WIDER Working Paper 2024/88

Raindrop in the drought? Vulnerability to climate shocks and the role of social protection in Zambia

Katrin Gasior,[1] Pia Rattenhuber,[2] Adnan Shahir,[2,3] and Anna Zasova[2]

December 2024

Abstract: Zambia's reliance on rain-fed agriculture makes its economy and population highly vulnerable to frequent droughts and irregular rainfall. This paper assesses the role of social protection, specifically the Social Cash Transfer (SCT) program, in mitigating drought-induced poverty and consumption declines. Using the MicroZAMOD microsimulation model and district-level rainfall data, we find that rainfall shocks significantly increase poverty and reduce household consumption, disproportionately affecting the poorest households. While the current SCT program provides some relief, reforms to eligibility criteria, particularly removing the household composition requirement, could improve targeting, expand coverage, and strengthen resilience against climate-related economic shocks.

Key words: Zambia, tax-benefit microsimulation, social protection, climate change

JEL classification: H84, I38, Q54

Acknowledgements: This work is funded by the project 'From Safety Net to Social Insurance: Strengthening Social Protection in Complex Humanitarian Settings', financed by the Ministry for Foreign Affairs of Finland. We are grateful to Olivier Bargain, André Decoster, Michal Myck, Rodrigo Oliveira, and participants of the EUROMOD Research Workshop 2024 and the UNU-WIDER seminar for their valuable feedback and comments. The results presented here are based on SOUTHMOD A2.0. The models are developed, maintained, and managed by UNU-WIDER in collaboration with the EUROMOD team at the Joint Research Centre (JRC) of the European Commission, SASPRI (Southern African Social Policy Research Insights), International Inequalities Institute at London School of Economics and Political Science, and local partners in selected developing countries. Originally maintained, developed, and managed by the Institute for Social and Economic Research (ISER), since 2021 the EUROMOD software has been maintained, developed, and managed by the JRC of the European Commission in collaboration with EUROSTAT and national teams from European Union countries. We are indebted to the many people who have contributed to the development of SOUTHMOD and EUROMOD. Any errors are our own.

[1] Southern African Social Policy Research Insights, Hove, UK; [2] UNU-WIDER, Helsinki, Finland; [3] University of Bologna, Bologna, Italy; corresponding author: Anna Zasova, anna.zasova@wider.unu.edu

This study has been prepared within the UNU-WIDER project Strengthening safety nets in post-conflict and humanitarian contexts, funded by the Ministry for Foreign Affairs of Finland. The project is part the research area From conflict to cohesion – pathways for peace and inclusive statebuilding.

Information and requests: publications@wider.unu.edu

ISSN 1798-7237 ISBN 978-92-9267-553-0

https://doi.org/10.35188/UNU-WIDER/2024/553-0

Typescript prepared by Mary Boss.

United Nations University World Institute for Development Economics Research provides economic analysis and policy advice with the aim of promoting sustainable and equitable development. The Institute began operations in 1985 in Helsinki, Finland, as the first research and training centre of the United Nations University. Today it is a unique blend of think tank, research institute, and UN agency—providing a range of services from policy advice to governments as well as freely available original research.

The Institute is funded through income from an endowment fund with additional contributions to its work programme from Finland and Sweden, as well as earmarked contributions for specific projects from a variety of donors.

Katajanokanlaituri 6 B, 00160 Helsinki, Finland

1 Introduction

Zambia's economy and population face substantial threats from frequent droughts and irregular rainfall. These events disrupt agricultural productivity and increase food insecurity (Ngoma et al. 2023). The country's reliance on rain-fed agriculture and subsistence farming makes it particularly vulnerable to climate variability, with the poorest households bearing most of the burden of these environmental shocks (Arslan et al. 2015). In this context, humanitarian social protection programs and their capacity for shock responsiveness play a critical role in mitigating consumption shocks and building resilience to future climate-related risks (Asfaw et al. 2017; Hallegatte and Rozenberg 2017).

Rain-fed agriculture depends entirely on natural rainfall, making crop yields highly sensitive to seasonal patterns. In Zambia, where this practice predominates (Ngoma et al. 2019), even small deviations in rainfall can result in substantial crop failures. For subsistence farmers, who primarily grow crops for their own consumption, these disruptions pose a direct threat to food security. Without access to irrigation infrastructure, shock-responsive social protection becomes a critical tool for mitigating the economic hardships caused by climate shocks (Bowen et al. 2020), though evidence on their effectiveness remains scarce.

This paper examines the role of social protection benefits in Zambia in mitigating the adverse effects of droughts on poverty and household consumption. We use the tax-benefit microsimulation model MicroZAMOD together with its underlying 2015 LCMS household budget survey and combine it with administrative district-level rainfall data to conduct our analysis in three main steps. First, we estimate the distributional impact of droughts under two rainfall shock scenarios to understand the extent of economic hardship caused by rainfall variability. Second, we assess the capacity of existing social assistance programs, particularly the Social Cash Transfer (SCT) program, to buffer affected households against the economic challenges posed by climate-induced shocks. Finally, we construct and evaluate several SCT reform scenarios to explore ways of enhancing the program's responsiveness as a social protection measure.

Our main findings indicate that rainfall shocks significantly increase poverty and reduce household consumption, with poorer households being disproportionately affected. In the lowest deciles, consumption declines by up to 40% vis-à-vis a no-climate shock scenario, while the poverty rate increases by as much as 20 percentage points among rural households. We also show that the existing SCT program provides notable, though limited, relief due to the restrictive household composition-based eligibility criteria. Without the SCT, the reduction in consumption during droughts would be even more severe, reaching up to 55% in the bottom deciles. The simulated reforms to SCT test alternative eligibility rules, showing that removing the household composition criterion expands benefit coverage to a wider range of affected households. This preserves effective targeting, achieving outcomes that closely approximate the automatic response benchmark, where eligibility is directly linked to reductions in consumption levels.

Our main contribution to the literature is examining the intersection of climate shocks and social protection in a developing country, focusing on the role of shock-responsive cash transfers. Existing evidence on social protection schemes in Africa suggests that these programs generally have a positive impact, improving child nutrition, health, and education outcomes while reducing extreme poverty (Baird et al. 2014; Gilligan et al. 2009). However, evidence on the effectiveness of cash transfers provided in response to disasters is much more limited (Hill et al. 2024) and remains mixed. For instance, Asfaw et al. (2017) document a positive effect of social assistance in three districts of Zambia, showing enhanced resilience to weather shocks. Similarly, Maffioli et al. (2023) and Osabohien et al. (2024) demonstrate the mitigating role of social protection in addressing COVID-19-related shocks in Myanmar and Nigeria, respectively. On the other hand, recent evidence from tax-benefit microsimulation models in selected developing countries suggests that while these systems reduce poverty under normal circumstances, their ability to cushion households during crises is minimal (Lastunen et al. 2023; Shahir et al. 2023; Gasior et al. 2024, 2022).

Another key contribution of this paper is the novel approach that evaluates the distributional and poverty effects of climate shocks and social protection by accounting for geographical variations and household-specific circumstances. Previous studies, such as Dang et al. (2023) and Ngoma et al. (2019), emphasize the importance of incorporating regional and household-level variations in analysing the effects of climate shocks on poverty and inequality. Using MicroZAMOD, we are able to comprehensively model the poverty and inequality impacts of climate shocks and simulate very specific reforms to the existing SCT program at a highly granular level. We contribute to the literature by offering a nuanced understanding of how social protection systems can mitigate climate-induced economic hardships while addressing inequality and poverty.

The rest of the paper is structured as follows. Section 2 provides a country profile of Zambia and focuses on historical rainfall patterns, which is the starting point for the empirical analysis as well as Zambia's social protection system. Section 3 introduces the methodological approach and data. The empirical analysis (Section 4) presents the poverty and consumption effects of the rainfall shock, the role of the current SCT, and the additional effects of SCT reforms. Section 5 concludes.

2 Zambia's rainfall patterns and social protection system

Zambia is classified as a lower middle-income country with a high level of extreme poverty by the World Bank. According to the 2022 Labor Force Survey (Republic of Zambia and Zambia Statistics Agency 2023), 36% of the working age population is part of the labour force and agriculture is the second-most important sector. Working life is characterized by high informal employment, and this is especially the case in the agricultural sector with an informality rate of 90%.

This has important implications for support through the social protection system. Informal sector employees typically do not have access to social insurance benefits as they do not pay social insurance contributions. Instead, social assistance (Social Cash Transfer) and agricultural benefits for small-scale farmers (Food Security Pack and the Electronic Farmer Input Support Programme) play a more pronounced role (Kalikeka et al. 2024). Other programs such as the Home-grown School Feeding program and top-up programs to SCT are not rolled out to all districts in the country.

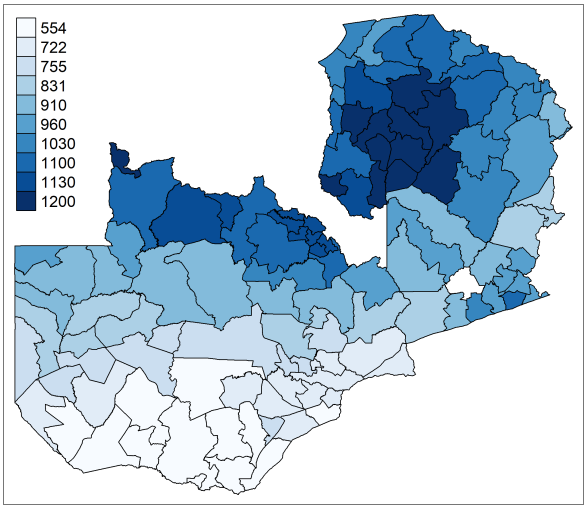
The SCT is the primary social protection instrument utilized by the Zambian government to support low-income households. Under the current policy framework, eligibility for SCT is assessed through two proxy-means tests. First, the **household composition test** targets female-headed households with three or more children, households with disabled or elderly members, and child-headed households. Second, households need to pass the **living condition test**, which assesses the housing situation (type of dwelling, toilet, floor, and energy sources as well as asset ownership) and the highest level of education in the household. The benefit amount is set at ZMW200 per household per month, independent of the size of the household. Individuals with a disability receive an additional amount of ZMW200 per month.

A large share of farming refers to rain-fed agriculture, and this is particularly the case among rural households engaged in subsistence farming (Arslan et al. 2015). Reliance on own-produced food is very high and even more so in poorer households and households in rural areas (see Figure A1 and Appendix Table A1). Thus, constant rainfall patterns are crucial for many households in Zambia.

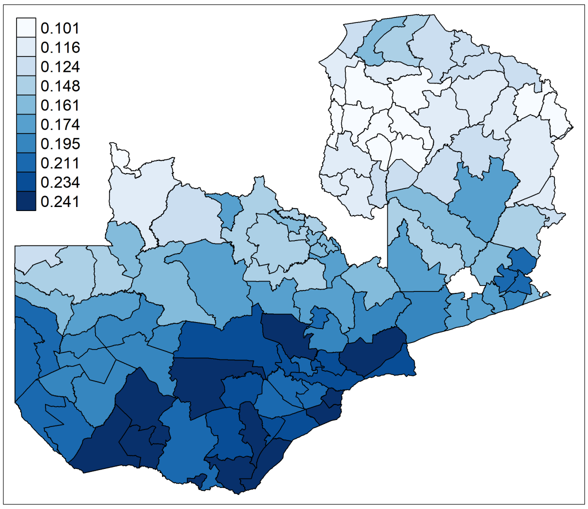
Northern regions of Zambia historically received more rainfall during the growing seasons, with precipitation levels decreasing towards the south (see Figure 1a). Rainfall in the southern and eastern regions is also less stable compared to the north (Figure 1b), making these areas historically more vulnerable to climate shocks.[1]

[1] We calculate the historical average using rainfall data from 1981 to 2009, intentionally excluding more recent years to avoid incorporating recent decreases in rainfall. Including these years would otherwise lower the historical averages and potentially distort our analysis of deviations.

Figure 1: Historical average rainfall during the growing season (mm) and its coefficient of variation, 1981–2009



(a) Average accumulated rainfall during the growing season in 1981-2009, mm

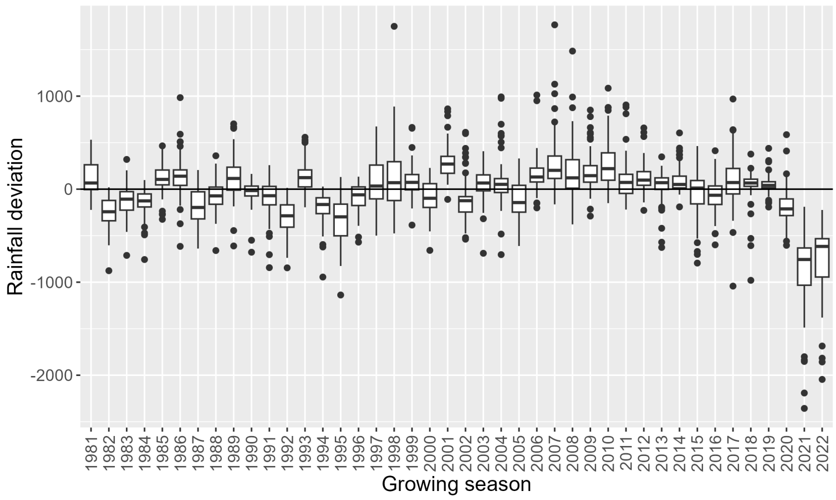


(b) Coefficient of variation of average accumulated rainfall during the growing season in 1981-2009

Note: legend shows lower bounds of depicted rainfall or coefficient of variation intervals.
Source: authors' illustration based on data from the Global Precipitation Climatology Centre of NOAA (Schneider et al. 2022).

