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Distributional impacts of agricultural policies in Zambia

A microsimulation approach

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Abstract: This paper examines the distributional impacts of agricultural policies versus those of cash transfers using a tax–benefit microsimulation model for Zambia for the policy year 2020. The analysis also considers the behavioural impacts of input subsidies and social cash transfers. The results indicate that Zambian agricultural policies reduce headcount poverty by 3–5 percentage points, depending on whether only their direct impacts or also behavioural impacts that lead to changes in agricultural production are taken into account. The paper also considers policy reforms where the goal is to achieve similar, or even greater, poverty reduction with smaller government net expenditure. The results from these simulations suggest that it is feasible to achieve this goal by better targeting input subsidies to more needy households, increasing the benefit amounts that reach the poorest part of the population, and by using direct benefits instead of indirect tax expenditures. The results, however, also highlight that the final impacts on poverty and inequality are heterogeneous across population groups.

Key words: agricultural policies, tax, cash transfers, poverty, inequality, Zambia

JEL classification: H23, H24, O12, Q18

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This study has received ethical approval by the Joint Ethical Review Board of the United Nations University (Ref No: 202104/01) on 11 May 2021.

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1 Introduction

While agricultural subsidies typically improve farming outcomes, they are also costly to the government, and an often-heard refrain is that their targeting is not sufficiently pro-poor (Holden 2019; Jayne et al. 2018). Sometimes the same or similar households may benefit from both agricultural subsidies and social cash transfers, or some poor agricultural households may be excluded from both. Social protection and agricultural policies may not have been designed in a coherent manner, possibly leading to unnecessary gaps in the coverage. The financing of these programmes, especially when they are scaled up, may also need strengthening. This is even more important in a post-COVID world, with governments facing severe strain on their public finances.

Tax–benefit microsimulation is a tool very often used by economists and public policy analysts to assess the overall distributional impacts of taxes and social protection. This approach, which combines representative household-level data with the modelling of tax and benefit rules, has been used for decades in the developed world. With the onset of domestic resource mobilization and low-income countries building up their social safety nets, microsimulation models are increasingly useful also in a developing country context, and the work using this approach has expanded rapidly.[1] However, the existing models typically do not cover agricultural policies, or they have been modelled in a cursory manner. In this study, we demonstrate how agricultural subsidies and related policies may be integrated into a microsimulation model. This is done in the context of Zambia, for which such a tax–benefit microsimulation tool, MicroZAMOD, exists. The improved model can be later adapted to any changes in agricultural and social protection programmes and used for analysing policy changes such as the recent expansion of the Food Security Pack (FSP) or remodelling of agricultural subsidies.

Coherent agricultural and social protection policies are a potentially powerful tool in combating rural poverty and food insecurity (see Gavrilovic et al. 2016). Such considerations are particularly true for Zambia: the Seventh National Development Plan emphasizes integrated multisectoral approaches and poverty and vulnerability reduction. In the past, concerns have also been raised about the pro-poorness of major agricultural programmes (see, for example, Harman and Chapoto 2017). The national extreme poverty headcount ratio in Zambia is close to 41 per cent, which makes the analysis of more pro-poor targeting in the benefit system in general very pertinent.

The analysis presented in this paper considers the joint impacts of agricultural and social protection polices and their financing on poverty and inequality. The analysis is conducted both in a static manner and considering the behavioural impacts of agricultural and cash benefits. Incorporating the latter mechanism is key since in addition to agricultural subsidies (Holden 2019) social cash transfers have been found to positively influence agricultural income (Correa et al. 2021; Daidone et al. 2019). The model is used to examine the distributional impacts of the existing benefits in Zambia as well as to simulate the hypothetical impact of counterfactual policy reforms. The guiding idea for these reform scenarios is to explore whether the agricultural benefit policies could be reformed in a pro-poor manner and how their financing could be bolstered.

This work is related to various strands of earlier literature. First, there is a vast literature evaluating the impacts and use of agricultural subsidies, which is reviewed by, for example, Holden (2019) and Jayne and Rashid (2013). This literature is of relevance for the present study in particular because the behavioural impacts we model are based on estimates obtained from impact

[1] See e.g. Decoster et al. (2019) and the articles in the special issue or Lustig (2018).

evaluations. Second, we extend and contribute to the analysis of taxation and social protection in developing countries based on a microsimulation approach.[2] Third, there exist some earlier simulations of the distributional impacts of agricultural subsidies, such as Jonasson et al. (2014)[3] and the references therein, as well as Thome et al. (2014),[4] but our approach is different and complementary.

Our paper contributes by providing a detailed, household-level analysis, which encompasses not only agricultural subsidies but also other tax and benefit instruments, including indirect taxes. We also run simulations that take into account the productive impacts of the agricultural and social protection instruments. These simulations are carried out using a transparent approach where the key behavioural parameters are based on credible estimates drawn from results of earlier works that involve modern impact evaluation approaches. Furthermore, we analyse the heterogeneity of effects by presenting the results for different population subgroups. As is common in microsimulation, our analysis captures the direct benefits to recipients but does not cover spillover effects on households not receiving benefits or the administrative costs of running benefit or subsidy programmes.

The approach and the results of the analysis can be used to study policy questions, such as: What are the impacts of existing agricultural subsidies and cash transfers on poverty and inequality? How much do these impacts vary depending on whether the subsidies are treated simply as transfers of income or accounting for second-order impacts on agricultural production? Are there possibilities for reforming these policies and achieving greater poverty reduction without increases in government spending? What are the joint distributional impacts of the benefits when they are financed via the tax system?

The paper proceeds as follows. Section 2 reviews the relevant impact evaluation literature, on which the behavioural reactions included in the model are based. Section 3 describes the institutional setting, including the tax and benefit arrangements in Zambia. Section 4 introduces the data and methods. Section 5 contains the results, pertaining to both the impacts of the Zambian tax and benefit system in 2020, including input subsidies, and possible policy reforms the goal of which is to achieve comparable poverty reduction while saving government money. Section 6 concludes.

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[2] For a recent example of this line of work, see Bargain et al. (2021).

[3] The authors build a behavioural simulation model to examine the distributional impacts of farming policies for six countries, including two in Africa (Ghana and Malawi). The model is a general equilibrium model based on representative households of six different rural household types; hence the distributional impacts are across these aggregated groups. In tax–benefit microsimulation models, households are not aggregated, also urban households are included, and the impacts studied only account for partial equilibrium impacts.

[4] The study uses a Local Economy Wide Impact Evaluation (LEWIE) methodology to assess the impacts of Zambia's child grant programme. The idea is to build household and region networks to allow an analysis of the spillover effects across the economy. The approach also entails estimating econometrically production and demand parameters, which requires invoking several assumptions.

2 Review of the impacts of agricultural subsidies and social benefits in Zambia[5]

This review covers the relevant econometric work that the behavioural parameters in the model are based on. This pertains to impact evaluations of agricultural subsidies and cash transfers in the African context in general, and in particular evidence based on Zambian data.

Jayne and Rashid (2013) summarize the evidence related to the benefits of agricultural subsidies. They conclude that the benefits clearly exceed the costs. This is highlighted by a review of value–cost ratios (VCRs)[6] of agricultural subsidies. While the estimates vary, a substantial share of them point to fairly large VCRs (above 1.5). Jayne et al. (2018), in turn, offer a recent review of the evidence on the impacts of agricultural subsidies in Africa. According to them, input subsidies have had modest positive effects on household-level production, whereas the evidence regarding impacts on farm income is more mixed.

Hemming et al. (2018) summarize the quantitative evidence on the impacts of farm input subsidies. The authors conclude that the average impact of subsidy programmes on yield per hectare amounts to 0.09 standardized mean differences (SMD) relative to the control group, with all but one of the reviewed studies finding statistically significant positive impacts on yield. They also summarize the average effect on farm income, which is found to be greater (0.17 SMD). Interestingly, the size of the subsidy and the associated impact do not seem to be linked.[7]

In the Zambian context, Mason et al. (2013) examine the effects of the Farmer Input Support Programme (FISP) and find that the effectiveness of the programme has been hindered by poor targeting and crowding out of private purchases. The benefit–cost rate of the policy would hence lie below 1. Recipient farmers' maize yields have been, however, positively influenced by the programme, with output elasticities around 0.15–0.35. Mason and Tembo (2015) also document positive impacts on farm income. According to their results, a 200 kg increase in FISP fertilizer would increase household income by 8 per cent.

Druilhe and Barreiro-Hurlé (2012) refer to earlier work for Zambia and note that subsidies targeted to poorer households suffer less from crowding out. Poorer farmers may also use the subsidies in a more efficient manner. An appropriate pro-poor targeting of the subsidies may therefore also be efficient.

As discussed above, evidence related to how cash transfer influences farm output is also relevant for the analysis of input subsidies. Government expenditure on input subsidy programmes can be contrasted with the provision of cash transfers using impact estimates obtained from research. Daidone et al. (2019) summarize the evidence of the impacts of cash transfers on agricultural production and household income generation for sub-Saharan Africa. Handa et al. (2018), who evaluate the impacts of two Zambian cash transfer programmes on agricultural production, find very large effects on consumption. The increase in consumption in a three-year follow-up turned out to be 67 per cent more than the value of the transfer, with the largest increase stemming from greater agricultural investments, and with non-farm income also playing a role. Asfaw et al. (2017) provide evidence showing that a specific form of social protection in Zambia, the Child Grant

[5] This section draws on Kangasniemi and Pirttilä (2022).

[6] Defined as the value of output produced per value of fertilizer applied.

[7] Jayne and Rashid (2013) document how diversion of subsidized inputs to other use severely restricts the impacts of input subsidies and lowers their benefit–cost ratios.

Programme (CGP), supported households coping with weather shocks. The impact was found to be greater among households in the bottom quantile of consumption and food security distribution.

If households can receive both agricultural and social benefits at the same time, it is possible that there are interaction effects of the two policies. Pace et al. (2018), who investigate the topic for Malawi, find that the policies are complementary, reinforcing their individual impacts. While this could be taken into account in the microsimulation analysis by altering the elasticities depending on whether the household receives only one type of benefit or both, we will abstract from such complications in our analysis below.

3 Institutional context

Zambia is a lower-middle-income country with a quite developed tax system and a benefit system that is relatively new but has expanded considerably over the last decade. Still, the coverage of social benefits remains low (Nakamba-Kabaso et al. 2020), and many programmes are yet to be up-scaled to all of Zambia's districts. According to the CSO (2016), 57 per cent of the household reside in rural areas, and 59 per cent of the employed population works in agriculture. These numbers highlight the overall importance of agricultural programmes for people's livelihoods and the distribution of incomes.

Programmes most relevant for households engaged in agriculture and with poverty reduction potential are the FISP, the Food Reserve Agency (FRA) Purchase Programme, and the FSP. As such, these three programmes are the focus of the empirical analysis.

3.1 Farmer Input Support Programme

FISP is implemented by the Ministry of Agriculture (MoA) in Zambia. The aim of the programme is to improve the distribution of agricultural inputs to small-scale farmers through private sector participation at affordable costs, increasing household food security and incomes.

In recent years FISP has involved two implementation modalities; the direct input supply (DIS) delivery mechanism, and an electronic voucher system (e-FISP) (Mulenga et al. 2020).[8] Under e-FISP the transportation, storage, and distribution costs are shifted to the private sector. The beneficiaries can choose among a wide choice of inputs, which allows farmers to move to more profitable and drought-resilient crops, whereas under DIS farmers were provided fixed input packs.

The government contribution under DIS through the subsidized inputs and the amount of money loaded in the voucher under e-FISP is valued as 1,700 kwacha (K1,700), conditional on the farmer picking up the voucher paying an up-front contribution of K400 (Mulenga et al. 2020). In what follows, we assume that beneficiaries in all districts receive the benefit equalling the value of the voucher.

According to the MoA, the key criteria for farmers to benefit from FISP are:

[8] The share of farmers receiving each modality has varied year to year.

- being a member of a cooperative or other farmer organization and paying the contribution of K400;
- cultivating 0.5–5 hectares of land, and the beneficiary cannot be raising more than 10 cattle, 30 pigs, 30 goats, 100 chickens, or overseeing more than 2 fishponds (it is not clear how strictly the lower bound pertaining to the land area is enforced in practice);
- being a registered small-scale farmer and actively involved in farming within the camp coverage area;
- not currently benefiting from the FSP programme; and
- not being a defaulter from FRA and/or any other agricultural credit programme.

Approximately one million farmers are targeted to receive inputs under the programme. In October 2020 over 945,866 farmers (95 per cent of the target) have already deposited their K400 contribution for the 2020/2021 farming season (MAL 2020). The target government expenditure for FISP in 2020 is K1,110,276 million (MoF 2021).

3.2 Food Security Pack

The FSP is a government-funded scheme that provides basic agricultural inputs, technology transfers, and training to 'vulnerable but viable' small-scale households (ILO 2008). The programme is administered by the Ministry of Community Development and Social Services, and beneficiary farmers are supposed to receive complementary technical support from the extension staff of the Ministry of Agriculture and Livestock (Tesliuc et al. 2013).

The objective of the scheme is that the selected households benefit from the programme for two or three years, until they achieve self-sustaining levels of food production and more commercial use of inputs, and thus 'graduate' from the FSP to other programmes such as FISP. Nevertheless, the FSP is not a free handout. Recipients are required to pay back in grain about 10 per cent of their harvest that should be donated to the community recovery or seed bank to support the community (Chilala 2017).

The targeting of beneficiaries is facilitated at the community level by the Community Welfare Assistance Committees and Area Food Security Committees (Weitz et al. 2015). Viable beneficiaries are farm households cultivating 0.5–2 hectares of land with adequate labour but not in gainful employment and experiencing food insecurity over a prolonged period or suffering negative effects of reduced access to farming inputs. In addition, households must also meet at least one indicator of vulnerability:

- female-headed household;
- household housing orphans;
- child-headed household;
- terminally ill household head;
- household headed by unemployed youth;
- household headed by disabled household member; or
- old-aged household head but with labour capacity.

