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Abstract

How should the cost of a decent life be quantified? Are the available living income methods and indicators valid welfare measures? Additionally, are these suitable for the rural contexts where they are being leveraged for agrifood policies and interventions? This paper critically examines two prevailing methodologies for estimating living income indicators and their application in rural agricultural contexts, with a focus on cocoa producers in Cameroon. It compares the main approaches for estimating a living income benchmark (LIB), documenting and highlighting key differences in data sources and computational assumptions. The study finds that LIB estimates are highly sensitive to food expenditure assumptions and the valuation of non-food, non-housing (NFNH) elements of a decent life. Statistical and indicator property tests are then applied to assess the robustness of the living income gap (LIG). Stochastic dominance analysis demonstrates that LIG indicators consistently identify vulnerable groups and thus harness targeting potential. Simulations based on poverty axioms indicate the indicators are distribution sensitive, illustrating their potential for informing the design and monitoring of LIG-reducing policy instruments. As a result of these tests, a new censored LIG is proposed that further enhances the possibility of measuring and monitoring the LIG among more vulnerable strata. Ultimately, while the living income approach reframes the narrative on welfare analyses from a subsistence to decency framework, the potential of the indicators to support equitable outcomes in agrifood systems would be enhanced by integrating greater methodological rigour, replicability and harmonization.

Keywords: Living income; welfare; poverty; agricultural commodities; sustainability; cocoa; Cameroon

JEL codes: C80; I32; O13; Q01; Q18; Q12

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1 Introduction

Ensuring that agriculture-based livelihoods meet both economic and food security needs requires a balanced approach to market integration. While connecting farmers to markets can provide opportunities for welfare gains, livelihood improvements and food security (Abate, Mitiku and Negash, 2022; Barrett *et al.*, 2022; Christiaensen and Martin, 2018; Gollin, Parente and Rogerson, 2002; Kilimani, Buyinza and Guloba, 2022; Stein and Santini, 2022), the benefits are not guaranteed for all farmers. Cash crops and export-oriented commodities in particular, such as cocoa, are often perceived as opportunities for livelihood enhancement due to the higher prices they may offer relative to staple crops. However, recent evidence suggests that economic benefits of participation in these commodities does not always trickle down to producers (Lescuyer *et al.*, 2019), and may have inequality-exacerbating effects (Dzanku, Asante and Hodey, 2024; Hillbom *et al.*, 2024; Ogutu and Qaim, 2019). Furthermore, the production of high-value agricultural commodities often entails significant environmental and social costs that are borne by local communities and are not fully reflected in consumer prices (FAO, 2024a). While consumers may absorb some of the upward pressure from shifts in production costs (Bonjean and Brun, 2014), the hidden social and environmental costs remain a challenge for producers. In response, there is growing recognition of the need for more equitable and sustainable approaches to market integration. This shift has prompted the development of policies aimed at aligning agrifood value chains with principles of equity and sustainability, mitigating potential risks and vulnerabilities.[1]

In this context, the emergence of the living income concept has sought to provide a new paradigm for assessing the well-being of producers of export-oriented commodities. The concept adapts internationally accepted standards of living conditions, and based on the United Nations' Conventions and Declarations,[2] to a specific context by considering elements of local culture and prevailing traditions to define the goods and services required for a decent life (LICoP, 2021). The approach quantifies the cost of attaining this normative definition of a decent life, calling it the *living income benchmark* (LIB).

The idea of a living income is conceptually and computationally different from the typical monetary poverty indicators that have predominantly steered the analysis of deprivation and policies aimed at the reduction of poverty. Those indicators identify the poor using a subsistence threshold, determined by the cost of a basic basket of consumption goods valued at local prices. The international poverty line has further guided poverty statistics, establishing a cross-country standard to identify the extreme poor (Gonzalez Sabatino *et al.*, 2023; Ravallion, 2016). While poverty analysis tools have diversified to encompass non-monetary

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[1] This includes increasing regulatory requirements, legislation on Responsible Business Conduct (RBC) due diligence seeking to ensure that companies identify and address human rights and environmental risks in their operations and supply chains, including with an increased focus on incomes and wages (OECD, 2024). Specifically, the EU Corporate Sustainability Due Diligence Directive (CSDDD) (*Regulation (EU) 2023/1115*, 2023; *Directive (EU) 2024/1760*, 2024)

[2] The Universal Declaration of Human Rights (UNHR), the ILO Constitution calling for the provision of "an adequate living wage", and the Declaration of Philadelphia (1944) calling the ILO to promote "full employment and the raising of standards of living" (III.a) and "policies in regard to wages and earnings, hours and other conditions of work calculated to ensure a just share of the fruits for progress to all, and a minimum living wage to all employed and in need of such protection" (III.d).

dimensions of welfare and attempted to produce indicators of utility for targeting purposes, such as the multidimensional poverty index (Alkire *et al.*, 2015), the focus on subsistence has dominated the narrative. Instead, the living income approach implies that the cost of a decent life represents a threshold that ultimately exceeds monetary poverty lines (van de Ven *et al.*, 2021).

Shifting the narrative on rural welfare from a focus on extreme poverty eradication to one centred on the attainment of decent life has gained traction among agrifood systems' stakeholders. The LIB has become an instrument to guide policies and interventions directed at producers of global value chains, such as cocoa. Notably, the concept has been used to determine fair remuneration levels for farmers, particularly in price-setting processes, including the provision of a guaranteed minimum price. The *living income differential,* a policy specifying a minimum farmgate price for producers of an exported commodity (Boysen *et al.*, 2023; Staritz *et al.*, 2023), has been applied by Côte d'Ivoire and Ghana seeking to bridge the gap between the actual income of cocoa farmers and the LIB. However, the evidence supporting the living income differential as an effective and sustainable tool to raise cocoa producer incomes is weak (Gilbert, 2024; Ruf, 2022; Staritz *et al.*, 2023; van Vliet *et al.*, 2021). This outcome has been explained in part by the small area under cocoa cultivation by individual farmers (Marinus *et al.*, 2022; Waarts *et al.*, 2021), considered unviable for sustaining a household livelihood. This policy application reflects the persistent view in the sector that commodity farmers are specialized in cocoa production. However, in reality, their incomes are often highly diversified, drawing from multiple sources, as has been extensively demonstrated in the literature (Davis, Di Giuseppe and Zezza, 2017; De la O Campos *et al.*, 2023) and their farms too small (Lowder, Sánchez and Bertini, 2021).

The limited evidence on the outcomes of living income interventions at the farmer level, coupled with a lack of clarity on how to translate the concept into specific (and successful) policies like minimum price guarantees or other agricultural policies, raises questions about the adequacy of living income indicators as a tool to inform policies that impact millions of small-scale producers. While the living income approach has the potential to guide broad-reaching policies initiatives, it also underscores an urgent need for a more rigorous assessment of the methods used to estimate these indicators. Such an assessment is essential to ensure the relevance, accuracy, and applicability of living income metrics in shaping policies that support small-scale producers.

This paper has several interrelated objectives. First, we provide systematic documentation of LIB measurement methodologies, drawing upon the two main documented approaches (Anker and Anker, 2017; van de Ven *et al.*, 2021). Second, using statistical tests and properties of poverty measures, we assess the main living income indicators available in the literature, drawing upon the main axioms from the poverty metrics literature (Ravallion, 2016a). In doing so, we propose a new approach to estimate the difference between the LIB and household incomes (the LIG). Drawing comparisons to other available deprivation indicators, we additionally seek to assess empirically the reliability of living income indicators for targeting purposes. Finally, we discuss the contextual relevance of the living income concept and indicators for rural, agricultural environments characterized by small-scale producers and derive conclusions about the utility and operability of the approach for policy makers and practitioners. Ultimately, this paper seeks to fill an evidence gap in the literature by rigorously assessing the reliability and consistency of living income methods for informing policies and interventions.

Our empirical application relies on primary data collected from the cocoa producing areas of Cameroon. The cocoa sector of Cameroon provides an appropriate context to frame our empirics given that cocoa contributes to the livelihood of approximately half a million Cameroonian households (National Cocoa and Coffee Board, 2024) while at the same time the sector is has been identified as a main driver of forest loss in the country (INTPA, 2023). Evidence suggests that cocoa farmers in Cameroon are cited to accrue only one third of sectoral profits due to a combination of low prices and low yields (Lescuyer *et al.*, 2019). Given government targets to expand the sector that already contributes up to 60 percent of the country's export earnings (National Cocoa and Coffee Board, 2024), an important question that arises is whether and how living income indicators can provide a policy framework that addresses the multiple shortcomings of the sector.

Our analysis reveals that the differences in data collection modalities and estimation assumptions lead to significant variation in the level of the LIB, reinforcing our concerns about the lack of harmonization in its current applications. This variation is attributed to the price assumptions for valuing the model diet, for which primary and secondary data are combined to estimate non-food, non-housing elements of the benchmark, and the extrapolation methods used to obtain household level cost estimates from individual level data. Taking into consideration these findings and drawing comparisons with other relevant and available data and indicators, we offer recommendations for the estimation of LIB. Our assessment of the statistical properties of the main living income indicator, the living income gap (LIG), reveals the estimator is distribution sensitive, which implies living income indicator-based policies can monitor inequality impacts among target populations. We propose a new, censored LIG indicator meeting an additional statistical property relevant for monitoring vulnerable groups.

The rest of this paper is organized as follows. In the next section we define the LIB components and review the concepts and methods underlying the prevailing LIB approaches. Section 3 describes the data we use to estimate the living income indicators and the methods for testing their statistical validity. In Section 4, we present the results from our comparative analysis of LIBs and Section 5 from our analysis of the statistical validity and targeting consistency of the living income indicators. Section 6 discusses the findings, providing recommendations, and Section 7 concludes.

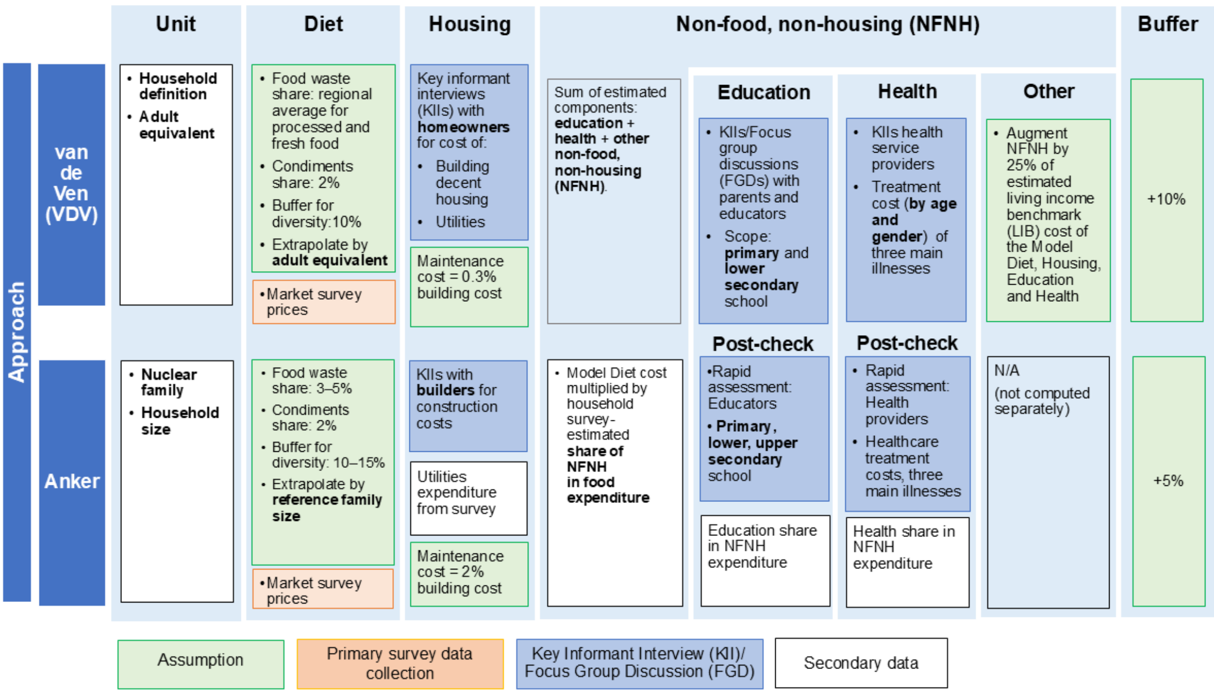
2 Living income benchmarks – a comparative perspective

A living income benchmark (LIB) estimation is based on the premise that a decent standard of living is the minimum level of resources needed for a household to be able to consume a low-cost, nutritious diet, to access decent housing, education and healthcare, as well as other non-food, non-housing (NFNH) essential expenses and still have resources available for responding to unforeseen events. In simple terms, the LIB can be expressed as the sum of four components: (1) the value of a low-cost, nutritious diet; (2) the cost of a healthy, durable housing; (3) the cost of non-food, non-housing expenses; and (4) a buffer for savings and shocks.

We identify two prevailing methods for computing living income indicators: (1) the (Anker and Anker, 2017) approach and (2) the (van de Ven *et al.*, 2021) approach, hereafter referred to, respectively, as the Anker and van de Ven (VDV) methods. The former was developed by the Anker Research Institute, based upon the methods developed for assessing a decent wage for wage-employed individuals in commodity value chains (Anker and Anker, 2017), while the latter was proposed as a cost-effective alternative to the Anker method, for contexts in which rural, smallholder agricultural producers are the target population (van de Ven *et al.*, 2021).

Figure 1 provides an overview of the key features of each approach. The comparison indicates the main differences are found in the unit of analysis, the data requirements for assessing costs, the scope of expenditures considered for each sector (food, housing, education, health) and the assumptions integrated to the computation of non-sectoral expenditures. In the following subsections we elaborate on these differences.

Figure 1. Overview of data and assumptions, by living income benchmark estimation approach



Source: Authors' own elaboration.

2.1 Benchmark estimation

2.1.1 Unit of analysis: the reference family versus the household

A fundamental element of the LIB estimation is the definition of the measurement unit for which the expenditure requirement is calculated. The magnitude of the unit of analysis bears direct implications on the LIB since it is the basis for extrapolating all other expenditure computations, namely the caloric requirements for a nutritious diet, the dwelling size, the profile of health expenditures and the number of members for which educational expenses are incurred. Establishing this reference unit is thus crucial for ensuring the comparability and consistency of living income estimates across contexts.

Unlike benchmarks indexed to a single individual, the LIB is based on a family or household unit. This highlights the need for establishing a clear approach to defining the group of cohabiting individuals for whom expenditures must be computed. Since household expenditures increase with household size but also vary according to household composition, the Anker methodology emphasizes the definition of the *reference family.* This typically consists of a specified number of adults and minors in a nuclear family unit who share a dwelling, meals and resources.

A secondary data review of location and context relevance for the benchmark is typically deemed sufficient for approximating the size of the reference household. However, the Anker and VDV methods leverage that information in distinct ways. As the Anker method (Anker and Anker, 2017) was developed for wage workers, it assumes a reference family that ranges from 4 to 6 members, including 2 adults, at least one of whom is a full time wage workers. This approach maintains a relatively fixed and standardized family structure to ensure comparability across regions and contexts. In contrast the VDV method adopts a more flexible reference household approach, which accounts for the fact that meals and resources may be shared among all individuals living under the same roof, even if not forming part of the nuclear family unit. This broader conceptualization of the reference unit reflects the reality of multi-generational living arrangements, which are particularly common in rural areas of developing countries (Cakouros and Reynolds, 2022; Rosenzweig and Wolpin, 1985). As a result, the VDV approach implies a larger reference unit of analysis.

