East Africa Journal of Social and Applied Sciences (EAJ-SAS)
Vol.5, Issue 1; Publication Date: June 30, 2023
ISSN: (Online) 2714-2051, (Print) 0856-9681
Full articles of this journal are available at: https://journals.mocu.ac.tz/index.php/eaj-sas

Cite this article as: Kweka, G. J. (2023). Navigating the conundrum of agricultural commodity price fluctuations and household welfare in Tanzania. *East Africa Journal of Social and Applied Sciences,* 5(1): 64-79.

NAVIGATING THE CONUNDRUM OF AGRICULTURAL COMMODITY PRICE FLUCTUATIONS AND HOUSEHOLD WELFARE IN TANZANIA

Godfrey J. Kweka
Department of Economics and Statistics,
Moshi Co-operative University,
PO. Box 474, Moshi, Tanzania
Email: godfreyjkweka@icloud.com

ABSTRACT
Agricultural commodity price fluctuations pose a complex challenge for developing countries, engendering a predicament akin to Timmer's policy conundrum - the confluence of desiring lower prices to benefit consumers and higher prices to bolster production. This research endeavours to untangle this dilemma by examining the impact of changes in agricultural commodity prices on household welfare in Tanzania, employing a non-separable agricultural model. Drawing on four waves of national panel survey data spanning from 2008 to 2015, elasticities as the basis for analysis were calculated. Subsequently, these elasticities inform the compensating variation framework, facilitating an assessment of both the static and dynamic repercussions of shifts in agricultural commodity prices on household welfare. Notably, this evaluation considers household net-market positions and strata. Our findings, derived from an exploration of static and dynamic effects, demonstrate that households' welfare experienced degradation owing to diminished prices of agricultural commodities in comparison to scenarios featuring elevated agricultural prices. Evidently, the extent of these effects varies among different household strata and net-market positions. These outcomes underscore the adverse impact of modest fluctuations in agricultural commodity prices on the well-being of household farmers. This, in turn, accentuates the policy imperative of fostering agricultural growth and transformation. Thus, opting for reduced agricultural prices does not align with households' preferences. The discoveries in this article advocate for policies centred on augmenting market access and elevating agricultural product prices, potentially leading to substantial enhancements in household welfare. Further exploration is warranted to delve into areas such as the interconnectedness of welfare effects stemming from changes in agricultural commodity prices with households, integrating considerations of consumption, production, and shadow wages, particularly in the context of the Covid-19 pandemic.

Keywords: Agricultural commodity, Household welfare, Compensating variation, Market access, Price fluctuation,
Paper type: Research paper
Type of Review: Peer Review

1. Introduction and Background to the Study

Agriculture, as a pivotal sector, holds the potential to propel economic growth and development. Stable and appropriate pricing of agricultural commodities is imperative for sustaining agricultural expansion, enhancing economic progress, and ultimately elevating household welfare. Regrettably, persistent fluctuations in agricultural commodity prices persist, garnering substantial scholarly attention across both developed and developing nations. Notably, global agricultural commodity prices exhibit inherent volatility, a concern that has gained prominence among policy circles and political circles alike. Evidently, extreme price fluctuations pose a direct threat to a nation's advancement, impinging on household welfare with notable impacts on substantial portions of the food budget expenditure. An illustrative example lies in the consortium of developed and leading emerging economies (G20), which prominently prioritised food

price escalation and food security on their agenda in 2011. This issue was particularly amplified during the agricultural price surges of 2008/2009 and 2010/2011, causing apprehensions about the repercussions of extreme price variations in Low and Middle-Income Countries (LMIC) (UNCTAD, 2011; Usman et al., 2021). Additionally, policymakers and practitioners face the challenge of addressing pervasive constraints within the agricultural sector. Such constraints include the elevated transaction costs, significant post-harvest losses throughout the food supply chain, insufficient agricultural research and extension programs, and restricted market access. Collectively, these constraints have adverse impact on production, consumption, and labour allocation in economies dependent on agriculture (Sakho-Jimbira & Hathie, 2020; Mila et al., 2022)..

Government entities and international organisations have responded with diverse trade control mechanisms, including direct interventions and market instrument utilisation, in an attempt to mitigate risks linked to extreme price fluctuations (Davis et al., 2021). In Tanzania, for instance, decision-makers and politicians have taken concerted steps to grapple with the issue of agricultural price volatility. The government has embraced viable policy measures such as "agricultural trade policy reforms," typified by initiatives like Kilimo Kwanza (Agriculture First) in 2009 and the Agricultural Sector Development Strategy (ASDP I & II). Additionally, the Value-Added Tax (VAT) for food commodities subject to the East Africa Community (EAC) Customs duty was lowered to 18 percent in 2008/2009. These reforms have led to some mitigation of the welfare loss experienced by impoverished rural households from 2000 to 2007 (Leyaro et al., 2010). However, critiques assert that the implemented trade policies have been suboptimal, potentially distorting local and international market prices of agricultural products (Stiglitz, 1987; Anderson & Nelgen, 2012; Dorward et al., 2004; Espitia et al., 2022). Tanzanian cereal crop prices, for instance, have displayed instability over time, with the period from 2006 to 2017 showcasing fluctuating prices. Maize prices, for instance, declined by 50 percent in 2006 and plummeted to negative 19 percent in 2007. A subsequent uptick ensued, with a 57 percent increase in 2008, followed by another drop to 17 percent and negative 10 percent between 2008 and 2010, a period coinciding with the economic crisis.

Notably, cereal crop prices witnessed a rapid increase between 2010 and 2011, with sorghum prices peaking at 61 percent, followed by maize (41 percent), rice (32 percent), and beans (20 percent) (BOT, 2017). This aligns with findings by Leyaro (2009) indicating seasonal shifts in world food prices during 2007, with prices surging even in the peak month of January 2007 and during the economic crunch of 2008. Although prices saw a subsequent decline, they rebounded in June 2010, reaching their zenith in 2011. The imposition of Covid-19 restrictions (food safety regulations) and protectionist measures took a toll on trade prospects and revenues for livestock, pulses, and horticulture (Barichello, 2020). Nevertheless, the extent to which these fluctuations in agricultural prices influence household welfare remains a pivotal empirical question addressed in this paper.

While substantial market liberalisation has taken place, several commodities continue to exhibit indicative pricing (Amolegbe et al., 2021). The Tanzanian government has at times directly intervened, issuing directives through the National Food Reserve Agency (NFRA) and the Cereals and Other Produce Board of Tanzania (CPB) (Chapoto & Jayne, 2009). Notably, periodic export bans on cereal crops, particularly maize, have been envisioned since the early 1980s as a strategy to stabilise prices and ensure ample domestic food supply (Wilson et al., 2021). Consequently, recurrent bans on cereal exports, including instances in 2003, 2006, 2008, 2011, and from late 2017 to October 2018, have emerged. However, these bans, while aimed at benefiting domestic consumers by lowering prices, pose challenges to domestic producers and traders by curtailing their access to higher prices in international markets (Wilson et al., 2021). These interventions, despite their acknowledged contributions to agricultural production and export-based economic growth, have been characterised by frequent policy shifts in Tanzania.