Unlike in e-FISP, the composition of the food security packs is adapted to variations in agroecological conditions, and to budget constraints. For rainfed cropping which relies on rainfall the pack consists of:[9]

1. 10 kg cereal seed (maize, rice, or sorghum);
2. 10 kg legume (beans, cowpeas, or groundnuts);
3. 2 × 50 kg compound D fertilizer;
4. 2 × 50 kg urea fertilizer;
5. tubers (cassava cuttings, sweet potatoes);
6. agricultural lime;
7. planting and cultivating tools; and
8. a sprayer.

The first four items are always included in the package, and the monetary value of these four components is K5,100, including costs for transport to the districts. However, the actual value for the farmer is less and varies depending on the market prices. In what follows, we have assumed the value of the package for the farmer is K2,420.[10]

In 2020, the official number of beneficiary households was 48,600, although the targeted number was 80,000 (Mulenga et al. 2020). For 2020, the FSP budget allocation was K100 billion, and the final outturn K160 billion (MoF 2021). In 2021 the programme was significantly scaled up: however, the analysis in this paper does not yet reflect the scale-up as the 2020 system is used. A simulation of the scale-up is reported in Appendix B.

3.3 FRA purchase programme

The FRA manages strategic food reserves for national food security and stabilizing crop prices through quality marketing and storage services. It buys predominantly maize and, to a smaller extent, soya beans and paddy rice (Mulenga and Chapoto 2020) from farmers at its depots throughout rural Zambia at a pan-territorial price (Table 1).[11] Hence, FRA effectively guarantees a set gross price for farmers' crops.

Between 2015 and 2020, the FRA maize price has been below the average wholesale price for maize, with some exceptions during the harvest months (CSO 2015–2020). Figure 1 depicts the average monthly producer prices of maize grain (K/50 kg) from May 2020 to April 2021 disaggregated by province. The FRA maize price has been below the average monthly producer price in all the provinces.

[9] This information was shared by FSP Coordinator to the Cash Plus Team on 12 April 2021.

[10] This is based on the following choices: 1 × 10 kg maize seed—during the 2019–20 marketing season, the price of maize was K110 per 50 kg bag (Mulenga et al. 2020); tubers K200 (based on an assessment from the FSP Coordinator); fertilizers K500 per 50 kg bag (based on various reports in the news).

[11] Price statistics data from CSO (https://zambia.opendataforafrica.org/data#source=Central+Statistical+Office+Zambia)

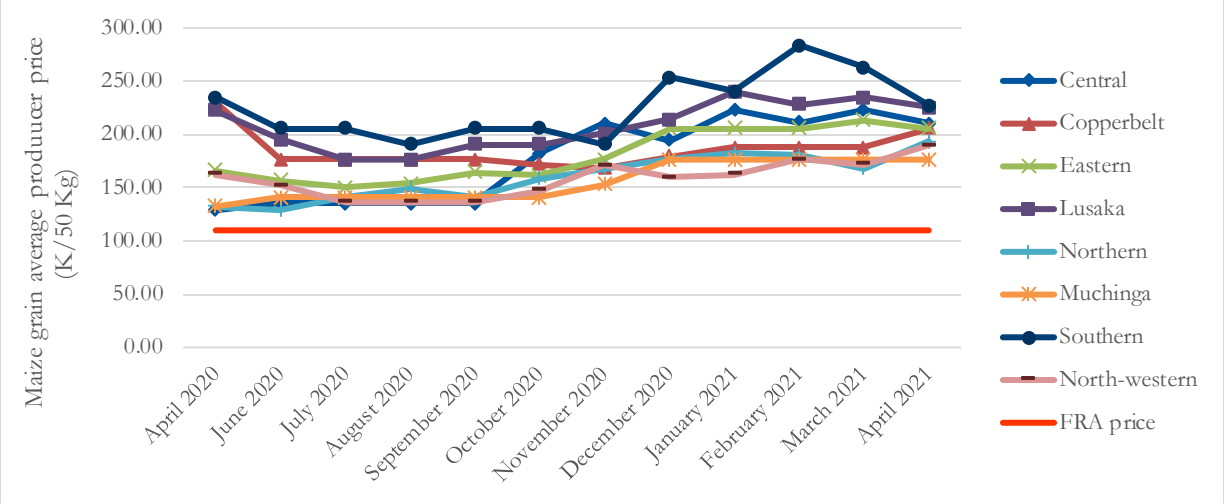
Table 1: FRA prices

Year	FRA price per 50 kg bag of maize	FRA price per 40 kg bag of paddy rice	FRA price per 50 kg bag for soya beans
2015	K75	K65	–
2016	K85	K60	–
2017	K60	K70[a]	K130
2018	K65	K70	K130
2019	K110	K70	K150
2020	K110	K70	K150

Note: [a] there were no purchases of paddy rice in 2017 because of competitive prices offered by the private sector in locations such as Western and Muchinga regions, who offered K100 per 40 kg bag of paddy rice (FRA 2018).

Source: authors' compilation based on IAPRI data, FRA announcements, and CSO (2015–2020).

Figure 1: Maize producer price by province vs. pan-territorial maize FRA price



Source: authors' compilation based on data from IAPRI, June 2021.

In addition, the analysis includes social assistance as well as child-related programmes that are included in the MicroZAMOD model. These benefits provide an important safety net for the extremely poor population of Zambia, and including them allows considering interaction effects between agricultural and social policies.

The flagship social programme in Zambia is the *Social Cash Transfer (SCT)*. It is targeted at elderly, individuals with disability, female-headed households with three or more children, and child-headed households. In addition, selection is based on an assessment of living conditions or a household score that is calculated based on the educational level, the ownership of certain items such as a bed, mattress, table, or TV, and the condition of the dwelling. The benefit amounts to K150 (K300 for households with a disabled member) per month independent of household composition and size. Previous research has pointed out that the programme is more successful in reducing poverty in households that receive additional support, including agricultural benefits (Gasior et al. 2021).

Two additional programmes provide complementary support for selected SCT recipients. The *Supporting Women's Livelihood (SWL) programme* targets fit-to-work women with at least one child living in very poor households. It provides them with a one-off payment of K2,900 and offers them training and mentorship. The second programme is the *Keeping Girls in School (KGS) programme*. It targets girls of secondary-school age and aims at keeping them in education by covering their

school fees. As such, it is a benefit in kind that provides quasi-cash support to parents of girls aged 14–18. The median amount of public-school fees is K900 per year. Both programmes are only available in selected districts (SWL in 64 districts and KGS in 29 districts).

In this study, we focus on the three agricultural policies introduced above (FISP, FSP, and the FRA purchase programme) and compare their impacts with the SCT and the benefits linked with it, namely SWL and KGS. In addition, the model includes information on social-security pension receipt from the Living Conditions Monitoring Survey (LCMS) data and simulates the Home-Grown School Feeding (HGSF) programme. This programme provides children attending public and community schools in the 25 eligible districts with free school meals daily prepared from maize meal, pulses, and oil (Gasior et al. 2021). The value of the meals amounts to approximately K264 per child per year. Pensions and the HGSF programme are not affected by the simulated reforms but are included in the results on overall benefit receipt and overall public expenditure.

4 Data and methods

The analysis is carried out using MicroZAMOD version 2.4 with project-specific adjustments, running on the EUROMOD software. MicroZAMOD is a tax–benefit microsimulation model developed for Zambia in the context of the SOUTHMOD project, with support from UNU-WIDER in cooperation with the Zambia Institute for Policy Analysis and Research (ZIPAR) and Southern African Social Policy Research Insights (SASPRI) (Nakamba-Kabaso et al. 2020).

MicroZAMOD is underpinned by the 2015 LCMS, covering 12,251 households and 62,880 individuals in 664 randomly selected enumeration areas (EAs)[12] across the ten provinces of Zambia. Additionally, in this project the 2015 RALS (Rural Agricultural Livelihoods Survey), shared by IAPRI with UNU-WIDER, has been employed to improve the microsimulation model by imputing information that is not available in the LCMS data. The 2015 RALS covers 476 standard EAs across the ten provinces, and a total of 9,520 interviewed households who practice agriculture. The objective of the survey is to obtain a comprehensive picture of the small- and medium-scale farming sector in the country.

The analysis is based on the 2020 policy system but omits measures implemented in the course of the COVID-19 pandemic, such as the COVID emergency cash transfer. This allows us to focus on recent tax–benefit rules (from 30 June 2020) while abstracting from the additional pressure caused by the health, social, and labour market consequences of the pandemic. Since 2020 the FSP has also been significantly scaled up: a simulation of the scale-up is presented in Appendix B.

The simulation of the programmes includes the cash or in-kind component (for which a monetary value can be given) only. Other forms of support (such as training and capacity building), whose value cannot be monetized and which households do not purchase, cannot be considered in the model. The impacts studied include only increases in income and consumption; those on other outcomes of potential interest, such as improvements in education, health, and food security,[13] are

[12] The EAs constituted the primary sampling units for the survey. To conduct household-based surveys, districts are subdivided into constituencies, which are in turn divided into wards, further split into census supervisory areas (CSAs), and subsequently subdivided into EAs (CSO 2016).

[13] Food security at the household level can be measured by using different indicators, such as subjective measures of experience of food insecurity or dietary quality that are not available in these data. Food consumption at the household

not part of this analysis. Similarly, expenditure for benefits includes payments to benefit recipients only, but does not include administrative and other costs.

4.1 Augmented MicroZAMOD with an in-depth modelling of agricultural policies

The standard model of MicroZAMOD partly relies on proxies for certain elements of the agricultural (benefit) policies due to lack of information in the LCMS data. The additionally used RALS in this analysis contains relevant information to complement (via imputations) the LCMS and to improve the simulation of agricultural programmes. Specifically, RALS data has been used to add imputed variables on variables that are needed for the simulation of FISP.

The background variables (demographics, area, farming characteristics) that exist in both datasets are used for estimating probabilities of being a cooperative member and selling to the FRA in the RALS. By using the parameter values, these probabilities are then predicted for all households in the LCMS, though the probabilities are effectively zero or very low for households that are not engaged in farming. In the model, those whose highest probabilities are set to either be a cooperative member or to sell to the FRA. The threshold values are aligned with the overall share of such households in the RALS data. For example, since around 20 per cent of households who are engaged in agriculture sell to the FRA (directly or through a cooperative), the same share is predicted to sell to the FRA in the imputations of the LCMS data.

Additionally, the modelling of the FSP is enhanced by adding the imputed probability of benefiting from the FSP to the standard dataset used by MicroZAMOD. Though eligibility can be simulated by using the primary and secondary criteria, the number of beneficiaries obtained this way is larger than the number of households actually benefiting from the FSP in 2020. Selection of beneficiaries by Community Welfare Assistance Committees was not captured by the categorical criteria and hence the beneficiary status of the FSP needs to be further imputed. Using the same methodology as above, the probability of receiving FSP is estimated with the RALS and predicted in the LCMS. The variable indicating this probability and the total number of recipients available is obtained from the RALS data and government documents. In the model, among the eligible households, those whose probabilities are the lowest are set not to receive the subsidy. This share is aligned with the number of actual recipients in the entire country in external sources.

All imputations are based on logit models that use the same predictors: (1) for the membership of a farmer cooperative, (2) for FSP recipients and (3) for selling to the FRA:

$$\begin{aligned} Coopmember_{hh} = \; & \pi + \alpha \sum Demog_{hh} + \beta HaCultivated_{hh} + \mu \sum IncomeCrop_{hh} \\ & + \Omega \sum IncomeLivestock_{hh} + \varepsilon_{hh} \end{aligned} \tag{1}$$

$$\begin{aligned} FSP_{hh} = \; & \pi + \alpha \sum Demog_{hh} + \beta HaCultivated_{hh} + \mu \sum IncomeCrop_{hh} \\ & + \Omega \sum IncomeLivestock_{hh} + \varepsilon_{hh} \end{aligned} \tag{2}$$

$$\begin{aligned} FRA_{hh} = \; & \pi + \alpha \sum Demog_{hh} + \beta HaCultivated_{hh} + \mu \sum IncomeCrop_{hh} \\ & + \Omega \sum IncomeLivestock_{hh} + \varepsilon_{hh} \end{aligned} \tag{3}$$

level (mechanically converted into individual consumption) could be hypothetically studied by using assumptions about consumption patterns; this is, however, not done in this paper.

The dependent variable is regressed on a number of characteristics that are likely to be correlated with the outcome variable and are included in both LCMS and RALS:

- $\sum Demog_{hh}$: vector of demographic variables (age, gender, marital status, head of the household, province of residence, highest level of formal education completed, number of children and number of adults in the household).
- $HaCultivated_{hh}$: area of land cultivated in hectares.
- $\sum IncomeCrop_{hh}$: vector of indicator variables capturing whether the farm has income from selling various crops. The types of crops reported are maize, cassava, sorghum, rice, millet, sunflower, groundnuts, soybeans, seed cotton, Irish potato, tobacco (virginia and burley), beans (mixed and velvet), sweet potato (white and orange), and paprika.
- $\sum IncomeLivestock_{hh}$: vector of indicator variables capturing whether the farm has income from selling various types of livestock. The types of livestock reported are cattle, goat, pig, sheep, and chicken.

The estimations for models (1), (2), and (3) are specified in Table A7 in Appendix A. As per the first regression, age, being married, number of children in the family, number of adults, number of hectares cultivated, and selling maize, groundnuts, millet, soybeans, sunflowers, cattle, goats, and pigs are positive and significantly correlated with being a member of a cooperative.

The probability of selling to the FRA is significantly positively correlated with being married, the number of hectares cultivated, selling maize and goats, and living in Eastern, Muchinga, Northern, and North-Western provinces. It is interesting that variables for whether the households sell soyabeans and rice are not statistically significant, even though those are crops purchased by the FRA to a smaller extent than maize. Variables accounting for the number of children and selling seed cotton are negative correlated with selling to the FRA.

Receiving FSP is significantly positively correlated with selling maize, rice, and pigs, and significantly negatively correlated with selling seed cotton and living in Copperbelt, Eastern, Lusaka, Northern, and North-Western provinces.

