{s3}{s1})^{*}pc & if\ \ \varepsilon\neq 1\end{cases}$$ …… (20)

$$\begin{cases}s1=\sum_i w_i\quad s2=\sum_i w_i y_i^{1-\varepsilon}\quad s3=\sum_i w_i y_i^{-\varepsilon}x_i^j & if\ \ \varepsilon\neq 1\\ s1=\sum_i w_i\quad s2=\sum_i w_i\log(y_i)\quad s3=\sum_i w_i\,{}^{x_i}/_{y_i} & if\ \ \varepsilon\neq 1\end{cases}$$ …… (21)

Where *PC* represents the percentage change in the j[th] income component and x_i^1 represents the value of the j[th] component for individual i[th]. This explains how much social welfare will alter if a *PC* increases is seen in a component j[th] of total income.

3. Shapley's decomposition technique

In many areas of economics, the Shapley decomposition methods are used to help separate and measure the effects of different causal factors (Wu *et al*., 2021). Their use is especially prevalent in research on poverty and disparity. It is stated as follows:

$Y = f$ (C_1, C_2 , C_3 ---- C ñ) …… (22)

Where:

Y represents aggregate level of inequality

f is aggregator function representing underlying model

C k denotes contributory factor

C_1 = Age (years)

C_2 = Gender (male =1, otherwise = 0)

C_3 = Marital status (married =1, otherwise = 0)

C_4 = Household size (number)

C_5 = Educational status (year)

C_6 = Farming experience (year)

C_7 = Co-operative membership (yes =1, otherwise = 0)

C_8 = Credit access (yes =1, otherwise =0)

C_9 = Credit utilization (yes =1, otherwise = 0)

I will serve as an index that can be determined using *Y* as follows:

I = I (Y) = I (f (C_1, C_2 , ---------C_n),) …….. (23)

The decomposition exercise will be applied to the model in order to give contribution k to each of each factor k, and I will be utilized for expressing the sum of the factors' contributions. According to Kimhi and Hanuka-Taflia (2019), variables like the composition of each household, the supply-side impact, unearned income, educational level, gender, and age will all be taken into account.

The collection of real values C k, K_0 K that make up a breakdown (decomposition) of +K, F will show the relative contributions of the various factors. A function called a decomposition C will produce a number of component contributions.

$I = X_K\ C_{K}{}'\ C_K\ (K, F), K_0 K$ …… (24)

RESULTS AND DISCUSSION

Annual Income Distribution of Paddy Rice Processors: The income distributions of the processors are presented in Table 2 and Figure 1. The total annual income Gini indexes of par-boilers, millers and the overall groups being 0.2473, 0.1616 and 0.2660 respectively, implies low inequality in the income distribution across each of the target groups. Empirically, the decomposition analysis showed evidence of inequalities between the par-boilers and millers; likewise within the processors' (overall) group. Thus, inequality between groups (par-boilers and millers) contributed 10.67% to the total inequality while the inequality within the overall group contributed 14.75% to the total inequality. However, the contribution of between the target groups inequality to the total inequality owes to trans-variation/ overlap/ interaction that explains 1.22% of total inequality while within-group inequality contribution owes to disparity between the low and medium income earners in the millers' category. Therefore, based on the empirical evidence, the inequality in the distribution of the income among the millers tends to be very less compared to that of the par-boilers. Further, the Lorenz curve not been farther from the line of equality vis-à-vis the target categories as depicted graphically in Figure 1 justified the almost evenness in the income distribution among the par-boilers, millers and the overall group. The implication is that, the par-boiling category is mostly dominated by low income earners alongside few medium income earners while the constitution of the milling category is almost all low income earners. Therefore, it can be inferred that the market nature of par-boilers in the supply value chain is that of a perfect market while that of the millers is oligopolistic. Nevertheless, based on the pool result, it can be concluded that the rice processing supply value chain in the study area is a perfect market. Furthermore, the income gap between the low income and high income earners vis-à-vis the par-boiling, milling and the overall groups were 24.73, 16.16 and 26.60% respectively. Therefore, policy aimed at income redistribution should be made effective in the study area so as to bridge the income gap, thus containing the risk of the supply value chain drifting into a monopolistic market.