The stated interventions not only deplete public resources allocated for societal needs, but also potentially disrupt the proper functioning of the market over the long term (Stiglitz, 2021). Furthermore, excessive interventions could undermine the objectives of the African Continental Free Trade Agreement (AfCFTA), designed to support Africa's agribusiness, foster new regional markets for farmers, enhance the agro-value

chain, and potentially reduce the need for imports (Oloruntoba, 2023). The sustainability of such policies remains a topic of debate, given the resultant market uncertainty, which could yield enduring ramifications for future food production, employment, trade prospects, and, consequently, household welfare.

2. Literature Review

The fluctuation of agricultural prices can give rise to risks that exacerbate poverty and reduce the adequacy and quality of nutritional intake (Adekunle et al., 2020; Elijah, 2010; Headey & Ruel, 2022). Moreover, these fluctuations can hinder the utilisation of non-food essentials like education, healthcare, clean water, and suitable housing, thereby yielding longer-term detrimental effects on human capital investment and, subsequently, a nation's growth and development (Anríquez et al., 2013; World Bank, 2011). Similarly, Mafuru and Marsh (2003) and Ma et al. (2022) argue that the overall impact of agricultural price changes can either augment or erode household welfare, contingent upon factors such as the role of specific crops in foreign currency generation, employment, GDP contribution, and interconnections with other sectors, which could be exacerbated or ameliorated by extreme price changes.

The immediate effect of agricultural price shifts on household welfare is likely to be ambiguous, as price increases can benefit producers while detrimentally affecting net consumers. The degree of benefit hinges on variables including the product in question, household income patterns, and governmental policy reactions (Mafuru & Marsh, 2003; Rahman et al., 2022). Notably, rural households experience a partial shield from the impacts of extreme price fluctuations, in contrast to cash-crop farmers, commercial grain producers, and wage labourers (Benson et al., 2008; Fan et al., 2022). Conversely, elevated agricultural prices can fuel increased future production, higher export earnings, and reduced trade deficits, albeit at the expense of augmented consumption costs. Conversely, reduced agricultural prices can hamper supply while rendering consumption less costly (Tefere et al., 2012). Similarly, substantial fluctuations in agricultural product prices can reverberate across firms' financial health. For instance, lower/higher prices for agricultural goods can gradually diminish/boost farmers' revenues/sales, or discourage/encourage their continued engagement in agriculture.

According to Nigatu et al. (2020) the extended periods of elevated commodity prices correlate with heightened production and, consequently, augmented farm revenues. Adekunle et al. (2020) delve into the welfare implications of agricultural price shifts across a spectrum of food categories in Nigeria, validating that households adjusted their consumption and production patterns to mitigate welfare deterioration, revealing significant discrepancies across net-market positions and household strata. However, the net effect is inherently contingent on the household's net-market position and geographical location (Tiberti & Tiberti, 2018). Notably, households oriented toward net food sales and those oriented toward net food purchases experience divergent consequences in response to agricultural price hikes or drops. Building on this premise, Minot and Dewina (2015) assert that households' welfare directly hinges on agricultural price shifts, shaping their purchasing power variations and net profit from agricultural endeavors. Accordingly, urban and landless rural households encounter more pronounced welfare reductions during periods of soaring agricultural prices. Globally, agricultural commodity prices exhibited a 4 percent decline annually from 2018/19 to 2021/22 but subsequently surged by an average of 12 percent over the same period (Nigatu et al., 2020).

Diao and Kennedy (2016) discerned that inconsistent policies surrounding maize export bans in Tanzania translated into maize price reductions of 7 to 26 percent. Ultimately, this intervention curtailed maize farmers' profitability and disincentivised maize production. Notably, the microeconomic analysis of the relationship between agricultural commodity price changes and household welfare remains relatively limited, heterogeneous, and inconclusive (Leyaro, 2009; Mbegalo & Yu, 2016; Martuscelli, 2017; Tiberti & Tiberti, 2018). However, none of these studies have systematically scrutinised welfare implications based on periods of elevated and diminished agricultural prices for produce in Tanzania. Consequently, this paper contributes in two key ways: first, it employs actual agricultural product price shifts to evaluate the welfare implications of both higher and lower agricultural prices; second, it provides empirical evidence, rooted in the non-separable agricultural model, regarding the welfare ramifications of the noted higher and lower

agricultural prices during the periods of 2008/2012 and 2013/2015 in Tanzania, thereby offering distinct policy directions for the Tanzanian government grappling with the classical policy dilemma outlined by Timmer et al. (1983).

3. Methodology

Central to this article is the examination of the extent to which fluctuations in agricultural prices, whether higher or lower, impact household welfare in Tanzania. Traditionally, the evaluation of welfare has commonly been undertaken within the framework of Computable General Equilibrium (CGE). CGE is a prevailing approach for welfare analysis due to its recognition as a coherent economy-wide model for probing trade policy matters (Abbott et al., 2007). Nevertheless, McKibbin (1998) argues that sectoral aggregation in the CGE framework overlooks the nuanced analysis of specific markets. Echoing this sentiment, Rama and Sa (2005) contend that CGE estimates are often predicated on stringent assumptions, and the variables employed are frequently aggregated to a degree that might undermine the inherent relationships. Additional scholarship further questions the suitability of CGE for disaggregated analysis (Abbott et al., 2007; Piermartini & Teh, 2005; Narayanan et al., 2010). Thus, the employment of a model that aligns more closely with the pertinent sector is imperative. In this context, the Quadratic Almost-Ideal Demand System (QUAIDS) and Compensating Variation (CV) models are adopted.

QUAIDS: The accurate estimation of the welfare implications stemming from price fluctuations within the agricultural sector hinges on dependable price and income elasticities, typically derived from utility-based demand models. Consequently, we deploy the QUAIDS model introduced by Banks et al. (1997), an extension of the Almost Ideal Demand System (AIDS) model initially formulated by Deaton and Muellbauer (1980). The QUAIDS model stands as a suitable choice for demand analysis, striking a balance between ease of estimation and consistency with the essential demand properties, including symmetry, additivity, and homogeneity, inherent in the AIDS model, as corroborated within the literature (Tafere et al., 2010; Lecocq & Robin, 2015). Foremost, the QUAIDS model offers a ranking of demand systems featuring more comprehensive Engel and price effects relative to alternative demand systems like the AIDS model. At its core, the model operates on an indirect utility function, which subsequently informs the distribution of expenditure shares across diverse categories of goods and services. These shares are then modified with demographic characteristics to yield insights.

To circumvent the endogeneity in expenditure and contend with selection bias due to observed zero consumption, the unique maximum likelihood estimator articulated by Lecocq and Robin (2015) is employed to estimate the QUAIDS coefficients. Subsequently, the derived elasticity coefficients from the QUAIDS model find application within the CV framework, which accommodates profit function and substitution effects. This framework delves into the investigation of how household welfare is influenced by variations in agricultural produce prices, be they elevated or diminished, within the Tanzanian context. In essence, this research uniquely combines the strengths of the QUAIDS model with the insights offered by the CV framework to comprehensively assess the welfare implications stemming from fluctuations in agricultural prices, thereby providing a nuanced understanding of the dynamics at play. As generalised by (Lecocq & Robin, 2015), the budget share w_i^h on consumption bundle $i = 1,\ldots,N$ for a household $h = 1,\ldots,H$ with log total-expenditure x^h, log price N-vector p^h and $a's$ household demographic characteristics are expressed as:

$$w_i^h = a_i + g_i \mathbb{R}^h + b_i \left\{ x_h - a\left(\mathbb{R}^h, q\right) \right\} + I_i \frac{\left\{ x^h - a\left(\mathbb{R}^h, q\right) \right\}^2}{b\left(\mathbb{R}^h, q\right)} + m_i^h \quad (1)$$

with the nonlinear price aggregators

$$a\left(\mathbb{R}^h, q\right) = a_0 + a \mathbb{R}^h + \frac{1}{2} \mathbb{R} \mathbb{C}^h \mathbb{G} \mathbb{R}^h \quad (2)$$

$$b\left(\mathbb{R}^h, q\right) = \exp\left(b \mathbb{R}^h\right) \quad (3)$$

where $a = (a_1,...,aN)' b = (b_1,..., bN)' G = (g_1,..., gN)' q$, is the vector of all parameters, and u_i^h is an error term.

