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Published in:
Development Policy Review

DOI:
10.1111/dpr.12038

2013

Link to publication

Citation for published version (APA):
Weldegebriel, Z., & Prowse, M. (2013). Climate change adaptation in Ethiopia: to what extent does social protection influence livelihood diversification? *Development Policy Review*, *31*(Suppl. s2), o35-o56. https://doi.org/10.1111/dpr.12038

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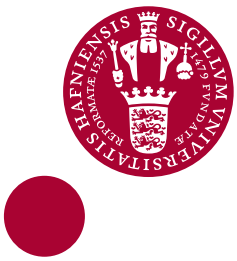

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Download date: 27. mar.. 2015

Development Policy Review, 2013, 31 (S2): 035-056

Climate-Change Adaptation in Ethiopia: To What Extent Does Social Protection Influence Livelihood Diversification?

Zerihun Berhane Weldegebriel and Martin Prowse*

Social-protection programmes like the Productive Safety-Net Programme (PSNP) in Ethiopia can play a positive role in promoting livelihoods and enhancing risk management. This article uses propensity score matching to estimate its effect on income diversification. The results suggest that receiving transfers from the PSNP, on average, did not increase farm or non-farm income but significantly increases natural-resource extraction (one component of off-farm income). While these results should be treated with caution, they suggest that the PSNP may not be helping smallholders diversify income sources in a positive manner for climate adaptation. The article concludes by arguing for the promotion of positive forms of income diversification and the further investigation of the PSNP's influence on autonomous adaptation strategies.

Key words: Social protection, adaptation, income diversification, Productive Safety-Net Programme, Ethiopia

1 Introduction

Climate change is expected to have some adverse impacts on Ethiopia, particularly on the agricultural sector – a key source of livelihoods for many citizens. It could exacerbate current food insecurity: both chronic and transient insecurity are widespread and severe, particularly in the moisture-deficient North-East Highlands and pastoral areas. As these areas are likely to experience higher temperatures and less or unpredictable rainfall patterns, food security in these regions may become more precarious (Haakansson, 2009).

Addressing food insecurity is already a major policy challenge.[1] Since the mid-1980s, the country has relied on emergency interventions to meet national food deficits (FDRE,

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1. According to the Famine Early Warning Systems Network, an estimated 3.7 million people required emergency food assistance in August 2012 and a similar number accepted food aid in October 2012 (FEWS

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2005). However, such interventions were rendered ineffective due to recurrent droughts, resulting in a gradual deterioration of households' food-security status (Barrett and Maxwell, 2005). As a response, proactive food-security measures were introduced to try to break the cycle of hunger and food-based emergency assistance (FDRE, 2004). One such measure is the Productive Safety-Net Programme (PSNP), initiated by the Government of Ethiopia and a group of donors in 2005.[2] The programme is designed to address the needs of food-insecure households through 'multi-year predictable resource transfers' rather than emergency humanitarian aid. It aims to provide transfers to food-insecure populations in chronically food-insecure districts in a way that prevents asset depletion at the household level and creates assets at the community level (ibid.).

There is an increasingly recognised link between social-protection (SP) schemes and climate adaptation since both seek to reduce the vulnerability to livelihood shocks (see Davies et al., 2013). Such schemes can play a positive role in promoting livelihoods and supporting the risk-management strategies of vulnerable households. The recent drought in the Horn of Africa has shown the need to address climatic shocks better and build up the resilience of rural livelihoods. In this regard, some suggest scaling-up existing SP programmes as one response to climatic extremes (for example, Demombynes and Kiringai (2011) make this argument for Kenya). However, it is not certain how such programmes contribute to climate adaptation. For instance, recent work on the PSNP suggests that even if the programme succeeded in improving households' food security and well-being, its effects are not sufficiently robust to shield recipients against the impacts of severe shocks such as droughts (Béné et al., 2012). Coupled with projected climate impacts, this poses important questions for the design and implementation of such schemes (Davies et al., 2009; Conway and Schipper, 2011). For example, it remains unclear to what extent such schemes influence households' diversification strategies. This is relevant, given the strategic role of diversification in managing risk and its contribution to smallholders' autonomous adaptation strategies (Ellis, 2000; Barrett et al., 2001; Niehof, 2004; Prowse and Scott, 2008; Sabates-Wheeler et al., 2008; Below et al., 2012).