Table 2: Income decomposition of the processors

Items	Par-boilers	Millers	Pool
Total	0.247279	0.161616	0.265972
Within	-	-	0.1475068
Between	-	-	0.1066939
Overlap/interaction	-	-	0.01219632
Contribution	0.137671611	0.009835185	-
Share income	0.6947116	0.3052884	-
Share group	0.8014055	0.1985945	-

Source: Field survey, 2022

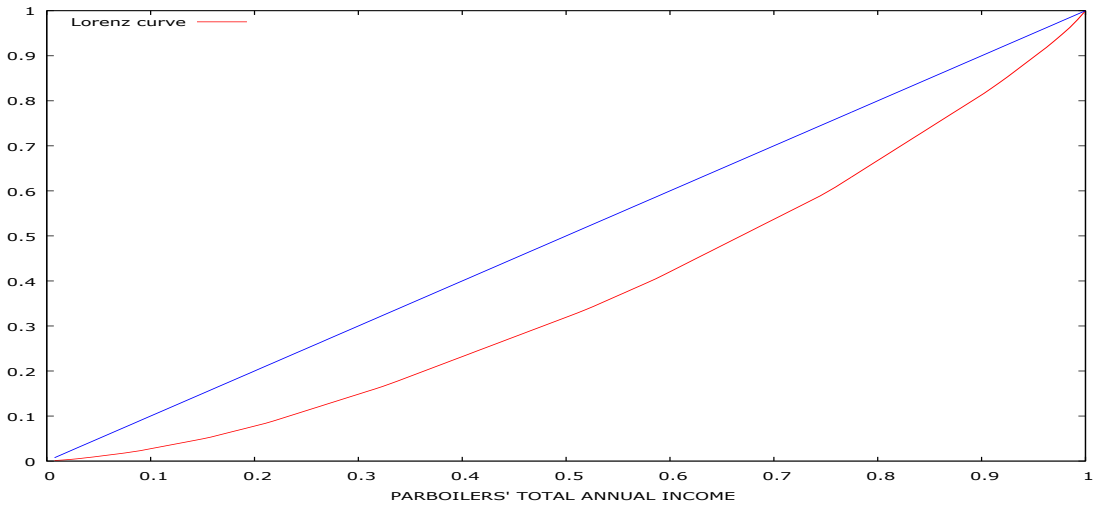

Figure 1a: Income distribution of par-boilers

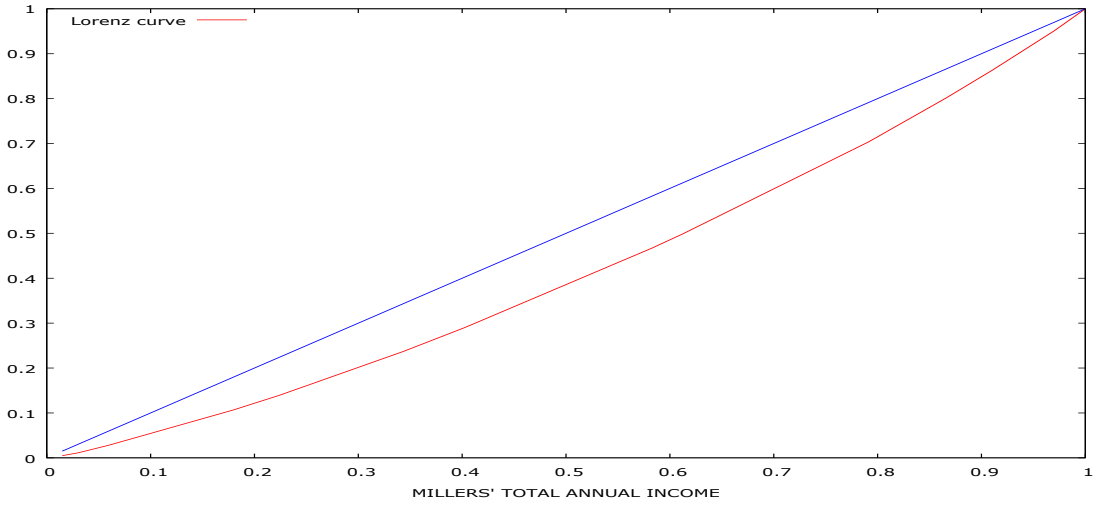

Figure 1b: Income distribution of millers

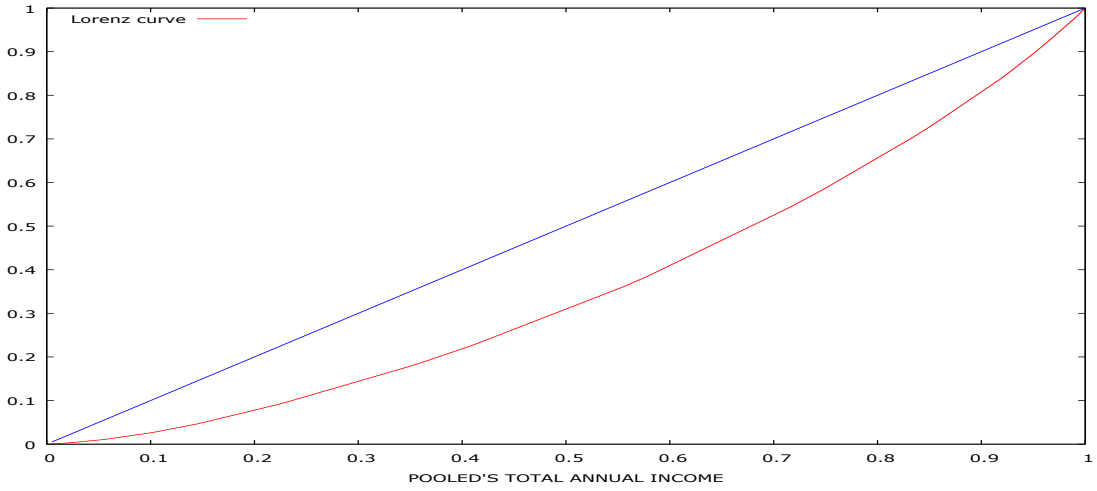

Figure 1c: Income distribution of pool group

Social Welfare Status of the Processors: At household's weight, a cursory review of Atkinson's social welfare result showed that an equivalent annual income of ₦326448.78, ₦614183.83 and ₦411798.84 from the average income if given to everyone in the par-boilers, millers and the overall groups respectively will generate the same social welfare as the existing distribution of income (Table 3a). In addition, these same levels of social welfare among the par-boilers, millers and the overall group respectively can be achieved with approximately 95, 98 and 94% of their respective actual average incomes as evident by the index of inequality estimate. Contrarily, the results of S-Gini and Atkinson-Gini welfare indexes respectively, though less than the former, revealed ₦259026.25, ₦523474.60 and ₦320042.34; and, ₦245223.40, ₦513433.09 and ₦301226.50 respectively to be the share of respective current average incomes of par-boilers, millers and the overall group that can be sacrificed without reducing social welfare if perfect inequality is established. Besides, given the index estimates of S-Gini and Atkinson-Gini welfare respectively, with only 75, 83 and 73%; and, 71, 82 and 69% of the actual average income of par-boilers, millers and the overall group respectively, the same level of social welfare can be achieved.