The QUAIDS model, underpinning the assessment of welfare implications driven by agricultural price fluctuations, operates within specific structural constraints, each reinforcing distinct assumptions including:

(i) Homogeneity Assumption: This fundamental tenet posits that nominal variables' proportional increments do not alter the underlying dynamics of real variables. Consequently, expenditures remain invariant when subjected to proportional increases in both price and income.

(ii) Additive Assumption: Underpinning the additive assumption is the notion that a consumer's expenditure fully depletes the allocated budget. This principle ensures that total spending aligns with the available resources, reinforcing the coherence of the model's outcomes.

(iii) Slutsky Symmetry Assumption: This crucial premise facilitates the dissection of the Marshallian demand function into two constituent components: the substitution effect and the income effect. This disentanglement transpires in response to price modifications, and it contributes to a deeper comprehension of how these effects interact and ultimately impact welfare as a result of price changes[1]Adding up: $\sum_{i=1}^{n} d_i = 1 \sum_{i=1}^{n} b_i = 0 \sum_{i=1}^{n} g_{ij} = 0 \sum_{i=1}^{n} l_i = 0$

[2]Homogeneity: $\sum_{i=1}^{n} g_{ji} = 0$ (4)

[3]Slutsky symmetry: $g_{ji} = g_{ij}$

The QUAIDS model accommodates these key assumptions to provide a structured framework for evaluating the intricate interplay between agricultural price shifts and household welfare. The model leverages these assumptions to offer a comprehensive analysis, shedding light on the multifaceted repercussions of changing prices within the agricultural domain on the broader welfare landscape in Tanzania.

The seminal document by Ray (1983) employed the QUAIDS model to account for the socio-demographic effects of household behaviour in terms of demand and allocation of expenditure among other goods. Other researchers such as Pollak & Wales (981)), Tafere et al. (2010) and Sola (2013) have followed a similar vein. Household heterogeneity enters the demand system through $a's$ and are modelled as a linear combination of a set of socio-demographic characteristic (s^h) observed in the data in such a way that $a^h = As^h$, and $A = (a_i)$. According to (Pollak & Wales, 1981), this process is called the translog approach which allows the level of demand to depend upon demographic variables.

3.1 Elasticities

The legitimate need for estimating the QUAIDS model is to obtain a precise value of expenditure (income) and price elasticities that are necessary for assessing the welfare consequences arising from agricultural price changes, particularly when a compensating variation model is applied. Hence, the elasticities for the Quadratic AIDS model with demographic characteristics of the household can be obtained by differentiating equation (1) with respect to $x\ p_j$ and only after omitting h superscripts ((Lecocq & Robin, 2015). Doing so, we end up with the following:

[1] All must sum to zero overall equations except the constant term, which must sum to one (additivity).

[2] Log price parameters must sum to zero within each equation.

[3]The effect of the log price i on the budget share j must be equal to the effect of the log price j on the budget share i.

$$\mu_i = \beta_i + 2\tau_i \frac{\{x - \alpha(R,q)\}}{\beta(R,q)} \quad (5)$$

$$\mu_{ij} = \gamma_{ij} - \mu(\alpha_j + \gamma_j R) - \lambda_i \beta_j \frac{\{x - \alpha(R,q)\}^2}{\beta(R,q)} \quad (6)$$

Following (Lecocq & Robin, 2015), the expenditure elasticities are then given by $e_i = \mu_i / w_i + 1$; uncompensated price elasticities by $e_{ij}^u = \mu_{ij} / w_i - \delta_{ij}$ where δ_{ij} is the Kronecker delta; and compensated price elasticities by $e_{ij}^c = e_{ij}^u + e_i w_j$.

3.2 Addressing Endogeneity and Welfare Assessment

In estimating a demand system, the endogeneity issue often emerges, particularly in developing countries where both quantity and expenditure data are collected. This challenge is widely acknowledged in the literature, with the practice of employing the ratio of observed expenditures and quantity, termed as unit value, as a proxy for commodity prices. This practice, as highlighted by Deaton and Muellbauer (1980), Deaton (1997), and Dong et al. (1998), captures not only the variation in market prices faced by households but also encapsulates endogenous factors arising from disparities in commodity quality. Utilising unit value as a price surrogate is predicated on the understanding that it inherently accounts for quality distinctions.

Empirical demand analyses relying on survey data typically encounter difficulties in treating total consumer expenditure as endogenous. This stems from measurement errors commonly associated with zero expenditure signifying non-consumption, as well as the infrequent nature of certain purchases (Keen, 1986; Meghir & Robin, 1992; Beatty, 2006; Tafere et al., 2010). In light of these challenges, to address endogeneity and consider socio-demographic factors and zero expenditure, the expenditure and Hicksian price elasticities are estimated via a modified version of the approach proposed by Poi (2012). This modified method, introduced by Lecocq and Robin (2015) through the "aidsills Stata command," effectively tackles endogeneity problems in demand systems. This approach serves to not only rectify measurement errors and account for zero expenditure scenarios but also incorporates the complex interplay of socio-demographic attributes.

On the other hand, while extreme agricultural price fluctuations can introduce uncertainty into factors such as production, consumption, trade gains, and consequently household welfare, discerning the specific effects of price increases or decreases under the non-separability of the agricultural model presents a challenge (Mukasa, 2015). The direct and total effects are not straightforward to deduce, particularly for net buyers and sellers. Addressing this uncertainty, Mukasa (2015) and Friedman and Levinsohn (2002) assert that the sign and magnitude of welfare effects linked to price changes lack theoretical predictability. However, it remains feasible to estimate the monetary measure of welfare impact, referred to as the "compensating variation," contingent upon food price elasticity.

3.3 Compensating variation model

The evaluation of welfare changes consequent to agricultural price shifts commonly employs the compensating variation (CV) framework, initially formulated by Deaton and Muellbauer (1980). The CV represents the monetary quantum necessary to reestablish the pre-change utility level following price adjustments. Similar concepts have been utilised by other researchers to scrutinise price effects on household welfare (Tafere et al., 2010; Badolo & Traore, 2015; Roosen et al., 2022). Recognising that a substantial proportion of households are not solely consumers but also producers of food, Vu and Glewwe (2011) advocate for the incorporation of both price and income effects to holistically assess the influence of price variations on implicit profits.