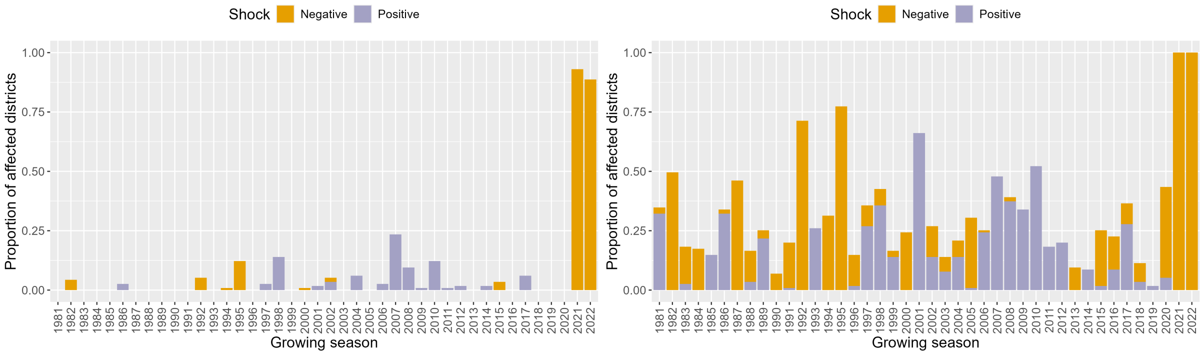
Rainfall instabilities have significantly increased during the last years and represent the main climate shock affecting Zambia in recent years (Ngoma et al. 2023). Figure 2 illustrates the rainfall deviation from the historic average shown in the maps above, highlighting lower rainfall across districts in recent years. In a similar vein, Figure 3 shows the share of districts affected by positive and negative rainfall shocks over the years. Rainfall shocks are defined as cases where actual rainfall falls outside either the ± 2 (left-hand panel) or ± 1 (right-hand panel) standard deviation interval from the historical mean, calculated at the district level. The figure shows that the share of districts affected by positive rainfall shocks has been gradually declining in recent years. In contrast, the proportion of districts experiencing negative rainfall shocks has sharply increased. Specifically, in 2021 and 2022, approximately 90% of all districts experienced negative rainfall shocks when defined by the ± 2 standard deviation threshold, and all districts were affected when using the ± 1 standard deviation threshold.

Figure 2: Rainfall deviation from the historical average at the district level



Source: authors' illustration based on data from the Global Precipitation Climatology Centre of NOAA (Schneider et al. 2022).

Figure 3: Proportion of districts affected by positive and negative rainfall shocks



(a) Shocks defined outside $\pm 2SD$

(b) Shocks defined outside $\pm 1SD$

Source: authors' illustration based on data from the Global Precipitation Climatology Centre of NOAA (Schneider et al. 2022).

Even though district-level data of monthly rainfall is only available until 2022, current events highlight the continuation of this trend. In 2024, Zambia is faced with a severe drought, leading to an increase in famine due to severe food shortages and water scarcity, and has declared a national emergency (Africanews 2024). This highlights the urgency to develop a plan for adaptive social protection that supports households to cope with climate-change-related shocks.

The SCT is particularly relevant to this analysis, as the Zambian government has currently implemented a drought emergency assistance initiative through a modified SCT following the emergency situation. Specifically, the government doubles the benefit amount for existing SCT recipients and nearly doubles the number of beneficiaries by extending this increased support to new recipients in 84 drought-affected districts. A similar approach has been taken during the COVID-19 pandemic where the COVID-19 Emergency Cash Transfer reduced the adverse effect on poverty (Kalikeka et al. 2021).

Unfortunately, detailed information on how this vertical expansion to new recipients is achieved during times of crisis is not available. The current system prior to expansion due to shocks is known to have significant gaps in targeting the extremely poor (Gasior et al. 2021; Kampamba et al. 2019) and does not respond to shocks in the household (Gasior et al. 2022), i.e. coverage is not automatically adjusted to higher needs in drought-hit districts. Thus, modelling the impact of the SCT under current policy parameters, along with simulating potential reforms, provides an appropriate approach to stress-test (Atkinson 2009) the capacity of Zambia's social assistance system in responding to climate-related crises.

3 Methodology and data

The analysis proceeds in four key steps. First, we utilize historical rainfall data to identify past rainfall shocks and construct two future shock scenarios. Second, we map these shocks to changes in household consumption and income in the 2015 Living Conditions Monitoring Survey (LCMS), which underpins the tax-benefit microsimulation model MicroZAMOD. MicroZAMOD is part of the SOUTHMOD models for developing countries (Decoster et al. 2019) and runs on the EUROMOD platform (Sutherland and Figari 2013). It simulates cash and quasi-cash in-kind benefits, direct and indirect taxes, and social insurance contributions based on market incomes and personal characteristics included in the input dataset. Third, we apply the MicroZAMOD model to the shocked dataset to assess the effectiveness of the current social transfer system in mitigating the impacts of rainfall shocks. Finally, we simulate several benefit reform scenarios using the MicroZAMOD model to evaluate the system's capacity to address and alleviate the adverse effects of these shocks.

The main outcome measures of the analysis are relative changes in equivalized household consumption as well as changes in poverty rate and gap. Consumption is adjusted using the national calorie-based equivalence scale. Poverty estimates are based on Zambia's national severe poverty line.[2]

3.1 Identification of rainfall shocks

Rainfall shocks are defined following Asfaw et al. (2017), where a negative rainfall shock is considered to occur when district-specific rainfall levels fall below two standard deviations from its historical average during the crop growing season.

Drawing on the shocks observed over the previous decade, we construct two scenarios to model potential future shocks:

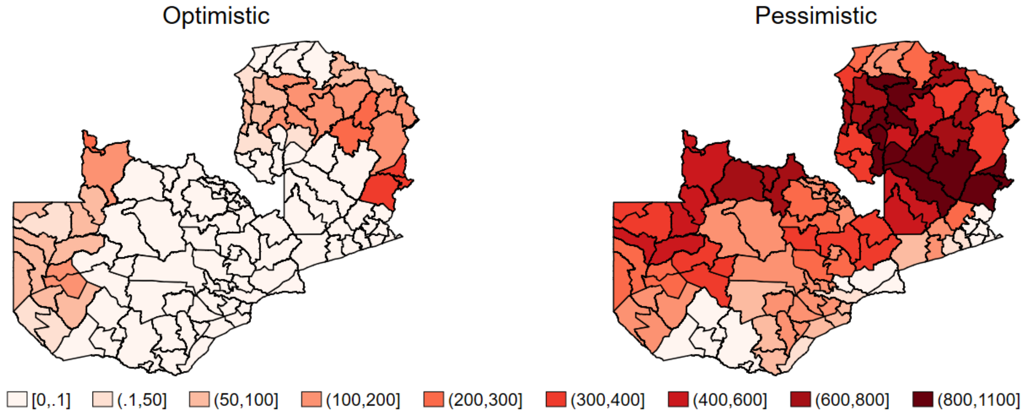
- The **optimistic scenario** captured the rainfall shocks observed over the past decade. We use the district-specific average rainfall shocks in the years 2015 and 2022. We select 2015 as it received relatively adequate rainfall compared to recent years, though several districts still experienced negative rainfall shocks (see Figure 3). The year 2022 is included as it represents the most recent data point available in our dataset. The average of the two years provides a more optimistic scenario than developments in recent years.

[2] The national poverty line is set at ZMW336.73 per month, which is comparable to World Bank's international extreme poverty line of US$2 per day.

- The **pessimistic scenario** assumes rainfall levels equivalent to those in 2022, the most recent year in our dataset. The year 2022 was an exceptionally dry year, with approximately 90% of districts affected by rainfall shocks, and reflects better the situation in more recent years with stark increases in negative rainfall shocks.

Figure 4 depicts the districts impacted by negative rainfall shocks under each scenario, measured in millimetres of rainfall deficit during the growing season. In the optimistic scenario, negative rainfall shocks are concentrated in districts within the Western, North-Western, Northern, and Muchinga provinces. Under the pessimistic scenario, the majority of districts experience negative rainfall shocks, with exceptions limited to districts in the Southern, Lusaka, and Eastern provinces.

Figure 4: Size of negative rainfall shocks under optimistic and pessimistic scenarios



Note: the figures show the size of rainfall shocks, measured in millimetres of deficit rainfall during the growing season.
Source: authors' illustration.

3.2 Implementing rainfall shocks in MicroZAMOD

To implement these shocks in the model, we follow Asfaw et al. (2017), adopting the same definition of shocks, and use their elasticity estimates. Specifically, we use two estimates: a 1 mm negative deviation in rainfall reduces household food consumption by 3.8–4.0% and non-food consumption by 3.0%. We apply these estimates to shock four variables in the MicroZAMOD dataset: household non-food consumption, consumption of purchased food, consumption of own produce, and income from agriculture. For the latter, since we do not have an external elasticity estimate, we use the estimated elasticity for food consumption from Asfaw et al. (2017).

We also conduct a sensitivity analysis by exploring alternative methods for implementing the shocks in the model (see Table B1 in the Appendix for the alternative scenarios). First, we assess the sensitivity of the results to different shocked model variables by implementing two scenarios where not all model variables are shocked. Second, given the greater severity of our identified rainfall shocks compared to those in Asfaw et al. (2017), we apply an upper bound of 30% on the effect size in these sensitivity scenarios.

Asfaw et al. (2017) estimate rainfall shocks at the ward level, whereas our analysis is conducted at the district level, which is the most granular regional unit available in the underlying LCMS input dataset.

The district-level deviations in our dataset are measured in absolute terms (in millimetres) and, thus, need to be rescaled to the ward level. Specifically, we calculate the rescale factor by dividing the number of districts in the input dataset (76) by the total number of wards in Zambia (1,624), resulting in a rescale factor of 0.047. This factor is then applied to the identified rainfall shocks prior to incorporating them into the model dataset.

Note that the elasticities used are not differentiated by household type or income level. However, we implicitly model a greater reduction in consumption for poorer households, as their consumption relies more on their own produce and contains fewer non-food items (see Figure A1 in the Appendix). In the model, the shock to household agricultural income translates directly into an equivalent reduction in consumption, assuming a marginal propensity to consume of 1. This mechanism also ensures that poorer households are more affected, as the proportion of households receiving income from agriculture is higher in the lower consumption deciles (see Table A4 in the Appendix).

3.3 Simulating the impact of rainfall shocks and the role of social protection in MicroZAMOD

We simulate the effects of rainfall shocks and benefit policies for the year 2022. This year was selected based on the availability of climate data, as it is the most recent year for which we have information on rainfall patterns. Additionally, the rainfall shortage modelled under the pessimistic climate scenario corresponds to the actual rainfall levels observed in 2022, making it a suitable reference point for our analysis. Table 1 provides an overview of the simulated scenarios.

We begin by simulating the **impact of rainfall shocks** on consumption and poverty with benefit rules in place in 2022. First, we generate a baseline scenario by running the MicroZAMOD policy for the year 2022 using the actual, non-shocked input data. Second, we create alternative scenarios under optimistic and pessimistic climate conditions by running the MicroZAMOD policy on datasets where income from agriculture and household consumption are adjusted according to the shocks. The impact of the rainfall shock on consumption and poverty is then derived by comparing the outcome of the baseline scenario with the outcome of the rainfall shock scenarios.

Table 1: Overview of simulated scenarios

Scenario name	Rainfall scenario	SCT eligibility and amount	Comparison to baseline measures
Baseline, without rainfall shock	No change	No change	-
Optimistic rainfall scenario	Optimistic change	No change	Impact of rainfall shock
Pessimistic rainfall scenario	Pessimistic change	No change	Impact of rainfall shock
No SCT scenario	Pessimistic change	Abolished SCT	Impact of rainfall shock without SCT
Automatic response	Pessimistic change	Consumption test for shocked districts	Impact of rainfall shock after SCT reform
Automatic response + amount	Pessimistic change	Consumption test and amount doubled for shocked districts	Impact of rainfall shock after SCT reform
Excl. living condition test	Pessimistic change	Household composition test only for shocked districts	Impact of rainfall shock after SCT reform
Excl. living condition test + amount	Pessimistic change	Household composition test only and amount doubled for shocked districts	Impact of rainfall shock after SCT reform
Excl. household composition test	Pessimistic change	Living condition test only for shocked districts	Impact of rainfall shock after SCT reform
Excl. household composition test + amount	Pessimistic change	Living condition test only and amount doubled for shocked districts	Impact of rainfall shock after SCT reform

Source: authors' compilation.