Furthermore, given the impact of price change on welfare, the empirical evidence showed that price inflation of sorghum and rice (the major consumed commodities) by 1 percent significantly increase social risk aversion to inequality marginally in each of the target categories (3b). Consequently, a 1 percent inflationary effect on the prices of sorghum and rice respectively will lead to a significant decline in the equivalent incomes that generates the same social welfare for par-boilers, millers and the overall group by 3.75, 3.59 and 3.79%; and, 8.57, 8.20 and 8.66%. Nevertheless, the impact of price change by a percent vis-à-vis sorghum and rice prices respectively significantly declined the average income of par-boilers, millers and the overall group uniformly by 3.50 and 8.0%. Further, except par-boilers, it was established that tax reform has a marginal negative effect on equivalent income that generates the same level of social welfare in each of the target categories if perfect inequality was instated. Conversely, tax reform has no effect on social risk aversion to inequality and the average income as evident by their respective index. Therefore, it can be inferred that the consequence of food price inflation on purchasing power- a monetary policy and tax reform- a fiscal policy reduced the social welfare of the target categories in the study area.

For the impact of income-component growth on welfare, the empirical evidence revealed that income growth from processing has a significant marginal positive effect on social risk aversion to inequality across each of the target categories (Table 3c). Conversely, income growth from other income sources has a negative significant marginal effect on risk aversion to inequality across all the target categories. Besides, a percent increase in only processing income vis-à-vis the par-boilers, millers and the overall group will significant increase social welfare equivalent income and average income respectively by ₦2003.24, ₦4270.09 and ₦2662.96; and, ₦2119.49, ₦4372.75 and ₦2866.09. Also, a percent growth increase in the other income sources will significantly increase the social welfare equivalent income and the average income respectively of par-boilers, millers and the overall group by ₦1261.25, ₦1871.75 and ₦1455.02; and, ₦1329.68, ₦1910.03 and ₦1521.98. Thus, it can be inferred that