The final benchmark is reported by the Anker method in reference family units, $size_{ref}$, while the VDV approach converts the LIB to per adult equivalent (AE) units, which facilitates alignment with other metrics such as international poverty lines.

2.1.2 Data sources and collection modalities

Both methods rely on a combination of primary and secondary data collection, leveraged at different points in the LIB estimation process.

The Anker method requires two primary data collection exercises. First, (1) a market survey is conducted to obtain local food prices, which are used for the valuation of the model diet. This ensures that the cost of a nutritionally adequate diet reflects local market conditions and price fluctuations. Second, (2) key informant interviews are held with housing sector experts, including national, provincial and municipal authorities; NGOs involved in building affordable housing; architects and builders. These interviews are essential for estimating the cost of building and maintaining decent housing that meets basic living standards.[3] In addition to these primary sources, the cost of NFNH requirements is obtained from secondary data sources, such as recent household surveys, or relevant publications on household expenditures levels and expenditure shares. These secondary data are then corroborated with a rapid assessment of the local cost of education and healthcare services.

In contrast, the VDV approach places greater emphasis on primary data collection, employing a combination of key informant interviews, focus group discussions and, similar to the Anker method, a market survey to collect local price data. This multi-source approach allows for a more context-specific and participatory estimation process and may allow it to capture the broader social and economic conditions that influence household expenditure needs. Unlike the Anker method, the VDV approach also engages community guides to identify relevant informants for interviews on education, housing and healthcare services. Secondary data is used to validate and complement the primary data, particularly for the estimation of NFNH requirements.

Table 1 summarizes the key informants for each set of sectoral interviews. While certain types of informants, such as for food prices and healthcare costs, are common across methods, the type of respondents differs significantly for other sectors. For housing, the Anker method relies on housing experts and service providers (such as architects, builders, and housing authorities) to estimate the cost of building and maintaining decent housing. In contrast the VDV approach collects data directly from owners of decent housing, focusing on the out-of-pocket costs they incurred in building their home. A similar distinction is seen in the approach to collecting information on education costs. The Anker method gathers information from educators and school administrators, focusing on the official costs of schooling. The VDV approach, however, interviews parents of school-aged children, emphasizing the real, out-of-pocket costs they face for tuition fees, uniforms, and school materials. By prioritizing actual household expenditures, the VDV approach seeks to provide a grounded and accurate assessment of the financial burdens faced by households in meeting essential living standards.

Table 1. Target respondents for service provider interviews

Interview sector	Anker	van de Ven (VDV)
Prices	• Market vendors • Food shop vendors	• Market vendors • Food shop vendors
Housing	• Government officials • Affordable housing NGOS • Architects; Builders; construction companies	• Owners of decent housing
Healthcare	• Key informants of public and private hospitals, health clinics, or pharmacies	• Key informants of public hospitals and health clinics

[3] These respondents are for the case in which rental markets are thin and most housing is owner-occupied. For contexts with widespread rental markets, the Anker methods instead recommend collecting rental costs from tenants.

Interview sector	Anker	van de Ven (VDV)
Education	• Educators and administrators of primary and secondary schools	• Parents of school-enrolled children • Educators and administrators of primary and lower secondary schools

Source: Authors' own elaboration.

2.2 Benchmark components and assumptions

2.2.1 Model diet

The LIB relies on the valuation of a low-cost "model diet" aligning with World Health Organization (WHO) recommendations for macro- and micro-nutrients and ensuring sufficient caloric intake for the age and sex composition of the reference family.

The Anker method defines a model diet comprising approximately 20 food items over 11 food groups, ensuring alignment with the food preferences of the target population. To estimate caloric intake per person-type, the method uses Schofield Equations,[4] which calculate the basal metabolic rate (BMR) based on key parameters such as average weight, height and physical activity level (FAO, WHO and UNU, 2004). These individual caloric requirements are computed for each member of the reference family. To derive an overall per capita estimate, the total caloric needs of all reference family members are summed and then divided by the reference family size. This per capita estimate serves as the basis for valuing the cost of the model diet, ensuring that the dietary needs of the reference family are accurately reflected in the living income benchmark.

To ensure that the diet is nutritionally adequate, the caloric intake is distributed across food items in the model diet in accordance with WHO/FAO dietary guidelines. These guidelines specify that caloric shares should come from carbohydrates (55–75 percent), protein (10–15 percent) and fats (15–30 percent). Additional nutritional requirements include limiting sugar intake to no more than 30 g of sugar and ensuring the inclusion of at least 300 g of fruits and vegetables as well as some dairy products to support adequate intake of micronutrients and minerals.[5] The construction of the model diet begins with an analysis of the observed local consumption patterns or nutritional guidelines for the target context. This is then iteratively adjusted to ensure it accounts for edible food shares,[6] aligns with the aforementioned

[4] The Schofield Equation is a method for estimating the basal metabolic rate (BMR) of adult men and women, first published in 1985. It is widely recognized and adopted, notably serving as the basis for BMR estimation in the World Health Organization's (WHO) technical report series. Despite its prominence, the Mifflin-St. Jeor equation is the one recommended by the US Academy of Nutrition and Dietetics for BMR estimation, as it is often considered to provide more accurate predictions for modern populations. Both equations are used in contexts such as nutrition planning, health assessments, and energy requirement calculations.

[5] Adjustments are also made for pregnancy and lactation.

[6] As reported in the U.S. Department of Agriculture (USDA) FoodData Central and FAO International Network of Food Data Systems (INFOODS) databases.

nutritional objectives, and remains low-cost (cost-effective), prioritizing affordability for households.

Using food prices collected for the LIB estimation, the quantity of each food item required to meet the per-capita model diet is valued applying per-gram prices. That per capita valuation of the model diet cost (md_exp_{pc}) is then multiplied by the reference family size to obtain the cost of the model diet for the reference family md_exp^{Anker} (Equation [1]).

$$md\_exp^{Anker} = size_{ref} \times md\_exp_{pc}^{Anker} \quad (1)$$

The VDV approach follows similar principles to the Anker method but introduces key differences in the design and valuation of the model diet. The food components are guided by the food groups of the Women's Dietary Diversity Score (WDDS) (Kennedy, Ballard and Dop, 2010), a proxy of micronutrient adequacy in women's diets It tracks the number of distinct food groups consumed by a women over a 24-hour period. Furthermore, the extrapolation to the size of the reference household is undertaken using adult male equivalent (AME) units. The daily caloric requirement of an active male adult is first estimated, calibrated to meet macro- and micro-nutrient targets and then valued in local currency units. This valuation of the cost of the model diet for an adult male equivalent (md_exp_ame) is then used to extrapolate the daily caloric requirements of each household member type j (e.g. female adults; other male adults; children) in the household using an appropriate AME scale, ame_j, for N_j individuals, as shown in Equation (2).

$$md\_exp^{VDV} = \sum_j (ame_j * N_j) \times md\_\mathrm{exp}\_ame^{VDV} \quad (2)$$

The model diet valuation represents the cost of consuming an affordable, nutritious diet for an active and healthy reference family. However, on its own, it does not fully capture the real-world cost of food consumption. Key factors, such as a food waste, the use of condiments and seasonings, and dietary diversity in terms of portion sizes and food choices are not initially accounted for. Therefore, the cost of the model diet is adjusted upward to incorporate these elements. This adjustment recognizes the practical realities of food preparation, consumption, and household dietary preferences, resulting in a more comprehensive and realistic estimate of food costs for living income benchmarks.

The Anker method augments the model diet cost by 3–5 percent for food waste (f_w), by 2 percent for condiments (f_c) and 10–15 percent for dietary diversity (f_d). For the sub-Saharan Africa context, the VDV approach also augments the cost by 2 percent for condiments and 10 percent for dietary diversity, but instead estimates the food waste component as the average of fresh and processed food waste shares documented for the region. The final model diet cost, $Diet^m$, of method m (Anker or VDV) is then extrapolated into monthly units, as shown in Equation (3):

$$Diet^m = 30.42 \times (1 + f_w + f_c + f_d) \times md\_exp^m \quad (3)$$

Both the Anker and VDV approaches seek to obtain locally current prices for the lowest cost, acceptable quality food items that make up the model diet. While both methods prioritize affordability and quality, they differ in how they handle seasonal price variability. The VDV approach states it directly addresses seasonality by collecting data on the most common price for food items that exhibit at least 25 percent price variability, as reported by food vendors. The

Anker method relies on secondary data analysis to assess and account for the potential impact of seasonal fluctuations on food prices. Both approaches seek to obtain at least ten price estimates per food item and then use the median or trimmed mean[7] as the reference price.

2.2.2 Housing

The estimation of decent housing for the LIB requires defining a set of locally relevant housing characteristics that align with international principles for healthy or "decent" housing. These principles include durable structure, sufficient living space, access to safe water, sanitary toilet and washing facilities, adequate ventilation, adequate food storage and separation from animal quarters. These criteria ensure that housing conditions support minimum requirements for health, safety, and human dignity.

The Anker method defines the minimum standard for healthy housing in a given context primarily using secondary data sources. In contrast, the VDV approach interviews local experts and refers to secondary data to define the minimum housing characteristics. The VDV method allows to reflect local housing realities and ensure that the defined standards are both achievable and relevant to the target population.

Both methods assume owner-occupied housing, which implies estimating the cost of building healthy, durable dwelling with a 50-year service life (assuming periodic maintenance of the dwelling). This approach reflects the long-term nature of housing as a capital investment rather than a recurring rental expense.

The valuation of the cost of obtaining, maintaining and inhabiting decent housing for a reference family is then based on a series of assumptions, represented by Equation (4). The equation indicates the *monthly* cost of decent housing, $Housing^m$ the sum of (1) b_exp_{sqm}, per-square-meter housing construction costs, depreciated to align with an expected service life, $E(Y)$; and regular maintenance expenditures, m_exp_{sqm}, multiplied by the size, $size_{sqm}$, in square meters, of a decent size dwelling; (2) the per-dwelling expenditure on taxes and insurance, $taxes\_insurance$; (3) u_exp_{pc}, the estimated per capita expenditure on water and cooking fuel costs, multiplied by the reference family size, $size_{ref}$ and (4) the per-reference-family expenditure on energy (heat, electricity and lighting, e_exp).

$$Housing^m = \left[size_{sqm} \times \left(\frac{b\_exp_{sqm}}{E(Y)} + m\_exp_{sqm}\right) + (ti\_exp) + \left(size_{ref} \times u\_exp_{pc}\right) + (e\_exp)\right] \times \frac{1}{12} \tag{4}$$

The Anker method assumes that the cost of utilities such as water and cooking fuel varies with the size of the reference family, reflecting the increased consumption associated with larger households. In contrast, the costs of electricity, heat and lighting are assumed to remain constant regardless of family size, as these expenses are considered more fixed in nature and less sensitive to changes in the number of household members. The VDV approach makes no distinction in this respect. Finally, whereas Anker assumes the expected annual expenditure

[7] The trimmed mean is the average price after removing a percentage of the highest and lowest prices.

on dwelling maintenance amounts to 2 percent of total dwelling building costs, the VDV approach assumes 0.3 percent.

2.2.3 Non-food, non-housing (NFNH)

The LIB also accounts for the cost of essential NFNH needs, which include healthcare, education and other non-food, non-housing items (other goods and services). The underlying principle is that, beyond covering basic material goods and services, a reference family should be able to afford treatment costs for the main, prevalent illnesses in its local context, ensure that children can complete a full cycle of education, and meet the cost of other essential elements that support quality of life. These essential elements include expenses related to transportation, communications, clothing and sociocultural factors, reflecting the broader dimensions of human dignity, social inclusion, and well-being.

The VDV valuation of NFNH relies on primary data collected through key informant interviews and focus group discussions to estimate the education and healthcare components of NFNH costs. For education, a "decent" level of educational attainment is assumed to include primary and lower secondary schooling. The valuation is based the essential out-of-pocket expenditure for parents to send children to school ($Educ^{VDV}$). For healthcare, $Health^{VDV}$, out-of-pocket, uninsured costs are estimated for the three main illnesses or injuries afflicting the reference population, differentiating treatment costs according to age and gender. The cost of clothing, transportation, communications and other miscellaneous expenses ("other NFNH", ONFNH) is then estimated based on the share of those elements in total household expenditure as obtained from secondary data sources, as in Equation (5). (van de Ven *et al.*, 2021) obtains the ONFNH share from secondary survey data,[8] which indicates it accounts for 20 percent of total household expenditure. Using that relationship to estimate the importance of ONFNH as a proportion of food, housing, health and education yields a factor of 25 percent. The total cost of NFNH is then the sum of the health, education and ONFNH elements (Equation [6]).

$$ONFNH^{VDV} = 0.25 \times (Diet^{VDV} + Housing^{VDV} + Educ^{VDV} + Health^{VDV}) \tag{5}$$

$$NFNH^{VDV} = Health^{VDV} + Educ^{VDV} + ONFNH^{VDV} \tag{6}$$

The Anker approach relies primarily on secondary data sources to obtain an initial estimate of the NFNH expenditure level, $NFNH^{Anker}_{initial}$, as in Equation (7),

$$NFNH^{Anker}_{initial} = Diet^{Anker} \times \frac{NFNH_{survey}/totexp_{survey}}{foodexp_{survey}/totexp_{survey}} \tag{7}$$

The model diet valuation is multiplied by the ratio of the share of NFNH in total expenditure ($NFNH_{survey}/totexp_{survey}$) to the share of food in total expenditure ($foodexp_{survey}/totexp_{survey}$). This initial estimate is validated by a series of "post-checks" using rapid assessments of education and healthcare costs in the local context. These are estimated as a reference family's out-of-pocket expenditures to ensure the attainment of the

[8] The authors derive this estimate using survey data from three sub-Saharan African countries.

full primary and secondary school cycle for education (school fees, uniforms, materials) and for treating the three main illnesses or injuries prevalent in the study context.

Transportation costs are also included in the rapid assessment if these represent an important[9] expenditure in a given context. The sectoral cost estimate from the rapid assessment ($Sector_{RA}$) is compared to an initial secondary data cost estimate of the corresponding sector, computed as the ratio of the sector (education or health) share in total expenditure to NFNH share in total expenditure, multiplied by the initial NFNH estimate, as in Equation (**8**). If the rapid assessment estimate is significantly[10] higher than the secondary data estimate of NFNH for that sector, the initial level of NFNH expenditure is then increased to bridge the difference between the initial and the rapid assessment estimates, as in Equation (**9**). No guidance is provided for the case in which the rapid assessment value is significantly lower than the initial NFNH estimate.

$$\boldsymbol{PC_{sector}^{Anker} = Sector_{RA} - \left[NFNH_{initial}^{Anker} \times \frac{Sector_{survey}/totexp_{survey}}{NFNH_{survey}/totexp_{survey}}\right]} \quad (8)$$

$$\boldsymbol{NFNH^{Anker} = NFNH_{initial}^{Anker} + \sum_{Sector} PC_{Sector}^{Anker}} \quad (9)$$

2.2.4 Non-food, non-housing: Healthcare

The Anker method rapid assessment of healthcare costs is based on the same set of cost categories as the VDV method. Both methods estimate treatment costs considering the following elements:

(1) **Consultation fees (**C_{exp}). The average consultation fee across three types of medical practitioners (general doctor; nurse; specialist) is multiplied by the reported average number of consultations required to treat the illness/injury.

(2) **Hospitalization fees (**H_{exp}). This is obtained by multiplying the nightly hospitalization fee by the average number of nights needed for the specific illness and the proportion of cases of the illness/injury reported to result in in-patient treatment.

(3) **Diagnostic tests (**L_{exp}). For each illness/injury, the sum of the average cost of performing a range of relevant diagnostic tests is computed. These tests include blood tests, urine tests, x-rays, ultrasounds, CT scans, etc.