In the next step, we assess the **impact of the SCT under the current policy framework**. We do this by comparing the simulated pessimistic rainfall scenario against a pessimistic rainfall scenario where SCT is abolished ('No SCT scenario'). The difference between these two scenarios shows the extent to which the existing program mitigates the adverse effects of the climate shock.

Finally, we **simulate benefit reform scenarios aimed at enhancing the responsiveness of the SCT to negative shocks**. We model three different reforms where we alter the eligibility criteria of the program. Each reform is furthermore modelled with and without an increase in the benefit amount. A comparison of these scenarios allows assessment of the role of benefit coverage and the size of the benefit. A comparison to the pessimistic rainfall scenario without SCT reform shows how the social protection system can be improved to a more shock-responsive system that mitigates the impacts of rainfall shocks. It furthermore shows the SCT's potential as a tool for providing targeted assistance to the most vulnerable populations.

The first hypothetical SCT reform is designed to ensure perfect targeting of social assistance to those most affected by rainfall shocks, serving as a benchmark for analysing potential SCT reforms. We refer to this scenario as **Automatic Response**, with 'automatic' indicating that eligibility for the benefit is determined by reduced consumption levels, thereby automatically targeting those most impacted. In drought-affected districts, both the household composition and the living condition test are removed as eligibility criteria. Instead, households in shock-affected districts qualify for SCT if their consumption level falls below a specified threshold, set at approximately the 90th consumption decile of current SCT recipients.[3] Although real-time changes in consumption are challenging to track in practice, this scenario serves as a theoretical benchmark for assessing the SCT program's stress-mitigating potential.

We then simulate two hypothetical SCT reforms that are closer to the existing eligibility rules. In the first scenario, which we label **Exclusion of Living Conditions Test**, we simulate the existing SCT rules with one modification: in drought-affected districts, the living condition test is removed, and benefits are allocated solely based on the household composition test. In the second reform scenario, labelled **Exclusion of Household Composition Test**, we keep the living condition test but remove the household composition criterion when modelling SCT eligibility in drought-affected districts.

All SCT-specific scenarios are calculated on top of the pessimistic rainfall scenario. The pessimistic scenario has been selected as it is the more likely scenario given the situation in 2024.

In the following sections, we present our results, decomposing the overall reform impact into the effect of relaxed eligibility and the combined effect of modified eligibility rules and increased benefit amounts.

4 Results

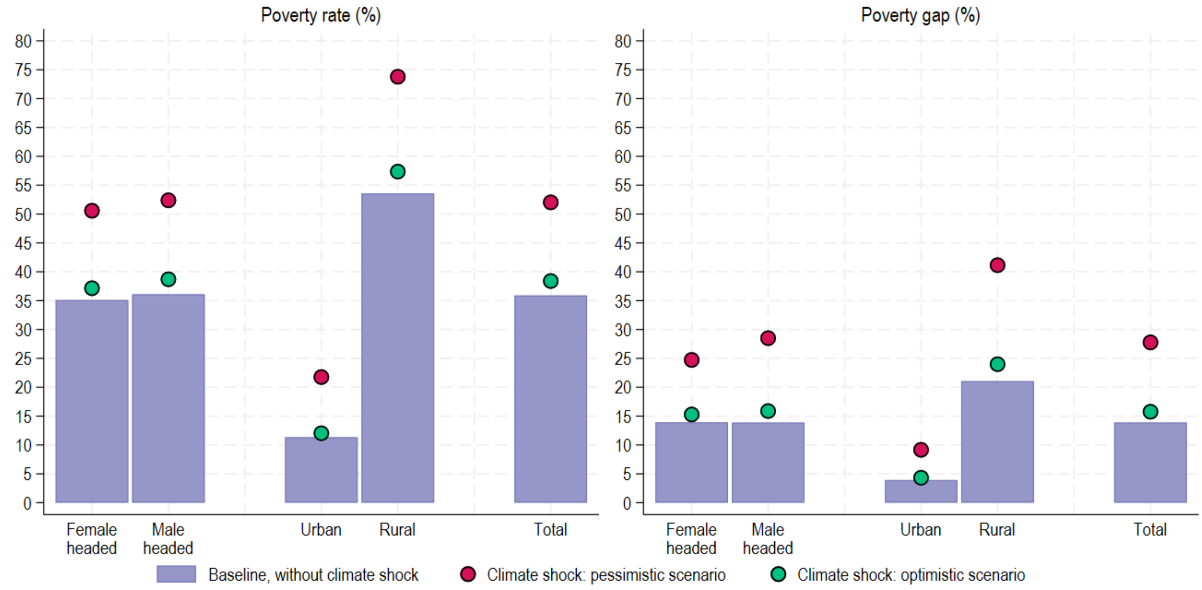
4.1 Impact of rainfall shocks on consumption and poverty

The first part of the empirical analysis focuses on the impact of rainfall shocks on poverty and consumption under the current SCT program. As outlined in the previous section, two rainfall shock scenarios—optimistic and pessimistic—are simulated.

Figure 5 illustrates the impact of rainfall shocks on poverty rate and gap across different household types. Overall, the rainfall shocks are estimated to increase the poverty rate by up to 15 percentage points and the poverty gap by approximately 10 percentage points under the pessimistic scenario. The effects are particularly pronounced in rural areas, i.e. areas that are already in a more severe situation in the baseline. This heightened impact results from the direct shocks to agricultural income in the model, as well as the greater vulnerability of poorer households, who allocate a larger proportion of their consumption to food.

[3] ZMW3,687.25 per month in rural areas and ZMW3,982.23 in urban areas to account for higher living costs.

Figure 5: Poverty rate and gap under pessimistic and optimistic rainfall scenario

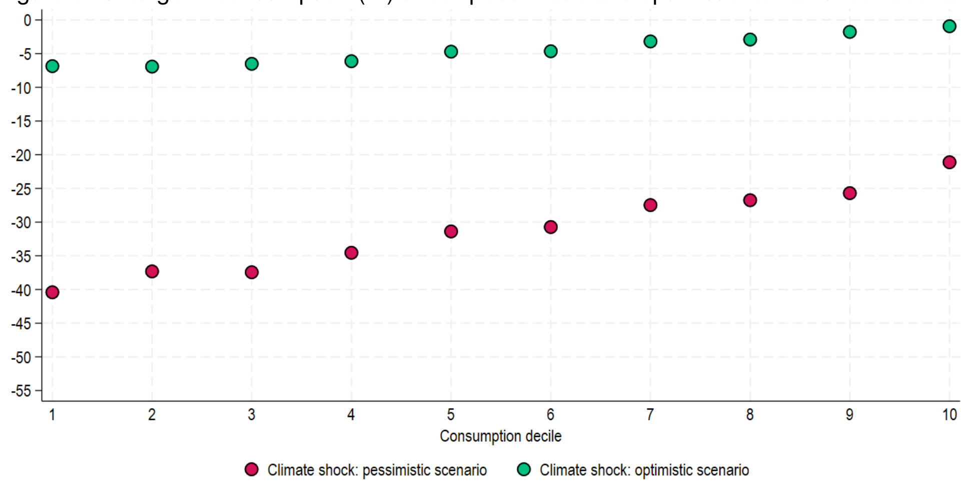


Note: the figure presents rainfall shock effects under the main rainfall shock scenario (see Table 1 for description). Results for the sensitivity scenarios are available in Appendix Figure B1.

Source: authors' illustration.

The stronger impact on poorer households is clearly illustrated in Figure 6. It demonstrates that the shocks have a regressive effect, with consumption in the lowest deciles being more strongly affected. This is especially the case for the main scenario, while effects are smaller and slightly less regressive in the sensitivity scenarios that apply restrictions to the loss in consumption (see Appendix Figure B2).

Figure 6: Change in consumption (%) under pessimistic and optimistic rainfall shock scenario

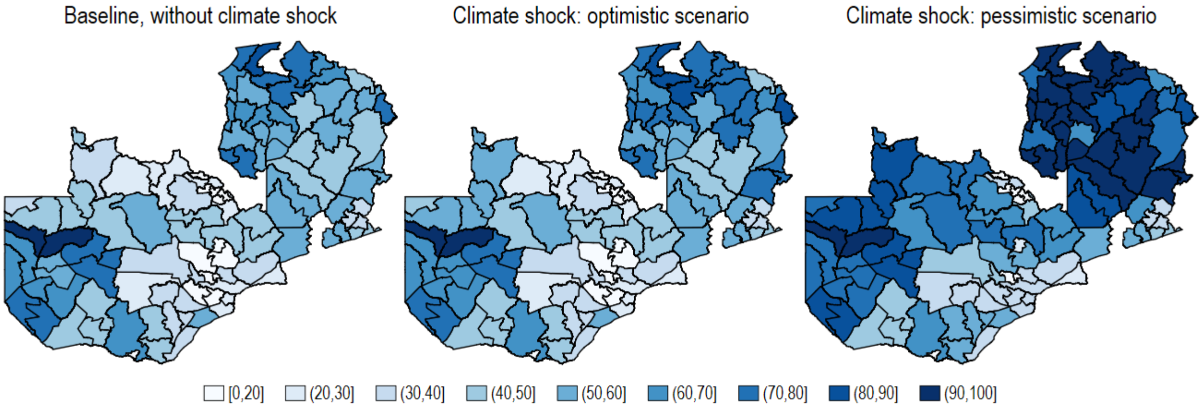


Note: the figure presents rainfall shock effects under the main rainfall shock scenario (see Table 1 for description). Results for the sensitivity scenarios are available in Appendix Figure B2.

Source: authors' illustration.

The regressive nature of the impact is further illustrated in Figure 7. The map on the left shows poverty rates in the absence of rainfall shocks (i.e. baseline results), highlighting that districts in the Western and Northern provinces tend to have higher baseline poverty levels. The simulated shocks disproportionately impact these districts (see Figure 4), thereby exacerbating poverty in these already vulnerable regions.

Figure 7: Poverty rates (%) by regions under pessimistic and optimistic rainfall scenarios



Note: the figure presents rainfall shock effects under the main rainfall shock scenario (see Table 1 for description). Results for the sensitivity scenarios are available in Appendix Figure B3.
Source: authors' illustration.

4.2 The social protection role of the current SCT

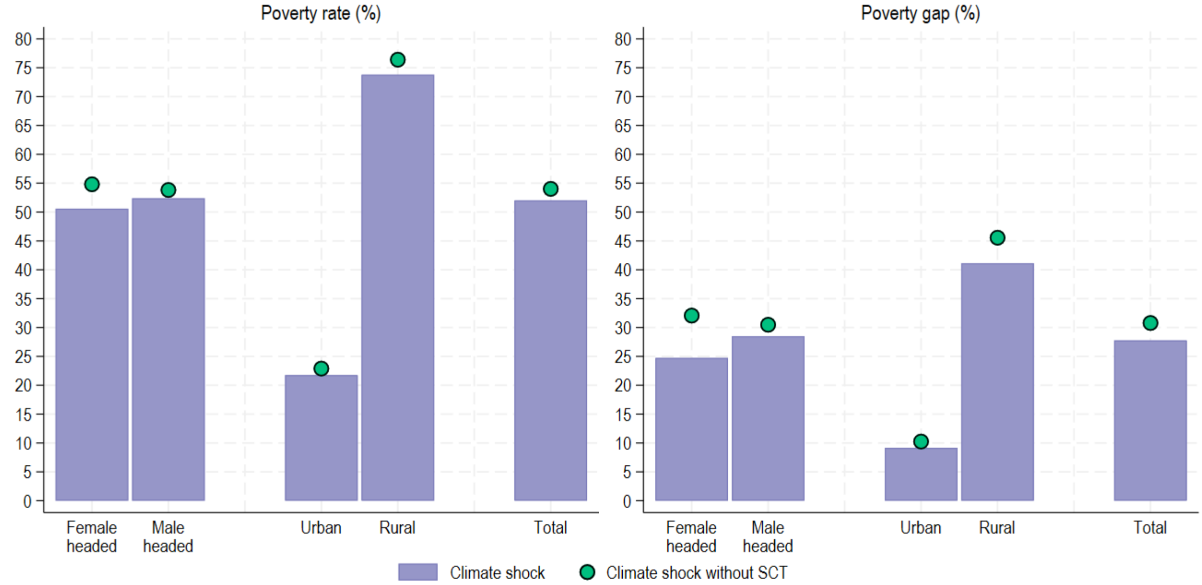
In this section, we focus on the role of the existing SCT in cushioning the adverse effect of a rainfall shock. We compare the size of the rainfall shock with a hypothetical scenario where households do not receive the benefit. The difference in the impact of the shock between the baseline scenario and this 'no SCT' scenario highlights the effectiveness of the benefit in mediating a shock. Results are presented for the pessimistic rainfall scenario. Additional results for the sensitivity scenarios are provided in the Appendix, enabling a more comprehensive assessment of the SCT's impact across various model assumptions.