Price fluctuations induce common effects. Primary effects stem from direct price impact on welfare, while secondary effects are attributed to substituting relatively more expensive items with more affordable alternatives (Minot & Goletti, 2000; Alem & Söderbom, 2012; Tefera & Shahidur, 2012). These effects are

estimated via first and second-order Taylor expansion techniques, as elaborated in detailed model specifications by Friedman and Levinsohn (2002) and Faharuddin et al. (2022). In its functional form, the first-order Taylor expression becomes

$$CV \approx \sum_{i=a,n} \frac{\Delta p_i}{p_i}\left(p_i\left(Q_i - C_i\right)\right) \tag{7}$$

Equation (7) CV represents only the immediate effect of price changes (see, (Vu & Glewwe, 2011). However, the first order of Taylor's expansion of the expenditure function would be an upper bound because it would not consider the possibility of a consumer switching from expensive food items to cheaper ones. Thus, Friedman & Levinsohn (2002), Porto (2010), and Vu & Glewwe (2011) contend that the expression for the short-run effect is derived by taking the second-order Taylor series expansion of the expenditure function that allows the substitution effect. Therefore, the second order of Taylor's expansion of the expenditure functions becomes:

$$CV \approx \underbrace{\sum_{i=a,n} \frac{\Delta p_i}{p_i}\left(p_i\left(Q_i - C_i\right)\right)}_{first.....order.....effects} + \underbrace{\frac{1}{2}\sum_{i=a,n}\sum_{j=a,n}\left(\frac{\Delta p_i}{p_i}\right)\left(\frac{\Delta p_j}{p_j}\right)\left\{E\left[C_i/p_j\right]\right\}\left(p_i C_i\right)}_{substitution.....effects} \tag{8}$$

where $\frac{dp_i}{p_i}$, $\frac{dp_j}{p_j}$ are the percentage change in prices of the commodity i, and j p_i, p_j are the prices of commodity i j and, $\left(Q_i - C_i\right)$ denotes the net market position of the household, and $E\left[C_i/p_j\right]$ is the Hicksian compensated elasticity.

3.4 Data Type, Source, and Management

In addressing the central inquiry, the study leveraged available Tanzanian national panel survey data (TZNPS) spanning four distinct periods: 2008-2009, 2010-2011, 2012-2013, and 2014-2015. These data serve as a critical benchmark for elucidating the repercussions of fluctuating agricultural product prices. The TZNPS data originates from the Tanzanian National Bureau of Statistics (NBS), constituting an invaluable resource for conducting a comprehensive analysis within a non-separable agricultural household framework. The distinctive feature of these panels lies in their encompassing national consumption and production data, thereby furnishing the requisite information for estimating the welfare effects resulting from shifts in prices.

The TZNPS data encompasses both quantity and monetary value information, extending to own-production and in-kind data expressed in terms of quantity. However, the challenge arises as this dataset does not directly encompass a comprehensive spectrum of price information for different consumed goods. To surmount this limitation, a common strategy involves the use of unit prices, calculated by ratio of expenditures to quantities purchased, as proposed by Deaton and Muellbauer (1980). The derived unit prices serve to impute monetary values for own production and in-kind food consumption, essential for calculating food expenditure and varying budget allocations. However, missing data points pose a challenge, arising from instances where households either did not purchase or consume certain commodities during the survey period, or where data pertaining to these transactions were incompletely recorded. To address this, a strategy akin to that employed by Tafere et al. (2010) was adopted: missing unit values were substituted with the mean unit values of corresponding areas.

Additionally, TZNPS records non-food expenditures, often reported over differing and possibly longer recall periods. These figures, frequently recorded monthly and annually, were harmonised to ensure compatibility with the agricultural production module's reference period. The production module encapsulates critical insights into households' harvested quantities, quantities sold in the market, and associated monetary values. These data illuminate the household's net market position, a pivotal variable for estimating the welfare impact of price changes, factoring in whether the household assumes the role of

a net buyer or net seller.

Finally, before engaging the consumption and production modules, three preliminary data screening steps were executed. Firstly, the discrepancies between the list of food items in the consumption module and the agricultural production module were addressed, with the focus on matching items with comparable levels of processing, a conventional practice. Secondly, food items underwent aggregation into broader categories like cereals, starches, pulses, nuts, vegetables, meat, and fish, a step that contributes to manageable complexity and facilitates estimation (Ecker & Qaim, 2011). Lastly, data standardisation was pursued to ensure uniform units of measurement, culminating in the calculation of weighted averages for each food category. To construct a balanced panel data reflecting periods of high and low prices (2008/2009 and 2010/2011, and 2012/2013 and 2014/2015 respectively), waves 1 and 2, and waves 3 and 4 were merged, yielding sample sizes of 2344 and 2306 households respectively. Notably, the inclusion of variables such as age, primary and secondary education, household size, and the number of children served as control mechanisms to account for the influence of other sociodemographic characteristics in each panel.

4. Findings and Discussion

4.1 Descriptive Statistics

A comprehensive overview of descriptive statistics pertaining to the variables of interest across the four survey rounds of TNPS is presented in Table 1. These variables encapsulate critical aspects, including the distribution of food category shares and demographic attributes associated with the household head in Tanzania. These elements hold substantial relevance in the estimation of welfare effects resultant from fluctuations in prices, bearing profound implications for household dynamics and well-being. The depicted descriptive statistics offer a foundational understanding of the central tendencies and variabilities inherent in the data, fostering a contextual comprehension of the subsequent analyses. By detailing the prevalence and diversity within food category shares and key demographic attributes, this table furnishes a basis for more nuanced interpretations of the ensuing findings.

Table 1: Descriptive Statistics of the Head of the Household (Expenditure share %) and Demographic Characteristics

	2008/9		2010/11		2012/13		2014/15	
Variable	**Mean**	**S.D**	**Mean**	**S.D**	**Mean**	**S.D**	**Mean**	**S.D**
Cereals	0.403	0.282	0.395	0.269	0.406	0.274	0.345	0.251
Starches	0.080	0.156	0.071	0.133	0.073	0.139	0.073	0.124
Pulses	0.052	0.113	0.049	0.098	0.047	0.101	0.046	0.089
Nuts and seeds	0.042	0.081	0.034	0.069	0.033	0.067	0.036	0.076
Vegetables	0.165	0.213	0.169	0.203	0.165	0.195	0.190	0.203
Fruits	0.027	0.077	0.030	0.085	0.028	0.077	0.036	0.073
Meat and fish	0.233	0.244	0.250	0.230	0.248	0.231	0.274	0.232
Demographic characteristics								
(HH)	0.749	0.434	0.753	0.431	0.754	0.431	0.715	0.451
Age (HH)	45.861	15.494	45.880	15.773	45.315	16.096	44.415	14.987
Household size	4.967	2.839	5.216	3.105	5.055	3.152	4.848	2.848
Number of Children	2.696	2.214	3.926	3.726	2.555	2.303	2.579	2.226
Primary education%	0.584	0.493	0.571	0.495	0.571	0.495	0.553	0.497
Secondary and above education%	0.416	0.493	0.429	0.495	0.429	0.495	0.447	0.497
Sample Size	3265		3924		5010		3352	

Note: HH represents the household head, S.D represent the standard deviation
Source: Author's computation based on TZNPS (2008/2009, 2010/2011, 2012/2013, 2014/2015).

The findings detailed in Table 1 underscore crucial trends and patterns within the data, shedding light on the dynamics of food expenditure and demographic attributes among Tanzanian households. Cereals

emerge as a dominant component of food expenditure, encompassing 40% of all food categories in 2008/2009. This share experienced a minor decline to 39.5% in 2010/2011, potentially influenced by significant commodity price shocks during that period. Subsequently, cereal expenditure shares exhibited a rebound, ascending to 40.6% in 2012/2013. However, a noteworthy reduction occurred in the fourth round (2014/2015), plummeting to 34.5%. This oscillation in expenditure patterns holds implications for food security and the overall well-being of Tanzanian households. While supply constraints may contribute to such variations, the interplay of price risks and government interventions, including export bans, could be contributing factors.