As a robustness check, we analysed whether the logistic distribution or the standard normal distribution (probit model) is better when it comes to modelling the link between the probability of selling to the FRA, receiving FSP, or being a member of an agriculture cooperative, with the regressors specified in Equations (1), (2), and (3). Although the estimations did not differ much between the probit and the logit (signs of the betas and the significance is the same under both approaches), the percentage correctly predicted using the logit specification is slightly higher than using the probit specification. For the cooperative membership, selling to the FRA, and receiving FSP estimations, the logit model predicts 72.24, 81.55, and 96.95 per cent of the cases correctly, respectively; the estimated outcomes match the observed ones in these proportions.

The simulations of selected programmes are furthermore improved by downscaling the simulated number of recipients from the number modelled to be eligible to receive the benefit to the official number of recipients (see Table A2 in Appendix A). This is the case for FSP, which is given to recipients with a high probability to receive it on the basis of the coefficients estimated using the RALS. In addition, the number of women receiving SWL and the number of children receiving KGS is reduced randomly from the level suggested based on eligibility alone, which is modelled in MicroZAMOD using the policy rules.

4.2 Policy scenarios

MicroZAMOD allows analysing the impact of the existing agricultural policies on poverty and inequality and testing how such impact changes in policy reform scenarios with different targeting schemes and how indirect taxation can be used to fund such reforms. Tables A5 and A6 in Appendix A provide details of the policy scenarios analysed in this paper.

The first set (see Table A5) focuses on the joint impact of the existing policies on poverty and inequality. We simulate counterfactual scenarios where we remove the FISP, FSP, and SCT programmes all at the same time and then one by one to calculate the joint poverty and inequality impact and that of each policy, respectively. Changes in SCT coverage also affect KGS and SWL as both target SCT households; when SCT is removed, KGS and SWL are also dropped.

The second set focuses on reform scenarios for improving pro-poor targeting of agricultural policies by increasing the budget for FSP, which is known to be more pro-poor than FISP. The detailed reform scenarios are presented in Table A6 in Appendix A:

- For the simulation 'Greater poverty impact through indirect tax reform' we created the reform scenarios:
    5. 'Increase VAT and excise duty'; and
    6. 'Generated revenue from indirect taxes to reform FSP and SCT'.
- For the simulation 'Better targeting of FISP and accompanying changes in FSP' we created the reform scenarios:
    7. 'Restricted FISP'; and
    8. 'Generate revenues from restricting FISP, to increase the coverage and benefit amount of FSP'.
- For 'Examining the role of the FRA purchase programme' we created the reform scenarios:
    9. 'FRA';
    10. 'No FRA'; and
    11. 'Part of the allocated budget to FRA, used to increase the coverage and benefit amount of FSP'.

4.3 Static and behavioural effects

The results presented include static simulations or the first-order effect of policy reforms ('overnight effect') as well as effects when behavioural responses to the policy changes ('mid-term effect') are taken into account.

Static impacts are simulated by treating monetary and/or in-kind benefits as increases in households' disposable incomes. Similarly, other direct contributions such as personal income tax, turnover tax, and social insurance contributions reduce households' disposable incomes. Since poverty in Zambia is measured using consumption,[14] we assume households consume all additional income, and hence income increases feed into consumption and subsequently reduce consumption poverty. Second, those impacts that operate via the price system (indirect taxes and subsidies) are modelled as indirect taxes that increase or reduce households' purchasing power.

[14] Consumption in the 2015 LCMS data is obtained by adding the various goods and services purchased, consumed from own production, and received as gifts (CSO 2016).

This is captured by the concept of post-fiscal consumption, which is equal to consumption after indirect tax payments.[15]

Beyond static impacts, two behavioural impacts are considered in this analysis. First, the impact of receiving input subsidy on agricultural income; and second, behavioural adjustments to changes in the received benefits. The latter is applied in the counterfactual scenarios where FISP, FSP, and/or SCT are removed, triggering behavioural response to the loss in income, in addition to the loss of the subsidy or benefit itself, namely on agricultural income.

The impact evaluation literature, reviewed briefly above, provides the quantitative point estimates for the impact of benefits on agricultural income. In the case where the household did not receive input subsidy to begin with, but does receive it in the reform scenario, the household's agricultural income is uprated with a factor based on the econometric impact evaluation literature. Agricultural income here refers to the total value of agricultural production, including sales of crops and livestock and production for own consumption. The simulation is then run again with the adjusted input data including increased agricultural income for the households now receiving the subsidy. Thus the overall impact of the policy change accounts for both the direct impact of the subsidy on consumption and the indirect impact through greater agricultural income.

In the case where the household already received a benefit, but the benefit amount is raised, we use elasticity estimates from the empirical literature, linking the percentage change in the benefit amounts to proportional increases in agricultural income. The procedure entails the calculation of the proportional benefit increase, after which agricultural incomes are adjusted accordingly using the elasticities. The final simulations of the impacts of policy changes on households' consumption and their poverty are conducted with the amended agricultural income. For the counterfactual scenarios with no FISP, FSP, and SCT, an alternative input database is created with household consumption and agricultural income that have been decreased as a reaction to removing the benefits.

We have chosen to use 20 per cent[16] as the elasticity of farm income with respect to receiving FISP benefits, and scaled up proportionally with respect to FSP, since the FSP amount is somewhat greater. Receiving SCT is assumed to raise agricultural income by a smaller amount (10 per cent), due to the fact that the benefit is not tied to agricultural use.

The impact of the FRA purchase programme is modelled as follows. According to Fung et al. (2020), producers selling to the FRA have benefited from faster income growth and poverty reduction.[17] However, there is also evidence showing that the FRA purchase programme has led to an increase in maize prices by approximately 18 per cent (Mason and Myers 2013). In the simulations the FRA purchase programme therefore increases agricultural incomes by 10 per cent among the farmers selling maize to the FRA. The indirect effect on maize prices is modelled as an implicit tax equal to 18 per cent of maize expenditure among households.

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[15] For a more detailed description of post-fiscal income, see Lustig (2018) and the SOUTHMOD modelling conventions (UNU-WIDER 2022).

[16] This represents a mid-point estimate between Mason et al. (2013) and Mason and Tembo (2015).

[17] According to their results in table 4, the poverty gap falls by approximately 10 per cent, which is the parameter used in this study; that is, if the FRA purchases are discontinued, agricultural incomes would drop by 10 per cent for those selling to the FRA.

4.4 Poverty and inequality measures

For the assessment of the targeting effectiveness, we employ coverage rates of programmes among the extreme poor—that is, the proportion of the extreme poor who receive each benefit. To analyse the impacts on poverty, we use two measures: first, poverty headcount, which is the share of the population living in poor households; and second, the poverty gap, which refers to the ratio by which the mean income of the poor falls below the poverty line and is hence a measure of the depth of poverty. All poverty-specific results are based on Zambia's extreme poverty line.

A household is defined as poor if its consumption level is below the poverty line. We use the lower-bound poverty line (or extreme or food poverty line as defined by CSO), which was K152 per adult-equivalent per month in 2015 (K149 using post-fiscal concepts[18]) and update it to 2020 using changes in prices.

All measures are based on consumption expenditure and expressed in equivalized terms using the calorie-based equivalence scale used in the country. The consumption level within the household is measured by dividing the total household consumption by the number of adult-equivalent household members.

To analyse the impacts on inequality, we use the Gini coefficient, which ranges from 0 to 1. A Gini coefficient equal to 1 indicates that one household receives all consumption. A Gini coefficient close to 0 occurs if all households have the same level of consumption. In Section 5.2, for examining 'The role of the FRA purchase programme' and 'Greater poverty impact through indirect tax reforms' we apply post-fiscal consumption also to calculate the Gini.

All results are presented for the total population as well as for population subgroups to account for the heterogeneous effect of policy changes on different groups. Table A1 in Appendix A provides detailed definitions of the subgroups. The first set is defined based on individual characteristics such as age, disability status, and living in a rural or urban area. The second set uses characteristics of the household head or other household members and applies them uniformly to all members of the household. These characteristics are the gender of the household head, income sources of the household, and whether the household cultivates land. The subgroups on income sources are not mutually exclusive given that an individual can live in a household that, for example, receives income from employment and from selling agricultural products at the same time. Table 2 provides an overview of the groups, their population share, poverty headcount, poverty gap, and Gini coefficient. It presents the starting point for the analysis and the policy impact of the reform and counterfactual scenarios.

Poverty and inequality levels are generally high in Zambia, with a poverty headcount ratio of 41 per cent, a poverty gap of 17, and a Gini of 0.54. The age groups with the highest share of households facing extreme poverty and income inequality are individuals outside of working age: the youngest and oldest age cohorts. Other groups affected by very high poverty levels are individuals who are permanently disabled and/or unfit to work (49 per cent). The extreme poverty headcount difference is highest between rural and urban households (60 per cent in rural vs 14 per cent in urban areas). This is partly driven by differences in the economic status of people living in urban and rural areas. Individuals living in a household with income from employment or self-employment fare much better than individuals living in households with income from sales of agricultural products. Regarding cultivated land area, small-scale landholders with fewer than 5 ha,

[18] When post-fiscal income or consumption is used, indirect taxes are subtracted. Hence, the post-fiscal poverty line excludes the indirect taxes inherent in the consumption basket that defines the poverty line.

representing 45 per cent of the sample, face a poverty headcount of 56 per cent, compared to farmers with 5 ha or more land, with 38 per cent. Comparing the share of individuals living in a household that cultivates land with the share of individuals living in a household with income from sales of agricultural products shows that not all households cultivating land generate market income from selling agricultural products.

Table 2: Overview of population subgroups, their population share, poverty and inequality levels

Population subgroups	Share	Extreme poverty headcount	Poverty gap	Gini coefficient
Aged 0–17	50.8	45.3	19.6	0.5226
Aged 18–24	14.3	34.4	13.9	0.5107
Aged 25–64	32.0	35.7	14.6	0.5697
Aged 65+	2.9	44.9	17.3	0.5182
With disability	2.4	48.6	18.8	0.5030
Rural	58.2	60.0	26.0	0.4287
Urban	41.8	13.7	4.7	0.4816
Female-headed	19.6	41.3	18.1	0.5345
Male-headed	80.4	40.5	16.9	0.5456
Income from employment	26.3	11.6	4.0	0.4851
Income from self-employment	49.4	30.4	12.1	0.5116
Income from agricultural sales	33.2	55.4	23.5	0.4547
Cultivates <5 ha	45.1	56.1	23.2	0.4351
Cultivates ≥5 ha	3.4	37.8	15.1	0.4594
Total population	100.0	40.6	17.1	0.5437

Note: detailed definitions of population subgroups are documented in Table A1 in Appendix A.

Source: authors' representation based on the LCMS (2015), with incomes uprated to the 2020 level, and authors' calculations using MicroZAMOD with 2020 policy rules.

5 Results

5.1 The impact of existing programmes

The first part of the analysis focuses on the current design of the programmes. The baseline scenario is simulated for the 2020 Zambian tax–benefit system; for the counterfactual scenarios, FISP, FSP, and SCT are then excluded one at a time from the system, and the simulation is run with the new tax–benefit system. The resulting poverty and inequality levels are contrasted with the baseline scenario to examine the impact of each policy on poverty and inequality.

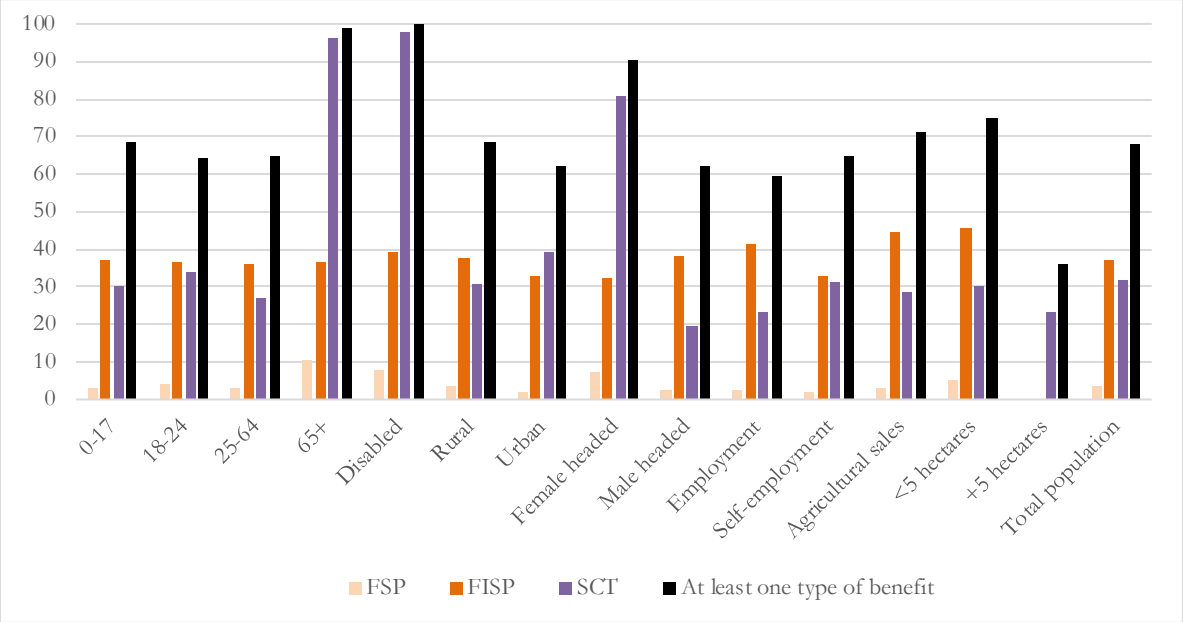
Figure 2 presents the coverage rate of the extreme poor by programme and population subgroups in the baseline scenario, or the 2020 tax–benefit system. Overall, 68 per cent of the extreme poor population live in a household that receives at least one benefit, including the programmes mentioned in Section 3 (FISP, FSP, SCT, SWL, and KGS), plus the HGSF programme and public pensions; 37 per cent receive FISP; 32 per cent receive SCT; and 3 per cent receive FSP.