Our findings indicate that the SCT program plays a significant role in providing adaptive support to households facing potential negative shocks. Figure 8 illustrates the simulated poverty rate and gap with and without the SCT. The benefit does not only prevent 2% of the population to fall below the poverty line but also prevents the poverty gap to grow by 2 percentage points.

However, the impact of SCT is not uniform across household types, largely due to the household composition test embedded in the program's eligibility requirements that target specific vulnerable groups. Consequently, non-targeted households receive less protective support despite experiencing similar levels of consumption vulnerability. Poverty reductions are particularly pronounced among female-headed households, reflecting SCT's eligibility rule that prioritizes benefits for female-headed households with three or more children. In contrast, the poverty-reducing effect of SCT for male-headed households is relatively modest as they would only be eligible if they live with an elderly or disabled person.

These findings emphasize the differential impact of SCT across household types and underscore the importance of eligibility criteria in shaping the program's effectiveness in addressing poverty among various demographic groups.

Figure 8: Poverty rate and gap under pessimistic climate scenario, with and without Social Cash Transfer

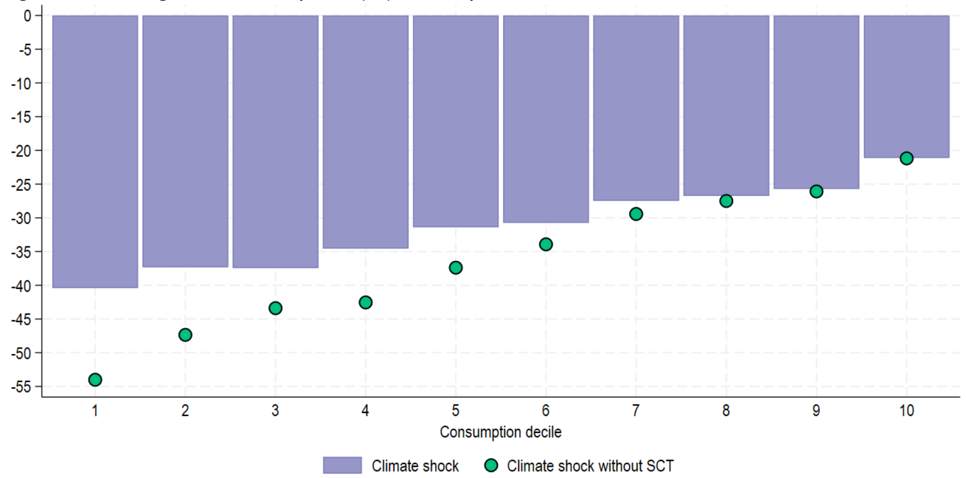


Note: the figure presents rainfall shock effects under the main climate shock scenario (see Table 1 for description). Results for the sensitivity scenarios are available in Appendix Figure C1.

Source: authors' illustration.

The simulated effect on household consumption with and without SCT indicates that, overall, the current system is well-targeted to provide protective support to the poorest population groups (see Figure 9). In the lowest deciles, SCT mitigates the potential negative impact of the rainfall shock by approximately 15 percentage points, and our simulation results suggest that, without SCT, the reduction in consumption in the bottom decile could reach as high as 55%.

Figure 9: Change in consumption (%) under pessimistic climate scenario, with and without Social Cash Transfer



Note: the figure presents rainfall shock effects under the main climate shock scenario (see Table 1 for description). Results for the sensitivity scenarios are available in Appendix Figure C2.

Source: authors' illustration.

4.3 Simulation of Social Cash Transfer reform scenarios

In this section, we examine the impact of reformed SCT on poverty and consumption. We begin by analysing the simulated changes in the number of benefit recipients and government spending on SCT (see Table 2).

Under the **Automatic Stabilizer** (our benchmark) scenario, the number of recipients more than triples, reflecting the effect of removing both eligibility tests (household composition and living condition test) in drought-affected regions and basing eligibility solely on the consumption shocks caused by less rainfall. This results in an increase in government spending of nearly ZMW4 billion annually.

When the benefit amount is doubled in shock-affected districts (**Automatic Stabilizer + Amount**), the increase in spending rises to ZMW9.3 billion. Although substantial, this figure is close to the Zambian government's budget allocation of ZMW8.9 billion for the currently implemented Drought Emergency Cash Transfer program, a one-year initiative. This comparison suggests that our simulated benchmark scenario approximates the resources allocated to the program while achieving efficient targeting of assistance. As such, it serves as a good benchmark for evaluating the effectiveness of the simulated SCT reform scenarios.

The **exclusion of the living conditions test** results in a moderate increase in the number of SCT recipients, with 26.6%. This suggests that the living conditions test is not a binding criterion for most drought-affected households in accessing assistance. Doubling the benefit amount in this scenario (**Excl. Living Conditions Test + Amount**) leads to an increase in government spending of ZMW2.5 billion.

In contrast, the **household composition test** appears to be a major restrictive factor limiting access to SCT. When this test is removed, the number of recipients nearly triples. Combining this reform scenario with an increase in the benefit amount (**Excl. Household Composition Test + Amount**) results in a total increase in spending of ZMW7.7 billion. Therefore, the household composition criterion, while intended to target specific vulnerable groups, significantly limits assistance for households that do not meet its requirements, even when they are similarly impacted by the shock.

Table 2: Change in the number of benefit recipients and government spending after the SCT reforms, compared to baseline

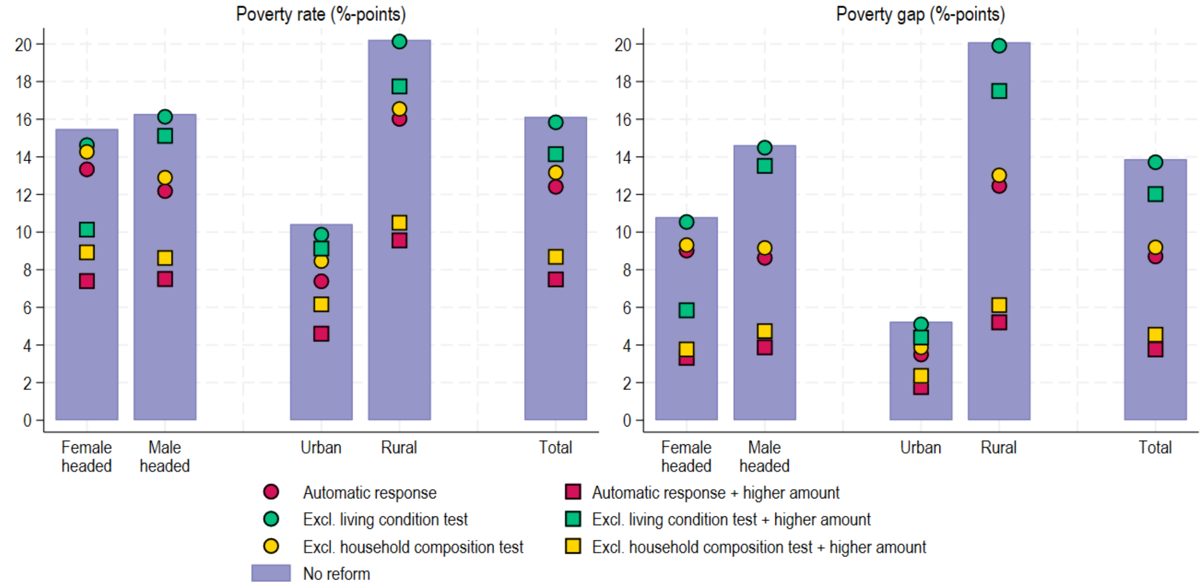
	Change in number of households receiving SCT (% of baseline)	Change in government spending per year (million ZMW)
Automatic stabilizer	+239.5%	+3,957.2
Automatic stabilizer + amount	+239.5%	+9,345.4
Excl. living condition test	+25.6%	+550.4
Excl. living condition test + amount	+25.6%	+2,451.8
Excl. household composition test	+189.8%	+3,093.1
Excl. household composition test + amount	+189.8%	+7,670.8

Source: authors' calculations.

The effectiveness of relaxing the household composition test is further highlighted by the impact of the reforms on both the poverty rate and gap (Figure 10). The circles represent the effect of modified eligibility rules alone, while the squares show the combined impact of reformed eligibility rules and increased benefit amounts. For male-headed households, relaxing the living conditions test provides minimal additional protection against shocks. In contrast, excluding the household composition criterion mitigates an approximate 4-percentage-point increase in the poverty rate and a 6-percentage-point rise in the poverty gap, relative to the no reform scenario (bars).

When the change in eligibility criteria is combined with increased benefit amounts, the reform that removes the household composition criterion prevents an overall increase in the poverty rate and gap by about 8 and 10 percentage points, respectively. This outcome is very close to the results achieved under the Automatic Response reform, indicating effective targeting.

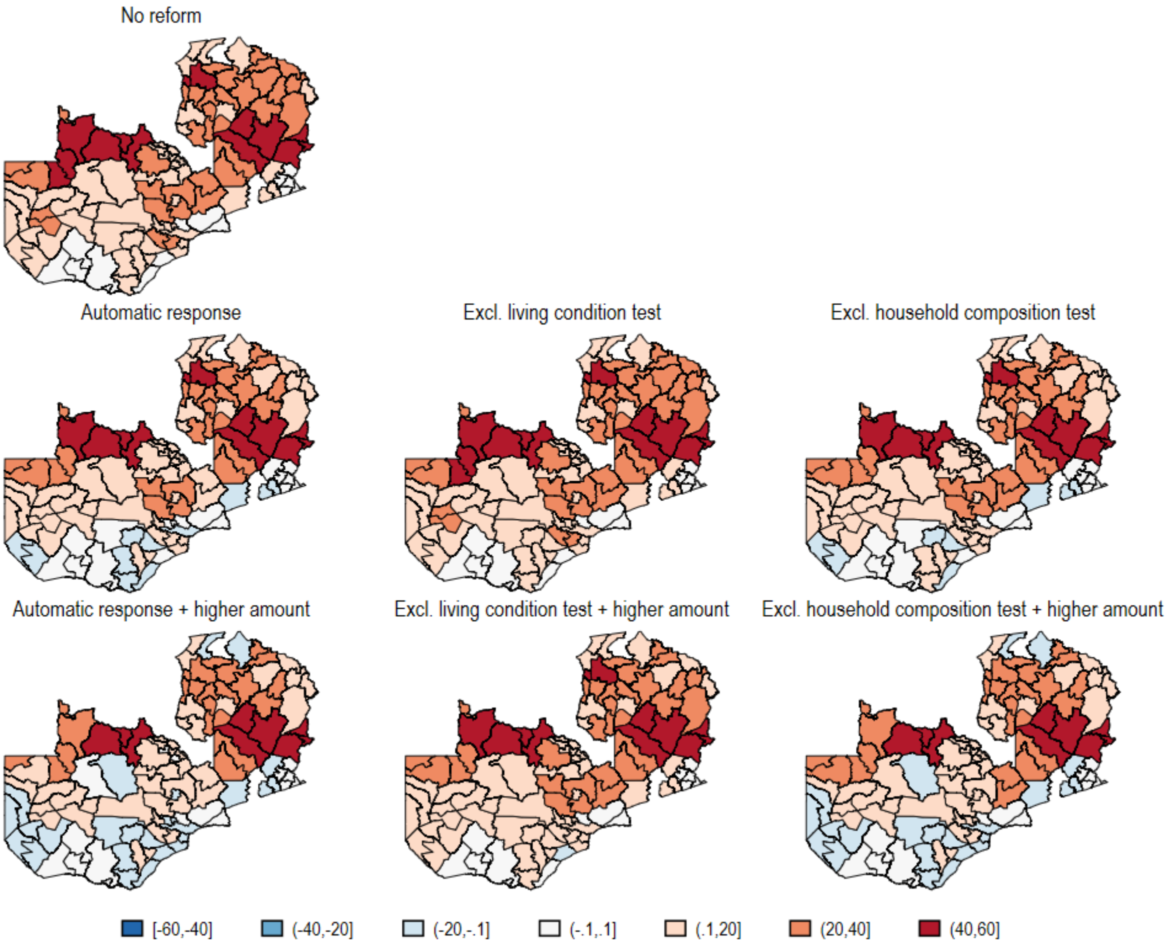
Figure 10: Change in poverty rate and gap compared to baseline under pessimistic climate scenario, with and without Social Cash Transfer reforms



Note: the figure presents rainfall shock effects under the main climate shock scenario (see Table 1 for description). Results for the sensitivity scenarios are available in Appendix Figure D1.
Source: authors' illustration.

Examining the regional effects on poverty (Figure 11), we find that excluding the household composition test (right column in the chart) mitigates the increase in poverty rates in districts across the North-Western, Northern, and Muchinga provinces. In some districts, this exclusion even results in a reduction in the poverty rate compared to the baseline scenario without rainfall shocks. Once again, the poverty impact at the district level achieved by removing the household composition test closely approximates the effect of the benchmark hypothetical reform scenario.