The category of meat and fish, alongside vegetables, constitutes the second most substantial group in terms of food consumption expenditure in Tanzania. Meat and fish consumption expenditure represented 23% in 2008/2009, averaging at 24% between 2010/2011 and 2012/2013, and peaking at 27.4% in 2014/2015. In parallel, vegetable consumption expenditure exhibited a stable share of approximately 16% between 2008/2009 and 2010/2011, subsequently escalating to 19% in 2014/2015. Conversely, starches, pulses, and nuts constitute the least significant portions of consumption expenditure, accounting for 7% of starches, 4% of pulses, and 3% of nut seeds. The demographic characteristics highlighted in Table 1 underscore an average household size of 5, an average household age of 45.7, and educational attainment figures where approximately 47% completed primary school while about 43% attained secondary education or higher.

Furthermore, Table 2 elucidates nominal prices of food commodities/categories and their growth rates. The data showcases a lack of stability, with fluctuations observed since 2008. Notably, cereal prices displayed an increase of nearly 12.57% between 2008 and 2011. Starches, nuts, and seeds experienced an approximate 30% increase, meat and fish witnessed a 17% rise, vegetables exhibited a 9.8% increase, and pulses registered a growth of 14.03%. These descriptive statistics provide a foundational understanding of the data distribution, enabling a preliminary assessment of key trends and variations. By delineating the intricate dynamics underlying food expenditure and demographic attributes, this analysis sets the stage for more in-depth interpretations and discussions.

Table 1: Descriptive Statistics of the Unit Prices (per kg) for Food Categories by Survey Rounds (Tanzanian shillings)

	2008/09		2010/11		2012/13		2014/15	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Cereal	969.5515	310.4254	1091.439	376.4167	1486.62	1024.007	1379.713	514.7778
Starches	538.9187	262.5751	702.3896	256.405	900.9052	414.2936	1122.808	700.8814
Pulses	1205.929	333.8116	1375.156	319.5779	1647.463	340.1636	1902.455	558.8656
Nuts and seeds	951.7403	569.9822	1246.433	460.9708	1423.405	800.8255	1867.378	1336.328
Vegetable	959.501	447.2804	1053.77	487.0604	1289.316	730.1369	1359.484	684.348
Fruits	648.0597	268.1918	845.2343	362.0121	1068.587	603.4696	1338.923	668.7464
Meat and fish	2483.516	1362.085	2923.214	1371.691	3857.102	2080.061	4443.925	2232.393
Mean % Change	2008/11		2011/13		2013/15		2008/15	
Cereal	12.57		36.21		-7.19		42.30	
Starches	30.33		28.26		24.63		108.34	
Pulses	14.03		19.80		15.48		57.76	
Nuts and seeds	30.96		14.20		31.19		96.21	
Vegetable	9.82		22.35		5.44		41.69	
Fruits	30.43		26.42		25.30		106.60	
Meat and fish	17.70		31.95		15.21		78.94	

Source: Author's computation based on TZNPS (2008/2009, 2010/2011, 2012/2013, 2014/2015)

4.2 Budget Shares, Compensated and Uncompensated Price Elasticities

In the pursuit of gauging the welfare repercussions stemming from price fluctuations within the agricultural sector, the application of a non-separable agricultural household model necessitates robust price and income elasticities. The subsequent analysis showcases the estimated budget share and expenditure

elasticities at the mean level across various food groups, as outlined in Table 3. This crucial endeavor enables a comprehensive comprehension of the intricate relationships between price changes, consumption behaviours, and household welfare. By scrutinising the budget shares and expenditure elasticities, this analysis unveils insights into the responsiveness of consumption patterns to shifts in prices, thus underscoring the potential ramifications for the overall well-being of households.

Table 2: Budget Shares of Food Categories and expenditure elasticities at Population Mean

	Budget Shares				**Expenditure Elasticities**			
	2008/9	**2010/11**	**2012/13**	**2014/15**	**2008/9**	**2010/11**	**2012/13**	**2014/15**
Cereals	0.390***	0.420***	0.410***	0.386***	0.979***	0.974***	0.979***	0.762***
	(0.006)	(0.005)	(0.005)	(0.005)	(0.022)	(0.018)	(0.020)	(0.022)
Starches	0.079***	0.073***	0.073***	0.081***	0.804***	0.915***	1.015***	1.133***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.064)	(0.055)	(0.059)	(0.065)
Pulses	0.050***	0.048***	0.046***	0.044***	0.865***	0.742***	0.757***	0.668***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.070)	(0.062)	(0.066)	(0.075)
Nuts& seeds	0.040***	0.031***	0.031***	0.042***	0.737***	1.253***	1.250***	1.220***
	(0.002)	(0.001)	(0.001)	(0.002)	(0.064)	(0.066)	(0.062)	(0.079)
Vegetables	0.155***	0.171***	0.165***	0.142***	0.714***	0.529***	0.560***	0.606***
	(0.004)	(0.004)	(0.003)	(0.005)	(0.042)	(0.032)	(0.033)	(0.043)
Fruits	0.031***	0.014***	0.022***	0.037***	1.376***	2.029***	1.645***	1.522***
	(0.002)	(0.003)	(0.001)	(0.002)	(0.076)	(0.320)	(0.085)	(0.073)
Meat and fish	0.256***	0.244***	0.252***	0.269***	1.287***	1.360***	1.275***	1.457***
	(0.005)	(0.004)	(0.004)	(0.005)	(0.028)	(0.026)	(0.026)	(0.026)

Robust standard errors in brackets. *, ** and *** denote significance at the 10%, 5% and 1% levels respectively.

Source: Author's computation based on TZNPS (2008/2009, 2010/2011, 2012/2013, 2014/2015)

A comprehensive overview of critical indicators, shedding light on the intricate dynamics of consumption patterns and their responsiveness to changes in prices and expenditures across various food categories is provided in Table 3. Cereals consistently occupy a substantial portion, constituting an average of 40% of all food categories. Following closely, meat and fish hold a notable share, accounting for an average of 25.5% across the surveyed rounds. The prominence of vegetables is evident, comprising an average of approximately 15% of the total food groups analysed. Conversely, food groups like nuts and oil, pulses, and starches exhibit comparatively smaller shares.

The examination of expenditure elasticities, calculated based on the mean values of the population for each survey round, reveals insightful trends. All estimated expenditure elasticities are positive and statistically significant at a 1% significance level. Notably, meat and fish, as well as fruits, emerge as luxury goods throughout the surveyed rounds. In contrast, staple food categories like cereals, pulses, vegetables, nuts, and seeds are categorized as normal goods. This trend is attributed to their prevalence in the diets of a substantial portion of the population. It is particularly intriguing that nuts and seeds exhibit expenditure elasticities surpassing one in the 2010/11, 2012/13, and 2014/15 survey rounds, suggesting a vulnerability to demand fluctuations. Turning to Table 4, the derived price elasticities are showcased, manifesting the characteristic inverse relationship between own-price elasticities and commodity prices. The presentation in Table 4 focuses solely on the computed price elasticities, streamlining the presentation for clarity.