The coverage rate varies greatly between population subgroups. The elderly, individuals with a disability, and female-headed households are the subgroups with the highest share of benefit recipients.

Differences in coverage rate are, of course, explained by the eligibility conditions of the programmes: FISP targets individuals living in households with fewer than 5 ha of land and being

members of agricultural cooperatives; SCT targets elderly, disabled, and female-headed households; and FSP supports elderly, disabled, and female-headed households with fewer than 2 ha of land. Additionally, the coverage rate depends on the number of households selected to receive the benefit. By design, SCT and FISP have higher budgets and are supposed to reach considerably more households than FSP.

Figure 2: Baseline scenario: coverage rate of the extremely poor by FSP, SCT, FISP, and at least one type of benefit



Source: authors' representation based on the LCMS (2015), with incomes uprated to the 2020 level, and authors' calculations using MicroZAMOD with 2020 policy rules.

In a second step, Table 3 focuses on the poverty and inequality impact of the three programmes as well as government expenditure and government revenues from direct taxes. The baseline scenario is compared to counterfactual scenarios where all three programmes as well as each programme (FISP, SCT, and FSP) in turn is excluded from the simulations—that is, when their coverage rate is set to zero. Excluding SCT from the simulation automatically excludes KGS and SWL, given that receipt of the latter two is conditioned on the household receiving SCT.

After removing all three benefits, poverty headcount and poverty gap increase by 3.1 and 3.4 percentage points, and the Gini coefficient increases by 0.02. Under the behavioural scenario, the increments in poverty and inequality are more significant due to lower agricultural production and consumption levels leading to poverty headcount and poverty gap increases of 5.0 and 5.1 percentage points, and an increase of Gini by 0.03. The fiscal impact of excluding the three programmes is similar in the arithmetic and the behavioural simulations, and reduces government expenditure by K3,000 million.

Considering each programme in turn shows that overall government expenditure levels and poverty and inequality impacts vary considerably between FISP, SCT, and FSP. Removing FISP saves the government K1,750 million but increases the poverty headcount by 3.3 percentage points when behavioural effects are included and 1.6 percentage points without behavioural effects. After removing SCT, the government saves K1,130 million, and the poverty headcount increases by 1.8 and 1.4 percentage points, with and without behavioural effects, respectively. This is not only caused by the loss of SCT but also KGS and SWL in the targeted districts. Finally, removing FSP, the government saves K65 million (without the administrative costs savings) and there is an

increase in poverty headcount of 0.2 percentage points when behavioural impacts are taken into account and 0.1 percentage points when they are not.

Table 3: Changes in government revenues and expenditure, poverty, and inequality after removing FISP, FSP, and SCT

	Behavioural effects	Government expenditure on social transfers				Poverty headcount	Poverty gap	Gini
		FSP and FISP	Child benefits**	Social assistance*	Total			
Impact of removing FISP, FSP, and SCT	Without	–1,881.60	–13.68	–1,111.49	–3,006.78	3.09	3.40	0.0203
	With	–1,881.60	–13.68	–1,111.49	–3,006.78	4.99	5.10	0.0309
Impact of removing FISP	Without	–1,748.48	No change	No change	–1,748.48	1.59	1.54	0.0093
	With	–1,748.48	No change	No change	–1,748.48	3.28	2.71	0.0169
Impact of removing SCT	Without	No change	–13.68	–1,111.49	–1,125.18	1.43	1.57	0.0094
	With	No change	–13.68	–1,111.49	–1,125.18	1.78	1.92	0.0117
Impact of removing FSP	Without	–64.52	No change	No change	–64.52	0.08	0.10	0.0006
	With	–64.52	No change	No change	–64.52	0.15	0.17	0.0010

Note: * social assistance includes SCT and SWL; ** child benefits include KGS. Government revenues and expenditures are presented in million kwacha. Poverty and inequality are measured based on consumption possibilities. Poverty changes are presented in percentage points.

Source: authors' calculations using MicroZAMOD V2.4 and the LCMS and RALS databases.

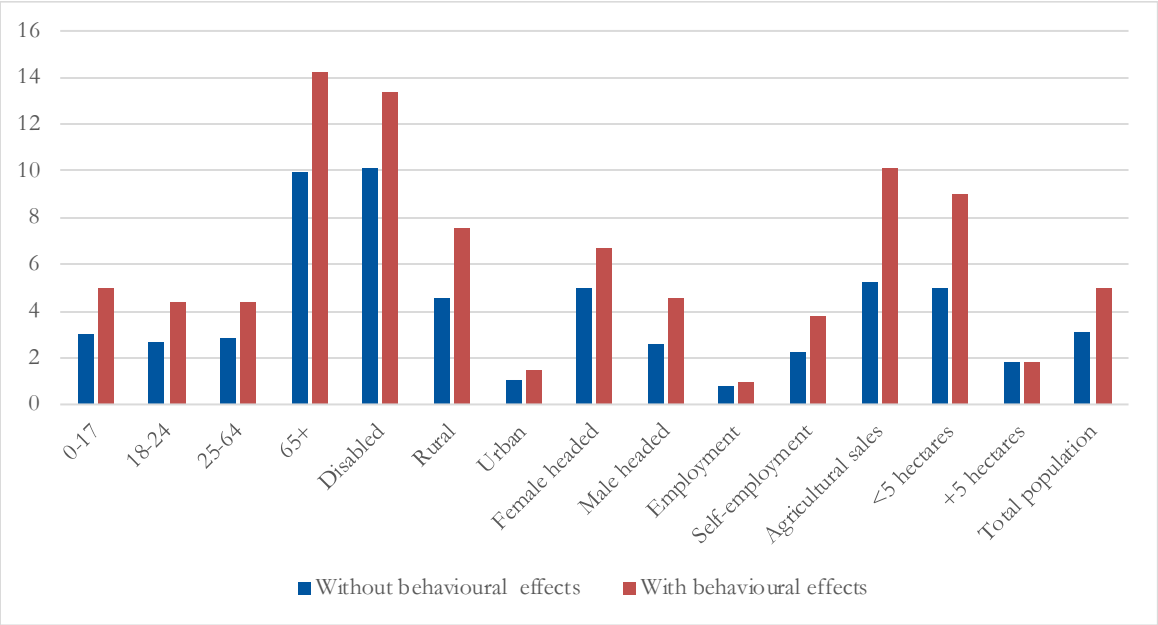
The poverty and inequality impacts of the three programmes differ by population subgroups. Figure 3 shows the combined effect of the three programmes (plus the indirect effect on SWL and KGS, which are set to zero if SWL is absent) on poverty headcount. Figures 4–6 show the isolated effect if only one programme at a time is excluded from the simulation. All four graphs present the poverty impacts with and without considering behavioural effects. Results for the poverty gap and the Gini coefficient are provided in Appendix A only, as they mostly mirror the presented results on poverty headcount (see Figures A1–A8).

When accounting for behavioural effects, the combined programmes have the greatest impact on reducing poverty for the elderly population (–14.3 percentage points) as well as individuals with disability (–13.3 percentage points), households with income from agricultural sales (–10.1 percentage points), and households with fewer than 5 ha of land (–9.0 percentage points). As in the overall results, the impact on poverty is greater than when including only static effects. The difference in poverty impacts is in general higher in the subgroups that are more likely to benefit from the programmes.

The isolated poverty effects of the programmes highlight that they often target similar groups and that behavioural effects matter considerably more for programmes with higher benefit amounts and for programmes for which the behavioural effects are assumed to be larger. Figure 4 shows that the subgroups most affected by removing FISP are the households with income from agricultural sales, households with fewer than 5 ha, and households with disabled persons, increasing their poverty levels by 7.47, 6.4, and 5.4 percentage points, respectively. Figure 5 shows that the households most affected by removing SCT are those of the disabled and the elderly, with the poverty headcount increasing by 8.6 and 7.3 percentage points, respectively. The difference between the static and the behavioural simulations is greater in the case of FISP than with SCT, since FISP beneficiaries' agricultural incomes and their consumption decline relatively more

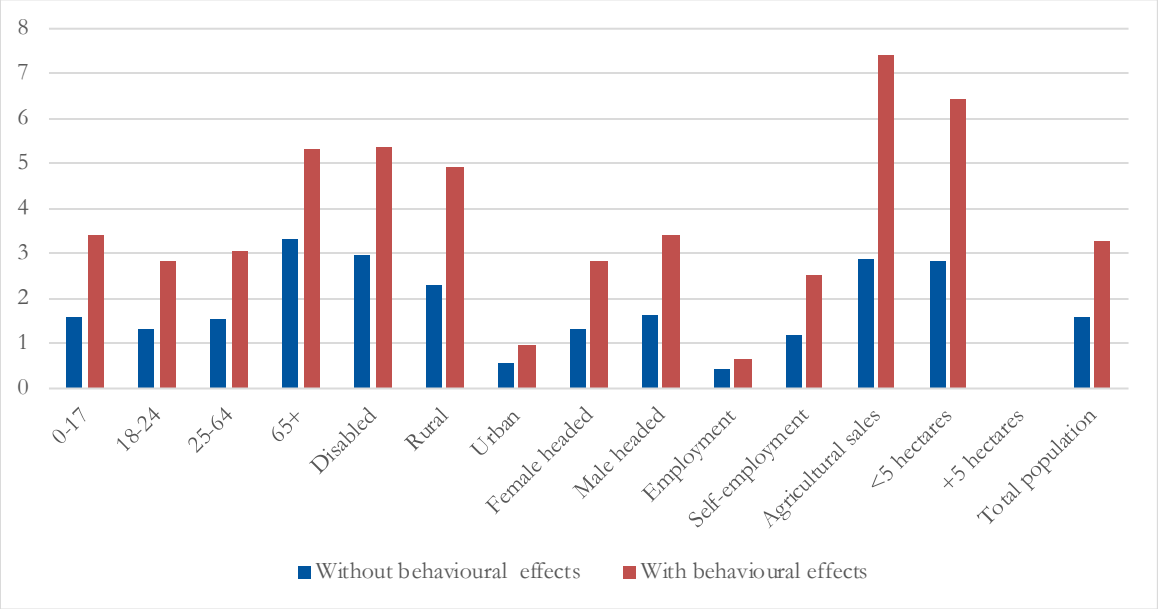
through both the loss of the direct effect on their income and the decline in agricultural income. The greatest increments in poverty levels after removing FSP occur for the elderly (0.6 percentage points), disabled (0.5 percentage points), and female-headed households (0.4 percentage points) due to all three household types being specifically targeted by FSP. Again, the impact of behavioural changes is more pronounced than after removing SCT as the loss of FSP leads to larger decreases in agricultural income and in consumption levels. Households cultivating 5 ha or more land are not targeted by either of the two agricultural benefits and hence removal of these programmes does not lead to reductions in poverty for this population subgroup.

Figure 3: Impact on poverty headcount when removing benefits, with and without behavioural effects



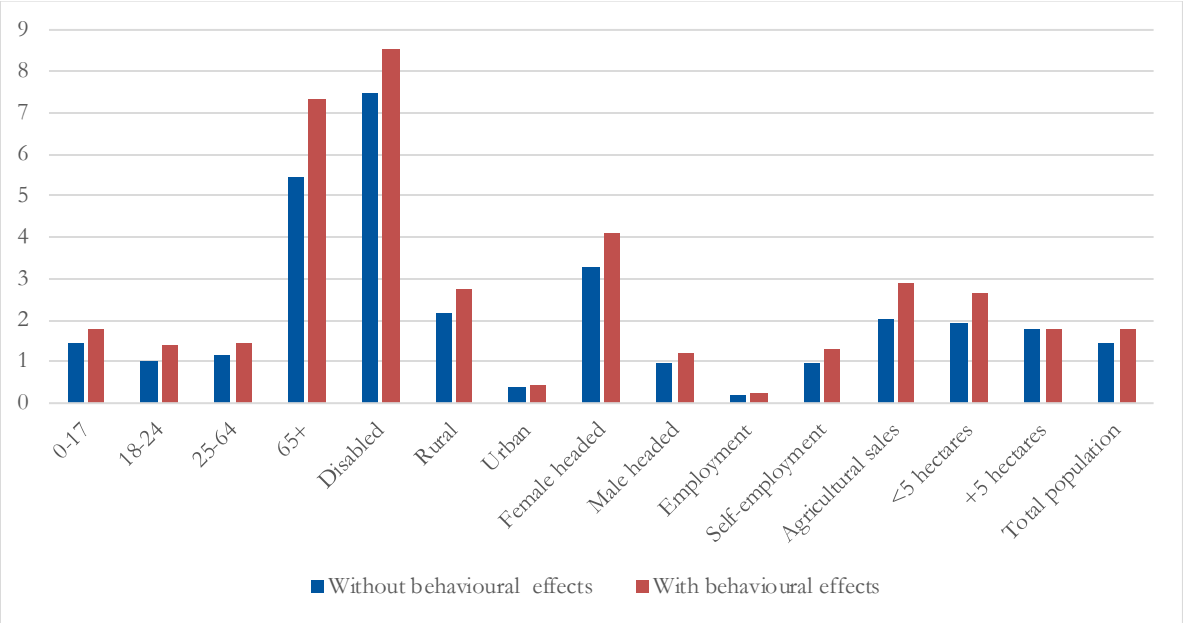
Source: authors' representation based on the LCMS (2015), with incomes uprated to the 2020 level, and authors' calculations using MicroZAMOD with 2020 policy rules.