(4) **Medications**. These are collected for in-patient (IM_{exp}) and outpatient (OM_{exp}) cases as the average total cost of medications to treat the illness/injury.

However, the extrapolation of healthcare costs to the reference family size is computed differently by each approach. The Anker method assumes the illness incidence rate and treatment costs are the same for all household members while the VDV approach adjusts for

[9] According to Anker and Anker (2017), if the sum of the food, health, housing and education shares do not exceed 60–70 percent of total expenditures, a transportation expenditure post-check is warranted.

[10] Anker and Anker (2017) do not provide guidance on how to define a significant difference between the rapid assessment and the secondary data NFNH estimate.

different incidence rates and treatment costs by sex and age groups. This implies different equations to compute the total healthcare expenditure for the LIB.

The Anker approach is summarized by Equations (**10**) and (**11**), for which treatment costs for illness i are scaled according to the annual per-person incidence and prevalence of ambulatory versus in-patient treatment of the illness, N_{out}, for out-patient cases and N_{in}, for in-patient cases. The total annual healthcare expenditure is then the sum of the annual, per person treatment costs over the set of most prevalent illnesses, multiplied by the reference family size.

$$\begin{aligned} \boldsymbol{Health_i^{Anker}} = \big[& \boldsymbol{N_{out_i}(C\_exp_i + L\_exp_i + OM\_exp_i)} \\ & + \boldsymbol{N_{in_i}(C\_exp_i + L\_exp_i + H\_exp_i + IM\_exp_i)} \big] \end{aligned} \tag{10}$$

$$\boldsymbol{Health^{Anker} = hhsize \times \sum_i Health_i^{Anker}} \tag{11}$$

Instead, the VDV approach estimates the total annual treatment expenditure for each population group j affected by illness i, as expressed in Equation (**12**). The total reference family health expenditure, Equation (**13**), is computed by summing the treatment costs for the three main illnesses/injuries for each population group j, namely, adult males, adult females and children. The total health expenditure for the reference family is based upon the weighted, w_j, sum of those health expenditures, for which the weights represent the number of population group members in the reference household unit. For a reference household comprised of one adult male, one adult female and three children, the weight assigned to adult males and females would be, respectively, 1 and for children, 3.

$$\begin{aligned} \boldsymbol{Health_{ij}^{VDV}} = & \boldsymbol{N_{out_{ij}}\left(C\_exp_{ij} + L\_exp_{ij} + OM\_exp_{ij}\right)} \\ & + \boldsymbol{N_{in_{ij}}\left(C\_exp_{ij} + L\_exp_{ij} + H\_exp_{ij} + IM\_exp_{ij}\right)} \end{aligned} \tag{12}$$

$$\boldsymbol{Health^{VDV} = \sum_j w_j \sum_i Health_{ij}^{VDV}} \tag{13}$$

2.2.5 Non-food, non-housing: Education

Like the cost of healthcare, the valuation of education costs across the two methods is also based upon the same principles, albeit different data collection approaches, as documented in Section 2.1.2. Apart from pursuing different target respondents for collecting education data, the main difference across methods is in the levels of schooling considered. Whereas Anker considers decent education to cover the full primary and lower- and upper-secondary cycles, the VDV approach considers primary and lower-secondary schooling.

The total cost of schooling across these levels, i, is computed as expressed in Equation (**14**), first by summing the expected (Anker), or observed out-of-pocket (VDV), annual household expenditures on school fees, f_i, books, b_i, and uniforms, u_i, then multiplying by the number of years of schooling per level, yrs_i. In contexts where technical and general secondary schools exist, requiring children to select a single educational track, school expenditures in that level may be weighted by the factor, $eduw_i$, representing the proportion of children following the given track. As primary school is compulsory, the weight assigned to that level is 1.

$$\boldsymbol{Educ^m = \frac{1}{12} \times \frac{1}{18} \times size_{children} \times \sum_i yrs_i \times eduw_i \times (f_i + b_i + u_i)} \quad (14)$$

The monthly reference family/household expenditure on education, $Educ^m$, is then the sum of the total annual expenditure across all levels, multiplied by the number of children in the reference unit ($size_{children}$), scaled by the number of years in which a child is a minor (18) and divided by 12 months.

2.2.6 Buffer

The final component of the benchmark is the so-called 'buffer' which is conceived to account for savings and unforeseen costs. This buffer provides a financial cushion for households to manage unexpected expenses, such as emergencies, health crises, or economic shocks, and to support future investments in education, housing improvements, or small business ventures. The Anker approach estimate this margin, shm, at 5 to 10 percent of the sum of food, housing and NFNH. The VDV approach adopts the upper bound of 10 percent to account for expenditures that were not quantified in the other components and to account of the high exposure of many rural households in developing countries to shocks, including their lack of insurance to mitigate the impact of shocks (van de Ven *et al.*, 2021).

$$\boldsymbol{Buffer^m = shm^m \times (Diet^m + Housing^m + NFNH^m)} \quad (15)$$

2.2.7 Living income benchmark

The LIB for each method, m, is ultimately the sum of the four components: the cost of the model diet, that of decent housing, NFNH and the margin/buffer, as expressed in Equation (**16**).

$$\boldsymbol{LIB^m = Diet^m + Housing^m + NFNH^m + Buffer^m} \quad (16)$$

3 Data and methods

We compute two distinct LIB estimates using data collected from interviews with 203[11] sectoral service providers in the Centre region of Cameroon, broadly following the data collection guidance of the Anker and VDV methods. We conducted a main survey from March to April, 2024, for which the Anker method guided the data collection approach, as well as a comparative methods survey in May to June 2024, following the data collection guidance provided by the VDV approach.

Food markets were visited to collect data on local food prices, whereas data on education, healthcare and housing were conducted with locally identified key informants. In the case of the VDV approach, which indicates that local experts should guide the selection of households, markets, schools and health centres to identify relevant respondents, a village questionnaire was conducted with the village chief in each of the six Centre-region localities selected for the methodological comparison in order to map the availability of health and education providers and to identify key informants for the education and decent housing interviews. Table 2 reports the number of interviews conducted by each survey, by sector and type of respondent

Table 2. Number of interviews conducted, by type of respondent

Interview sector	Respondent	Main survey	Methods survey
Food	Markets (vendors)	19 (n.d.)	6 (43)
Health	Clinics, hospitals	16	10
Housing	Builders	17	-
	Homeowners	-	59
Education	Schools	19	18
	Parents	-	61

Notes: The main survey covered 32 enumeration areas with 170 villages while the methods survey visited 6 enumeration areas (EAs) containing 16 villages; n.d. stands for no data and was collected on the number of food vendors interviewed by the main survey.

Source: Authors' own elaboration.

Localities for service provider interviews were selected from the enumeration areas obtained from a stratified, two-stage random sampling strategy designed to obtain a representative sample for a survey of cocoa-producing households in the seven most important cocoa-producing regions of Cameroon.[12] The household survey obtained comprehensive data on income, multidimensional poverty, food security and indicators of agricultural livelihoods'

[11] This figure counts the number of interviews conducted across sectors; however, for collecting food prices, it reports the number of multiple-vendor markets and food shops visited rather than the number of vendors interviewed.

[12] The seven regions include the East, Centre, Littoral, Northwest, South, Southwest, and West regions.

resources, strategies and constraints for 4 294 cocoa producing households, providing information on actual incomes against which to compare the LIB estimate.

3.1 Estimation methods

To test the relevance, reliability and performance of the LI indicators, we first conduct an empirical assessment of the LI indicators, estimating two LIBs according to the Anker and VDV methods, as described in Section 2, using data collected from the Centre region. The two estimates are compared, decomposed and re-estimated according to different assumptions in order to assess the main sources of variation across approaches.

We then estimate total cocoa producing household income following the methodology developed by FAO's Rural Income Generating Activities Project (RIGA) (Carletto *et al.*, 2007) and pair it with the LIB to compute different living income indicators. We use simulations to assess the statistical features of these indicators in terms of the poverty literature axioms of monotonicity, scale invariance, replication invariance and transferability (Ravallion, 2016). This approach provides greater confidence that the indicators are suitable for guiding policy and supporting targeted interventions for living income-enhancing interventions.

Given that dominance theory can be applied to poverty and inequality analysis for producing robust unambiguous ordinal rankings (Araar, 2006; Davidson and Duclos, 2000; Duclos and Araar, 2006), we employ stochastic dominance analysis to assess whether the LI indicators produce consistent and robust ordering of welfare distributions. Specifically, we create population groups according to the criteria of other vulnerability indicators and assess whether the cumulative distribution of each group's living income indicator stochastically dominates that of the other group. Formally, the distribution of group A is said to first-order stochastically dominate (FOSD) that of group B in terms of a living income (LI) indicator if the cumulative distribution function (CDF) of A is everywhere below (or equal to) that of B, as in Equation (17). This implies that the LI indicator of group B is higher than (or equal to) that of group A, for all possible LIB levels. FOSD of B by A means poverty is higher in B than in A.

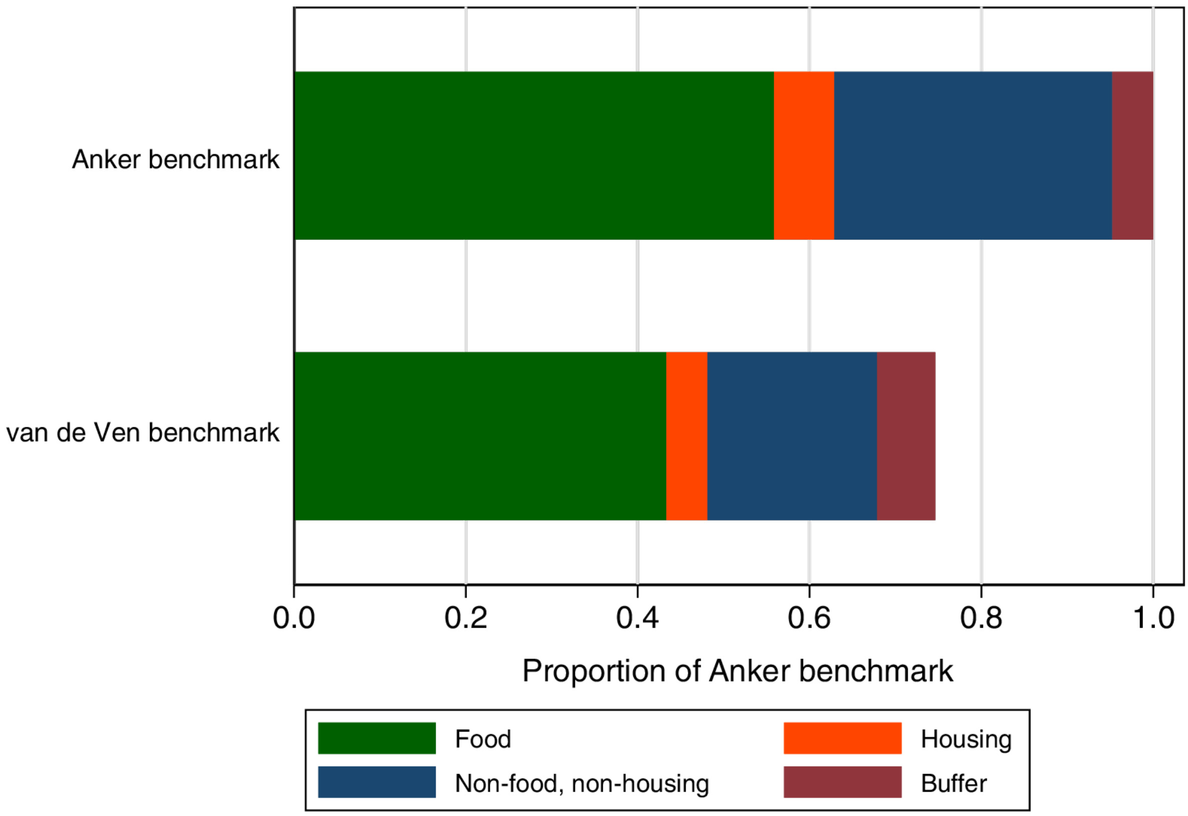
$$F(LI_A) \leq F(LI_B) \qquad \forall LI_i \geq 0 \tag{17}$$

We statistically assess FOSD, applying the Kolmogorov-Smirnov (K-S) test (Murphy *et al.*, 1968), evaluating the null hypothesis of equality of distributions.

4 Living income benchmark methods – an empirical perspective

The estimation of the Anker and VDV LIBs yields very different outcomes. To facilitate comparison between the two, we index the VDV benchmark to the Anker benchmark, as the actual LIB level is not the focus of this paper. We find the VDV approach obtains a LIB that is nearly 25 percent lower than the Anker method.[13] The decomposition of the LIBs illustrates that the food and NFNH components account for most of this difference. The food component of the LIB^{VDV} is approximately 22 percent lower than that estimated by the Anker method; the LIB^{VDV} NFNH component is 39 percent below the LIB^{Anker} NFNH estimate. Despite contributing smaller shares to the total LIB, the LIB^{VDV} housing element is 32 percent lower, while the LIB^{VDV} buffer element 43 percent higher than the corresponding LIB^{Anker} element.

Figure 2. Comparison of living income benchmarks and components



Source: Authors' own elaboration.

Given the many differences in methods underlying the computation of the food and NFNH components of the LIB, we test the sensitivity of the LIB^{VDV} by replacing key assumptions in the LIB^{VDV} estimation with those characterizing the Anker approach, holding all other elements constant. Four adjustments are introduced:

(1) **Model diet extrapolation based on reference family size instead of adult-equivalents**. Given that adult equivalent units place lower weight on children than

[13] Although the VDV approach would normally report the LIB in per adult equivalent terms, we first follow the reference household approach to enable comparison with the Anker method.

adults, the model diet cost will necessarily vary according to how household composition is addressed. The first assumption tested is to extrapolate the VDV model diet cost according to the size of the reference family.

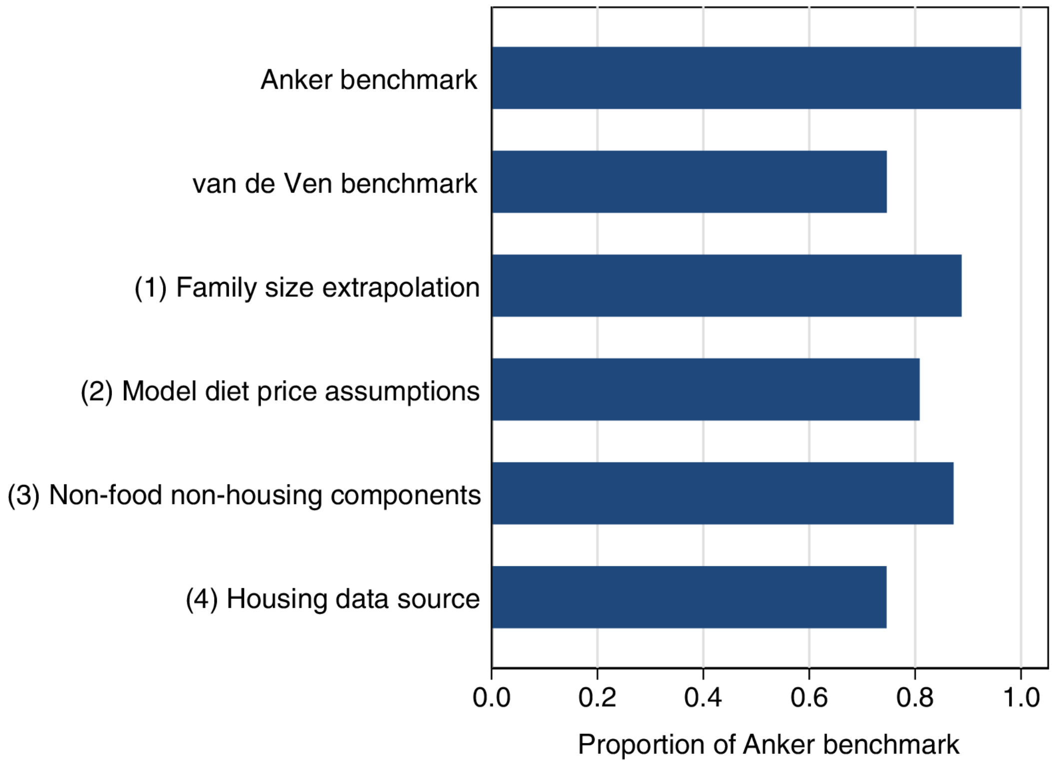
(2) **Model diet price assumptions**. Second, given differences in the number and type of price points collected as part of the market survey across the two approaches, it is possible that questionnaire design and spatial or temporal price fluctuations could influence the model diet cost. In the Annexes, Table A1 reports the prices used to value the model diet by each of the two methods, demonstrating that for certain food items, the deviation across prices is significant. We therefore adjust the VDV price assumptions, estimating LIB^{VDV} using the prices collected by the Anker survey.