Figure 11: Change in poverty rate compared to baseline by regions under pessimistic climate scenario, with and without Social Cash Transfer reforms

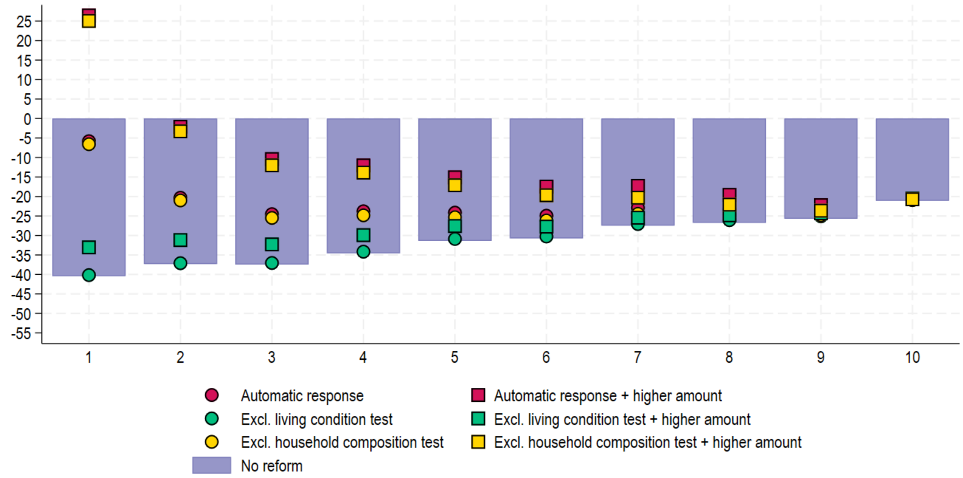


Note: the figure presents rainfall shock effects under the main climate shock scenario (see Table 1 for description). Results for the sensitivity scenarios are available in Appendix Figures D2 to D4.

Source: authors' illustration.

Finally, examining the impact of the reforms on household consumption (see Figure 12), we find that relaxing the living condition test provides minimal additional protection against consumption declines relative to the current SCT rules. In contrast, the reform that relaxes the household composition test delivers a distinctly progressive protective effect: in the lowest consumption decile, the relaxed eligibility rules prevent an almost 35-percentage-point drop in consumption. When combined with increased benefit amounts, this reform results in a 25% increase in consumption for the poorest households compared to the scenario with no rainfall shocks, closely approximating the effect of the benchmark reform scenario.

Figure 12: Change in consumption (%) compared to baseline under pessimistic climate scenario, with and without Social Cash Transfer reforms



Note: the figure presents rainfall shock effects under the main climate shock scenario (see Table 1 for description). Results for the sensitivity scenarios are available in Appendix Figure D5.
Source: authors' illustration.

5 Conclusions

In this paper, we use the MicroZAMOD tax-benefit microsimulation model to examine the effects of droughts on poverty and consumption in Zambia, as well as the role of social protection benefits in mitigating these impacts. Specifically, we simulate the effects of rainfall shocks—the primary climate shock affecting Zambia—on agricultural incomes and consumption overall. Next, we assess the SCT, Zambia's main social assistance benefit, in alleviating consumption declines and poverty increases. Finally, we explore potential SCT reforms to evaluate how the program could act as an adaptive safety net in response to heightened vulnerabilities from climate shocks.

Our findings demonstrate that droughts significantly increase poverty and reduce household consumption, with regressive effects that disproportionately affect poorer households. The existing SCT program provides notable relief but remains limited in scope, as its benefits are concentrated among households meeting composition-based eligibility criteria, such as female-headed households with multiple children.

Reforms to SCT eligibility have the potential to significantly enhance the program's reach and effectiveness. Our findings indicate that the household composition criterion used to determine SCT eligibility restricts the program's reach to households affected by the shock. While this criterion is designed to target specific vulnerable groups, it inherently excludes households that do not meet these requirements, even if they are similarly impacted by the shock.

Key policy implications emerge from this analysis. Removing the household composition criterion expands SCT coverage to a broader range of affected households while maintaining effective targeting, closely mirroring the automatic response benchmark where eligibility is linked directly to consumption losses. Making social protection systems more adaptive and inclusive is critical to addressing the challenges posed by climate variability. Policymakers should prioritize reforms that expand eligibility and increase benefit amounts in disaster-affected regions to ensure social assistance reaches a wider spectrum of vulnerable households.

In this context, the recently implemented Drought Emergency Cash Transfer program, a one-year initiative targeting drought-affected districts, represents a promising step forward. However, to maximize its effectiveness, it is crucial to ensure that eligibility rules within these districts are clearly defined and transparent to households. The benefit also needs to be targeted at a sufficiently broad range of affected households to prevent exclusions of vulnerable groups. Timely and well-targeted assistance is essential to mitigate the adverse effects of droughts and build resilience among the most vulnerable populations.

References

Africanews (2024). *Zambia Declares National Emergency Over Drought.* Available at: https://www.africanews.com/2024/03/01/zambia-declares-national-emergency-over-drought/ (Accessed on January 9, 2025)

Arslan, A., McCarthy, N., Lipper, L., Asfaw, S., Cattaneo, A., and Kokwe, M. (2015). 'Climate Smart Agriculture? Assessing the Adaptation Implications in Zambia'. *Journal of Agricultural Economics*, 66(3): 753–80. https://doi.org/10.1111/1477-9552.12107

Asfaw, S., Carraro, A., Davis, B., Handa, S., and Seidenfeld, D. (2017). 'Cash Transfer Programmes, Weather Shocks and Household Welfare: Evidence From a Randomised Experiment in Zambia'. *Journal of Development Effectiveness*, 9(4): 419–42. https://doi.org/10.1080/19439342.2017.1377751

Atkinson, A. B. (2009). 'Stress-Testing the Welfare State'. In B. Ofstad, O. Bjerkholt, K. Skrede, and A. Hylland (eds), *Rettferd og politik festskrift til hilde bojer* (pp. 31–9). Oslo: Emiliar Forlag.

Baird, S., Ferreira, F. H., Özler, B., and Woolcock, M. (2014). 'Conditional, Unconditional and Everything in Between: A Systematic Review of the Effects of Cash Transfer Programmes on Schooling Outcomes'. *Journal of Development Effectiveness*, 6(1): 1–43. https://doi.org/10.1080/19439342.2014.890362

Bowen, T., Del Ninno, C., Andrews, C., Coll-Black, S., Johnson, K., Kawasoe, Y., Kryeziu, A., Maher, B., and Williams, A. (2020). *Adaptive Social Protection: Building Resilience to Shocks*. Washington, DC: World Bank Publications. https://doi.org/10.1596/978-1-4648-1575-1

Dang, H.-A. H., Cong Nguyen, M., and Trinh, T.-A. (2023). 'Does Hotter Temperature Increase Poverty and Inequality? Global Evidence From Subnational Data Analysis'. Working Paper 104. London: International Inequalities Institute, The London School of Economics and Political Science. https://doi.org/10.1596/1813-9450-10466

Decoster, A., Pirttilä, J., Sutherland, H., and Wright, G. (2019). 'SOUTHMOD: Modelling Tax-Benefit Systems in Developing Countries'. *International Journal of Microsimulation*, 12(1): 1–12. https://doi.org/10.34196/ijm.00192

Gasior, K., Kalikeka, M., McLennan, D., Bwalya, M., Jouste, M., Kalikeka, M., Bwalya, M., and

Jouste, M. (2021). 'Towards Greater Poverty Reduction in Zambia - Simulating Potential Cash Plus Reforms Using MicroZAMOD'. WIDER Working Paper 164. Helsinki: UNU-WIDER. https://doi.org/10.35188/UNU-WIDER/2021/104-4

Gasior, K., Tasseva, I. V., and Wright, G. C. (2022). 'The Effectiveness of Social Protection in Five African Countries Through Normal Times and Times of Crisis'. WIDER Working Paper 2022/174. Helsinki: UNU-WIDER. https://doi.org/10.35188/UNU-WIDER/2022/307-9

Gasior, K., Wright, G., Barnes, H., and Noble, M. (2024). 'Adaptive Social Protection in Indonesia: Stress-Testing the Effect of a Natural Disaster on Poverty and Vulnerability'. *Social Policy & Administration*, 58(3): 505–20. https://doi.org/10.1111/spol.12983

Gilligan, D. O., Hoddinott, J., and Taffesse, A. S. (2009). 'The Impact of Ethiopia's Productive Safety Net Programme and Its Linkages'. *The Journal of Development Studies*, 45(10): 1684–706. https://doi.org/10.1080/00220380902935907

Hallegatte, S., and Rozenberg, J. (2017). 'Climate Change Through a Poverty Lens'. *Nature Climate Change*, 7(4): 250–6. https://doi.org/10.1038/nclimate3253

Hill, R., Nguyen, T., and Doan, M. K. (2024). *Climate and Equity: A Framework to Understand Welfare Impacts and Guide Policy Action.* Washington, DC: World Bank. Available at: https://openknowledge.worldbank.org/entities/publication/c77f6fe0-64f4-46d0-aed8-26bd47651bc4

Kalikeka, M., Bowa, C., Bwalya, M., Gasior, K., and McLennan, D. (2024). *SOUTHMOD Country Report Zambia - MicroZAMOD v2.16.* Helsinki: UNU-WIDER.

Kalikeka, M., Bwalya, M., Adu-ababio, K., Gasior, K., McLennan, D., and Rattenhuber, P. (2021). 'Distributional Effects of the COVID-19 Pandemic in Zambia'. WIDER Policy Brief 2. Helsinki: UNU-WIDER.

Kampamba, R., Pellerano, L., Banda, C., and Musama, O. (2019). 'Financing the Zambia Social Cash Transfer Scale-Up: A Tax Benefit Microsimulation Analysis Based on MicroZAMOD'. WIDER Working Paper 19. Helsinki: UNU-WIDER. https://doi.org/10.35188/UNU-WIDER/2019/653-1

Lastunen, J., Shahir, A., Rattenhuber, P., Adu-Ababio, K., and Oliveira, R. C. (2023). 'Performance of Tax-Benefit Systems Amid COVID-19 Crises in Sub-Saharan Africa: A Comparative Perspective'. WIDER Working Paper 130/2023. Helsinki: UNU-WIDER. https://doi.org/10.35188/UNU-WIDER/2023/438-0

Maffioli, E. M., Headey, D., Lambrecht, I., Oo, T. Z., and Zaw, N. T. (2023). 'A Prepandemic Nutrition-Sensitive Social Protection Program Has Sustained Benefits for Food Security and Diet Diversity in Myanmar During a Severe Economic Crisis'. *The Journal of Nutrition*, 153(4): 1052–62. https://doi.org/10.1016/j.tjnut.2023.02.009

Ngoma, H., Finn, A., and Kabisa, M. (2023). 'Climate Shocks, Vulnerability, Resilience and Livelihoods in Rural Zambia'. *Climate and Development*, 16(6): 490–501. https://doi.org/10.1080/17565529.2023.2246031

Ngoma, H., Mulenga, B. P., Snyder, J., Banda, A., and Chapoto, A. (2019). 'Poverty and Weather Shocks: A Panel Data Analysis of Structural and Stochastic Poverty in Zambia'. Research Paper 154. Lansing: Department of Agricultural, Food and Resource Economics, Michigan State University. Available at: https://ageconsearch.umn.edu/nanna/record/303061/files/RP%2B154.pdf

Osabohien, R. A., Jaaffar, A. H., Ibrahim, J., Usman, O., Igharo, A. E., and Oyekanmi, A. A. (2024). 'Socioeconomic Shocks, Social Protection, and Household Food Security Amidst COVID-19 Pandemic in Africa's Largest Economy'. *Plos One*, 19(1): e0293563. https://doi.org/10.1371/journal.pone.0293563

Republic of Zambia, and Zambia Statistics Agency (2023). *2022 Annual Labour Force Survey Report*. Lusaka: Republic of Zambia. Available at: https://www.zamstats.gov.zm/wp-content/uploads/2023/12/ZM_2022-Labour-Force-Survey-Report_01.09.2023-1.pdf

Schneider, U., Hänsel, S., Finger, P., Rustemeier, E., and Ziese, M. (2022). *GPCC Full Data Monthly Version 2022 at 1.0°: Monthly Land-Surface Precipitation from Rain-Gauges Built on GTS-Based and Historic Data.* Offenbach, Germany: Global Precipitation Climatology Centre (GPCC) at Deutscher Wetterdienst. https://doi.org/10.5676/DWD_GPCC/FD_M_V2022_100