Figure 4: Impact on poverty headcount when removing FISP, with and without behavioural effects



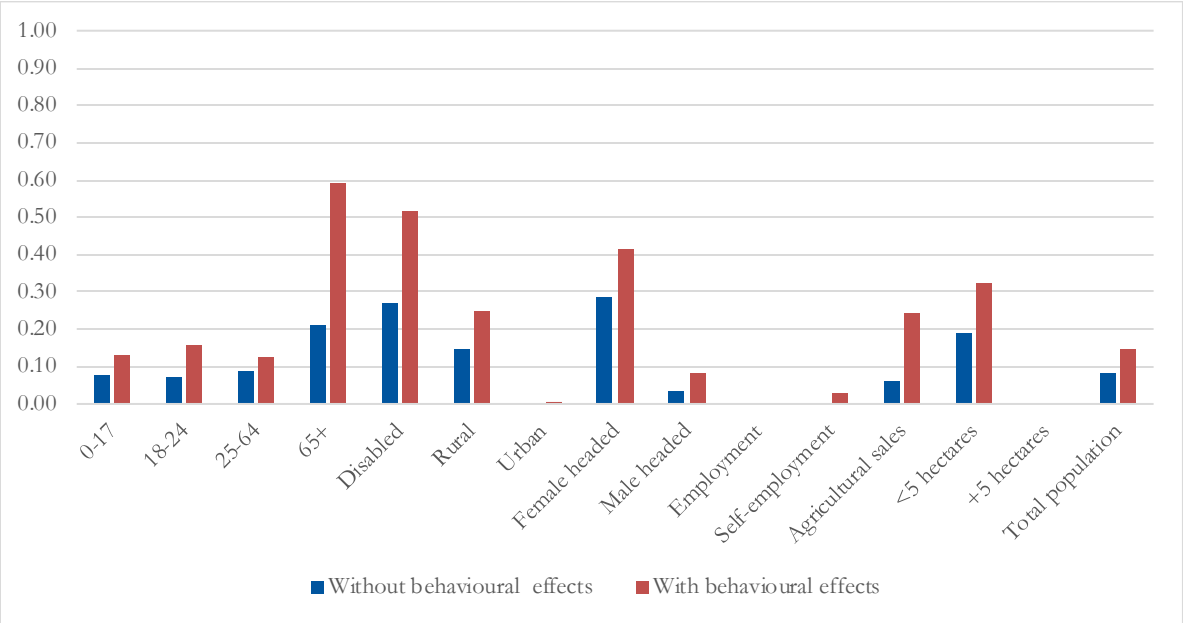
Source: authors' representation based on the LCMS (2015), with incomes uprated to the 2020 level, and authors' calculations using MicroZAMOD with 2020 policy rules.

Figure 5: Impact on poverty headcount when removing SCT, with and without behavioural effects



Source: authors' representation based on the LCMS (2015), with incomes uprated to the 2020 level, and authors' calculations using MicroZAMOD with 2020 policy rules.

Figure 6: Impact on poverty headcount when removing FSP, with and without behavioural effects



Source: authors' representation based on the LCMS (2015), with incomes uprated to the 2020 level, and authors' calculations using MicroZAMOD with 2020 policy rules.

5.2 Reform scenarios for improved pro-poor targeting

The second part of the empirical analysis focuses on potential reforms of agricultural programmes to provide a stronger pro-poor focus. Three kinds of different policy packages are considered, with the aim to generate a similar poverty reduction as the Zambian tax–benefit system of 2020 generates but with a lower net cost to the government.

Greater poverty impact through indirect tax reforms

Compared to cash transfers, achieving redistribution through indirect taxes is a comparably expensive and partly counterintuitive way to reach poor households, since the greatest monetary benefits of lower VAT rates are reaped by households that can spend more—that is, those at the upper part of the distribution (see, for example, Gcabo et al. 2019; Warwick et al. 2022). This is why we explore the poverty impacts of removing zero-rating from VAT and of generating more income by excise taxes (via raising excise rates by 10 per cent) and using the generated revenues to strengthen benefits (SCT and FSP).

Under the baseline scenario or the 2020 tax–benefit system, many goods and services are VAT-exempted—for example, health and education, books, and newspapers, as well as several agricultural and food products (Nakamba-Kabaso et al. 2020). In reform scenario 5 we test the fiscal impact and poverty and inequality effects of applying the 16 per cent standard VAT rate to the VAT-exempted items and of increasing the excise duty rates applied to alcohol, tobacco, and petrol/diesel by 10 per cent. Under reform scenario 6 (see Table A6 in Appendix A), a share of the additional revenues obtained through the indirect tax changes are then used to increase coverage and benefit amounts of SCT and FSP.

Table 4 shows that government revenue increases by approximately K5,900 million through the indirect tax reform. Since under the reform scenario all items in the consumption basket carry an indirect tax charge, taxes reduce the net purchasing power regardless of income levels. This results in higher poverty levels (+1.87 percentage points) and an increased poverty gap (+1.28 percentage points). Inequality decreases slightly, given that higher consumption households are hit harder, leading to an overall more equal distribution of consumption.

Figure 7 highlights that all population subgroups are affected by the reform of indirect taxes. Most affected are individuals living in households with more than 5 ha of land, those with income from self-employment, and urban households, increasing their poverty headcount by over 2 percentage points.

The compensatory mechanism of increasing the coverage and benefit levels of SCT and FSP requires the government to spend 32 per cent of the revenues gained by the indirect tax reform to achieve an overall neutral impact on poverty and inequality levels (see Table 4). This calculation is meant to illustrate the scale of compensation needed; other targeting options could also be considered.

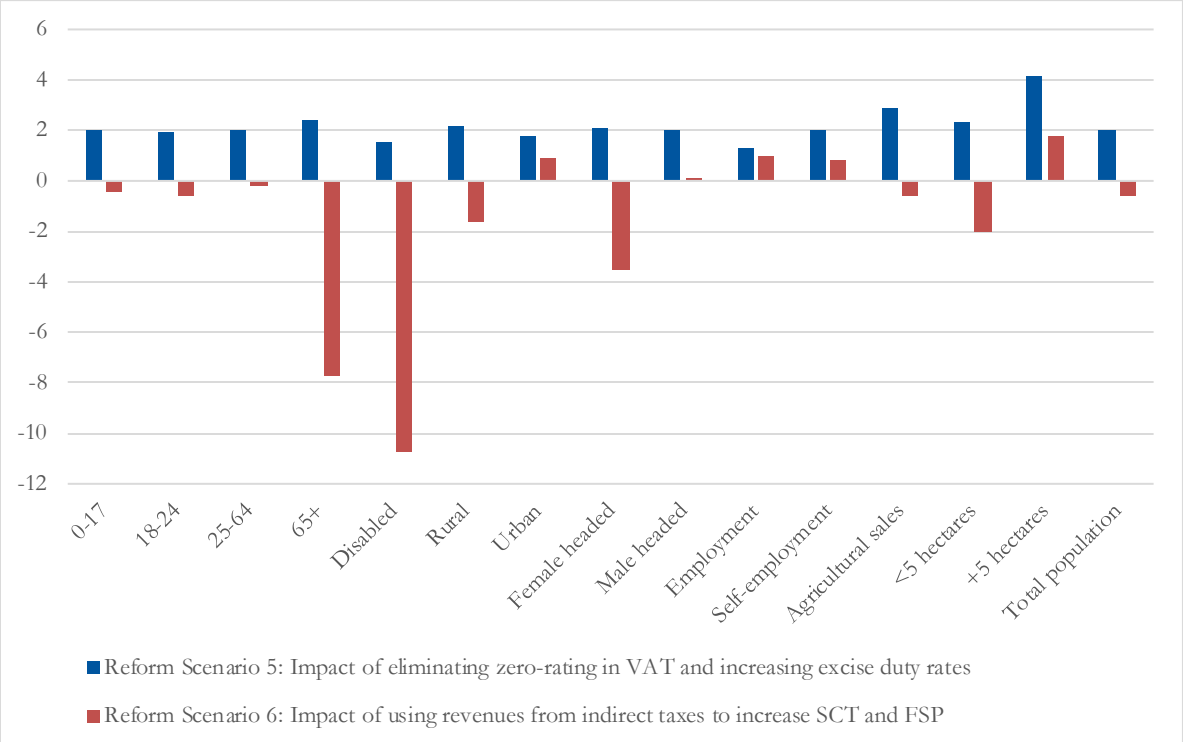
However, this only leads to a poverty-neutral reform for the population on average, while some population subgroups still show higher poverty and inequality levels as a result of the reform. This is the case for households with more than 5 ha (1.8 percentage points), urban households (0.9 percentage points), households with income from employment (1 percentage point) and self-employment (0.9 percentage points), and male-headed households (0.1 percentage points). Thus, measures aimed at fully compensating those below the poverty line for the tax increase would require additional government spending, further reducing the revenue gains from the tax increase. Winners of the reform are individuals with disability (–10.7 percentage points), the elderly (–7.7 percentage points), female-headed households (–3.5 percentage points), and households with fewer than 5 ha of land (–2 percentage points). These are also the target population of FSP and SCT in their current design.

Table 4: Changes in government revenues and expenditure, poverty, and inequality under scenario 5 and 6

	Government revenue through indirect taxes (million kwacha)	Government expenditure on social transfers (million kwacha)				Poverty head count	Poverty gap	Gini
		Child benefits (KGS)	FSP and FISP	Social assistance	Total			
Scenario 5	5,866.62	No change				2.01	1.14	–0.0024
Scenario 6	5,866.62	4.07	593.75	1,258.25	1,856.07	–0.58	–0.74	–0.0141

Source: authors' calculations using MicroZAMOD V2.4 and the LCMS and RALS databases.

Figure 7: Changes in poverty headcount by population subgroups: scenarios 5 and 6



Source: authors' calculations using MicroZAMOD V2.4 and the LCMS and RALS databases.

Geographical targeting of FISP and extension of coverage and benefit amount of FSP

The second set of hypothetical reforms focuses on the FISP. One concern related to the programme design is that households living in areas with ample private supply of inputs and who could themselves afford inputs also benefit from the programme. Thus, we simulate a reform scenario where the coverage of FISP is restricted to small-scale farmers living in districts with less access to input suppliers (scenario 7). In a second step, parts of the saved government expenditures are used to extend FSP to a larger number of households with the aim to reduce the risk of poorer farmers being hit by the changes of the FISP targeting and to increase the size of the FSP package (scenario 8).

Reforming FISP leads to fewer recipients and hence to a reduction in government expenditure of K774 million (Table 5). However, it also leads to a reduction in coverage among the extreme poor and increases in poverty headcount (0.6 percentage points) and gap (0.4 percentage points) as well as Gini (0.003). Considering behavioural effects, poverty and inequality increases are more

pronounced, given that agricultural production and consumption decrease at the same time for those households that received FISP under the baseline scenario but not under the reform scenario. This leads to poverty headcount and poverty gap increases of 1.4 and 0.9 percentage points and increases of Gini coefficient by 0.006.

To compensate these households, reform scenario 8 spends 56 per cent of the government savings from restricting FISP on increasing the coverage rate of FSP from 3.3 per cent to 8.2 per cent. Additional spending might be necessary for other components of FSP not taken into account in MicroZAMOD, as well as additional transport and storage costs.

Focusing on the pack itself, the additional spending on FSP fully compensates for the higher poverty headcount and poverty gap after reforming FISP. When behavioural effects are included in the simulation, in addition to consumption, agricultural income decreases for households that receive FISP under the baseline scenario but not under the reform scenario. Similarly, it increases for those households that were not covered by FSP in the baseline and are covered under the reform scenario. These behavioural effects lead to an only partial compensation of poverty and inequality increases: poverty headcount, poverty gap, and Gini are still slightly higher than in the baseline scenario (0.4 percentage points and 0.2 percentage points for poverty headcount and gap, 0.002 for Gini).

Table 5: Changes in government expenditure, poverty, and inequality under scenarios 7 and 8, with and without behavioural effects

	Government expenditure on social transfers (million kwacha)			Poverty headcount	Poverty gap	Gini
	FISP	FSP	Total			
Restricted FISP	–774.19	No change	–774.19	0.56	0.44	0.0027
Restricted FISP (behavioural effects)	–774.19	No change	–774.19	1.4	0.88	0.0058
Restricted FISP, higher FSP	–774.19	507.67	–266.52	–0.24	–0.18	–0.0011
Restricted FISP higher FSP (behavioural effects)	–774.19	507.67	–266.52	0.4	0.21	0.0016

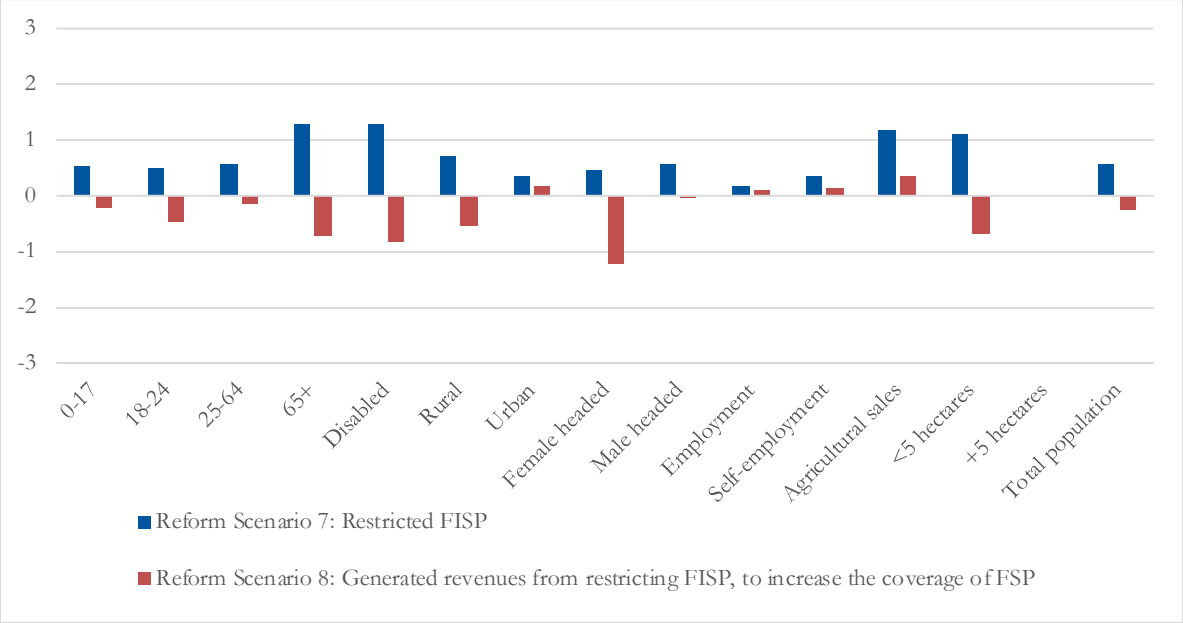
Note: poverty and inequality is a measure based on consumption possibilities. The number of beneficiaries is adjusted to the official number of recipients.