(3) **NFNH component**. Third, instead of computing the LIB^{VDV} NFNH element uniquely with primary data, we instead compute it relying on expenditure shares from the most recent, publicly available secondary data source, the fifth Cameroonian Household Survey (*Enquête Camerounaise Auprès des Ménages*, ECAM) and then augment it with the "post checks" approach.

(4) **Housing data source**. Finally, the data collected from owners of decent housing for the LIB^{VDV} is replaced with the estimates for constructing, maintaining and inhabiting decent housing from the LIB^{Anker}.

The results of this sensitivity analysis are reported in Figure 3, reporting indexed LIB estimates ($LIB^{Anker} = 1$), enabling the reporting of outcomes in terms of the percentage point deviation from LIB^{Anker}.

Figure 3. Sensitivity of living income benchmarks to estimation assumptions



Source: Authors' own elaboration.

Reflecting the decomposition of the benchmark estimates portrayed in Figure 2, where the NFNH element accounts for more than half of the LIB^{Anker}, we find that the most significant source of variation arises from the approach used to extrapolate the model diet according to the reference family unit. This factor alone accounts for approximately 56 percent of the difference between the LIB^{VDV} and LIB^{Anker} estimates, holding all other factors constant (certeris paribus). A key distinction lies in how the reference family size is treated in each approach. The VDV method estimates the cost of the model diet using a reference family size in adult equivalent (AME) units, while the Anker method applies a simpler approach, weighing all household members equally. This methodological difference results in nearly 14 percent increase in the LIB^{VDV} estimate compared to the LIB^{Anker}. While this outcome is not entirely unexpected, it highlights the critical role of that household composition and caloric needs play in the computation of the LIB. It also emphasizes the value of using per capita thresholds, as is standard practice for monetary poverty indicators.

The second most important source of variation is the NFNH estimation approach. Relying on the use of secondary data paired with primary data on health and education increases the level of the estimation of LIB^{VDV} by nearly 14 percentage points and accounts for 54.7 percent of the difference in the two benchmark estimates. This is an important difference attributable in part to the use of different sources of data to obtain the NFNH estimate.

The use of different price assumptions explains 24.6 percent of the difference between the two benchmark estimates. In other words, the LIB^{VDV} is 6 percentage points higher when the Anker survey price assumptions are used to value the model diet. This finding is significant, considering the VDV price data was collected from villages in the same region, using a consistent methodology that included a questionnaire covering the same broad range of food items. Enumerators were equipped with scales to weight produce, ensuring that unit prices were actually recorded based on actual weight measures. However, the VDV questionnaire approach is designed to obtain the lowest cost estimate, collecting multiple price points for food items reported to experience seasonal price fluctuations. In the VDV market survey, this accounted for 17 food items. By capturing multiple prices for these items, the VDV approach produces a more dynamic and potentially lower-cost valuation of the model diet, whereas the Anker method relies on a more stable price reference. This distinction highlights how pricing assumptions play a substantial role in the overall variation of LIB estimates, underscoring the importance of price collection methods and the treatment of seasonal price fluctuations in the computation of living income benchmarks.

Finally, applying the Anker housing estimates, coming from interviews with construction service providers paired with household survey estimates of utilities, leads to a negligible (-0.02 percent) downward shift in the LIB^{VDV}. The minimal deviation across the Anker and housing estimates is remarkable considering the different types of respondents providing data on decent housing costs.

5 Living income gap: indicators and validation

While the LIB quantifies a normative definition of a decent living standard, it is the indicators based on the LIB that require validation, as they form the basis for the formulation of living income policies and interventions. Since the LIB establishes a monetary threshold against which households' incomes can be compared, it can be used as a reference line for various poverty and deprivation measures. These include, but are not limited to, the Foster-Greer-Thorbecke (FGT) measures, the Watts Index and the Prosperity Gap.[14] These indicators capture the extent, depth, and severity of deprivation relative to the LIB, similar to how poverty lines are used in poverty measurement. Importantly, since the statistical properties of these metrics are well documented (Ravallion, 2016a), substituting the poverty line with the LIB does not alter their statistical properties.

Instead, our focus is on assessing the properties of the primary indicator used in living income studies: the living income gap (LIG). The LIG represents the difference between the LIB and actual household incomes, and can be evaluated at either the mean or the median income of the target population (Tyszler *et al.*, 2020). These two versions are formalized as the "LIG of mean income" (Equation [18]) and the "LIG of median income" (Equation [19]) respectively. This indicator is convenient as it can be estimated using secondary data on household incomes, which in certain data-restrictive contexts, may be the only source of information available.

$$LIG_{\bar{Y}} = LIB - \bar{Y} \tag{18}$$

$$LIG_{\tilde{Y}} = LIB - \tilde{Y} \tag{19}$$

However, since living income studies are typically applied in export commodity-specific contexts for which population surveys are not designed to produce representative estimates of the target commodity-producer population,[15] the use of primary data on incomes collected from the target population is advisable. In this case, the LIG can be computed for each household i in the population as the difference between its income and the LIB. For consistency, the LIB must be scaled appropriately, as in Equation (20) since households are not necessarily composed of the same number of members as the average, reference family.

In order to focus the indicator on the *gap* with the LIB, households with incomes above the LIB are censored to zero, unlike in the case of Equations (18) and (19) where the mean and median income levels are based upon the entire reference population. Finally, the mean LIG for the target population can be computed as in Equation (20):

$$LIG_i = \left(\frac{LIB}{size_{ref}} \times size_{i,AE}\right) - Y_i \quad I(Y_i < LIB) \tag{20}$$

---

[14] Equations for these are reported in Table A2.

[15] Population surveys collecting income data, such as the Living Standards Measurement Study of the World Bank, are designed to be nationally representative, and often representative at a sub-national level in terms of administrative divisions or geographic units (e.g., regions, agro-ecological zones or urban/rural). They are not typically designed to be representative of specific agricultural sub-populations (Oseni *et al.*, 2021; United Nations, 2005).

$$\overline{LIG} = \frac{1}{N}\sum_{1}^{N}(LIG_i) \tag{21}$$

It is worth noting that apart from the case in which all household incomes in a population fall above or below the LIB, Equations (18) and (21) do not yield the same result ($LIG_{\bar{Y}} \neq \overline{LIG}$).

5.1 Statistical validity of poverty metric axioms

The properties of poverty indicators are typically assessed against a series of axioms (Araar, 2006; Blackorby and Donaldson, 1980; Duclos and Araar, 2006; Foster *et al.*, 2013; Foster and Shorrocks, 1991; Ravallion, 2016a; Sen, 1976; Shorrocks and Foster, 1987; Zheng, 1993) that illustrate their features and limitations. We focus on four key axioms,[16] summarized in Table 3, that reflect the manner in which living income indicators may be used for assessing the magnitude of the LIG and for monitoring progress towards its reduction.

Table 3. Poverty axioms defined in relation to the living income indicators

Axiom	Definition
Focus	The living income gap (LIG) is unaffected by variation in the income of households whose income is above the living income benchmark (LIB) and for which income variation does not pull their income below the LIB.
Monotonicity	A ceteris paribus increase in the income of a cocoa household that is below the LIB cannot lead to an increase in the LIG (i.e., the value of the LIG indicator will either decrease or remain unchanged). Any deterioration of the income of the household can only therefore widen the LIG.
Scale invariance	The LIG measure does not change when all incomes and the LIB rise by the same proportion.
Transferability	A rank-preserving progressive (regressive) transfer across households below the LIB will lead the LIG to fall (rise).

Source: Authors' own elaboration.

Using the data described in Section 3, we estimate the relevant LIG equations with respect to the benchmark, LIB^{Anker} (using LIB^{VDV} for comparison) to empirically assess whether $LIG_{\bar{Y}}$, $LIG_{\tilde{Y}}$ and $\overline{LIG}$ (LIG of mean income, LIG of median income, and mean LIG, respectively) satisfy the fundamental poverty measurement axioms of focus, monotonicity, scale invariance and transferability. To test these axioms, we simulate changes in household incomes and, for the case of scale invariance, also introduce changes in the LIB itself. After each change, we recompute the LIG indicators to determine if they behave as predicted under the respective axioms. Specifically, we conduct the following simulations and analyse the deviation of the updated LIG from its initial value:

[16] Additional axioms, such as subgroup monotonicity, anonymity, replication invariance, and additivity, are discussed by Ravallion (2016).

- **Focus**. We simulate positive and negative income shocks of magnitude –150 percent to +100 percent to all households with income above the LIB, with the condition that the shock does not reduce household income to fall below the LIB. The LIG should remain constant.
- **Monotonicity**. We simulate positive income shocks ranging from 1 to 100 percent on each household with income below the LIB. The resulting should fall or remain constant – at least does not increase – as required by this axiom.
- **Scale Invariance**. We increase household incomes and the LIB by a factor $k = \{1 \dots 10\}$. According to the scale invariance principle, the LIG should remain unchanged as a result.
- **Transferability**. We simulate rank-preserving income transfers across household pairs of magnitudes ranging from 1 to 50 percent of initial household income from each higher (lower) income household in the sample to a corresponding lower (higher) income household in the sample, restricting the transfers to take place only among households below the LIB. These inequality-decreasing (inequality-increasing) transfers should decrease (increase) the LIG indicators.

The results of these empirical tests are summarized in Table 4 and presented graphically in Figure A3 – Figure A6. We find that the focus axiom is met by the $\overline{LIG}$ as it is an indicator that censors the income of those above the benchmark, which is not the case for $LIG_{\bar{Y}}$ or $LIG_{\tilde{Y}}$. In particular, the $LIG_{\tilde{Y}}$, passes the focus axiom so long as the median household income level falls below the LIB, rendering it immutable to income variation among those above the LIB. Since most households in the sample fall below the LIB^{Anker}, this was indeed the case.

Our analysis reveals that all the LIG indicators meet the monotonicity and the transfer axioms, indicating that they are distribution sensitive and can be considered Pigou Dalton sensitive (Kraay *et al.*, 2023).[17] This means that increases in the incomes of households below the LIB reduce the LIG, while redistributing income from poorer to richer households below the LIB increases the LIG, aligning with well-established principles of poverty and inequality measurement. However, none of the indicators satisfy the scale invariance axioms, meaning that proportional changes in both household incomes and the LIB do not leave the LIG unchanged. This result suggests that the indicators are not invariant to changes in the overall income scale, which may limit their interpretability in contexts where inflation or other proportional shifts in income occur. The failure of the LIG to pass the scale invariance axiom is largely due to the fact that the LIB is a household-level benchmark with both fixed and variable cost components, while household income is fully variable and based on individual earnings. Because the LIB is not fully proportional to family size or household income, changes in both the LIB and household incomes at the same rate do not maintain the same LIG ratio. This is not necessarily a problem, and it reflects real-life expenditure structures for households. If the LIB were fully proportional to household income, it would imply that if household income doubled, the family's housing, school fees, or healthcare costs would also double – which is not the case in practice.

[17] The authors call a measure satisfying monotonicity and transfer axioms as being Pigou-Dalton-sensitive. They reserve the term "distribution sensitivity" to refer to the three popular situations in the literature: (a) Pigou-Dalton sensitivity, (b) transfer sensitivity (of a Pigou-Dalton sensitive measure), and (c) growth sensitivity.

Furthermore, while the $LIG_{\bar{Y}}$ and $LIG_{\tilde{Y}}$ indicators are both distribution sensitive, they are also uncensored indicators, meaning they respond to changes in household incomes even for households with incomes above the LIB. This feature may introduce bias when the goal is to tack the income gap faced by households below the LIB. Considering all of the above, we find our proposed censored LIG indicator, $\overline{LIG}$, to be a statistically robust indicator for analysing and monitoring the LIG.

Table 4. Living income indicators and poverty metric axioms

Axiom	Focus	Monotonicity	Transfer	Scale invariance
$\overline{LIG}$	Y	Y	Y	N
$LIG_{\bar{Y}}$	N	Y	Y	N
$LIG_{\tilde{Y}}$	Y, if $\tilde{Y}$<LIB	Y	Y	N

Notes: Y (N) indicates the indicator meets (does not meet) the axiom.

Source: Authors' own elaboration. Consistency with other deprivation indicators

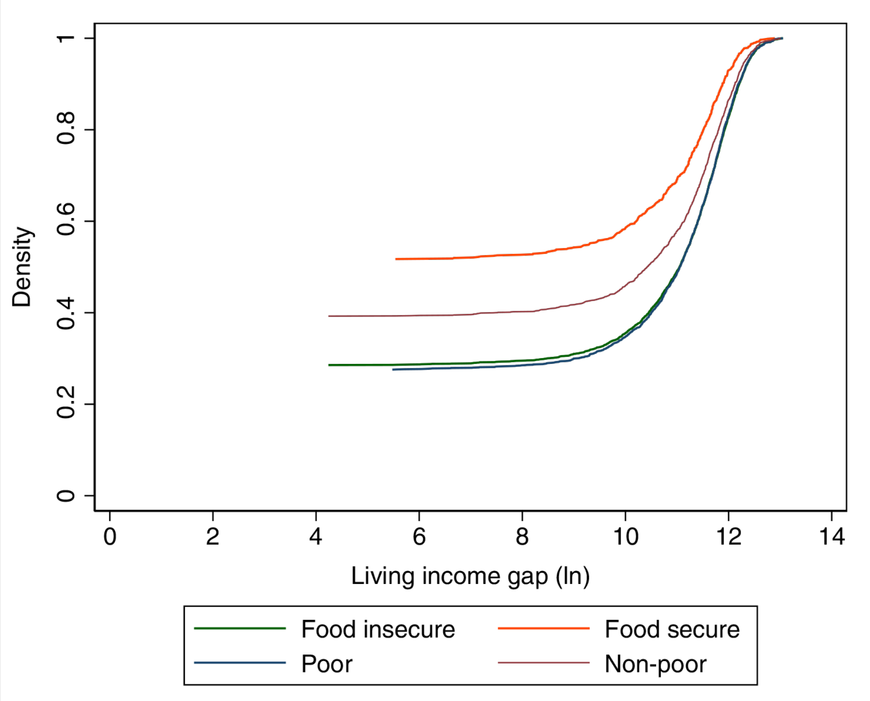
Another relevant consideration when assessing the LIG is whether it could be an effective tool for targeting purposes. For this, we draw on other non-monetary deprivation indicators to assess the comparability of the populations they classify as deprived. We estimate the multidimensional poverty index (MPI) following (Alkire *et al.*, 2015; Vollmer and Alkire, 2022) and the food insecurity experience scale (FIES) to classify households as moderate to severely food insecure following (Cafiero, Viviani and Nord, 2018). By comparing the classification outcomes of these indicators, we assess the degree of overlap and the extent to which the LIG identifies similar groups of vulnerable households as the MPI and FIES. This analysis sheds light on the targeting accuracy and consistency of the LIG relative to other widely used deprivation measures. If the LIG consistently identifies the same households as those flagged by the MPI and FIES, it could serve as a reliable and cost-effective tool for targeting policy interventions aimed at reducing deprivation and improving well-being.