Table 3: Uncompensated and Compensated Own-Price Elasticities of Food Demand at Population Mean

	Uncompensated Own-Price Elasticities				Compensated Own-Price Elasticities			
	2008/9	**2010/11**	**2012/13**	**2014/15**	**2008/9**	**2010/11**	**2012/13**	**2014/15**
Cereals	-1.102***	-1.077***	-1.031***	-0.794***	-0.720***	-0.667***	-0.629***	-0.500***
	(0.034)	(0.030)	(0.029)	(0.036)	(0.033)	(0.029)	(0.028)	(0.033)
Starches	-1.463***	-1.649***	-1.525***	-0.938***	-1.400***	-1.582***	-1.450***	-0.847***
	(0.080)	(0.085)	(0.086)	(0.061)	(0.080)	(0.086)	(0.087)	(0.062)
Pulses	-2.175***	-1.477***	-1.768***	-0.851***	-2.131***	-1.441***	-1.733***	-0.822***
	(0.137)	(0.139)	(0.132)	(0.078)	(0.138)	(0.139)	(0.131)	(0.078)
Nuts &seeds	-1.419***	-2.229***	-1.875***	-1.433***	-1.390***	-2.190***	-1.835***	-1.382***
	(0.067)	(0.119)	(0.089)	(0.068)	(0.068)	(0.120)	(0.090)	(0.069)
Vegetables	-1.065***	-0.955***	-1.055***	-0.663***	-0.955***	-0.864***	-0.963***	-0.577***
	(0.047)	(0.043)	(0.042)	(0.051)	(0.048)	(0.042)	(0.042)	(0.049)
Fruits	-1.396***	-2.776***	-1.567***	-0.984***	-1.353***	-2.748***	-1.530***	-0.928***
	(0.086)	(0.472)	(0.095)	(0.055)	(0.087)	(0.474)	(0.096)	(0.055)
Meat and fish	-1.187***	-1.132***	-1.105***	-0.966***	-0.858***	-0.800***	-0.784***	-0.573***
	(0.029)	(0.036)	(0.028)	(0.028)	(0.027)	(0.038)	(0.027)	(0.030)

Robust standard errors in brackets. *, ** and *** denote significance at the 10%, 5% and 1% levels respectively.

Source: Author's computation based on TZNPS (2008/2009, 2010/2011, 2012/2013, 2014/2015).

Table 4 offers an insightful exploration of uncompensated own-price elasticities, uncovering essential dynamics between price changes and the corresponding adjustments in consumption behaviours across different food categories. The concept of own-price elasticities encapsulates the percentage change in food consumption following a 1% alteration in the price of the respective food category. When the absolute value of the elasticity exceeds unity, the demand for a food group is characterised as price-elastic, signifying that changes in price lead to proportional adjustments in consumption. Conversely, a value between zero and one denotes price inelasticity, implying that changes in price result in proportionally smaller alterations in consumption. Aligned with consumption theory, the coefficients of compensated own-price elasticities display negativity and significance at a 1% level, substantiating the anticipated inverse relationship between price and consumption. This implies that higher prices correlate with reduced quantities demanded for each food group. Notably, except for nuts and seeds in the 2014/15 survey round, all other food categories exhibit price inelasticity, suggesting that changes in price have a relatively modest impact on quantity demanded.

A nuanced pattern emerges when comparing the magnitudes of uncompensated own-price elasticities across periods of high and low prices. Generally, these elasticities have higher absolute values during periods of high prices (2008/09-2010/11) and lower absolute values during periods of low prices (2012/13-2014/15). This pattern underscores the varying sensitivities of consumption to price changes across different economic conditions. Interestingly, despite the negativity property, the majority of food categories exhibit uncompensated own-price elasticities close to or greater than one. This signifies that uniform percentage reductions in food prices could lead to substantial demand increases. However, this upsurge in demand may come at the expense of reduced net sales, given the dual role of rural households as both producers and consumers.

Notable trends emerge in the changes of price elasticities over time. While price elasticities for cereals, starches, vegetables, and fruits experienced a decline from 2008/09 to 2011/12, the reverse trend was observed for pulses and meat and fish during the same period. Similarly, between 2012/13 and 2014/15, cereals, starches, nuts and seeds, and vegetables saw a reduction in price elasticities, while pulses and fruits showcased positive trends. Table 5 delves into the complex interplay between agricultural price changes and households' welfare, unpacking the nuances across various strata and net market positions. The analysis extends beyond first-order effects to include second-order effects, accounting for substitution and profit mechanisms.

Table 4: First and Second-Order Welfare Effects of Prices Changes (%)

	2008/11		2012/15		2008/15	2008/15
	1st order	2nd order	1st order	2nd order	D1st order	D2nd order
All	-22.87	-50.98	-20.23	-44.54	-11.57	-12.62
Urban	-21.81	-48.37	-20.23	-44.54	-7.25	-7.91
Rural	-22.87	-50.98	-19.77	-43.45	-13.56	-14.76
Net seller	-24.99	-56.22	-19.47	-42.73	-22.09	-24.00
Net buyer	-22.87	-50.98	-20.23	-44.54	-11.57	-12.62

Source: Author's estimation based on TZNPS (2008/2009, 2010/2011, 2012/2013, 2014/2015).

First-order effects are emblematic of immediate welfare repercussions driven solely by price changes, without considering the potential for commodity substitution. During the period of high prices (2008/09-2010/11), the study reveals an overall welfare gain of approximately 22.87%. This signifies that, on average, a typical Tanzanian household would have needed to reduce its expenditures by around 22.87% in 2011/12 to uphold the utility level achieved in 2008/09. Conversely, the effects of price decreases are strikingly pronounced, with households experiencing direct welfare gains of 20.23%. This implies that households would have required compensation amounting to 20.23% of their food expenditures in 2012/13 to counteract the impact of price decline between 2012/13 and 2014/15. As a result, household welfare gains deteriorated by 11.57% on average due to the price fall.

Divergent impacts emerge between net sellers and buyers. Net sellers experience welfare gains of 24.99% during periods of high prices, diminishing to 22.09% during periods of low prices. In contrast, net buyers achieve welfare gains of 22.87% and 20.23% during high and low-price periods, respectively. This dichotomy underscores the differential effects of price fluctuations on net market positions. The examination extends to rural and urban households, revealing substantial welfare deterioration associated with low prices. Urban and rural households witness welfare gains of 21.81% and 22.87%, respectively, during high prices, which recede to 20.23% and 19.77% during low prices. This signifies a decline of approximately 7.25% and 13.56% in urban and rural areas, respectively.

Considering substitution and profit mechanisms, second-order effects demonstrate enhanced welfare gains during periods of high prices, amounting to 50.98%. However, these gains decline to 44.54% during periods of low prices, indicating a considerable impact of agricultural price fluctuations on household welfare. When accounting for dynamic effects and comparing rural and urban households, welfare gains increase by 48.37% and 50.98%, respectively, during high prices, but diminish to 44.54% and 43.45% during low prices. Importantly, analysis by net-market positions highlights an uneven distribution of welfare gains associated with high agricultural prices. With the inclusion of substitution mechanisms, net sellers experience gains of 56.22% during high-price periods, which reduce to 22.09% during low-price periods. Similarly, net buyers achieve gains of 50.98% during high-price periods, declining to 11.57% during low-price periods.