Source: authors' calculations using MicroZAMOD V2.4 and the LCMS and RALS databases.

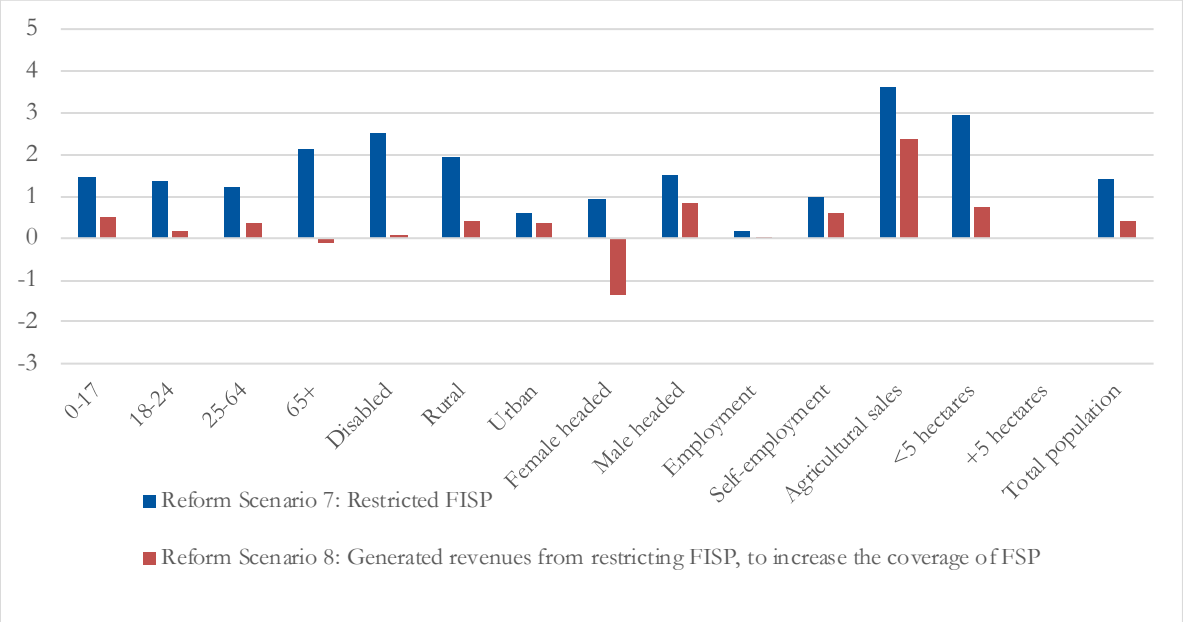
The reduction of FISP affects adversely those subgroups that are eligible for receiving it. Figure 8 shows that the highest increments in poverty headcount are to be found in households with agricultural income (1.2 percentage points), households with fewer than 5 ha of land (1.1 percentage points), and households with disabled and elderly members (1.3 percentage points). These effects are even larger after considering the behavioural effects. When changes in household behaviour are not taken into account, the increase in the poverty rate for many population subgroups is marginal or non-existent. With behavioural effects, poverty is reduced only among female-headed households (–1.4 percentage points), because a more restricted FISP programme would lead to relatively large losses in agricultural production.

Figure 8: Changes in poverty headcount by population subgroups: scenarios 7 and 8

Without behavioural effects



With behavioural effects



Source: authors' calculations using MicroZAMOD V2.4 and LCMS and RALS database

FRA purchase programme

The final set of scenarios focuses on the FRA. We analyse which of the two mechanisms—increased income among farmers selling to the FRA versus higher maize prices for consumers—have resulted in a greater impact on poverty and inequality levels by simulating a scenario where selling to the FRA is no longer an option (scenario 10). This is compared to an alternative baseline scenario (scenario 9) where the FRA is modelled through the increase in maize prizes as an implicit tax. In a second step, we test how an alternative use of the resources of the FRA purchase programme through improved FSP benefits would affect poverty and inequality levels (scenario 11).

Removing the FRA purchase programme, the poverty headcount and poverty gap increase by 0.3 and 0.1 percentage points (Table 6) due to the reduction in agricultural income for households selling to the FRA. Inequality measured through the Gini coefficient also slightly increases by 0.001. Even though under the 'FRA' scenario there is an upward pressure on maize prices, reducing the purchasing power of consumers and increasing national poverty and inequality, the effect of reducing agricultural income under the 'No FRA' scenario has a larger impact on increasing poverty and inequality. Population groups that benefit from lower price but do not sell maize to a significant extent, such as urban households, experience reductions in poverty.

Under reform scenario 11, the Zambian government spends K349 million out of the K660 million funds allocated to the FRA (Mulenga et al. 2020) on increasing the coverage of FSP from 3.3 per cent in the baseline to 8.1 per cent in the reform scenario. As shown in Table 6, the poverty and inequality increments are compensated, with a reduction to the poverty headcount and poverty gap from the baseline scenario 9 ('FRA') of 0.5 percentage points. The Gini coefficient also decreases by 0.003.

Table 6: Changes in government expenditure, poverty, and inequality under scenarios 10 and 11, using scenario 9 as a baseline

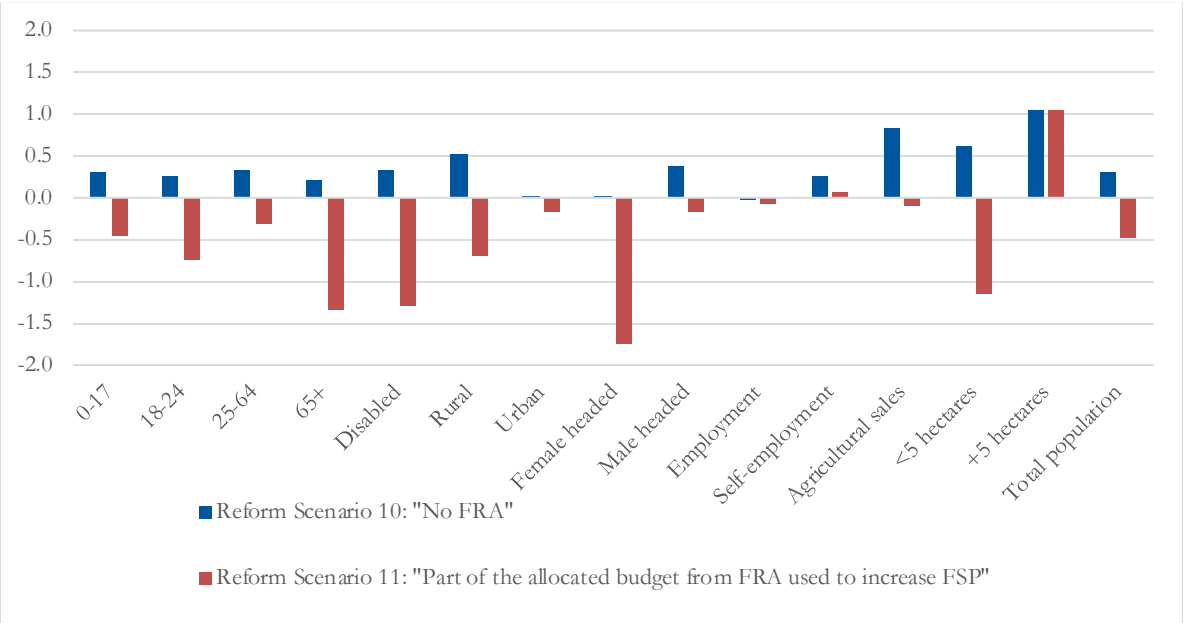
	Government expenditure on social transfers (million kwacha)	Poverty headcount	Poverty gap	Gini
Reform scenario 10	0	0.31	0.12	0.0008
Reform scenario 11	349.92	–0.48	–0.46	–0.0028

Note: results are based on post-fiscal consumption expenditure.

Source: authors' calculations using MicroZAMOD V2.4 and the LCMS and RALS databases.

Figure 9 shows that the increments on poverty from removing FRA are compensated for most subgroups except for households cultivating more than 5 ha of land and to a very small extent for households receiving income from self-employment, as about one-third of the larger-scale agricultural households also have income from self-employment. The main target groups of FSP benefit from the reform scenario: female-headed households, the elderly, disabled, and households with fewer than 5 ha of land. In this sense, the reform is successful as it reduces the poverty levels of those with the highest poverty headcount and distributes funds better to those with fewer hectares who are using the land to provide food for themselves rather than to those who have income from agricultural sales. On the other hand, increasing poverty levels of farmers with more than 5 ha implies that poverty in these groups is not negligible and restricting agricultural subsidies and benefits to small-scale farmers might not be sufficient for efforts to eradicate poverty overall.

Figure 9: Changes in poverty headcount by population subgroups: scenarios 10 and 11, using scenario 9 as the baseline



Source: authors' calculations using MicroZAMOD V2.4 and the LCMS and RALS databases.

6 Conclusions

This paper augmented MicroZAMOD, the tax–benefit microsimulation model for Zambia, with a more complete modelling of agricultural policies. The key advance was to also take into account the impacts of agricultural subsidies and social cash transfers on agricultural incomes based on earlier evaluations of impacts of such policies. The model was used to examine the distributional impacts of the 2020 system as well as investigating possible reforms in the tax–benefit system. The augmented model can be further adapted to accommodate changes in the tax–benefit system and agricultural policies and used for policy planning.

The analysis indicates that the FISP, FSP, and the SCT using the policy rules for the year 2020 lead to reduction in the poverty headcount of approximately 3.1 percentage points. When considering behavioural responses in farming practices to receiving these benefits, the poverty reduction impact is estimated to increase by a further 2 percentage points. The contribution of FISP, as a large programme, is the greatest, with an estimated poverty reduction of 1.6–3.3 percentage points, depending on whether behavioural effects are accounted for or not.

The objective of the reform simulations was testing the possibility of making the system more pro-poor, while keeping in mind the need to save government resources. Three experimental scenarios were considered. The first reform scenario involved raising indirect taxation, which was achieved by removing zero-rating in VAT and increasing the excise duty amounts and using the revenue to finance higher spending on FSP and SCT. The second reform reduced the coverage of FISP to farmers with less land and residing in areas not well served by private providers and using part of the saved resources to increase the coverage of FSP. The third scenario included discontinuing the FRA maize purchase programme, which has been shown to increase maize prices but also to improve incomes of maize producers, and spending part of the saved expenditures on expanding the FSP.

The simulation results demonstrate how the Zambian tax–benefit system can be adapted to achieve similar or greater poverty reduction with lower government net spending. However, it is important to highlight that average impacts mask significant heterogeneity. For example, when expansion of FSP and SCT are funded with indirect tax increases to reduce rural poverty, urban poverty increases. When behavioural impacts are taken into account in a scenario where FISP is retargeted, most household groups would still face, on average, higher poverty rates. Discontinuing the FRA purchase programme and compensation via FSP would benefit rural households overall, but those with larger land holdings would see poverty increases. Therefore, it does not appear to be straightforward to reduce spending while maintaining comprehensive poverty reduction in the country without making further modifications to the design of policies or being able to target the poor more accurately.

It is important to note that any envisaged reforms would need to be contrasted with broader policy objectives and involve further analysis. It needs to be carefully considered whether poverty reduction overall or in specific population groups compensates for possible negative effects and whether some groups require specific attention and other policy measures.

The results are also inevitably limited by the assumptions underlying the model. Furthermore, the model ignores the practical implementation costs of running larger benefit programmes. The point is rather to offer, and showcase the use of, a tool which the government and other analysts can use to quantify the trade-offs involved in policy reforms related to agricultural policies as a part of the overall tax–benefit system, as well as to carry out analysis of different policy scenarios.

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Appendix A: Additional tables and figures

Table A1: Definitions of population subgroups

Based on individual characteristics	
Aged 0–17	Children aged 0–17
Aged 18–24	Individuals aged 18–24
Aged 25–64	Individuals aged 25–64
Aged 65+	Individuals aged 65 and older
With disability	Individuals who are permanently disabled or/and unfit to work
Rural	Individuals living in rural areas as defined in LCMS
Urban	Individuals living in urban areas as defined in LCMS
Based on household characteristics:	
Female-headed	Individuals living in a female-headed household as defined in LCMS
Male-headed	Individuals living in a male-headed household as defined in LCMS
Employment	Individuals living in a household with income from employment
Self-employment	Individuals living in a household with income from self-employment
Agricultural sales	Individuals living in a household with income from sales of agricultural products
<5 hectares	Individuals living in a household that cultivates 0.5 to less than 5 hectares of land
5+ hectares	Individuals living in a household that cultivates at least 5 hectares of land

Source: authors' representation based on LCMS (2015).

Table A2: Overview of official vs. simulated number of recipients in 2020

Programme	Official statistics	Official budgeted number	Simulated before adjustment	Simulated after adjustment (baseline)
SCT	632,377	700,000	677,805	677,805
FISP	1,024,434	1,000,000	994,862	1,028,496
FSP	48,600	120,000	148,700	55,007

Source: authors' calculation using MicroZAMOD for simulated results. Official and budgeted numbers provided by the Ministry of Community Development and Social Services for the Cash Plus project (Gasior et al. 2021).

Table A3: Number of benefit recipients by scenario

Programme	Baseline	1	2	3	4	5	6	7	8	9	10	11
SCT	677,805	0	677,805	0	677,805	677,805	807,029	677,805	677,805	677,805	677,805	677,805
FISP	1,028,496	0	0	1,028,496	1,068,848	1,028,496	977,601	573,100	547,839	1,028,496	1,028,496	994,862
FSP	55,007	0	55,007	55,007	0	55,007	176,899	55,007	148,700	55,007	55,007	148,700

Note: when the reform implies increased FSP coverage (as in scenarios 7, 9, and 12) the number of FISP recipients decreases because of the FISP eligibility condition of 'Not currently benefiting from the Food Security Pack Programme'.