We test the consistency of the LIG, MPI and FIES indicators according to the FOSD principle described in Section 3.1 to identify whether the LIG of the non-poor and the LIG of the food secure stochastically dominates the LIG of vulnerable groups – the multidimensional poor and the food insecure. The distribution functions plotted in Figure 4 support this hypothesis. For both versions of the LIG (based on Anker and VDV methods), the distributions of the MPI-poor and FIES-food insecure groups lie to the right of the distributions for the non-poor and food-secure groups. This indicates that, for a given level of the LIG, the cumulative proportion of vulnerable households (multidimensionally poor and food insecure) below that LIG is higher than for non-vulnerable groups. This pattern confirms that non-poor and food-secure households have better welfare outcomes relative to their vulnerable counterparts.

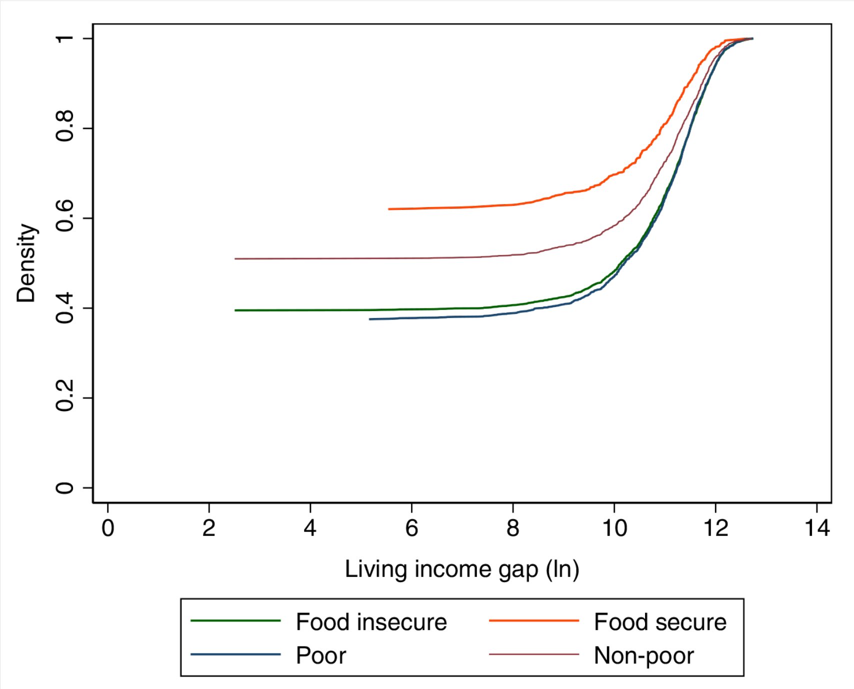
The stochastic dominance analysis highlights a strong relationship between income, non-monetary poverty, and food security. It reveals that households classified as MPI-poor or FIES-food insecure are more likely to fall below the LIB, while those above the LIB are unlikely to be classified as MPI-poor or FIES-food insecure. This consistency reinforces the utility of the LIG as a policy-relevant indicator that aligns with established measures of poverty and food insecurity. The findings suggest that income-based interventions targeting households below the LIB are also likely to reach the multidimensionally poor and food-insecure populations, thereby supporting integrated approaches to poverty reduction and food security policy.

Figure 4. Cumulative distribution of living income gap, by household non-monetary vulnerability status

a) Anker living income gap



b) van de Ven living income gap

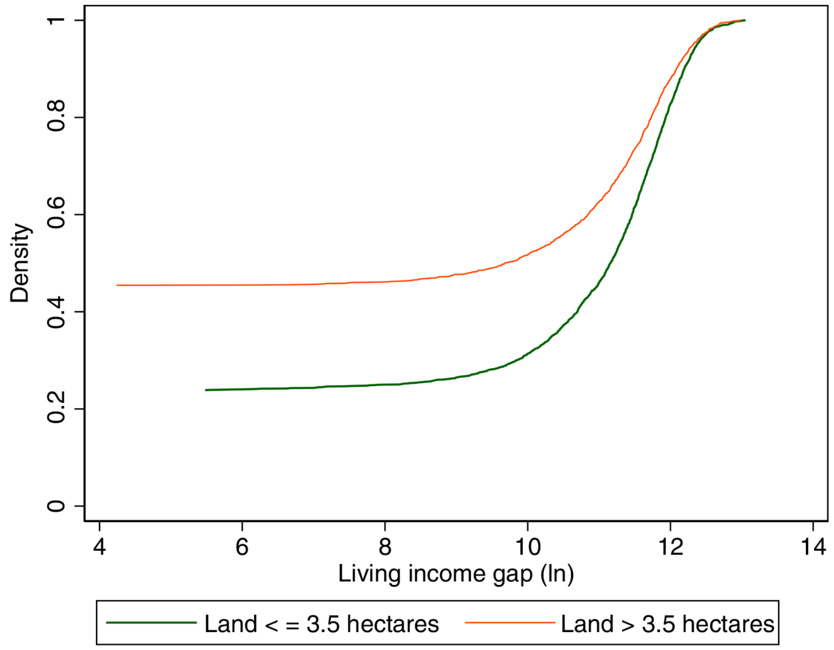


Source: Authors' own elaboration.

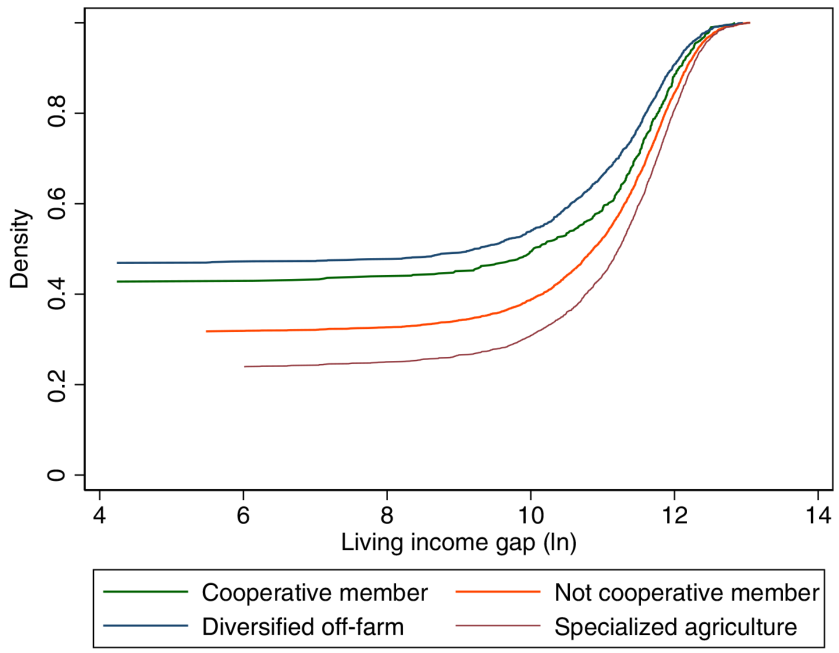
We extend the stochastic dominance analysis, testing for FOSD across the distribution functions of pairwise groups based on: (1) land holdings (smaller vs. larger); (2) cocoa cooperative membership (yes/no); and (3) off-farm income diversification (yes/no). The resulting distributions are presented in Figure 5.

Figure 5. Cumulative distribution of living income gap, by household characteristics

a) Land holdings



b) Cooperative membership and income diversification



Source: Authors' own elaboration.

We observe FOSD across all stratifications when assessing the LIG_i^{Anker} distributions as well as the LIG_i^{VDV} distributions.[18] Indicators of deprivation stochastically dominate indicators representing greater welfare. As the analysis is based on the cumulative distributions of the LIG, this implies that more vulnerable households are more likely to experience a LIG of greater magnitude than well-endowed households. In line with the graphical results, Kolmogorov-Smirnov (K-S) tests of equality of distributions confirms FOSD in all cases, as reported in Table 5, though with differing magnitudes of differences, as conveyed by the D columns.

Table 5. Kolmogorov-Smirnov tests of first-order stochastic dominance

	Anker living income gap		van de Ven living income gap	
Stratification	**D**	**p-value**	**D**	**p-value**
Household gender structure	0.33	0.00	0.27	0.00
Cooperative membership	0.11	0.00	0.11	0.00
Land size	0.22	0.00	0.23	0.00
Income diversification	0.24	0.00	0.27	0.00
Multidimensional poverty	0.12	0.00	0.13	0.00
Food insecurity	0.24	0.00	0.23	0.00

Notes: D represents the Kolmogorov-Smirnov test distance statistic. P-value reports significance level of the statistic.

Source: Authors' own elaboration.

The distributional analysis of the household level LIG is illustrative of its consistency with other vulnerability metrics but the graphical analysis indicates they are not substitutable by the LIG. Moreover, since the LIG level is dependent on the distribution of incomes in a population, the findings of the FOSD may vary according to that distribution.

[18] These are presented in Annex 5 (Figures A7, A8 and A9).

6 Discussion

How accurate and reliable are living income indicators as tools for formulating policies and interventions targeting household producers of export-oriented agricultural commodities? Our analysis has assessed the main methodologies and indicators used by living income analysts. We take stock of our findings and discuss the implications for future living income studies.

Data and methodological assumptions. Our comparative assessment of the Anker and VDV approaches reveals significant differences in the results, which can be attributed to **four key methodological elements**. The first is the use of a combination of primary and secondary data versus primary data and assumptions to estimate the NFNH component of the LIB. The Anker method employs an approach that leverages detailed household expenditure survey data to derive an estimate of the share of NFNH in total food expenditure, which is then applied and validated with rapid assessment primary data collected on the cost of education and healthcare. We find the approach is affected by certain shortcomings. **The first limitation of is that the food expenditure aggregate in a household survey may not represent the cost of a nutritious diet in the local context.** Using the survey-based share of NFNH in food expenditure to extrapolate the LIB NFNH element may result in an overestimation of the NFNH value and bias the estimate of LIB upwards, given that the survey estimate of food expenditure is likely well below the cost of a Model Diet. Current evidence indicates 72 percent of households in sub-Saharan Africa cannot afford a healthy diet (FAO, IFAD, UNICEF, WFP and WHO, 2024), suggesting that applying a ratio of NFNH to food expenditure may not appropriately represent the share of NFNH in the cost of a model diet. Moreover, basing the NFNH estimation on a combination of secondary and primary data may introduce inconsistencies in the LIB estimate if data sources represent different time frames and are collected based on different methodologies.

The second key issue is **the low value of the supplement** used to account for the range of other NFNH costs in the van de Ven *et al.*, (2021) approach. The VDV relies on observed, primary data estimates of education and healthcare costs and a 25 percent supplement to account for the range of other NFNH costs incurred as part of a decent life. However, since the supplement was calculated from a limited set of surveys from sub-Saharan Africa (SSA), we seek to validate the assumption using data for 33 SSA countries from 2003 to 2011 from the Global Consumption Database (DECDG, 2014). We find that the ONFNH share of total expenditure averages 24.5 percent and with respect to the known parameters in the LIB estimation (food, housing, health and education), ONFNH constitutes 34.5 percent of the aggregate expenditure (see Figure A1). This implies that the 25 percent share according to the VDV assumptions is somewhat below the average based on a broader sample and may therefore bias the LIB estimate downwards.

Third, **the valuation of the model diet** represents another source of variation in the calculation of the LIB across methods. The benchmark estimates were found to be highly sensitive to price assumptions, highlighting the importance of careful selection of market locations and price collection protocols, as well as obtaining sufficient data points per food item. The surveys we implemented for the LIB estimates were guided by the Anker and VDV documentation and followed the latest best practices in survey design and data collection (Dillon *et al.*, 2021; Siwatu *et al.*, 2021). Nevertheless, we still found differences in price levels for a range of products, despite interviews implemented in the same region of Cameroon. Overall, the Anker survey price estimates were on average higher than those from our VDV comparison survey, reflecting the VDV design to obtain the lowest price point for an acceptable quality food item in the model diet. While this approach demonstrably obtained lower prices for most food items, it could challenge the overarching objective of the LIB to represent the cost of a decent life in terms of normative parameters and in terms of the local prevailing prices. Rural consumers frequently experience significant seasonal price fluctuations, often for key staple products (Gilbert, Christiaensen and Kaminski, 2016). In other words, the decent level of income should be sufficient to purchase the low-cost nutritious diet also in periods when prices are higher. One potential solution would be to apply price deflators that account for spatial and temporal price variation, as are typically employed for the estimation of consumption aggregates for poverty estimation purposes (Mancini and Vecchi, 2022).

Furthermore, **the reporting unit of the LIB** has important implications for the comparability of the estimates and their relation to other monetary deprivation measures. While the definition of the reference family for the LIB estimation is a critical element in assessing the total set of expenditures required for a decent life, the use of the reference family for the reporting and analysis of the final LIB implies that policies are to be defined with respect to an average context. In practice, this approach may be inefficient since household structures are diverse and deviations from the average context will necessarily exist. Policies designed around average contextual conditions risk targeting inefficiencies and may lead to unintended consequences. Notably, a cocoa price policy designed using a cocoa-sector LIB is likely to affect different households differently, not only because of their level of involvement in the commodity, but simply because of their household composition and the constraints related to it. Estimating living income indicators in scalable units, such as adult-equivalent terms, as suggested by VDV, could improve targeting efficiency and offer a more fine-tuned policy tool.

Finally, certain elements are not considered by either approach. For example, for the housing component, the cost of land or of acquiring a land or house title allowing for secure dwelling tenure is not explicitly quantified. In addition, utilities expenditures on heat, lighting and electricity could be assumed to vary with the size of the dwelling and the number of users, however these are not indexed accordingly.

Recommendations to the living income benchmark estimation

Based on our findings, we suggest that future LIB estimations **consider alternate assumptions** to (1) enhance comparability with existing deprivation metrics, (2) improve alignment with recent methodological innovations in the scope of healthy diets, and (3) leverage institutional investments in data collection.

First and foremost, **we recommend the use of per capita units** to express the benchmark and its components in order to enable comparisons with monetary poverty indicators. Such reporting would also facilitate the use of the LIBs for different analyses and improve its application for the design of policies and interventions.

The LI model diet cost is a concept that is similar to **the Cost and Affordability of a Healthy Diet** (CoAHD) indicator (Herforth *et al.*, 2023) that since 2020 is being used for global monitoring of the “access to a nutritious diet” component of Sustainable Development Goal Indicator 2.1 (Masters *et al.*, 2024). The CoAHD approach uses national dietary guidelines, or the Healthy Diet Basket, and harmonized local price data to value contextually relevant healthy diets providing sufficient quantities to achieve nutrient adequacy and mitigate exposure to diet-related diseases. As an institutionalized metric based on high quality harmonized data and methods suitable for cross-country and within country assessments (Wallingford *et al.*, 2024), the CoAHD could provide an initial reference for the LI model diet estimation.