5. Discussion of the Results

A comprehensive analysis of the impact agricultural price fluctuations on household welfare based on QUAIDS model and CV framework was done. Ceteris paribus, the leveraged assumptions of the models, offer a shedding light on the multifaceted repercussions of changing prices within the agricultural domain on the broader welfare landscape in Tanzania. The adverse impact is immense regardless of the strata and net market positions of the household. The findings of this study show that higher agricultural prices are associated with greater welfare gains for households, emphasising the potential benefits of policies aimed at bolstering agricultural prices. These findings corroborate the findings by Mafuru & Marsh, 2003; Ma et al., 2022) that the overall effects of agricultural price changes can either increase or decrease households' welfare.

Using AIDS and extended, and QUAIDS model Tefera & Shahdur (2012), and D'Haese & Van Huylenbroeck, 2005) show that household welfare gains more improvement when receiving higher prices

of their produce. On the other hand, this study's findings highlights the detrimental impact of low agricultural prices on household welfare. The observed decline in welfare due to low prices suggests the potential pitfalls of policies that fail to ensure favourable price conditions for agricultural commodities. Such policies could hinder agricultural growth and transformation, ultimately undermining the welfare of households dependent on agricultural activities. Supporting this argument, Diao and Kennedy (2016) discerned those inconsistent policies surrounding maize export bans in Tanzania translated into maize price reductions of 7 to 26 percent. Ultimately, this intervention curtailed maize farmers' profitability and disincentivised maize production.

These findings emphasise the intricate relationship between price fluctuations and household welfare, showcasing the multifaceted mechanisms that drive consumer responses and economic outcomes. Furthermore, the disparities between net sellers and buyers highlight the unequal distribution of welfare impacts, influencing economic decision-making and overall household well-being.

6. Conclusion and Implications of the Results

This study provides valuable insights into the complex relationship between agricultural price changes and households' welfare in Tanzania. By employing the QUAIDS model and the compensation variation (CV) framework, the research sheds light on the dynamics of price and expenditure elasticities, as well as the nuanced effects of high and low agricultural prices on household well-being. The findings underscore the significance of price and expenditure elasticities, with their absolute values notably higher during periods of high prices compared to low prices. The CV analysis reveals that higher prices are associated with greater welfare gains for households, emphasising the potential benefits of policies aimed at bolstering agricultural prices. Such policies could serve as incentives for increased agricultural production, fostering economic growth and enhancing the welfare of farming households. Conversely, the study highlights the detrimental impact of low agricultural prices on household welfare. This is particularly significant given the dominant role of agricultural production and trade in Tanzania's economy. The observed decline in welfare due to low prices suggests the potential pitfalls of policies that fail to ensure favourable price conditions for agricultural commodities. Such policies could hinder agricultural growth and transformation, ultimately undermining the welfare of households dependent on agricultural activities. The unequal distribution of welfare gains among net buyers and net sellers, as well as disparities across different strata of households, further emphasizes the need for targeted policy interventions. Efforts to improve market access and promote fair prices for agricultural products could play a pivotal role in mitigating these inequalities and fostering sustainable agricultural development.

As a forward-looking suggestion, the analytical approach employed in this study could be extended to examine the impact of external shocks, such as the Covid-19 pandemic, on agricultural prices and household welfare. This would provide valuable insights into the resilience of the agricultural sector in the face of unforeseen challenges and contribute to the formulation of adaptive policy measures. In essence, this research underscores the intricate web connecting agricultural prices, household welfare, and policy outcomes, offering valuable guidance for policymakers seeking to foster agricultural growth, ensure equitable outcomes, and enhance the well-being of Tanzanian households.

References

Abbott, P., Bentzen, J., Huong, T. L., & Tarp, F. (2007). A Critical Review of Studies on the Social and Economic Impacts of Vietnam's International Economic Integration. *MPRA Paper*, (29789).Adekunle, C. P., Akinbode, S. O., Shittu, A. M., & Momoh, S. (2020). Food price changes and farm households' welfare in Nigeria: Direct and indirect approach. *Journal of Applied Economics*, 23(1): 409–425.

Alem, Y., & Söderbom, M. (2012). Household-level consumption in urban Ethiopia: The effects of a large food price shock. *World Development,* 40(1): 146–162. https://doi.org/10.1016/j.worlddev.2011.04.020

Amolegbe, K. B., Upton, J., Bageant, E., & Blom, S. (2021). Food price volatility and household food security: Evidence from Nigeria. *Food Policy*, *102*, 102061. https://doi.org/10.1016/j.foodpol.2021.102061

Anderson, K., & Nelgen, S. (2012). Trade barrier volatility and agricultural price stabilization. *World Development*, 40(1): 36–48.

Anríquez, G., Daidone, S., & Mane, E. (2013). Rising food prices and undernourishment: A cross-country inquiry. *Food Policy,* 38: 190–202. https://doi.org/10.1016/j.foodpol.2012.02.010

Badolo, F., & Traore, F. (2015). Impact of rising world rice prices on poverty and inequality in Burkina Faso. *Development Policy Review*, 33(2): 221–244.

Banks, J., Blundell, R., & Lewbel, A. (1997). Quadratic Engel curves and consumer demand. *The Review of Economics and Statistics,* 79(4): 527–539.

Barichello, R. (2020). The COVID-19 pandemic: Anticipating its effects on Canada's agricultural trade. *Canadian Journal of Agricultural Economics/Revue Canadienne d'agroeconomie*, 68(2): 219–224.

Beatty, T. K. (2006). Zero Expenditures and Engel Curve Estimation. In *Presentation at the American Agricultural Economics Association Annual Meeting, Long Beach*, 23–26.

Benson, T., Minot, N., Pender, J., Robles, M., & Von Braun, J. (2008). *Global food crises: monitoring and assessing impact to inform policy responses* (Vol. 19). Washington DC: International Food Policy Research Institution.Davis, K. F., Downs, S., & Gephart, J. A. (2021). Towards food supply chain resilience to environmental shocks. *Nature Food,* 2(1): 54–65.

D'Haese, M., & Van Huylenbroeck, G. (2005). The rise of supermarkets and changing expenditure patterns of poor rural households case study in the Transkei area, South Africa. *Food Policy,* 30(1): 97–113.

Deaton, A. (1997*). The analysis of household surveys: a micro econometric approach to development policy*. Baltimore: The Johns Hopkins University Press Deaton, A., & Muellbauer, J. (1980). An almost ideal demand system. *The American Economic Review*, 70(3): 312–326.

Diao, X., & Kennedy, A. (2016). Economywide impact of maize export bans on agricultural growth and household welfare in Tanzania: A Dynamic Computable General Equilibrium Model Analysis. *Development Policy Review,* 34(1): 101–134.

Dong, D., Shonkwiler, J. S., & Capps Jr, O. (1998). Estimation of demand functions using cross-sectional household data: The problem revisited. *American Journal of Agricultural Economics*, 83(3): 466–473.

Dorward, A., Kydd, J., Morrison, J., & Urey, I. (2004). A policy agenda for pro-poor agricultural growth. *World Development*, 32(1): 73–89.

Ecker, O., & Qaim, M. (2011). Analysing nutritional impacts of policies: An empirical study for Malawi. *World Development*, 39(3): 412–428.

Elijah, O. A. (2010). Global food price increases and nutritional status of Nigerians: The determinants, coping strategies, policy responses and implications. *ARPN Journal of Agricultural and Biological Science,* 5(2): 67–80.

Espitia, A., Evenett, S., Rocha, N., & Ruta, M. (2022). Widespread food insecurity is not inevitable: avoid escalating food export curbs: Global Economic Consequences of the War in Ukraine Sanctions, Supply Chains and Sustainability, 19.