Source: authors' calculation using MicroZAMOD. The number of beneficiaries is adjusted to the official number of recipients.

Table A4: Fiscal overview by scenario

	Baseline	1	2	3	4	5	6	7	8	9	10	11
Government revenue	19,881	19,881	19,881	19,881	19,881	25,747	25,747	19,881	19,881	19,881	19,881	19,881
• Direct taxes	9,076	9,076	9,076	9,076	9,076	9,076	9,076	9,076	9,076	9,076	9,076	9,076
• Indirect taxes	4,676	4,676	4,676	4,676	4,676	10,543	10,543	4,676	4,676	4,676	4,676	4,676
• Social-security contributions	6,128	6,128	6,128	6,128	6,128	6,128	6,128	6,128	6,128	6,128	6,128	6,128
Government expenditure	3,357	350	1,608	2,232	3,292	3,357	5,213	2,583	3,090	3,357	3,357	3,707
• FISP	1,748	0	0	1,748	1,817	1,748	1,662	974	931	1,748	1,748	1,691
• FSP	133	0	133	133	0	133	813	133	684	133	133	540
• SCT (incl. SWL, KGS)	1,125	0	1,125	0	1,125	1,125	2,387	1,125	1,125	1,125	1,125	1,125
• Other programmes	163	163	163	163	163	163	163	163	163	163	163	163

Note: the descriptions of the scenarios are presented in Tables A5 and A6. The total government expenditure also includes pensions and child benefits.

Source: authors' calculation using MicroZAMOD.

Table A5: Overview table: counterfactual scenarios

Simulation	Number	Scenario description	Policy changes	Changes to input data
Assess the impact of the existing policies	1	Tax–benefit system without FISP, FSP, and SCT	Benefit amount for FISP, FSP, and SCT is set to 0	When considering behavioural effects, agricultural income and subsequently consumption are adjusted downwards according to the behavioural parameters for those households who lose these benefits.
Assess the impact of FISP	2	Tax–benefit system without FISP	Benefit amount for FISP is set to 0	When considering behavioural effects, agricultural income and consumption are adjusted downwards according to the behavioural parameters for those households who lose FISP.
Assess the impact of SCT	3	Tax–benefit system without SCT	Benefit amount for SCT is set to 0	When considering behavioural effects, agricultural income and consumption are adjusted downwards according to the behavioural parameters for those households who lose SCT.
Assess the impact of FSP	4	Tax–benefit system without FSP	Benefit amount for FSP is set to 0	When considering behavioural effects, agricultural income and consumption are adjusted downwards according to the behavioural parameters for those households who lose FSP.

Note: for all the scenarios, measures of poverty and inequality are based on consumption expenditure. In the counterfactual scenarios 1–4, the FSP benefit amount is modelled using the prices of the items in the package without logistic costs. Then, the monetary value of the package is K2,420, including 10 kg cereal seed (maize, rice, or sorghum) valued at K220, 10 kg legume (beans, cowpeas, or groundnuts) valued at K200, 2 × 50 kg compound D fertilizer valued at K1,000 each, and 2 × 50 kg urea fertilizer valued at K1,000 each. For FISP, the own contribution is subtracted from the benefit amount.

Source: authors' compilation.

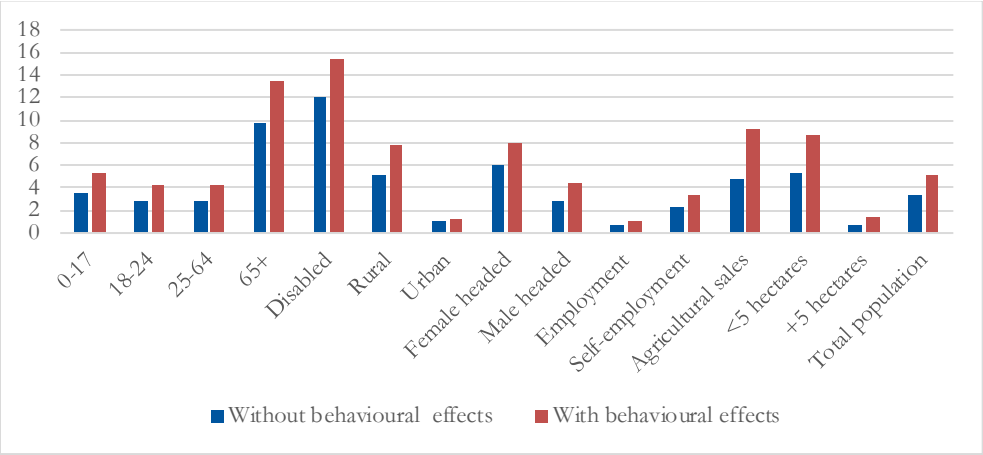
Table A6: Overview table: reform scenarios

Simulation	Number	Scenario description	Policy changes	Changes to input data
Greater poverty impact through indirect tax reforms	5*	Increase VAT and excise duty	• No items exempted from VAT. • Increase excise duty (applied to alcohol, tobacco, and petrol/diesel) to 10 per cent.	None
	6*	Generated revenue from indirect taxes used to reform FSP and SCT	'Increase VAT and excise duty' scenario, plus: • Increasing the coverage rate of FSP by removing the condition of adjusting the number of beneficiaries to the official number of 2020, and making the eligibility conditions for FSP more lenient: hectares cultivated from 0.5 to 5 instead of 0.5 to 2. This simulation is meant to compensate for the increment in poverty from the indirect tax reform, and other options in targeting could also be considered. • Increasing the coverage of SCT by raising the benchmark of the SCT 'living conditions index' score by 30 per cent • Increasing the monetary amounts given to beneficiaries of FSP and SCT by 90 per cent. • The KGS programme targets girls of second-grade school age in SCT households. Since under this reform scenario we have increased the number of households receiving SCT, the coverage rate of the KGS programme also slightly increases.	None
Better targeting of FISP and accompanying changes in FSP	7	Restricted FISP	FISP restricted to: • small-scale farmers cultivating less than 2 ha of land; and • living in districts where the fertilizer shop is more than 24 km away from their house	When considering behavioural effects, agricultural income and consumption are adjusted downwards for those households who lose FISP according to the behavioural parameters.
	8	Generated revenue from restricting FISP used to increase the coverage and benefit amount of FSP	'Restricted FISP' scenario, plus: • Increasing the coverage rate of FSP by removing the condition of adjusting the number of beneficiaries to the official number of 2020. • Increasing the FSP benefit amount by 90 per cent (from K2,420 to K4,598).	When considering behavioural effects, agricultural income and consumption for those households that used to receive FISP are adjusted downwards under the baseline scenario but not under the reform scenario according to the behavioural parameters and upwards for those households that were not covered by FSP in the baseline scenario, but are covered under the reform scenario.
Examining the role of the FRA purchase programme	9*	FRA	Represents the Zambian tax–benefit system, including the upward pressure from FRA on maize prices as an implicit tax. The sales of crops from the government under the FRA purchase programme are not modelled.	None

	10*	No FRA	None. This scenario represents the Zambian tax–benefit system (without simulating the FRA purchase programme) fed with different input database.	The employed input database accounts for the reduction on agricultural incomes and consumption for the predicted households selling to FRA.
	11*	Part of the allocated budget from FRA used to increase the FSP coverage and benefit amount	'No FRA' scenario, plus: • Increasing the coverage rate of FSP by removing the condition of adjusting the number of beneficiaries from policies to the official number. • Increase FSP benefit amount by 50 per cent (from K2,420 to K3,630)	The employed input database accounts for the reduction on agricultural incomes and consumption for the predicted households selling to FRA and increase in income for farmers that are receiving FSP under the reform scenario, but they were not receiving it under the baseline.

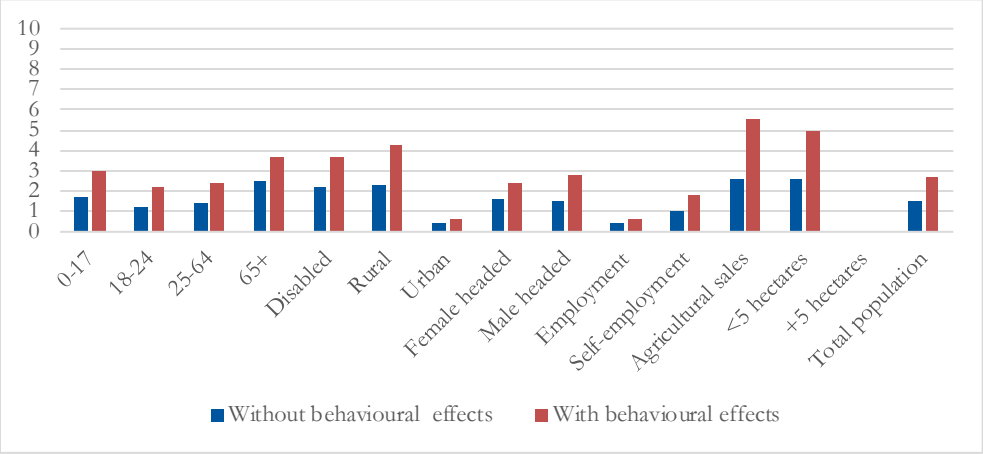
Note: all scenarios marked with an asterisk (*) are using post-fiscal consumption expenditure. All other scenarios are based on consumption expenditure.
Source: authors' compilation.

Figure A1: Impact on the poverty gap when removing FISP, FSP, and SCT, with and without behavioural effects



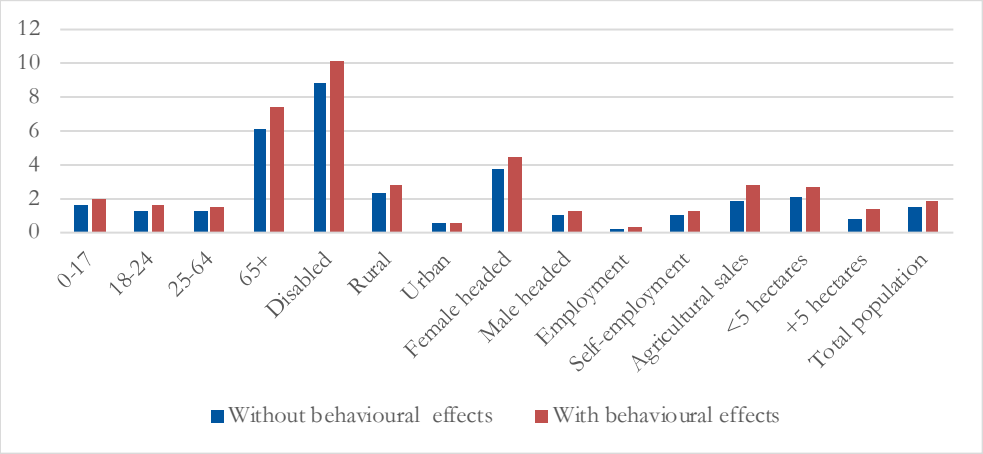
Source: authors' representation based on the LCMS (2015), with incomes uprated to the 2020 level, and authors' calculations using MicroZAMOD with 2020 policy rules.

Figure A2: Impact on the poverty gap when removing FISP, with and without behavioural effects



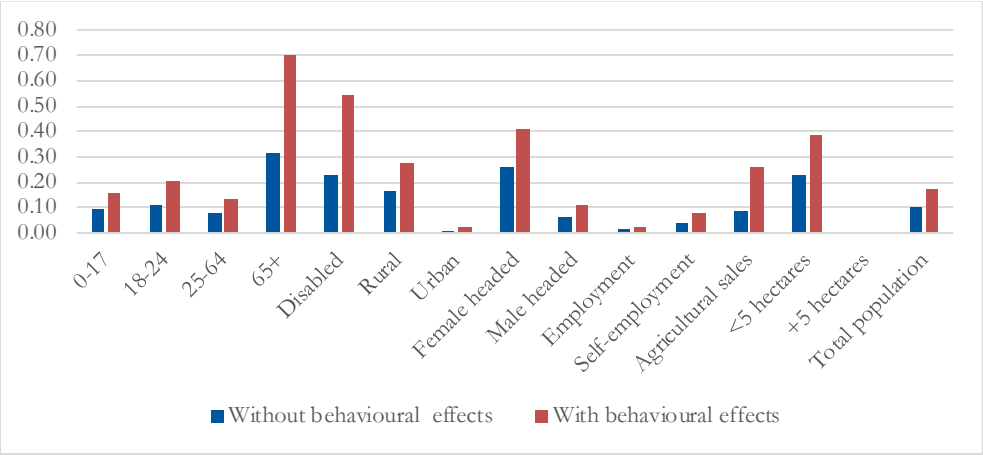
Source: authors' representation based on the LCMS (2015), with incomes uprated to the 2020 level, and authors' calculations using MicroZAMOD with 2020 policy rules.

Figure A3: Impact on the poverty gap when removing SCT, with and without behavioural effects



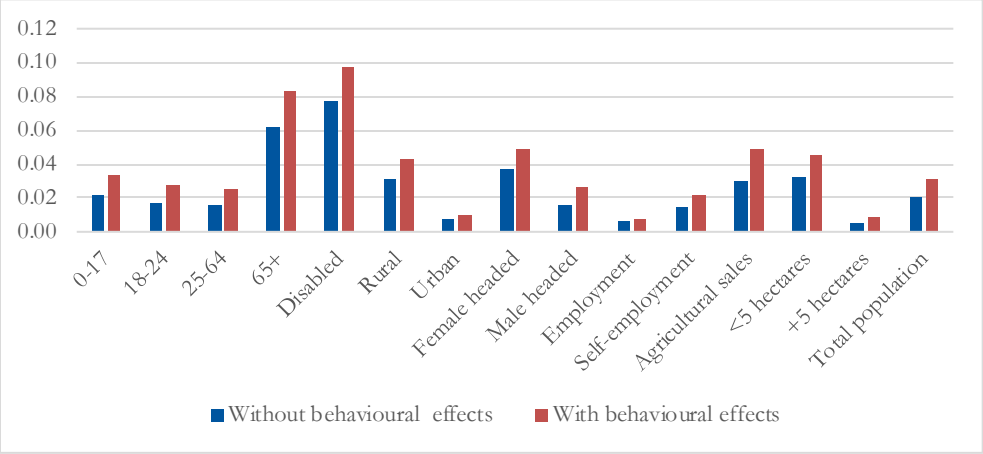
Source: authors' representation based on the LCMS (2015), with incomes uprated to the 2020 level, and authors' calculations using MicroZAMOD with 2020 policy rules.