While the use of the CoAHD would reduce data collection costs for a LIB estimation, it comes with certain drawbacks that would need to be assessed contextually. For one, the CoAHD is valued using the International Comparison Programme prices, which are updated only every five years and extrapolated in between. In contexts of high inflation or other economic instability, the ICP prices may not fully reflect the seasonality that is duly considered by the Anker and VDV methods. Furthermore, since the CoAHD adopts a parsimonious approach based on 11 food item types from six food groups, alignment with the LI approach would require augmenting the cost to account for condiments, waste and variety. Nevertheless, the use of the CoAHD could enhance coherence with existing indicators on food security and healthy diets and to minimize the risk the model diet cost is affected by measurement error in prices or market sample selection bias. Extrapolating the 2024 daily per capita CoAHD estimate for rural Cameroon (FAO, 2024b) to the size of the reference family per month and augmenting it to account for condiments, waste and variety yields a model diet cost that is 93 percent the level of the VDV model diet cost.

Comparable harmonized metrics for decent housing, healthcare, education do not exist, which points to the ongoing need to collect primary data on these, especially since institutionalized household survey programmes do not systematically collect information to meet the data requirements for the valuation of these elements. **Minor revisions to typical multi-topic living standards questionnaires** would facilitate estimation of the full costs of treating the most prevalent illnesses for different gender and age groups, the costs of schooling for children currently enrolled at different schooling levels and the identification of households with decent housing and their costs, enabling imputed housing costs.

Finally, the remaining elements of the LIB – ONFNH and the buffer – can be obtained by **applying relevant shares to increase the LIB level,** as recommended by the VDV method. For ONFNH, a systematic assessment of consumption data from the International Comparison Programme, which covered 176 countries in its latest 2021 cycle (World Bank, 2024b) could potentially fill this data requirement.

Cost effectiveness

Strategically selecting secondary data sources to fill information gaps underlying the LIB could enhance the cost effectiveness of the benchmark estimation. We conduct a resource effectiveness analysis (see Annex 3) that highlights the potentially elevated cost of market surveys; but that the overall efficiency relies considerably on the number and duration of interviews. Leveraging high quality, harmonized data that is publicly available may support a cost-effective approach, especially when considering the importance of investing in primary data collection for estimating household incomes. These can cost anywhere from around USD 100 to over USD 300 per interview for a typical, detailed living standards survey (Kilic *et al.*, 2017).

Statistical validity

We proposed a new, censored LIG indicator based on the average of household-level LIGs in a target population. Our assessment of this indicator against a set of key poverty axioms reveal it meets three of the four axioms, including distribution sensitivity. By contrast, the Gap of mean and median income indicators meet two of the tested axioms consistently. However, as uncensored indicators, they understate the magnitude of the LIG for households with income below the LIB.

Use of living income gap for policies and interventions

What implications do these observations have for assessing the effectiveness of LI-indicator-informed policies? For this, it is important to consider that the main policy tool developed to date for addressing the LIG relies on increasing incomes through a living income differential, a higher commodity price defined using the LIB and LIG as key parameters (Loos *et al.*, 2022). In principle, this price policy should increase household incomes in proportion to the scale of household involvement in a commodity's production. Depending on the extent to which households along the income distribution produce the commodity (and as seen earlier, depending on farm size, and the extent to which the household diversifies or specializes on a given commodity sector), such a price policy may be inequality increasing or decreasing, especially since the policy cannot distinguish between households above and below the LIB. Since the LIG indicators are monotonic and transfer sensitive, they are effective for monitoring the effectiveness of a LI price policy over time, including changes in inequality. However, since the magnitude of the uncensored LIG indicators also reflects households with incomes above the LIB, the true magnitude of the LIG among those with incomes below the LIB is understated. For this, our censored LIG indicator is well suited for depicting the scale of the gap to be bridge, in contexts where incomes can be monitored at a household level.

7 Conclusions

In a policy environment that seeks to ensure sustainable value chains and due diligence of actors in agrifood systems, the living income approach has received increasing attention. Binding European policies on deforestation, traceability and corporate due diligence (EU, 2023; EU 2024) imply that importers of agrifood commodities will seek cost-effective strategies to ensure compliance with economic, environmental and social sustainability standards. The living income approach provides indicators that are both easy to calculate and understand, rendering it attractive for public and private sector stakeholders. If the approach is to ensure the gains of commercialising export-oriented commodities effectively reaches producers, an understanding of the living income indicators and their limitations is critical.

This paper has sought to assess the utility of the living income approach for policies and programmes by evaluating data requirements, computational assumptions, statistical validity and resource-effectiveness. We find that living income indicators provide a decency threshold that distinguishes them from other indicators of deprivation and can lead to higher or much higher cost of living estimates than international poverty lines. The decomposability of the LIB allows for an understanding of which elements of a decent life account for most of the LIB, providing an opportunity to assess the affordability of essential goods and services for the target population. However, the selection of the LIG indicator must be made with consideration to the interventions or policies it will inform. Notably, an uncensored indicator risks underestimating the magnitude of the deprivation in a population.

Like Fair Trade and other similar product certifications, a living income differential seeks to support the economic and social sustainability of the traded commodity, in this case by pursuing an adequate remuneration for primary commodity producers. Even if this accountability approach passes the higher cost onto downstream value chain actors, complementary policies are needed to achieve the objective of bridging the LIG. Some examples include supporting farmer associativity and ensuring contract farming arrangements designed to protect both farmers and buyers. Contract farming frameworks could serve to meet other sustainability criteria by helping farmers access appropriate inputs or adopt specific production practices. These could also reduce risk for farmers operating in circumstances characterized by multiple market imperfections.

Due consideration to livelihood diversification strategies is also relevant, especially in contexts where farmer incomes are based on multiple sources. Living income policies targeted at commodity producers should be combined with other economic development policies that generate off-farm employment, potentially by further developing the value chain in country. A sectoral approach that prioritising diversification may also serve to support the broader sustainability goals of the sector, which also embody halting deforestation and child labour.

An important added value of this measure is its ability to highlight where efforts should be directed to reduce the cost of living. By identifying key cost drivers, it points to areas where improving the availability and quality of public services and markets can play a critical role in enhancing the affordability of essential goods and services related to health, education, and housing. On the supply side, such efforts can reduce household expenditures and close the LIG. Ultimately, the LIB and LIG provide crucial insights to guide the orientation and prioritization of rural investments, extending beyond sector-specific policies to support broader rural development objectives.

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Annexes

Annex 1. Additional tables

Table A1. Price assumptions in Central Africa Francs (CFA), by method and deviation

Food item	van de Ven (VDV)	Anker	Deviation
Maize (grains)	349	286	(63)
Plantain	200	313	113
Cassava	218	225	7
Cocoyam	118	250	132
Koki	963	563	(400)
Soya	200	490	290
Milk powder	1 417	1 100	(317)
Eggs	1 379	1 000	(379)
Fresh fish	1 500	1 500	-
Porcupine	313	1 667	1 354
Cassava leaves	74	633	559
***Ndole* leaves**	338	1 000	662
Cabbage	167	500	333
Carrot	310	611	302
Onion	405	500	95
Tomato	297	500	203
Avocado	366	268	(98)
Banana	178	200	22
Mango	588	183	(405)
Palm oil	600	900	300

Source: Authors' own elaboration.

Table A2. Existing poverty metrics

Indicator	Poverty metric		Living income adaptation	
Foster-Greer-Thorebecke[19]	$G_i = Z - Y_i I(Y_i < Z)$	(22)	$G_i^{LI} = LIB - Y_i I(Y_i < LIB)$	(23)
	$FGT_\alpha = \frac{1}{N}\sum_1^N \left(\frac{G_i}{Z}\right)^\alpha$	(24)	$FGT_\alpha^{LI} = \frac{1}{N}\sum_1^N \left(\frac{G_i^{LI}}{LIB}\right)^\alpha$	(25)
Watts Index	$Watts = \frac{1}{N}\sum_i^q \ln(Z) - \ln(Y_i)$ $(i < q)$	(26)	$Watts^{LI} = \frac{1}{N}\sum_i^q \ln(LIB) - \ln(Y_i)$ $(i < q)$	(27)
Prosperity gap	$W = \frac{1}{N}\sum_i^N \frac{Z}{Y_i}$	(28)	$W^{LI} = \frac{1}{N}\sum_i^N \frac{LIB}{Y_i}$	(29)

Source: Authors' own elaboration based on Foster, J., Greer, J. & Thorbecke, E. 1984. A Class of Decomposable Poverty Measures. *Econometrica*, 52(3): 761. https://doi.org/10.2307/1913475; Kraay, A., Lakner, C., Özler, B., Decerf, B., Jolliffe, D., Sterck, O. & Yonzan, N. 2023. *A New Distribution Sensitive Index for Measuring Welfare, Poverty, and Inequality*. Policy Research Working Papers. Washington, DC, The World Bank. https://doi.org/10.1596/1813-9450-10470; and Watts, H.W. 1969. An economic definition of poverty. In: *On Understanding Poverty*. New York, USA, Basic Books.

[19] Changing the value of alpha from 0 to 1 to 2 yields, respectively, the poverty incidence, the poverty gap, and the squared poverty gap.

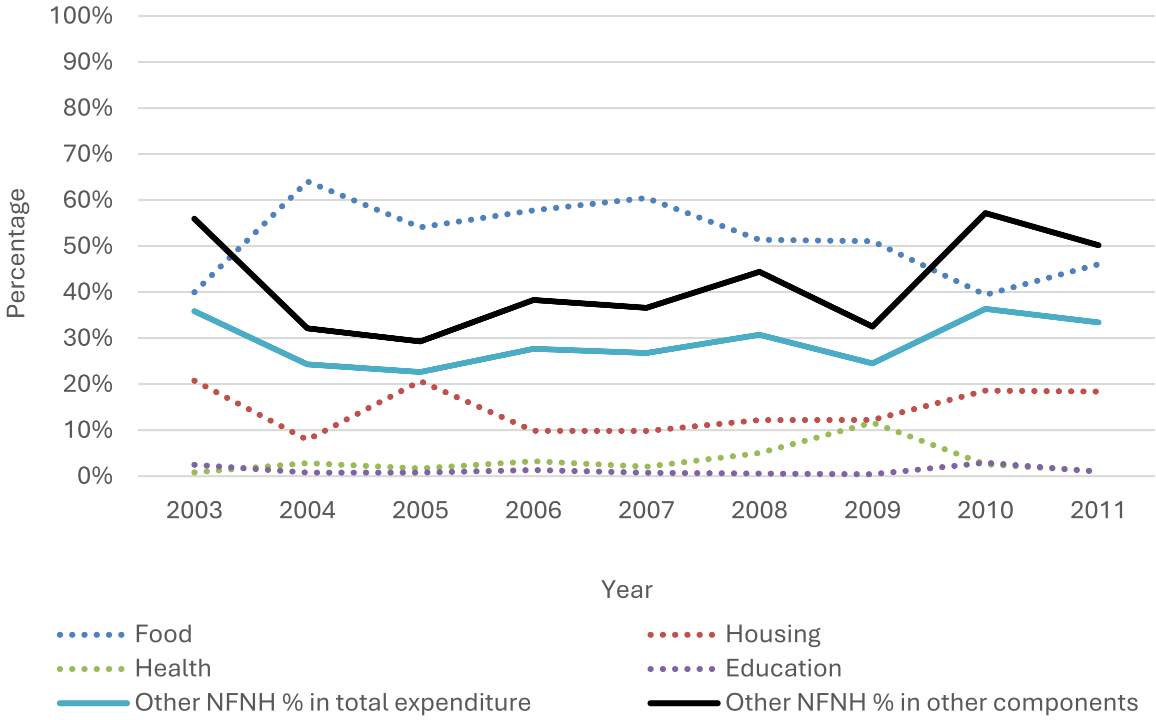
Table A3. Estimated interview frequency and duration, by method and sector survey

	Duration per price point	Median duration (hours)	Recommended minimum interview frequency	Notes
van de Ven (VDV)				
Market	0.03	.	180–360	Assumes 12 food groups, three items per group, 5–10 price points per food item
Housing		0.25	10	Ten housing interviews
Education		0.23	20	Ten education interviews per level; two levels (primary; lower secondary)
Health		0.88	3	Three health service provider interviews
Anker				
Market	0.04	.	120–250	Assumes 12–25 items per group, 10 price points per food item
Housing		0.73	10	Number of interviews not specified; apply same criteria as VDV.
Education		0.71	30	Ten education interviews per level; three levels (primary; lower secondary; upper secondary)
Health		0.94	3	Number of interviews not specified; apply same criteria as VDV.

Source: Authors' own elaboration using Anker, R. & Anker, M. 2017. *Living Wages Around the World*. Cheltenham, United Kingdom, Northampton, USA, Edward Elgar Publishing. https://www.elgaronline.com/monobook-oa/9781786431455/9781786431455.xml; FAO & JRC. Forthcoming. *Living Income Survey of Cocoa Producing Households, Market Vendors and Local Service Providers*. Rome; FAO & JRC. Forthcoming. *Cameroon cacao sector living income service provider survey - Centre region.* Rome; and van de Ven, G.W.J., de Valença, A., Marinus, W., de Jager, I., Descheemaeker, K.K.E., Hekman, W., Mellisse, B.T. et al. 2021. Living income benchmarking of rural households in low-income countries. *Food Security,* 13(3): 729–749. https://doi.org/10.1007/s12571-020-01099-8

Annex 2. Additional figures

Figure A1. Sectoral expenditure shares, rural sub-Saharan Africa



Notes: NFNH stands for non-food, non-housing.

Source: Authors' own elaboration.

Annex 3. Resource effectiveness and comparison with international poverty lines

Assessing the utility and value addition of the living income methods can be complemented by an understanding of their implementation costs. We assess the resource efficiency of calculating a LIB across the Anker and VDV methods, focusing uniquely on fieldwork costs.[20]

We first calculate total costs of collecting primary data from cocoa sector service providers, based on the surveys described in Section 0 following the Anker and the VDV methods. For both surveys, the questionnaires consisted in quantitative, closed-form questions and enumerators administered interviews with tablets equipped with Survey Solutions, which recorded interview times and durations.

The unit cost (USD per hour of interview) was calculated based on the total duration of all interviews conducted as part of this fieldwork, the main assumption being that the cost per hour of interview in a given location is independent of the type of interview conducted. Only active interview duration is counted; time spent locating respondents is excluded from the computation.[21] As our budget for the Anker method survey was developed to include household interviews for the estimation of household income, the total duration of household interviews also entered the cost estimation.

The total cost C^m of implementing each method m was computed as in Equation (30) where $d_{s,m}$ represents the median duration in hours of a sector s interview following method m; $f_{s,m}$ is the recommended interview frequency and c is the unit cost, expressed in USD per hour.

$$C^m = c_m \times \sum_s (d_{s,m} \times f_{s,m}) \qquad (30)$$

The parameters in equation (30) enable a series of ratios to be estimated. We compute the unit cost ratio, c^{VDV}/c^{Anker}, to assess relative fieldwork costs. We also compute the implementation time ratio as D^{VDV}/D^{Anker} , whereby $D^m = \sum_s (d_{s,m} \times f_{s,m})$, to assess the time effectiveness of each approach. Finally, the overall cost effectiveness of the Anker and VDV methods is based on a Benefit-Cost-Ratio formula as in Equation (31).

$$CER = \frac{C^{VDV} - C^{Anker}}{D^{VDV} - D^{Anker}} \qquad (31)$$

The results of the resource effectiveness analysis are presented in Table A4. We first assess the time efficiency ratio, hereafter D-ratio, of the two approaches. This ratio indicates that the VDV approach requires 63 percent shorter interview time to obtain the minimum number of interviews in a given location (Scenario 1). The D-ratio varies according to the number of price points required for the market survey. If the estimated duration of each method is estimated

[20] The cost of sample design, survey instrument development, pre-testing, training and piloting were excluded from the cost computation, since these were implemented to different extents across methods due to project timeline issues. Project staff salaries and benefits were also excluded since these also covered activities that were orthogonal to the implementation of the service provider interviews.