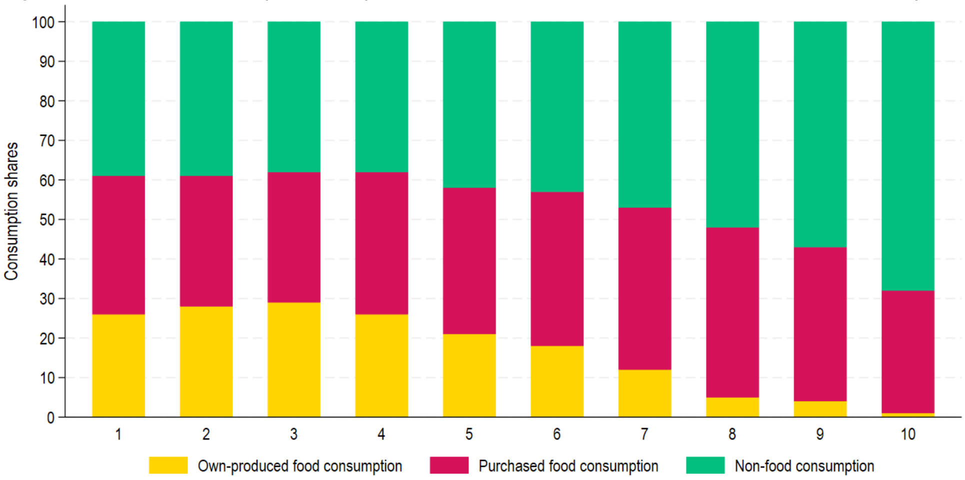
Shahir, A., Kanbur, R., Pirttilä, J., and Rattenhuber, P. (2023). 'Comparing the Poverty-Reduction Efficiency of Targeted Versus Universal Benefits Amid Crises'. WIDER Working Paper 100/2023. Helsinki: UNU-WIDER. https://doi.org/10.35188/UNU-WIDER/2023/408-3

Sutherland, H., and Figari, F. (2013). 'EUROMOD: The European Union Tax-Benefit Microsimulation Model'. *International Journal of Microsimulation*, 1(6): 4–26. https://doi.org/10.34196/ijm.00075

Appendix

A Descriptive graphs and tables

Figure A1: Share of own produce, purchased food, and non-food in household consumption



Source: authors' illustration

Table A1: Share of own produce in consumption, by consumption deciles and types of households

	Total	Female-headed	Male-headed	Urban	Rural
1	26.48	27.27	26.17	7.77	27.59
2	27.5	26.78	27.74	5.01	31.26
3	28.61	29.16	28.47	6.24	32.19
4	25.64	24.51	25.97	4.52	31.16
5	20.9	19.04	21.47	3.21	29.66
6	17.7	17.45	17.77	2.5	28.22
7	12.05	12.88	11.8	1.54	26.52
8	5.37	6.77	4.97	.9	17.1
9	3.7	5.24	3.23	.78	16.15
10	1.17	1.66	1.04	.64	6.14
Total	16.91	17.33	16.79	1.81	28.31

Source: authors' calculations.

Table A2: Share of purchased food in consumption, by consumption deciles and types of households

	Total	Female-headed	Male-headed	Urban	Rural
1	34.94	33.93	35.34	47.76	34.18
2	33.9	35.08	33.52	48.71	31.42
3	33.08	35.68	32.42	49.33	30.47
4	36.35	36.32	36.36	49.23	32.99
5	37.41	38.7	37.01	47.23	32.54
6	38.95	39.89	38.67	46.4	33.8
7	40.8	40.67	40.84	44.71	35.42
8	42.32	43.44	42	43.77	38.51
9	39.57	40.63	39.25	40.06	37.5
10	30.98	32.23	30.65	30.79	32.82
Total	36.83	37.62	36.59	41.65	33.19

Source: authors' calculations.

Table A3: Share of non-food in consumption, by consumption deciles and types of households

	Total	Female-headed	Male-headed	Urban	Rural
1	38.57	38.77	38.49	44.46	38.21
2	38.6	38.14	38.75	46.28	37.31
3	38.32	35.16	39.11	44.43	37.34
4	38	39.17	37.66	46.26	35.85
5	41.69	42.26	41.52	49.55	37.8
6	43.35	42.66	43.56	51.1	37.99
7	47.14	46.44	47.35	53.75	38.05
8	52.32	49.79	53.03	55.34	44.39
9	56.73	54.14	57.52	59.16	46.35
10	67.85	66.1	68.32	68.57	61.04
Total	46.25	45.05	46.62	56.54	38.49

Source: authors' calculations.

Table A4: Share of households receiving income from agriculture, by consumption deciles and types of households

	Total	Female-headed	Male-headed	Urban	Rural
1	68.07	60.43	71.03	41.8	69.64
2	71.61	66.16	73.36	35.6	77.63
3	75.35	70.01	76.7	39.58	81.09
4	71.21	64.33	73.22	24.4	83.43
5	65.09	54.54	68.35	24.62	85.14
6	57.49	51.64	59.26	18.62	84.39
7	42.59	41.55	42.91	14.15	81.72
8	29.65	36.41	27.75	12.74	74.03
9	23.55	21.33	24.24	12.47	70.8
10	14.68	12.06	15.39	11.29	46.57
Total	51.93	48.2	53.06	16.62	78.6

Source: authors' calculations.

B Sensitivity analysis: climate shock effect

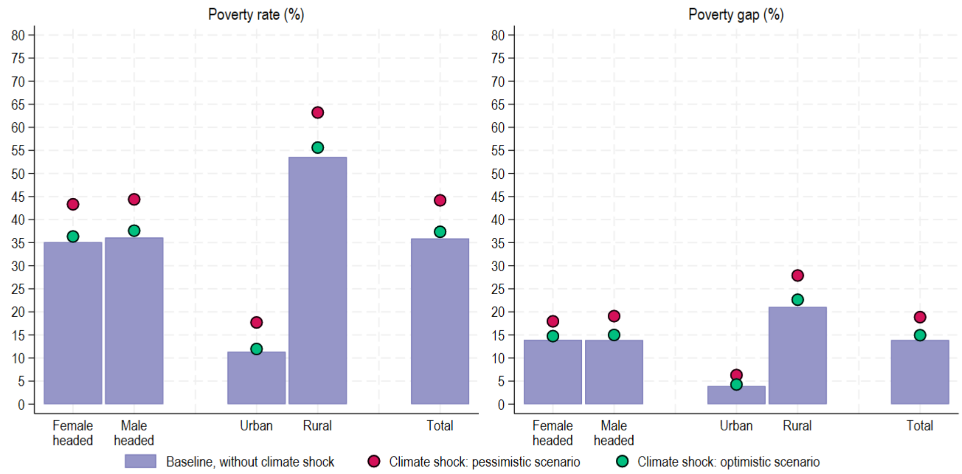
Table B1: Implementing shocks in MicroZAMOD: model variable elasticity to rainfall shocks

	Income of workers in agriculture	Consumption of purchased food	Consumption of own produce	Household non-food consumption
Baseline	No change	No change	No change	No change
Sub-scenario 1	3.8% elasticity, maximum reduction of 30%	3.8% elasticity, maximum reduction of 30%	No change	3.0% elasticity, maximum reduction of 30%
Sub-scenario 2	3.8% elasticity, maximum reduction of 30%	No change	3.8% elasticity, maximum reduction of 30%	3.0% elasticity, maximum reduction of 30%
Sub-scenario 3	3.8% elasticity, maximum reduction of 30%	3.8% elasticity, maximum reduction of 30%	3.8% elasticity, maximum reduction of 30%	3.0% elasticity, maximum reduction of 30%

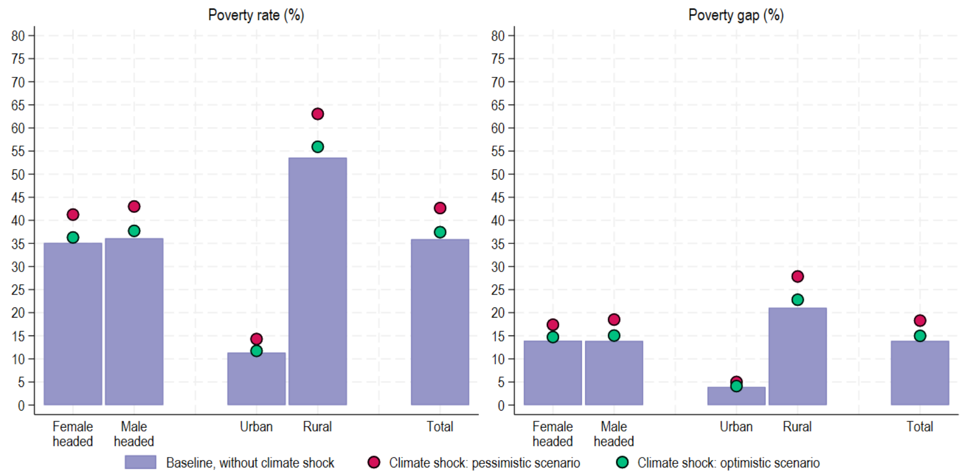
Note: each sub-scenario is applied to both climate shock scenarios.
Source: authors' compilation.

Figure B1: Poverty rate and gap under pessimistic and optimistic climate shock scenario

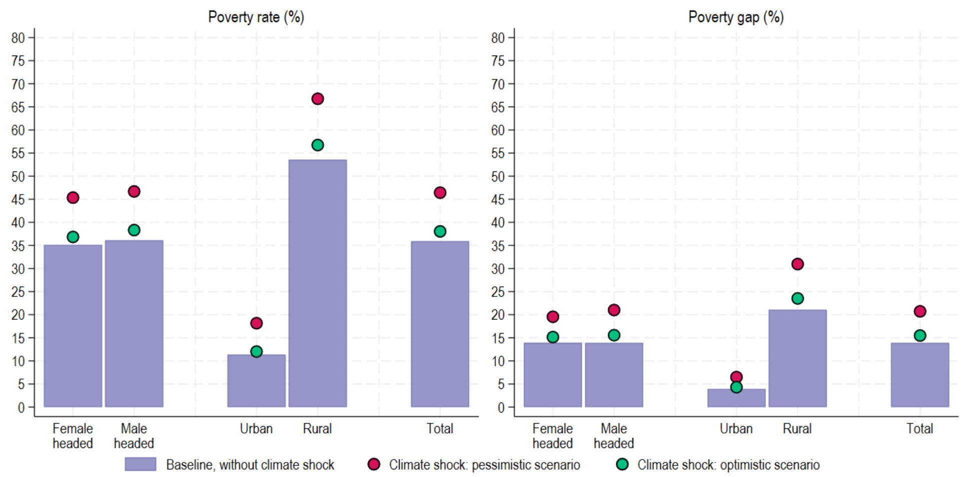
(a) Sub-scenario 1



(b) Sub-scenario 2

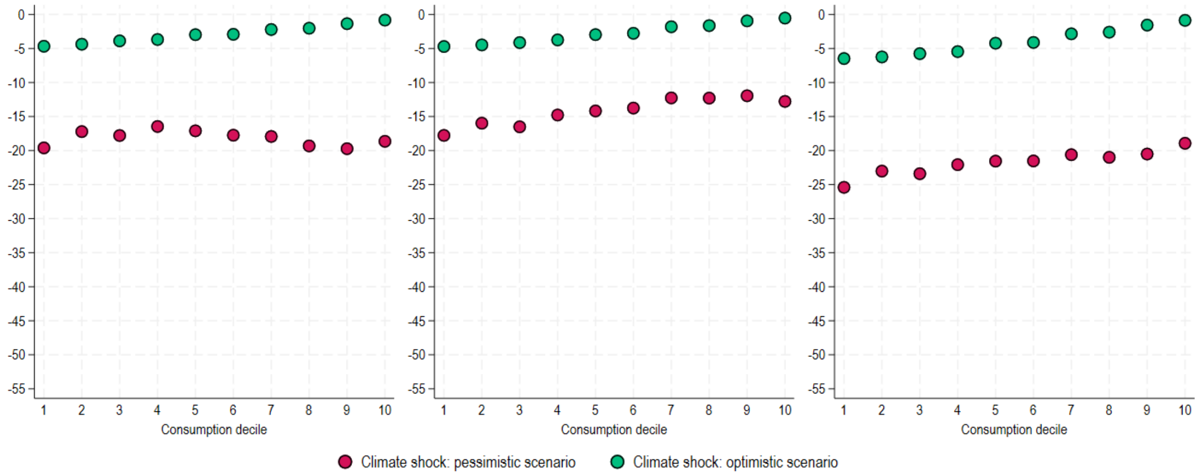


(c) Sub-scenario 3



Source: authors' illustration.