Faharuddin, F., Yamin, M., Mulyana, A., & Yunita, Y. (2022). Impact of food price increases on poverty in Indonesia: Empirical evidence from cross-sectional data. *Journal of Asian Business and Economic Studies* 30(2): 126-142Fan, L., ZHANG, H., & Khan, N. (2022). Commercial cash crop production and households' economic welfare: Evidence from the pulse farmers in rural China. *Journal of Integrative Agriculture,* 21(11): 3395–3407.

Friedman, J., & Levinsohn, J. (2002). The distributional impacts of Indonesia's financial crisis on household welfare: A "rapid response" methodology. *The World Bank Economic Review*, 16(3): 397–423.

Headey, D. D., & Ruel, M. T. (2022). *Food inflation and child undernutrition in low and middle income countries* (Vol. 2146). Washington DC: International Food Policy Research Institution.Keen, M. (1986). Zero Expenditures and the Estimation of Engel Curves. *Journal of Applied Econometrics*, 3(1): 277–286.

IMF, O., & UNCTAD, W. (2011). *Price volatility in food and agricultural markets: Policy responses*. Italy: FAO.

Lecocq, S., & Robin, J. M. (2015). Estimating almost-ideal demand systems with endogenous regressors. *Stata Journal*, 15(2): 554–573.

Leyaro, V. (2009). Commodity Price Changes and Consumer Welfare in Tanzania in the 1990s and 2000s. *CREDIT Research Paper No. 10/01.*

Leyaro, V., Owens, T., & Morrissey, O. (2010). Food price changes and consumer welfare in Tanzania 1991-2007. *CREDIT Research Paper No. 10/01.*

Ma, M., Lin, J., & Sexton, R. J. (2022). The transition from small to large farms in developing economies: A welfare analysis. *American Journal of Agricultural Economics*, 104(1): 111–133.

Mafuru, J. M., & Marsh, T. L. (2003). *An analysis of household food expenditure systems in Tanzania* (No. 1844-2016-152450).Martuscelli, A. (2017). Analysing the Impact of Price Shocks in Rural Economies: Do Household Responses Matter? *The Journal of Development Studies*, 59(9): 1518–1534.

Mbegalo, T., & Yu, X. (2016). The impact of food prices on household welfare and poverty in rural Tanzania. Courant Research Centre. *Discussion Papers*, (216).

Meghir, C., & Robin, J. M. (1992). Frequency of purchase and the estimation of demand systems. *Journal of Econometrics*, 53(1–3): 53–85.

Mila, F. A., Nahar, A., Amin, M. R., Culas, R. J., & Ahmed, A. (2022). Empirical assessment of onion supply chain constraints in Bangladesh: a pre-covid to covid situation. *Journal of Agriculture and Food Research*, 10: 100418.

Minot, N., & Dewina, R. (2015). Are we overestimating the negative impact of higher food prices? Evidence from Ghana. *Agricultural Economics*, 46(4): 579–593.

Minot, N., & Goletti, F. (2000). *Rice market liberalization and poverty in Viet Nam* (Vol. 114). Washington DC: International Food Policy Research Institution.Narayanan, B. G., Hertel, T. W., & Horridge, J. M. (2010). Disaggregated data and trade policy analysis: The value of linking partial and general equilibrium models. *Economic Modelling*, 27(3): 755–766.

Ndungu Mukasa, A. (2015). Empirical Essays on the Economics of Food Price Shocks: Micro-econometric Evidence from Uganda. Unpublished Doctoral Thesis. Trento: University of Trento.

Nigatu, G., Badau, F., Seeley, R., & Hansen, J. (2020). *Factors Contributing to Changes in Agricultural Commodity Prices and Trade for the United States and the World* (No. 1477-2020-055).Oloruntoba, S. O. (2023). The political economy of the African Continental Free Trade Area and structural transformation in Africa. *Journal of Contemporary African Studies*, 1-17. DOI: https://doi.org/10.1080/02589001.2023.2214715.

Piermartini, R., & Teh, R. (2005). *Demystifying modelling methods for trade policy*. WTO Discussion Paper (No. 10).

Poi, B. P. (2012). Poi, B.P. (2012). Easy Demand-System Estimation with QUAIDS. *Stata Journal*, 12(3): 433–446.

Pollak, R. A., & Wales, T. J. (1981). Demographic Variables in Demand Analysis. *Econometrica*, 49(6): 15-33.

Porto, G. G. (2010. Food prices: household responses and spillovers. *Centre for Economic Policy Research*, 167.Rahman, M. C., Pede, V. O., & Balié, J. (2022). Welfare impact of asymmetric price transmission on rice consumers in Bangladesh. *Review of Development Economics*, *26*(3): 1600-1617.Rama, M., & Sa, K. L. (2005). Impacts of WTO accession: can they be predicted? What to do about them? World Bank's Vietnam Development Report 2006.Ray, R. (1983). Measuring the costs of children: An alternative approach. *Journal of Public Economics*, 22(1): 89–102.

Roosen, J., Staudigel, M., & Rahbauer, S. (2022). Demand elasticities for fresh meat and welfare effects of meat taxes in Germany. *Food Policy*, *106*, 102194.Rudolf, R. (2019). The impact of maize price shocks on household food security: Panel evidence from Tanzania. *Food Policy*, 85: 40–54. DOI: https://doi.org/10.1016/j.foodpol.2019.04.005

Sakho-Jimbira, S., & Hathie, I. (n.d.). The future of agriculture in Sub-Saharan Africa.

Sola, O. (2013). Demand for food in Ondo state, Nigeria: Using quadratic almost ideal demand system. *Journal of Business Management and Economics*, 4(1): 1–19.

Stiglitz, J. E. (1987). Some theoretical aspects of agricultural policies. *The World Bank Research Observer*, 2(1): 43–60.

Stiglitz, J. E. (2021). The proper role of government in the market economy: The case of the post-COVID recovery. *Journal of Government and Economics*, 1:100004. https://doi.org/10.1016/j.jge.2021.100004Tafere, K., Taffesse, A. S., Tamiru, S., Tefera, N., & Paulos, Z. (2010). Food demand elasticities in Ethiopia: Estimates using household income consumption expenditure (HICE) survey data. *International Food Policy Research Institute, Documento de Trabajo del ESSP II*, 11: 1-39.

Tefera, N., & Shahidur, R. (2012). Welfare Impacts of Rising Food Prices in Rural Ethiopia: A Quadratic Almost Ideal Demand System Approach. In *IAAE 2012 Conference* in Brazil.

Tiberti, L., & Tiberti, M. (2018). Food Price Changes and Household Welfare: What Do We Learn from Two Different Approaches? *The Journal of Development Studies*, 54(1): 72–92.

Timmer, C. P., Falcon, W. P., Pearson, S. R., & Bank, W. (1983). *Agriculture and Rural Development Dept. Economics and Policy Division*. Baltimore: Johns Hopkins University Press.

Vu, L., & Glewwe, P. (2011). Impacts of rising food prices on poverty and welfare in Vietnam. *Journal of Agricultural and Resource Economics,* 36(1): 14–27.

Wilson, W. C., Slingerland, M., Baijukya, F. P., van Zanten, H., Oosting, S., & Giller, K. E. (2021). Integrating the soybean-maize-chicken value chains to attain nutritious diets in Tanzania. *Food Security*, 13(6): 1595–1612.

World Bank. (2011). *The world bank annual report 2011*. The World Bank.