[21] We assume the availability of respondents is unrelated to interview type.

using an upper bound on the number of price points (i.e. 360 instead of 180 for VDV; 250 instead of 120 for Anker), the D-ratio rises, with the VDV approach requiring 37 percent shorter interview time. We further test the sensitivity of these results by adjusting the interview frequencies for the housing, education and health sectors, as the Anker approach does not provide specific guidance on the target number of interviews for these sectors (Scenario 3). We reduce the number of interviews to five for housing, five for education and two for health. The resulting D-ratio increases and ranges from 0.92 (more market price points) to 0.96 (fewer market price points).

Table A4. Resource effectiveness ratios

	Scenario 1: Base assumptions		Scenario 2: Equal prices		Scenario 3: Fewer Anker non-food interviews	
Bounds (market prices)	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**
Time efficiency ratio (D-ratio)	0.37	0.43	0.37	0.43	0.96	0.92
Cost-Effectiveness ratio (CER)	9.67	7.34	32.29	32.29	(100.98)	(63.48)

Source: Authors' own elaboration.

Comparing unit costs (USD per interview hour), the VDV approach was 1.78 times more expensive to implement than the Anker approach. The magnitude of this ratio is striking, but could also be attributed to the fact that enumerators in the Anker survey were responsible for both household and LIB interviews, whereas in the comparison survey for the VDV method, only LIB interviews were conducted. This means that in a given locality, enumerators conducting the Anker survey carried out more interview activities than VDV enumerators, but were paid the same daily rate. Because of this difference, we compare the total Cost-Effectiveness Ratio (CER) on the basis of survey-specific unit prices and also on the basis of a common unit price.

When considering the total resource requirements, the CER ranges from 7.3 to 9.7, indicating a significantly higher cost-effectiveness of the VDV approach (Scenario 1). If the unit cost of the VDV survey is used to estimate the cost of interviews with the duration of the Anker approach, the ratio increases further to 32.3 (Scenario 2). However, if the lower interview frequency for the Anker approach is applied (Scenario 3), the CER ranges from –63.5 (more price points) to –101.0 (fewer price points). The more parsimonious approach for health, education and housing leads to lower interview times and thus lower costs for the Anker approach.

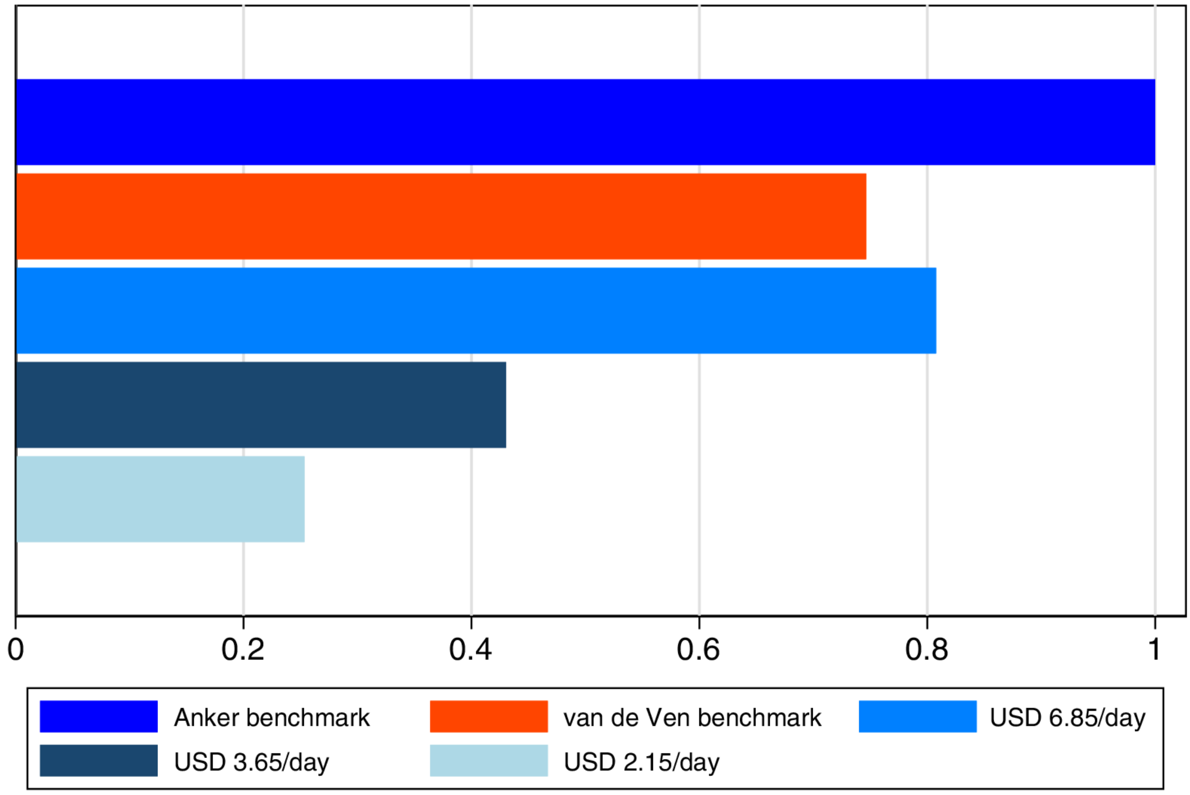
Overall, the extent to which one approach is relatively more cost effective depends primarily on the target number of interviews for collecting sufficient information to compute the LIB. Given the paucity of detail on the number of rapid assessment and housing interviews to conduct, a single CER is not possible to compute. Nevertheless, based on the available guidance our finding substantiates the assertion by (van de Ven *et al.*, 2021) regarding efficiency of their approach.

A direct comparison of the resource effectiveness of a LIB with respect to a monetary poverty line is also hindered by the type of data required to estimate a poverty line (household consumption expenditure) which differs from that which feeds a LIB (cost of living for a normative decent life). Back of the envelope estimates based on Living Standards Measurement Survey implementation costs from (Kilic *et al.*, 2017) indicate the per-household-interview cost in sub-Saharan Africa, net of technical assistance expenditures can range from around USD 150 to USD 258 per interview in 2014. By contrast, our service provider interviews for the living income benchmark averaged USD 123 per interview. If household interviews are also considered, the cost drops to around USD 40 per interview in 2014 dollars, reflecting the efficiency gains from having enumerators collecting both sorts of data in parallel.

The resulting deprivation or decency thresholds obtained from household and service provider survey investments are illustrated by Figure A2, which compares the LIBs with the World Bank international poverty lines, all expressed in purchasing power parity (PPP) units (World Bank, 2024a) per month per capita and indexed to $LIB^{Anker} = 1$. In line with the findings of (van de Ven *et al.*, 2021), the LIB^{VDV} exceeds the extreme (USD 2.15/day). and lower middle income country poverty lines (USD 3.65/day) but falls below the upper middle income country poverty line (USD 6.85/day). Instead, the LIB^{Anker} exceeds all three international poverty lines by a significant margin. It is 4 times greater than the extreme poverty line, 2.3 times greater than the LMIC poverty line and around 25 percent greater than the UMIC poverty line.[22] Overall, this underscores the difference between subsistence and decency thresholds, with implications for the types of policies and interventions that may emerge from a living income analysis.

[22] These differences are also indicative of the extent to which the LIB would differ with respect to a Minimum Expenditure Basket or a Basic Universal Income.

Figure A2. Comparison of living income benchmarks with international monetary poverty lines



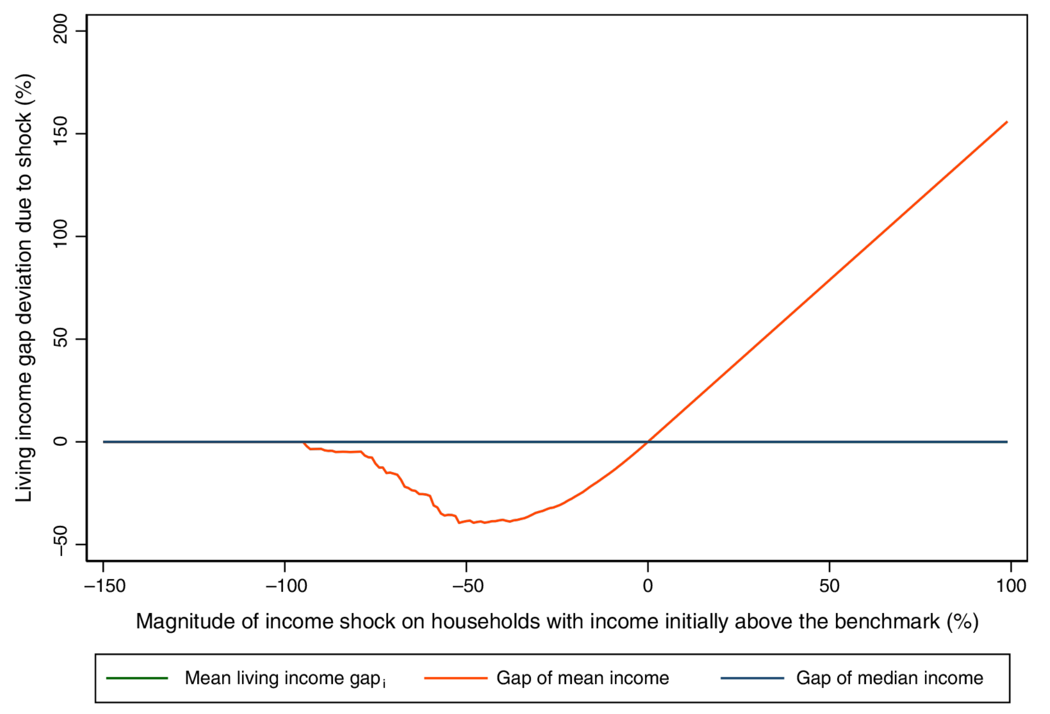
Source: Authors' own elaboration.

Annex 4. Test of poverty axioms

Focus

Our test of the focus axiom involves simulating positive and negative income shocks to all households with total income above the LIB. We shock the initial household income of these households by –150 percent to 100 percent in order to illustrate the outcome of these income variations on the three LIG indicators. As illustrated in Figure A3 we find that the Mean LIG is unaffected by any positive or negative income shock to households with incomes above the LIB, whose incomes do not decrease below the LIB as a result of the shock. Instead, the gap of mean income and the gap of median income are affected by income variations among households whose income exceeds the LIB. As both are uncensored measures, they are sensitive to changes in incomes across the distribution.

Figure A3. Focus axiom: deviation from initial living income gap

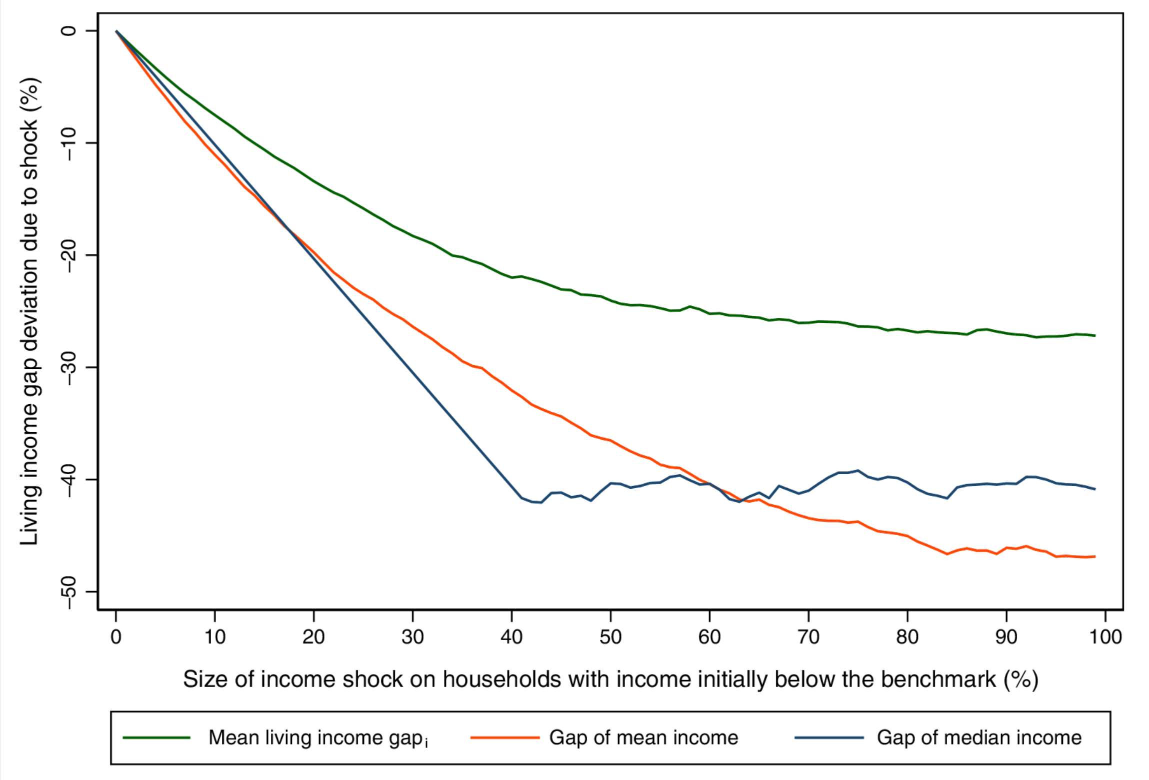


Source: Authors' own elaboration.

Monotonicity

We simulate positive income shocks on each household with income below the LIB and compute the resulting LIG to assess whether the LIG falls or remains constant – or at least does not increase – as required by this axiom. Figure A4 plots the result of these simulations for the gap of mean income, (18), the gap of median income, Equation (19), and the mean LIG. A clear negative relationship is observed between the increase in incomes and the magnitude of the LIG with respect to the initial LIG, demonstrating that all three indicators pass the monotonicity axiom.

Figure A4. Monotonicity axiom: deviation from initial living income gap

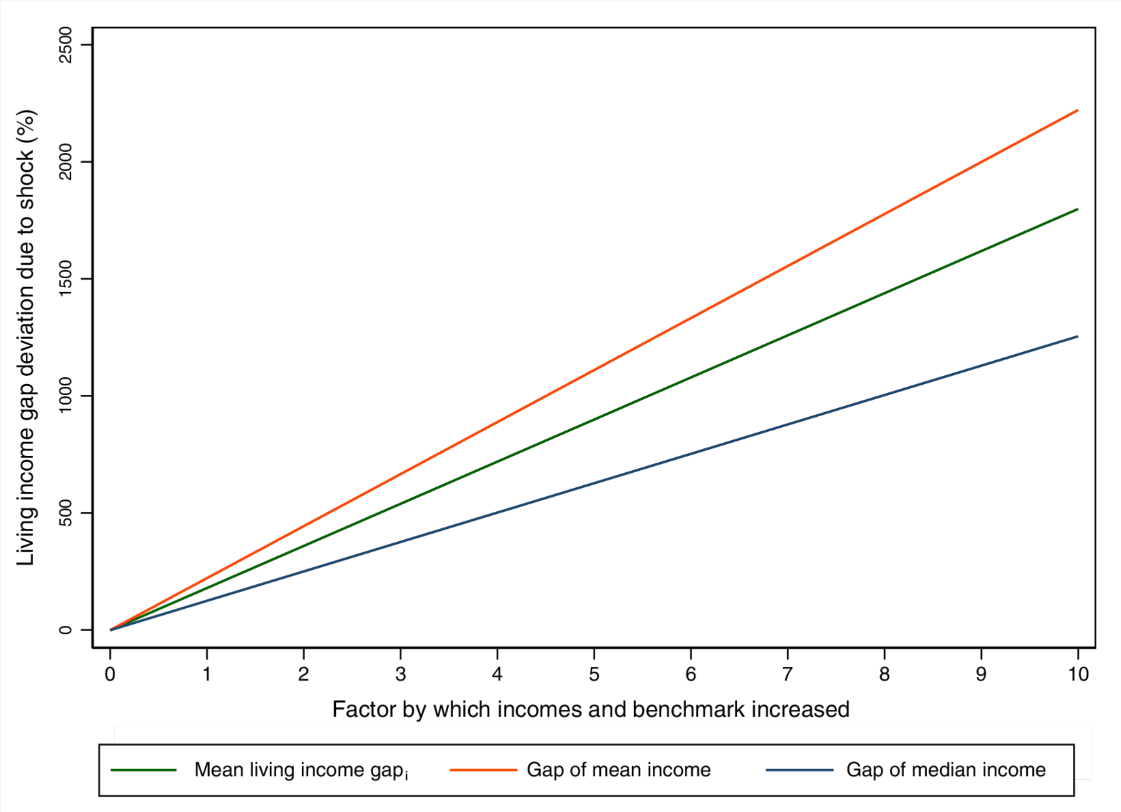


Source: Authors' own elaboration.