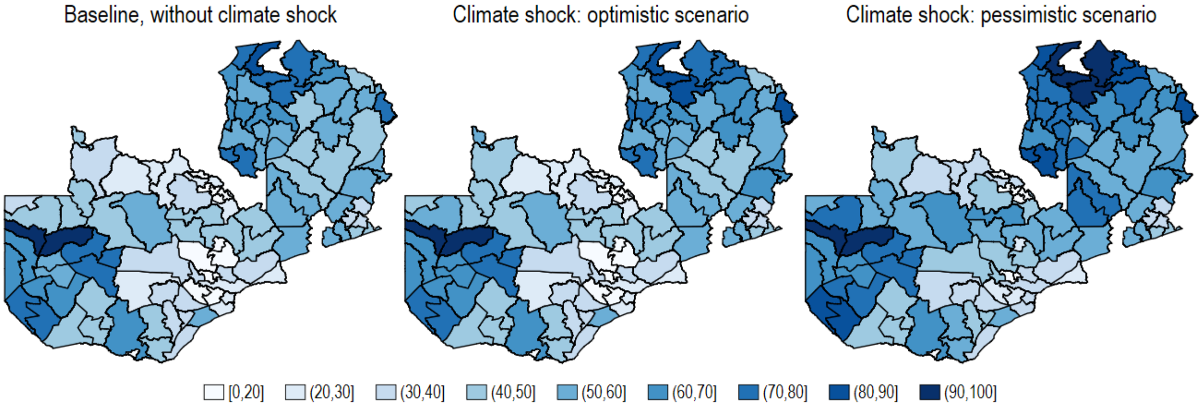
Figure B2: Change in consumption (%) under pessimistic and optimistic rainfall shock scenario, sub-scenarios 1, 2, and 3



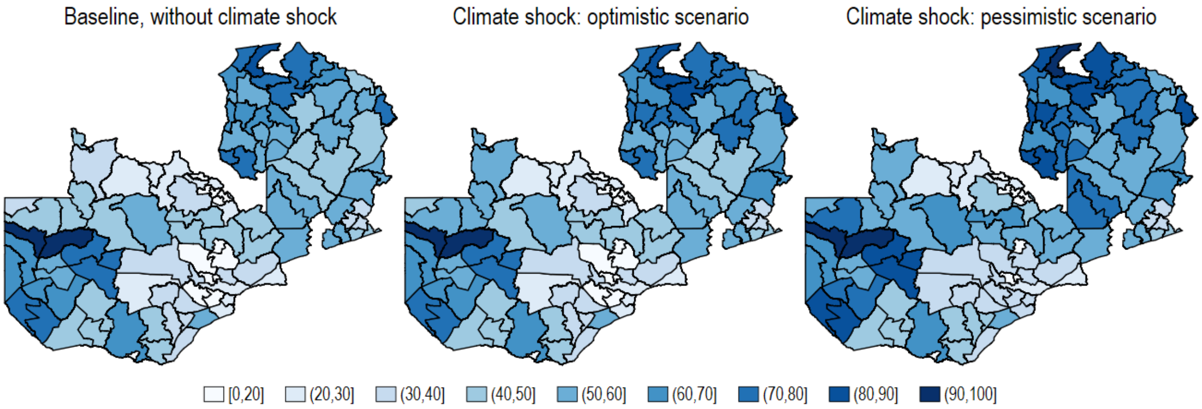
Source: authors' illustration.

Figure B3: Poverty rates (%) by regions under pessimistic and optimistic climate shock scenario

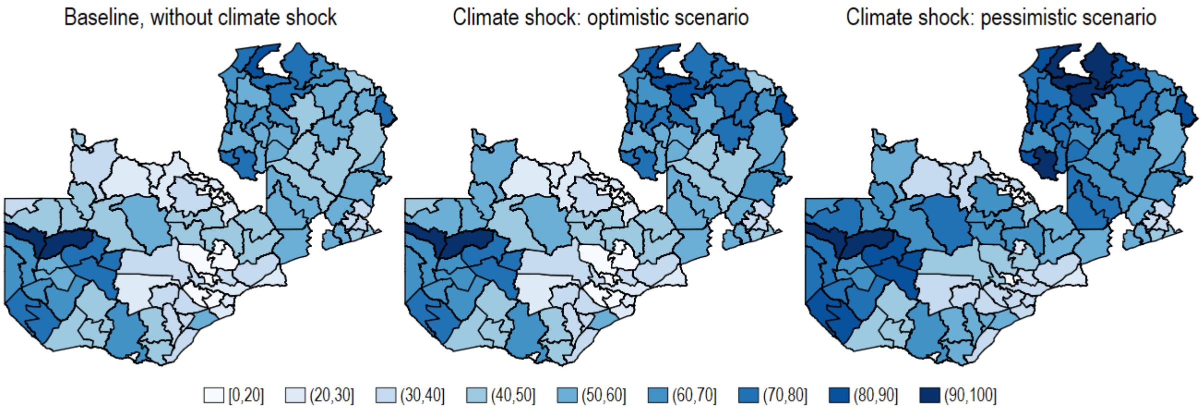
(a) Sub-scenario 1



(b) Sub-scenario 2



(c) Sub-scenario 3

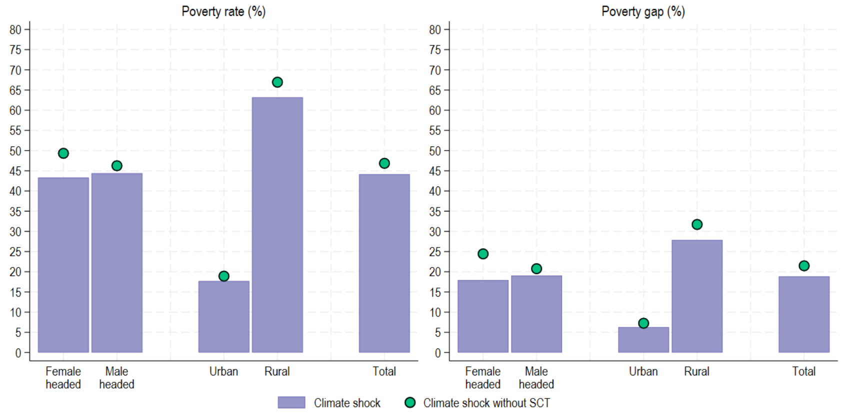


Source: authors' illustration.

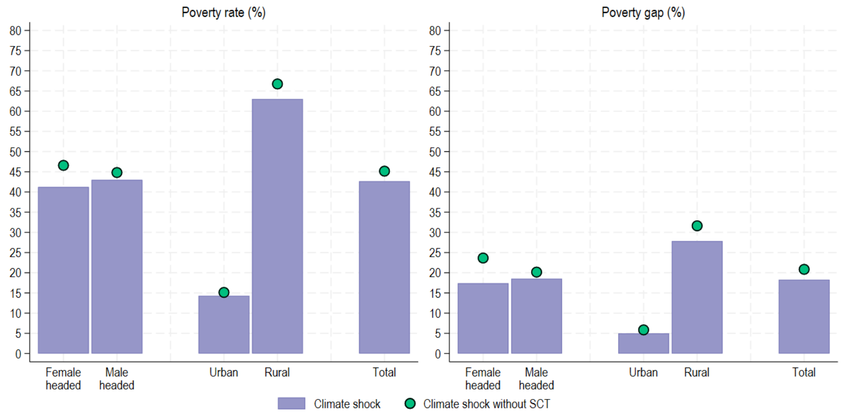
C Sensitivity analysis: effect of baseline Social Cash Transfer

Figure C1: Poverty rate and gap under pessimistic climate scenario, with and without Social Cash Transfer

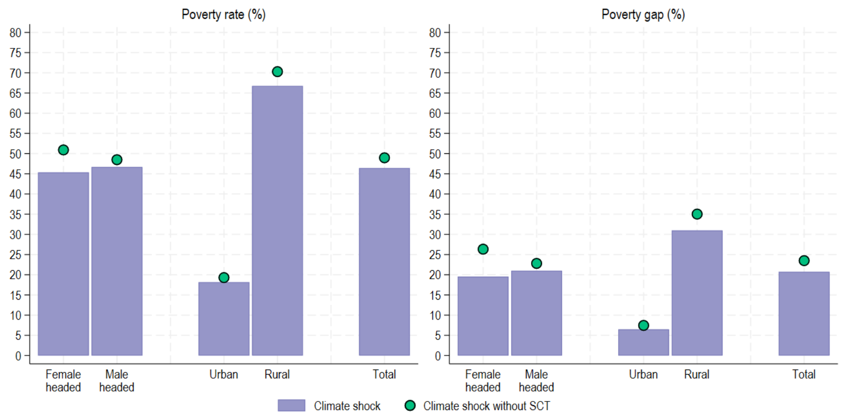
(a) Sub-scenario 1



(b) Sub-scenario 2

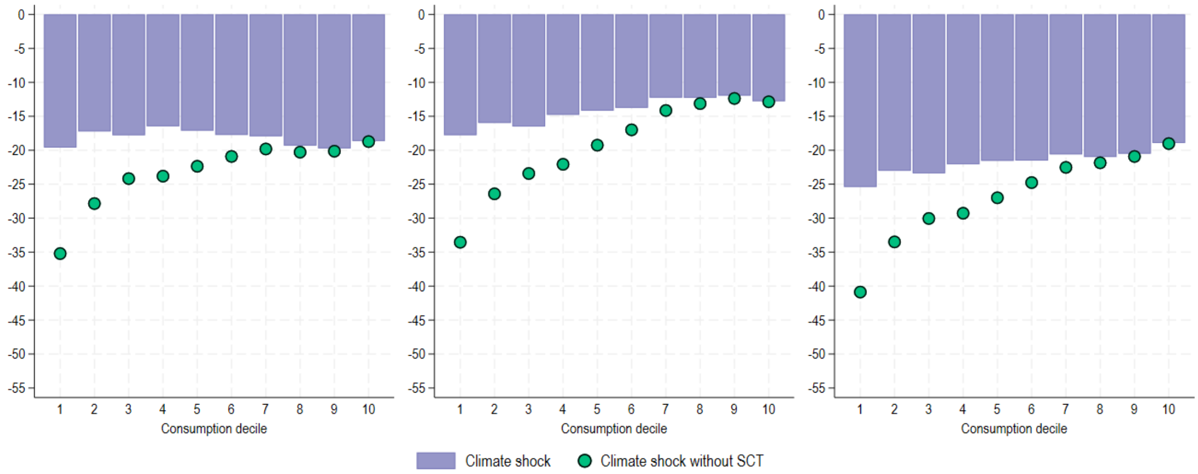


(c) Sub-scenario 3



Source: authors' illustration.

Figure C2: Change in consumption (%) under pessimistic climate shock scenario, with and without Social Cash Transfer, sub-scenarios 1, 2, and 3

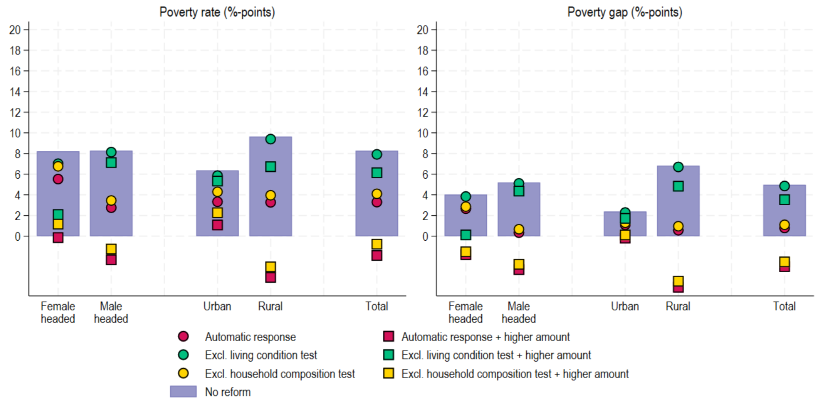


Source: authors' illustration.

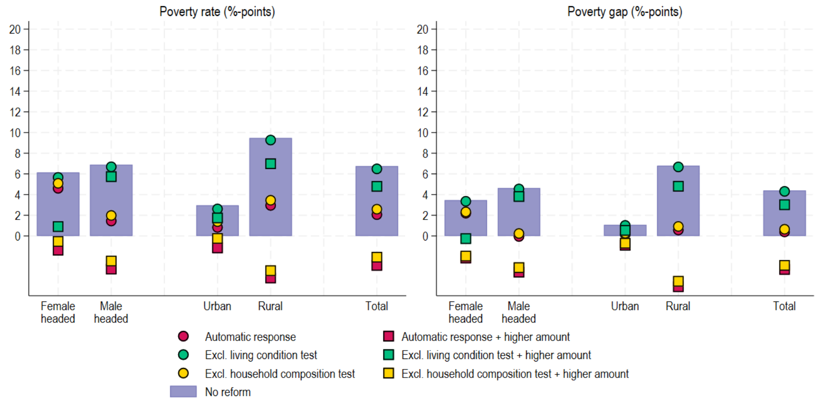
D Sensitivity analysis: effect of Social Cash Transfer reforms

Figure D1: Change in poverty rate and gap compared to baseline under pessimistic climate scenario, with and without Social Cash Transfer reforms