growth in processing income negatively affected social welfare compared to other income sources' growth which positively enhanced social welfare across the target categories in the study area. This clearly showed that pluriactivity is the centerpiece of livelihood survival strategy as the processors combined different occupations to enhance income and livelihood quality. Pluriactivity implies that these processors used a wide range of income opportunities, including those beyond rice processing enterprise. These processors have the opportunity to continue working in the agriculture supply chain, maintain their operation-however small, they earn enough money to at least partially meet their financial goals by engaging in other lucrative activities. Of the established social welfare difference of ₦287735.05 between the millers and par-boilers, the inequality component, mean component cum the interaction components respectively have significant contribution of ₦10730.92, ₦268188.07 and ₦8815.79 (Table 3d).

The empirical evidence of the inequality dominance showed that in the short-run, the inequality of the millers' group significantly dominates the distribution with a critical relative inequality line of 0.716 while in the long-run, the inequality of the par-boilers' group will significantly dominates the distribution with 0.720 being the critical relative inequality line (Table 3e and Figure 2a). Besides, for the poverty dominance, the empirical evidence showed that the par-boilers' group significantly dominates in poverty distribution against the millers' group by an extra of 37.85% (Table 3f and Figure 2b). Furthermore, the annual income threshold at which a par-boiler and miller is considered deprived are ₦83757.96 and ₦89460.17 respectively (Table 3g and Figure 2c).

Table 3a: Social welfare status of processors

Group	Variable	Atkinson welfare			S-Gini welfare			Atkinson-Gini welfare		
		Coeff.	SE	t-stat	Coeff.	SE	t-stat	Coeff.	SE	t-stat
PB	Estimate	0.05354	0.00666218	8.04***	0.249019	0.016443	15.14***	0.289037	0.020137	14.35***
	SW	326449	14437.1136	22.61***	259026.2	13803.33	18.76***	245223.4	14049.88	17.45***
	Mean	344917	14343.7395	24.05***	344917.2	14343.74	24.04***	344917.2	14343.74	24.04***
Millers	Estimate	0.02243	0.00357207	6.28***	0.16681	0.013582	12.28***	0.182791	0.015937	11.47***
	SW	614184	27713.2377	22.16***	523474.6	26511.06	19.75***	513434.1	26351.41	19.48***
	Mean	628278	27853.9218	22.56***	628277.6	27853.92	22.56***	628277.6	27853.92	22.56***
Pool	Estimate	0.06155	0.00620115	9.93***	0.270654	0.014141	19.14***	0.313534	0.01803	17.39***
	SW	411799	16932.7469	24.32***	320042.3	15124.37	21.16***	301226.5	15348.98	19.63***
	Mean	438807	17331.286	25.32***	438807.5	17331.29	25.31***	438807.5	17331.29	25.31***

Source: Field survey, 2022

Note: *** means significant at 1% probability level; PB = par-boilers

Table 3b: Impact of price change and tax reform on processors welfare

Group	Variable	Impact of sorghum price change (%)			Impact of rice price change (%)			Impact of tax reform on welfare (%)		
		Coeff.	SE	t-stat	Coeff.	SE	t-stat	Coeff.	SE	t-stat
PB	II	1.3E-06	0.00000019	6.68***	2.9E-06	4.3E-07	6.74***	0	0	0^{NS}
	IW	-3.7508	0.0362753	-103.39***	-8.57325	0.082915	-103.39***	0	-2E-08	0^{NS}
	IM	-3.5	0.44981918	-7.78***	-8	1.028158	-7.78***	0	0	0^{NS}
Miller	II	2.7E-07	0.00000005	5.40***	6.1E-07	1.1E-07	5.55***	0	0	0^{NS}
	IW	-3.5881	0.01659179	-216.26***	-8.20143	0.037924	-216.26***	-3E-08	-2E-08	1.5^{NS}
	IM	-3.5	0.85958259	-4.07***	-8	1.96476	-4.07***	0	0	0^{NS}
	II	1.2E-06	0.00000014	8.21***	2.63E-06	3.2E-07	8.22***	0	0	0^{NS}

	IW	-3.7903	0.03589755	-105.59***	-8.66364	0.082052	-105.59***	-1E-08	-1E-08	1^{NS}
	IM	-3.5	0.24995747	-14.00***	-8	0.571331	-14.00***	0	0	0^{NS}

Source: Field survey, 2022

Note: ***& NS mean significant at 1% probability level and non-significant; PB = par-boilers