Figure A4: Impact on the poverty gap when removing FSP, with and without behavioural effects



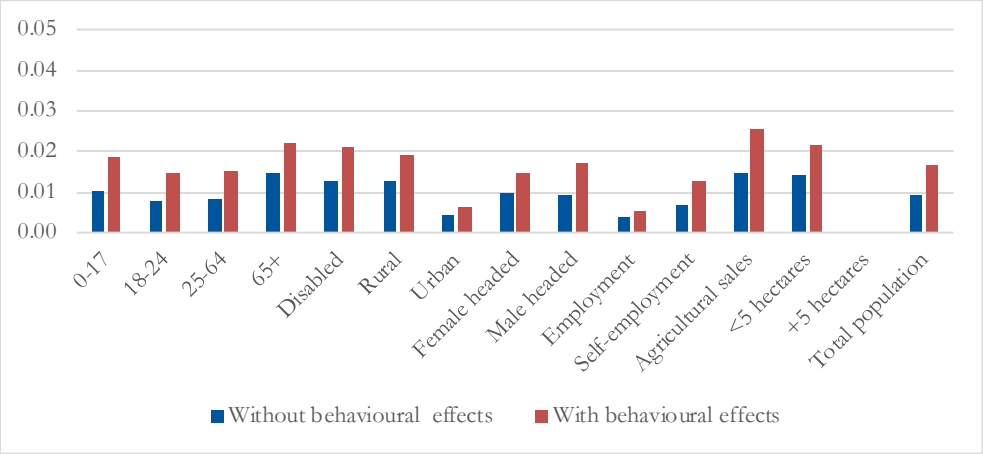
Source: authors' representation based on the LCMS (2015), with incomes uprated to the 2020 level, and authors' calculations using MicroZAMOD with 2020 policy rules.

Figure A5: Impact on the Gini coefficient when removing benefits, with and without behavioural effects



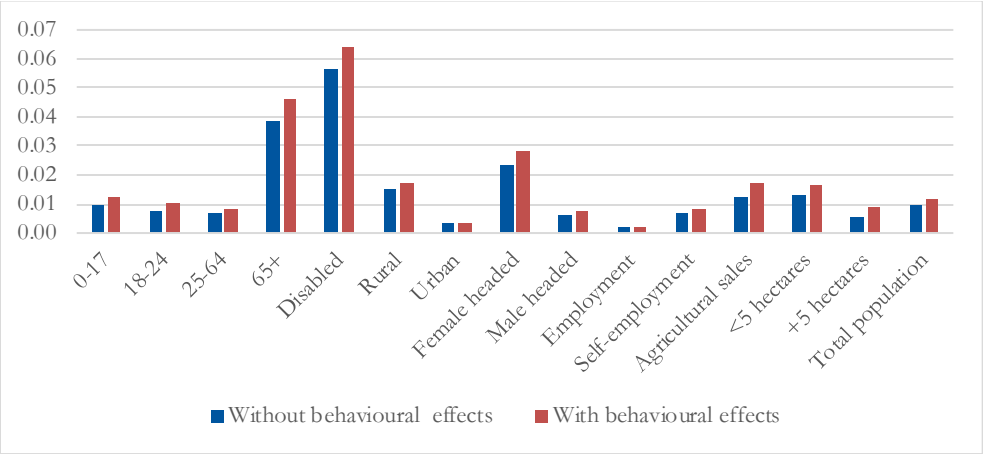
Source: authors' representation based on the LCMS (2015), with incomes uprated to the 2020 level, and authors' calculations using MicroZAMOD with 2020 policy rules.

Figure A6: Impact on the Gini coefficient when removing FISP, with and without behavioural effects



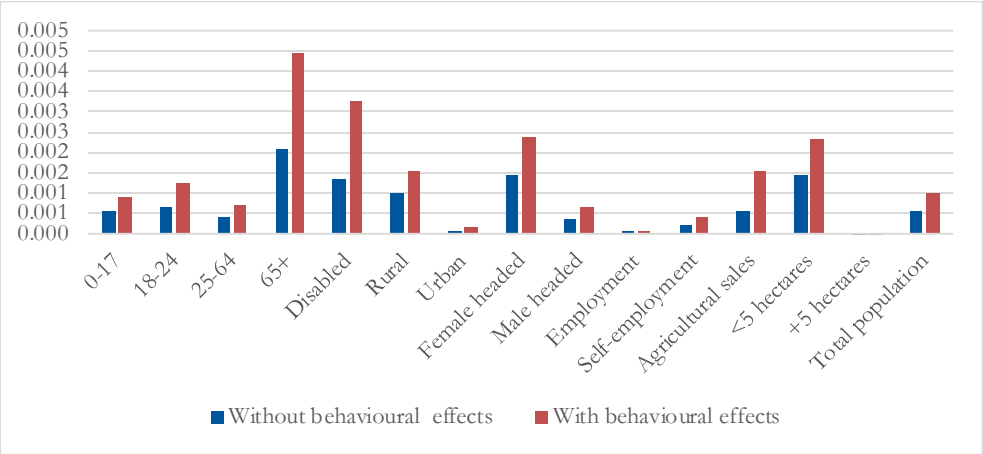
Source: authors' representation based on the LCMS (2015), with incomes uprated to the 2020 level, and authors' calculations using MicroZAMOD with 2020 policy rules.

Figure A7 Impact on the Gini coefficient when removing SCT, with and without behavioural effects



Source: authors' representation based on the LCMS (2015), with incomes uprated to the 2020 level, and authors' calculations using MicroZAMOD with 2020 policy rules.

Figure A8: Impact on the Gini coefficient when removing FSP, with and without behavioural effects



Source: authors' representation based on the LCMS (2015), with incomes uprated to the 2020 level, and authors' calculations using MicroZAMOD with 2020 policy rules.

Table A7: Logit estimations

Variables	(1) Cooperative Member	(2) Selling to FRA	(3) Receiving FSP
Male	–0.0999	–0.176	0.127
	(0.0900)	(0.132)	(0.378)
Age	0.0457***	0.00450	0.0396
	(0.00626)	(0.00826)	(0.0256)
Age square	–3.95e-06***	–4.70e-07	–3.42e-06
	(6.81e-07)	(9.00e-07)	(2.73e-06)
Pre-primary educ.	–0.127	–0.0287	
	(0.734)	(0.884)	
Primary educ.	0.117	0.0872	11.33
	(0.342)	(0.431)	(355.8)
Secondary educ.	0.209	–0.127	11.32
	(0.338)	(0.423)	(355.8)
Post-secondary educ.	0.447	–0.0137	11.63
	(0.337)	(0.421)	(355.8)
Degree	0.805**	–0.0626	11.47
	(0.356)	(0.440)	(355.8)
Master and above	0.466	0.397	11.87
	(0.363)	(0.450)	(355.8)
Married	0.270***	0.375***	–0.194
	(0.0828)	(0.116)	(0.352)
Number of kids	0.0524***	–0.0293*	–0.0230
	(0.0135)	(0.0168)	(0.0500)
Number of adults	0.0966***	0.0254	0.0505
	(0.0134)	(0.0161)	(0.0425)
Ha cultivated	0.158***	0.290***	–0.00878
	(0.0288)	(0.0336)	(0.0726)
Ha cultivated sq.	–0.00882***	–0.0135***	0.000516
	(0.00203)	(0.00235)	(0.00327)
Maize	1.485***	6.952***	0.500**
	(0.0583)	(0.709)	(0.235)
Cassava	0.0387	–0.217	0.0272
	(0.115)	(0.152)	(0.392)
Rice	–0.0121	–0.165	0.743*
	(0.152)	(0.248)	(0.404)
Groundnuts	0.322***	0.0945	0.0602
	(0.0604)	(0.0706)	(0.228)
Millet	0.261*	–0.0592	–0.399
	(0.147)	(0.160)	(0.612)
Sorghum	–0.874***	–0.541	
	(0.334)	(0.429)	
Soybeans	0.242**	0.175	–0.244
	(0.113)	(0.114)	(0.455)
Seed cotton	–0.0959	–0.407***	–0.809*
	(0.0834)	(0.113)	(0.423)
Sunflower	0.245**	–0.104	0.129
	(0.117)	(0.135)	(0.462)
Cattle	0.409***	–0.0771	–0.0871
	(0.130)	(0.133)	(0.402)
Goat	0.190**	0.215**	0.126
	(0.0930)	(0.103)	(0.320)
Pig	0.464***	0.149	0.752**
	(0.134)	(0.151)	(0.370)
Sheep	–0.272	0.145	0.648
	(0.415)	(0.400)	(1.066)
Chicken	–	–	–
Central province	1.155***	0.211	–0.619
	(0.153)	(0.237)	(0.448)
Copperbelt province	1.152***	0.112	–2.247***
	(0.154)	(0.241)	(0.770)
Eastern province	1.525***	1.145***	–0.964**
	(0.138)	(0.233)	(0.413)

Luapula province	0.642***	0.316	–0.473
	(0.150)	(0.243)	(0.408)
Lusaka province	2.156***	0.0531	–1.001*
	(0.164)	(0.262)	(0.537)
Muchinga province	1.547***	1.135***	–0.259
	(0.147)	(0.236)	(0.395)
Northern province	1.343***	0.493**	–1.714***
	(0.143)	(0.232)	(0.577)
North-Western province	1.375***	0.662***	–1.318**
	(0.155)	(0.240)	(0.550)
Southern province	1.139***	0.143	–0.516
	(0.141)	(0.235)	(0.390)
Western province	–	–	–
Constant	–4.981***	–8.827***	–16.86
	(0.426)	(0.901)	(355.8)
Observations	7,933	7,933	7,877

Note: standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Variables 'chicken' and 'Western province' omitted due to multicollinearity. 'Irish potato', 'paprika', 'tobacco', and 'beans' omitted due to lack of observations. In model (3), 'Pre-primary educ.' and 'sorghum' dropped because they predict failure perfectly.

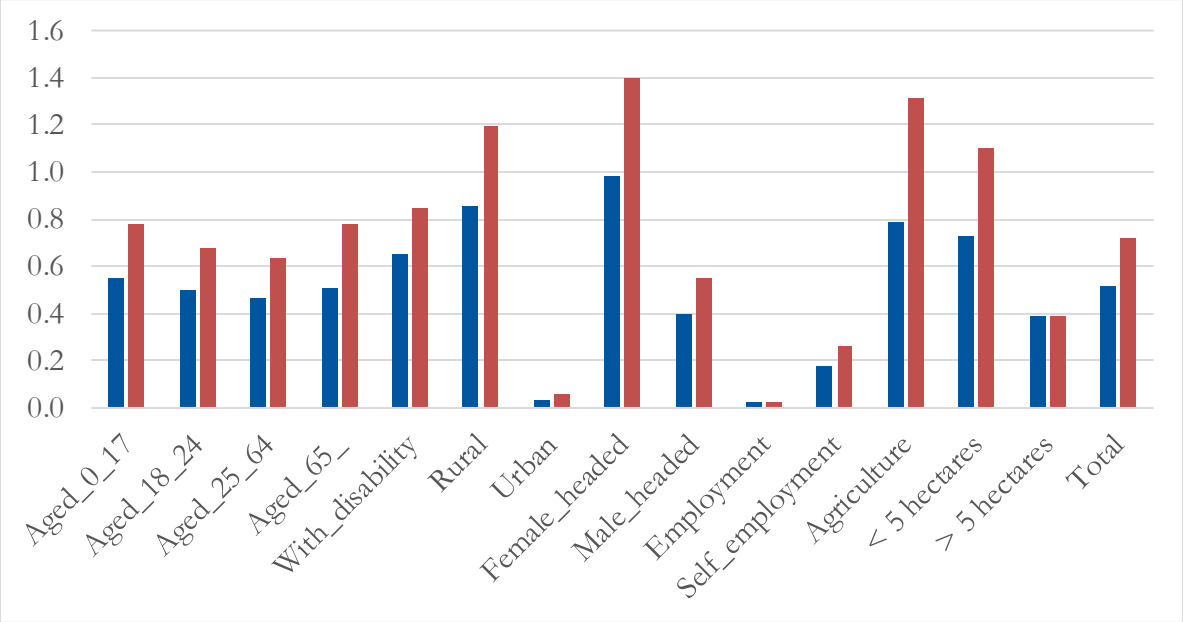
Source: authors' calculations.

Appendix B: Further simulations of the FSP

Partly because the model is underpinned by household-level data from 2015 and households' conditions may have changed, our baseline simulation—suggesting that FSP would have 55,000 recipients—does not reflect very well the latest developments. In the 2021–22 farming season, the government reached 263,000 recipients, with a further increase in 2022. We have updated the simulation model by slightly relaxing the eligibility criteria, and now our updated estimate is 292,000 beneficiaries, which is very close to the government target. This increase in the number of beneficiaries means that a larger number of low-income households receive support from the government, which works towards reducing poverty.

This policy reform implies that the poverty headcount ratio declines by 0.9 percentage points, and the corresponding reduction in the poverty gap ratio is 0.7. If one assumed that production would not react, the poverty reduction would be more muted, with the headcount ratio declining by 0.4 percentage points. The Gini index, which measures income inequality, is also slightly reduced, by –0.005 from a base of 0.54. Because of the targeting criteria, the household types mostly benefiting from the extension are rural, agricultural households with fewer than 5 ha of land (Figure B1). Female-headed households and households with elderly members also benefit relatively more.

Figure B1: Poverty reduction (positive numbers indicate a reduction in poverty headcount) by household type following a simulated increase in the number of FSP beneficiaries.



Source: authors' representation based on the LCMS (2015), with incomes uprated to the 2020 level, and authors' calculations using MicroZAMOD with 2020 policy rules.