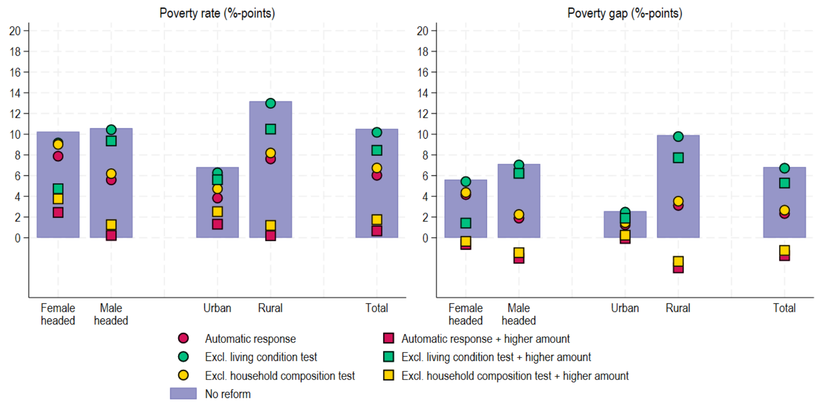
(a) Sub-scenario 1



(b) Sub-scenario 2

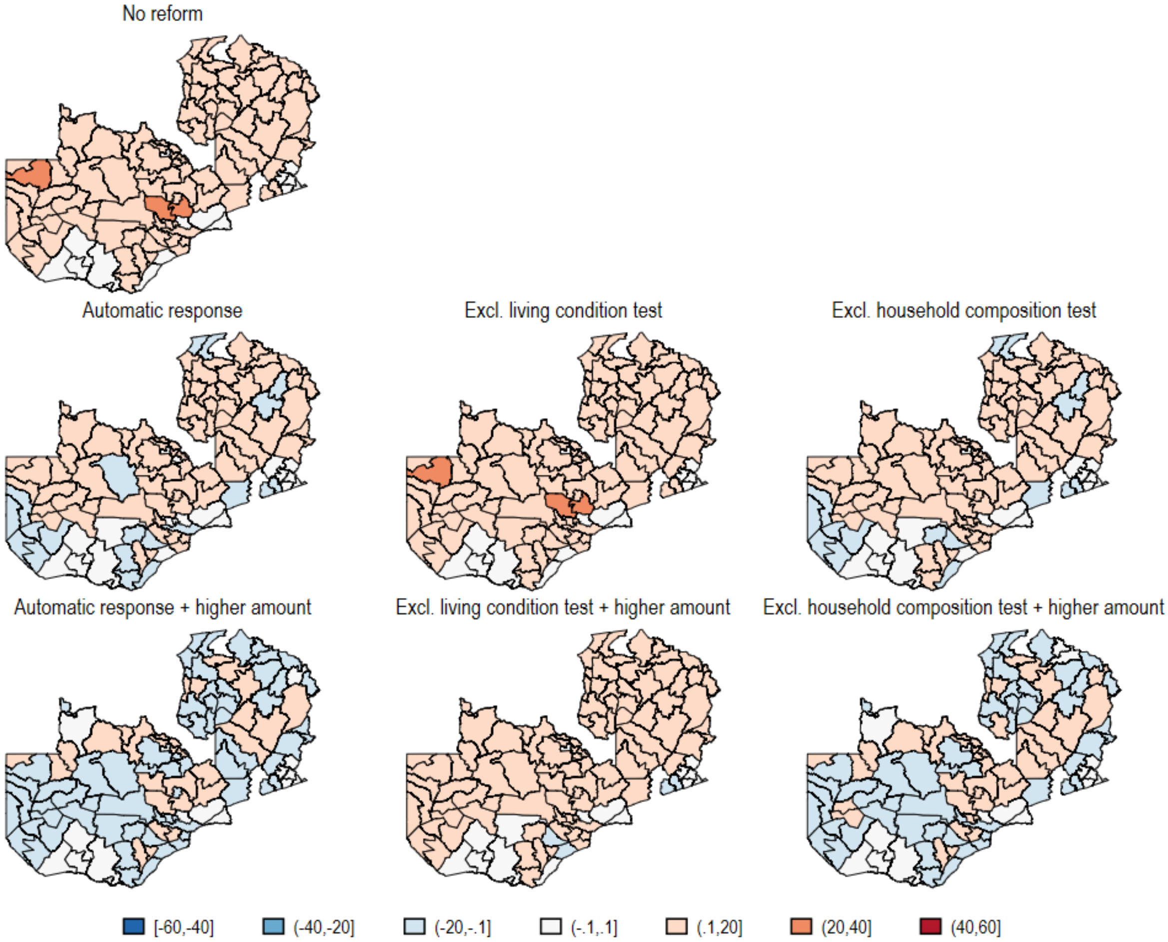


(c) Sub-scenario 3



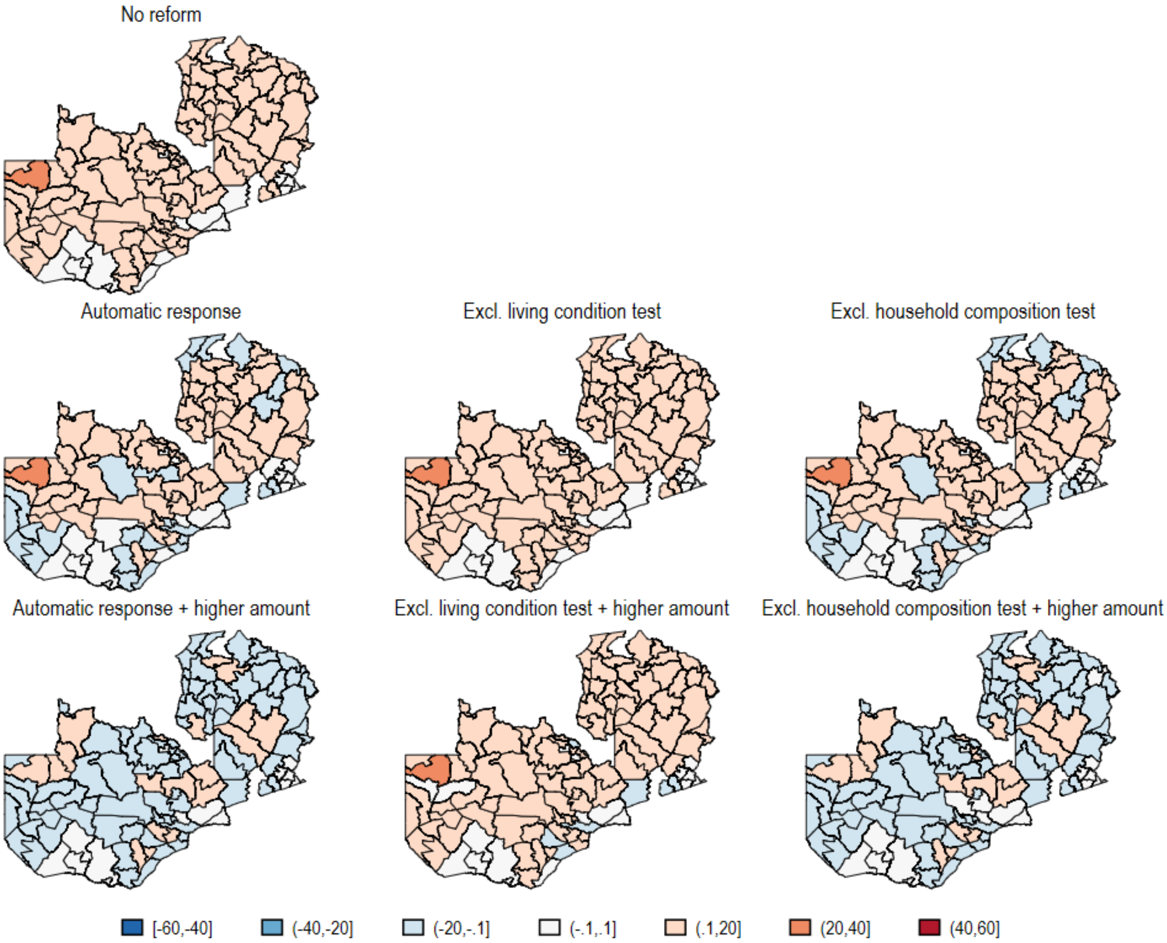
Source: authors' illustration.

Figure D2: Change in poverty rate under pessimistic climate scenario, sub-scenario 1



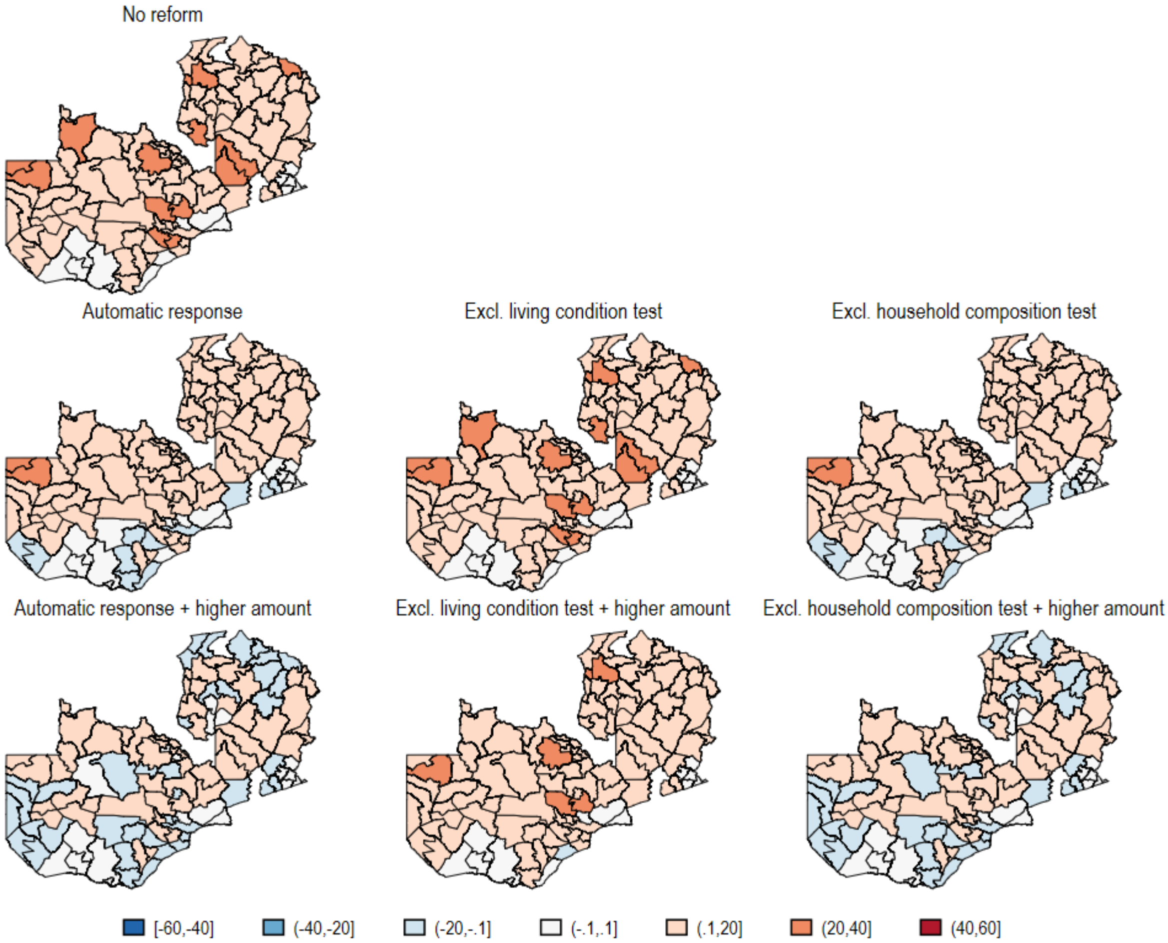
Source: authors' illustration.

Figure D3: Change in poverty rate under pessimistic climate scenario, sub-scenario 2



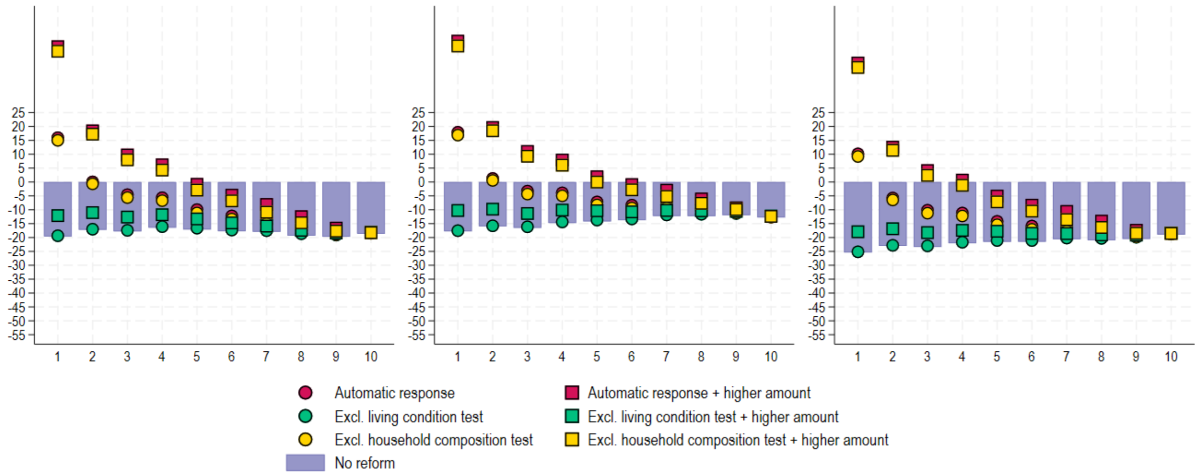
Source: authors' illustration.

Figure D4: Change in poverty rate under pessimistic climate scenario, sub-scenario 3



Source: authors' illustration.

Figure D5: Change in consumption (%) under pessimistic climate shock scenario, with and without Social Cash Transfer reforms, sub-scenarios 1, 2, and 3



Source: authors' illustration.