Table 3c: Impact of income component growth on processors welfare

Group		Variable	Impact of processing income			Impact of income from other sources		
			Coeff.	SE	t-stat	Coeff.	SE	t-stat
PB		II	8E-06	0.0000328	0.244^{NS}	-8E-06	3.3E-05	0.244^{NS}
		IW	2003.24	102.811261	19.484***	1261.25	77.3919	16.296***
		IM	2119.49	288.24702	7.353***	1329.68	184.44	7.209***
Millers		II	7.3E-06	0.00001716	0.423^{NS}	-7E-06	1.7E-05	0.423^{NS}
		IW	4270.09	213.183068	20.030***	1871.75	108.706	17.218***
		IM	4372.75	1095.75941	3.990***	1910.03	486.489	3.926***
Pool		II	6.1E-05	0.00002188	2.783***	-6E-05	2.2E-05	2.783***
		IW	2662.96	126.411109	21.065***	1455.02	69.1998	21.026***
		IM	2866.1	247.394774	11.585***	1521.98	128.848	11.812***

Source: Field survey, 2022

Note: ***& NS mean significant at 1% probability level and non-significant; PB = par-boilers

Table 3d: Change in social welfare of the processors

Index	Distribution 1	Distribution 2	Difference	Covariance
Inequality	0.05354	0.02243	0.03111	0
Standard error	0.00666	0.00357	0.00756	-
t-stat	8.037084***	6.279958***	4.115684***	-
Welfare	326449	614184	-287735	5.4E-05
Standard error	14437.1	27713.2	31248.3	-
t-stat	22.61178***	22.16211***	9.20803***	-
Mean	344917	628278	-283360	10730.9
Standard error	14343.7	27853.9	31330.2	-
t-stat	24.04653***	22.55616***	9.04431***	-

Source: Field survey, 2022

Note: *** means significant at 1% probability level

Table 3d: Continued ……

Item	Welfare: Dist. 2-Dist. 1	Inequality component	Mean component	Interaction
Estimate	287735	10730.9	268188	8815.79
Standard E.	31248.3	2525.44	29451	2521.3
t-statistic	9.208034***	4.249127***	9.106257***	3.496***

Source: Field survey, 2022

Note: *** means significant at 1% probability level

Table 3e: Inequality dominance of the processors

Crossing	Lambda value	Standard error	Case
1	0.71636	0.05129	2
2	0.72016	0.05115	1
3	0.80002	0.05115	2
4	0.80702	0.05727	1