Scale invariance

We increase household incomes and the LIB by a factor $k = \{1 \ldots 10\}$. The deviation from the initial LIG for each simulation is plotted in Figure A5. According to the scale invariance principle, the LIG should remain unchanged as a result; however, none of the three living income indicators, $LIG_{\bar{Y}}$, $LIG_{\tilde{Y}}$ and $\overline{LIG}$, pass the scale invariance test. Increasing the benchmark and household incomes leads the LIG to widen, reflecting the shape of the initial income distribution in which an important proportion of household income is concentrated below the LIB and namely, below the median income level. The slope of each LIG indicator curve reflects its sensitivity to the proportion of households below the LIB. For example, the Gap of mean income is uncensored and thus reflects the increase in incomes among households above the LIB as much as those with incomes below the LIB. As a result, it conveys the flattest slope of the three indicators. The steepest slope is observed for the Mean LIG, which only conveys the LIG among households below the LIB.

Figure A5. Scale invariance axiom: deviation from initial living income gap



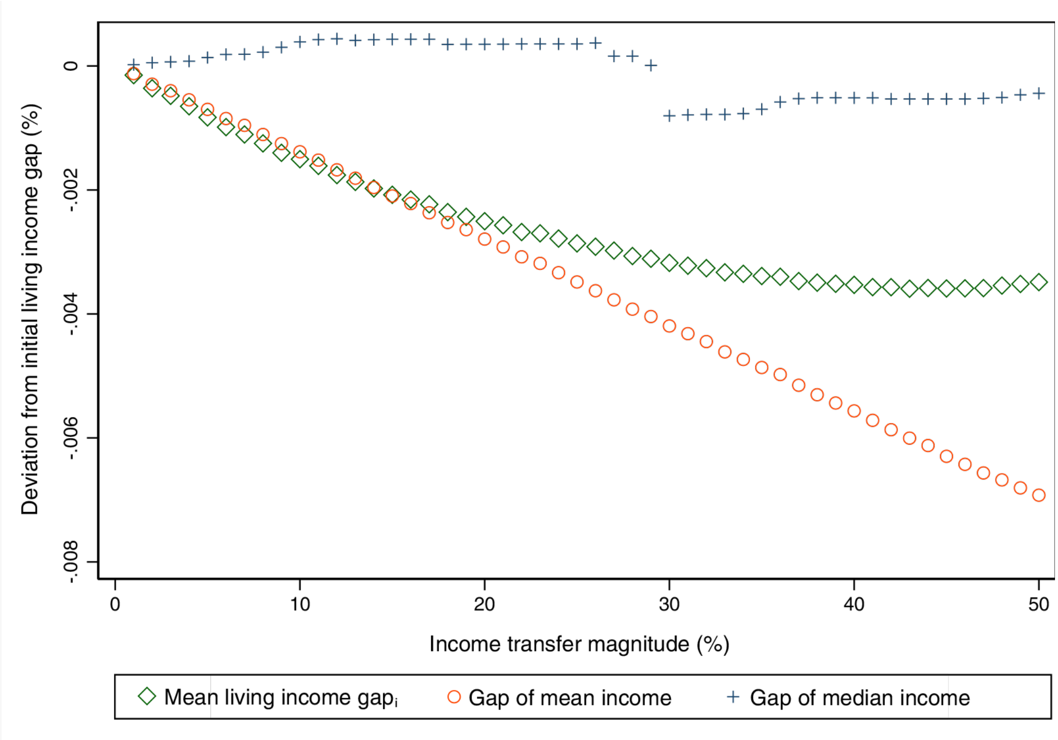
Source: Authors' own elaboration.

Transfer

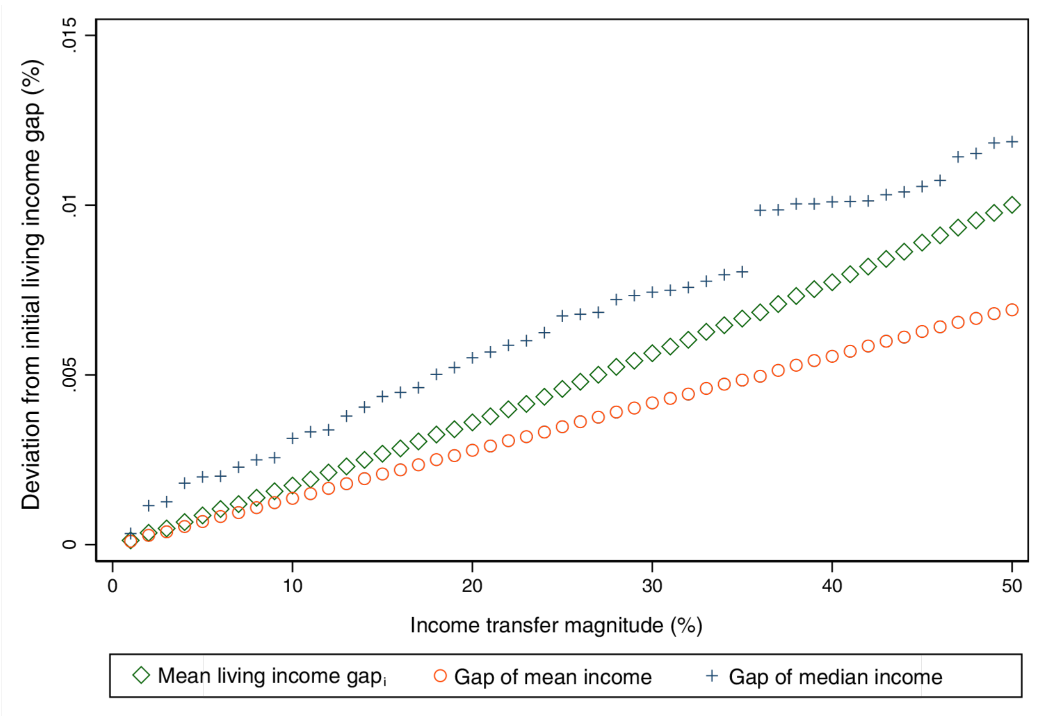
Like the scale invariance axiom, the transfer axiom is indicative of whether a monotonic deprivation metric is distribution sensitive. We simulate rank-preserving income transfers ranging from 1 to 50 percent of total household income from each higher income household in the sample to a corresponding lower income household in the sample, restricting the transfers to take place only among households below the LIB. These inequality-decreasing income shocks should decrease the LIG indicators, an outcome that is effectively observed for each of the LIG indicators, albeit of a very small magnitude. The magnitude of the change in the LIG is attributed to the fact that each simulation represented a transfer between two households in the sample. This implies that if transfers were to take place across an aggregate set of households, the magnitude in the observed deviation from the initial LIG would also (Figure A6, panel a). Figure A6, panels b reports the outcomes of simulations of inequality-increasing transfers, which should increase the LIG. We find once again that the LIG indicators also respond to regressive income transfers. As a result, the transfer axiom holds and we can conclude that the indicators are distribution sensitive.

Figure A6. Transfer axiom: deviation from initial living income gap

a) Progressive transfer



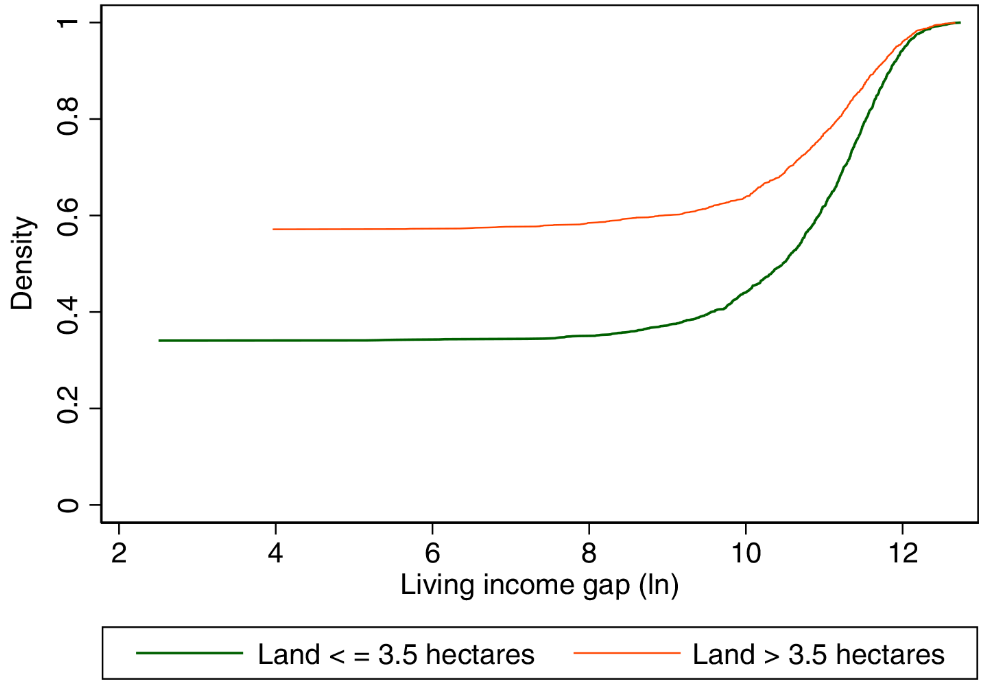
b) Regressive transfer



Source: Authors' own elaboration.

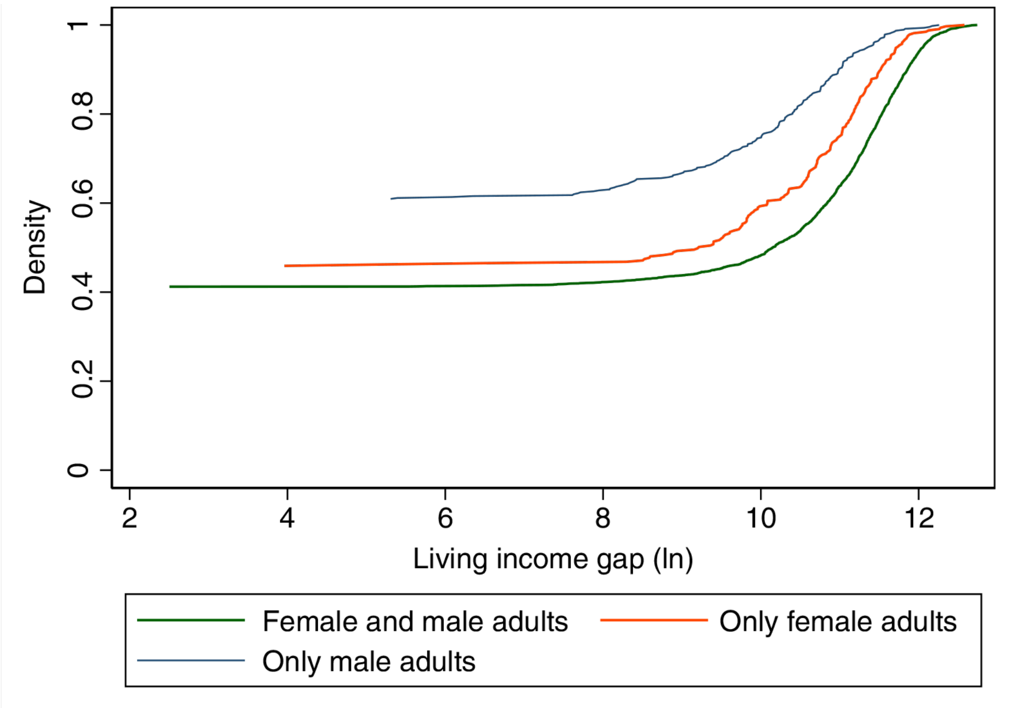
Annex 5. First order stochastic dominance tests based on the van de Ven living income benchmark

Figure A7. Cumulative distribution, by land size



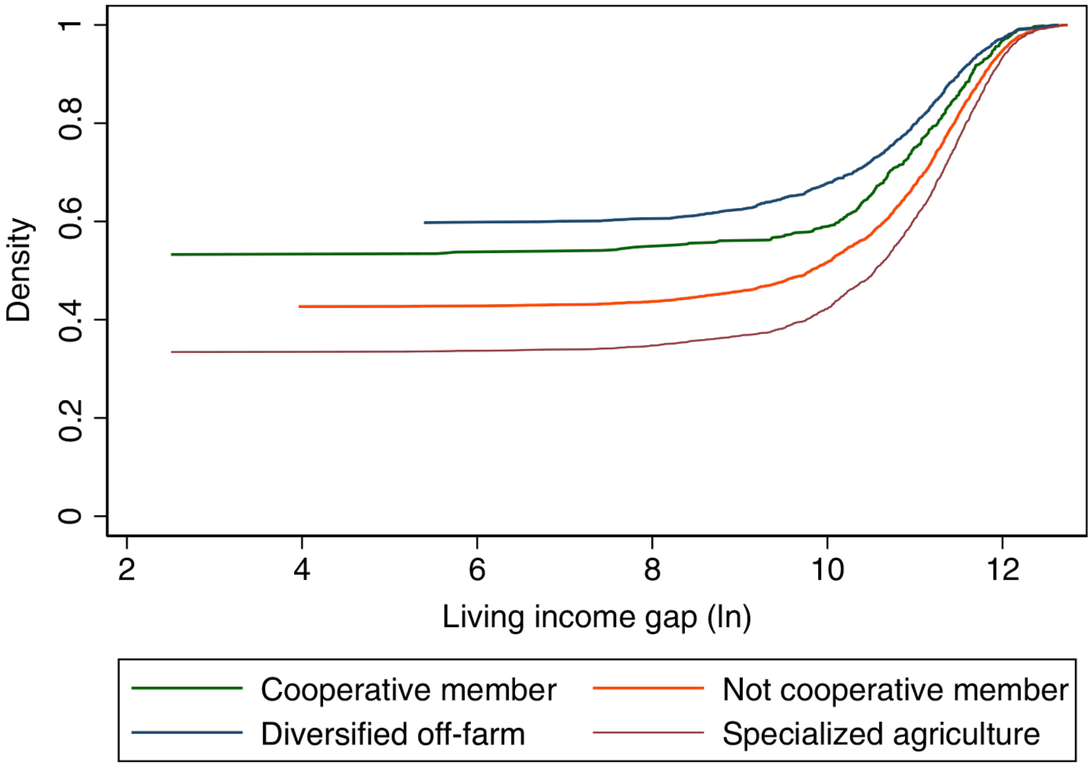
Source: Authors' own elaboration.

Figure A8. Cumulative distribution, by household adult gender structure



Source: Authors' own elaboration.

Figure A9. Cumulative distribution, by income diversification and cooperative membership



Source: Authors' own elaboration.

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