Source: Field survey, 2022

Note: Case #1 = Before, Distribution #1 Dominates Distribution #2

Case #2 = Before, Distribution #2 Dominates Distribution #1

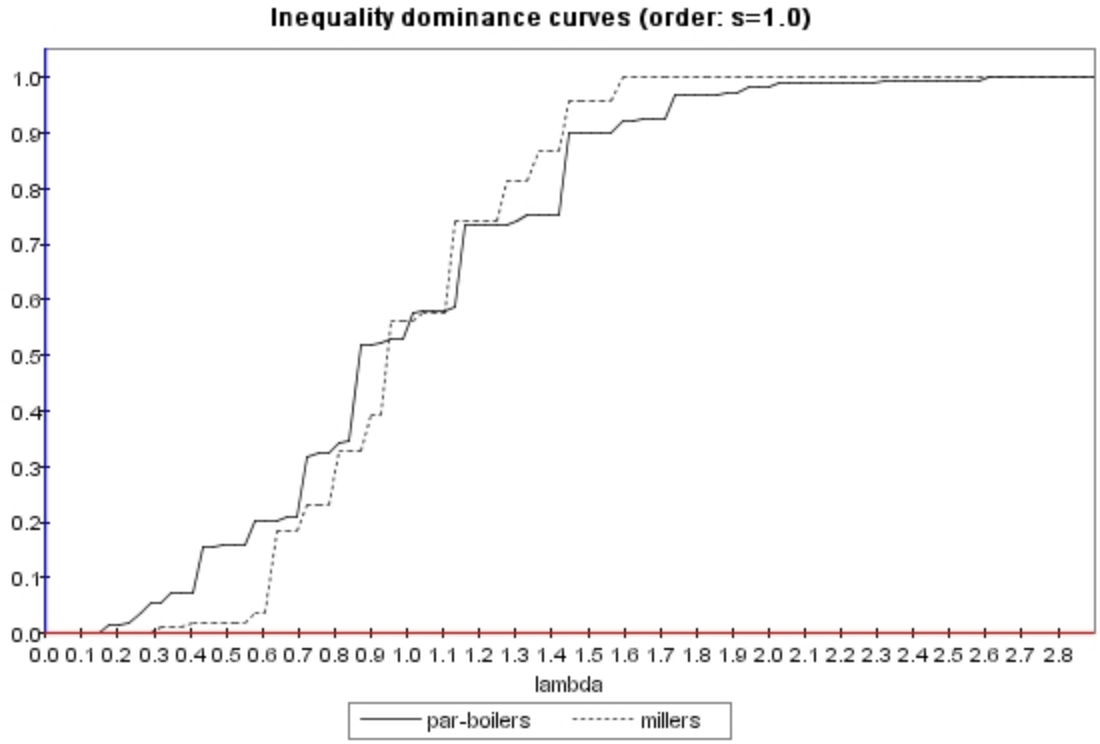

Figure 2a: Inequality dominance curves of rice processors

Table 3f: Poverty dominance of the processors

Variable	Par-boilers	Millers
Estimate	0.7218	0.34328
Standard error	0.03895	0.05815
t-statistic	18.5299***	5.90319***
Difference Index1-Index2	0.37852	-
Standard error	0.06999	-
t-statistic	5.40796***	-
Covariance Index1-Index2	-0.0000	-
Poverty line	86615.6	86615.6

Source: Field survey, 2022

Note: *** means significant at 1% probability level; Poverty line was calculated at weighted average

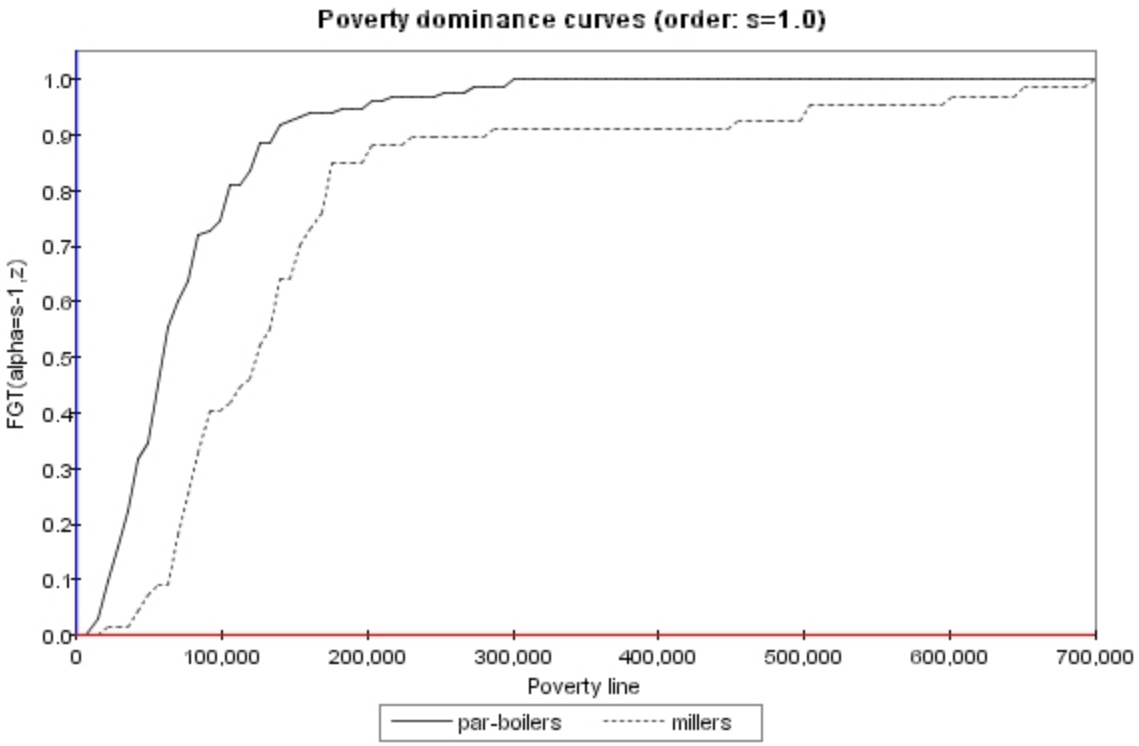

Figure 2b: Poverty dominance curves of rice processors

Table 3g: Deprivation threshold of the processors

Processor	Deprivation
Par-boiler	83758
Miller	89460.17

Source: Field survey, 2022

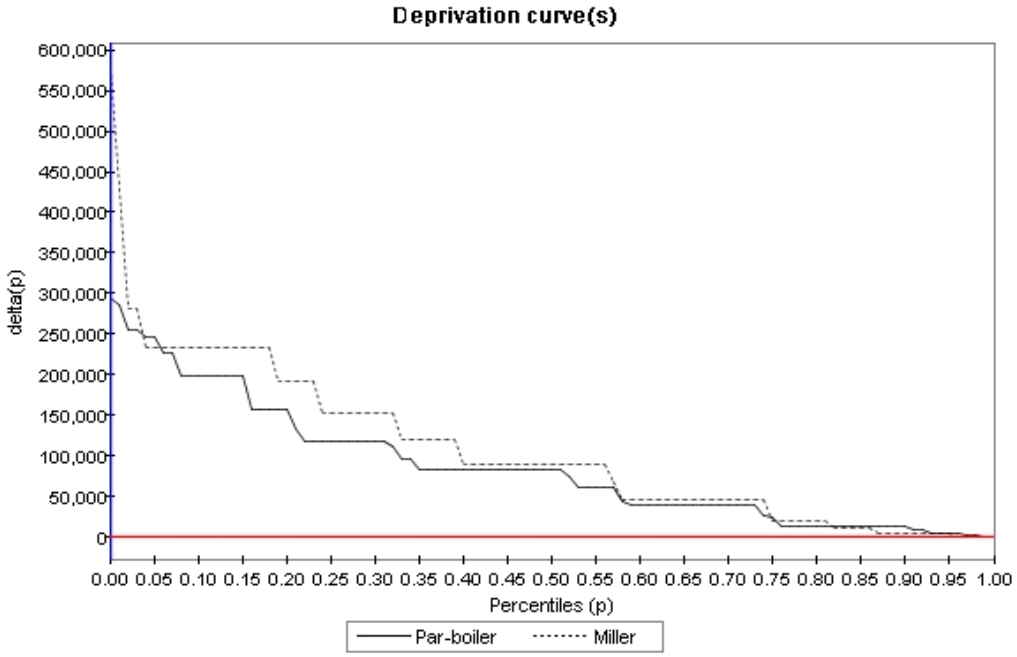

Figure 2c: Deprivation curves of rice processors

Determinants of Income Inequality among the Paddy Rice Processors: The disparate distribution of household total revenue is referred to as income inequality. One of the issues that developing nations with economies that are still expanding or where incomes are rising are facing is wage inequality. A perusal of Table 4 showed age, experience and co-operative membership to be the significant variables out of the nine predictors that contributed to income inequality among the par-boilers as evident by their respective regression parameters that were within the error gap of 10% probability level. Besides, these significant variables increased income inequality among the par-boilers as evident by the positivity of their respective decomposition inequality index. Age causing income inequality might be attributed to decline in labour productivity among the most of the youth actors as a result of drift in attention towards others small stream income sources. The effect of experience and co-operative membership on causing income inequality might be associated with complacency attitude towards innovative processing marketing technologies among the most experienced ones and poor utilization of social capital as evident from objective 1, respectively. Further, age, experience and poor utilization of co-operative association increase income inequality by 56.12, 18.75 and 5.83% respectively. Though, not significant, marital status, credit access, gender, credit utilization and education increased income inequality while household size decreased income inequality among the par-boilers. On the other hand, age is the only significant variable that caused income inequality among the millers as indicated by its regression coefficient that is different from zero at 10% probability level (Table 4). The possible reason why age increases income inequality might be linked to decline in labour productivity due to diversion of interest into numerous income sources. Besides, age increased income inequality among the millers by 23.08% while membership of association, experience, education, marital status

and credit access respectively, though not significant, increased income inequality by 38.50, 12.15, 7.44, 6.98 and 6.69%. Also, gender and household size increased income inequality by 4.40 and 1.10% respectively while credit utilization decreased income inequality by 0.34%. Generally, for the pool group, age, gender, experience and co-operative membership were the significant factors that caused income inequality as evident by their respective regression coefficients that were within the plausible margin of 10% degree of freedom. Besides, all these predictors increased income inequality among the pool category. Gender, age, experience and co-operative membership increased income inequality by 58.52, 19.27, 2.31 and 15.48% respectively. Though not significant, variables viz. access to credit, education and household size increased income inequality by 2.80, 1.98 and 0.46% while credit utilization and marital status decreased income inequality by 0.36 and 0.45% respectively. The consequence of gender discrimination and its stereotype due to religion and cultural influences that inhibits women access to credit market and active participation in the supply value chain might be the possible reason why gender widens income inequality. In addition, non-viability of social capital pooling might be the possible reason why cooperative membership affected income inequality. Also, declined in labour efficiency due to attention diversion among the teeming youth on white collar jobs which in real sense are not easy to come-by might be the possible reason why age caused disparity in income among the processors. Nevertheless, complacency towards innovative value chain technologies among most of the experienced actors might be the possible reason why experienced caused income disparity among the processors. Therefore, the study suggested the needs to strengthen the social network so as to enhance capital pooling across the value, adopt gender budget mainstreaming, adopt novelty technologies and incentivize the value chain, thus strengthening the viability of both the up and downstream rice supply value chain in the study area.

Table 4a: Income inequality determinants of paddy rice processors

Variable	Par-boilers		Millers		Pool	
	Gini index	%	Gini index	%	Gini index	%
Age	0.138739	56.10611	0.037309	23.08472	0.051241	19.26551
Gender	0.003471	1.403582	0.007113	4.401218	0.155646	58.51975
Marital status	0.056719	22.93732	0.01128	6.979444	-0.00121	-0.45349
Household size	-0.01829	-7.39631	0.001776	1.09872	0.00123	0.462488
Education	0.000543	0.219742	0.012018	7.4362	0.005257	1.976666
Experience	0.046354	18.7455	0.019642	12.15343	0.006151	2.312799
Cop. Mem.	0.014418	5.830609	0.062223	38.50044	0.041166	15.47772
Credit access	0.003918	1.58457	0.010811	6.689086	0.007432	2.794467
Credit utilization	0.001407	0.568882	-0.00055	-0.34326	-0.00095	-0.35591
Total (Gini index)	0.247279		0.161616		0.265972	
Residual	0.752721		0.838384		0.734028	

Source: Field survey, 2022

Table 4b: Regression-based decomposition of income inequality

Variable	Par-boilers			Millers			Pool		
	Coefficient	SE	t-stat	Coefficient	SE	t-stat	Coefficient	SE	t-stat
intercept	12.08007	0.288335	41.89***	12.48238	0.453957	27.49***	11.87978	0.227773	52.15***
Age	0.017777	0.007037	2.52***	0.01029	0.005878	1.75*	0.017818	0.00544	3.27***
Gender	0.094949	0.148032	0.64^{NS}	0.267089	0.300703	0.88^{NS}	0.469427	0.081518	5.75***
Marital Status	-0.16734	0.105122	-1.59^{NS}	0.165158	0.129742	1.27^{NS}	-0.11279	0.086418	1.31^{NS}
Household size	0.006036	0.020152	0.30^{NS}	-0.01131	0.014111	0.80^{NS}	0.004107	0.014734	0.27^{NS}
Education	0.013311	0.010323	1.29^{NS}	-0.0005	0.007609	0.06^{NS}	0.005358	0.007705	0.69^{NS}
Experience	-0.02285	0.010594	2.15**	0.010525	0.009582	1.09^{NS}	-0.01517	0.008358	1.81*
Co-op. mem.	0.286889	0.101615	2.82***	0.069797	0.084311	0.82^{NS}	0.219644	0.078806	2.78***
Credit access	0.097402	0.087494	1.11^{NS}	0.076684	0.220503	0.34^{NS}	0.104203	0.075987	1.37^{NS}
Credit utilization	0.050922	0.221627	0.23^{NS}	-0.03001	0.232925	0.12^{NS}	0.209089	0.173233	1.20^{NS}

Source: Field survey, 2022

Note: ***, ***, * & NS mean significant at 1, 5, 10% probability level and non-significant respectively.

CONCLUSION AND RECOMMENDATIONS

Given that the par-boiling category is dominated mostly by low income earners alongside few medium income earners while that of the milling category is low-income earners dominated, it can be inferred that the market structure of the par-boilers in the supply value chain is that of a perfect market while that of the millers is oligopolistic. Nevertheless, based on the pool result, it can be concluded that the rice processing supply value chain in the study area is a perfect market. However, disparity in income owes majorly to decline labour productivity across the target categories while poor social network and complacency attitude towards innovative marketing tools in causing income disparity are only common to the par-boilers. Empirically, inspite of pluractivity being the pivot of livelihood survival strategy, food price inflation and fiscal policy reduced social welfare in the study area. Therefore, it is pertinent for policymakers to adopt income redistribution policies for an even income distribution, thus enhance growth and livelihood wellbeing development in the study area.

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