Our analysis here attempts to estimate the impact of the PSNP on household diversification. The data used in this study come from a household survey in 2008 in four regions (Tigray, Amhara, Oromiya and the SNNPR). The survey generated statistics on 960 households in eight PSNP districts. A multi-stage sampling procedure was followed which involved region and *woreda* selection, *kebele* selection, village selection and household selection.[3] Apart from basic household/demographic characteristics, the survey generated data on annual household income, asset value, land (owned, and/or used), household expenditure, food shortages and coping mechanisms. However, the data do not include income from labour migration and remittances (perhaps because the eight districts are not close to the areas where rural households typically migrate in search of wage labour, such

NET, 2012a). More recently, FEWS NET (2013) indicates that about 2.5 million people are food-insecure and humanitarian assistance was needed between March and June 2013 in three regions of the country.

2. The joint donor group consists of the Canadian International Development Agency, the UK Department for International Development, Development Co-operation Ireland, the European Commission, the US Agency for International Development, the World Bank, and the World Food Programme.
3. *Kebele* refers to the lowest administrative unit in Ethiopia, and *woreda* is a larger administrative classification, roughly corresponding to a district.

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as the North-Western Lowlands, the Awash Valley and major urban centres). Thus, it was not possible to assess the role of migration as a diversification strategy.

The rest of the article is structured as follows. Section 2 discusses projected climate impacts in Ethiopia, and the relevance of diversification as an autonomous adaptation strategy, and gives a brief review of diversification in the country. Section 3 describes conceptual links between SP and climate adaptation before describing the PSNP in some detail. Section 4 presents the methodology used in estimating the programme's impact, and the results. Section 5 discusses these findings, and offers some brief concluding remarks and suggestions for future research avenues.

2 Climate-change adaptation and livelihood diversification in Ethiopia

The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) indicates that the majority of countries in sub-Saharan Africa are likely to experience a higher increase in mean temperatures and greater variability in rainfall patterns than other regions this century (IPCC, 2007). Similarly, the IPCC's Special Report on Extreme Weather Events indicates that the region is 'extremely vulnerable to climate extremes' such as droughts, heat waves and floods (IPCC, 2012: 253). The report specifies a likely increase in heavy precipitation in East Africa which arguably could cause more floods. There is less confidence about drought projections because of inconsistent results.

Ethiopia expereinces diverse climatic conditions with considerable variation in altitude and location. The mean annual rainfall distribution in the country ranges from a maximum of over 2000 mm in the South-Western Highlands to a minimum of around 300 mm over the South-Eastern and North-Western Lowlands. Similarly, mean annual temperatures vary considerably: from below 15°C in the highlands to over 25°C over the lowlands (FDRE, 2007). Such variability contributes to the classification of the three seasons in the country: the dry season (*Bega*) from October to January; the short rainy season (*Belg*) from February to May; and the long rainy season (*Kiremet*) from June to September. The impact of climate change on Ethiopia can therefore be explained in terms of how temperature (which has been increasing gradually in recent decades) and precipitation (which has shown some signs of greater variability) are likely to unfold in coming decades (Conway and Schipper, 2011).

Using a multi-model dataset, the National Meteorological Agency of Ethiopia indicates that the mean annual temperature is likely to rise significantly when compared with the 1961-90 level, by a maximum of 1.1°C by 2030, 2.1°C by 2050 and 3.4°C by 2080 (see Figure 1) (FDRE, 2007).[4] Conway and Schipper (2011) concur with multi-model averages of 1.2°C in the 2020s, 2.2°C in the 2050s and 3.6°C in the 2080s. FEWS NET (2012b) also projects that most of Ethiopia will experience a greater than 1.0°C increase in temperature by 2039 if recent warming trends continue (with the south-central part of the country likely to warm most).

Turning to precipitation, the IPCC's projections indicate an aggregate 7% increase for East Africa in the last decade of this century compared to the same period in the twentieth

4. Multi-model dataset combines individual simulation models to arrive at more reliable projections (IPCC, 2007).

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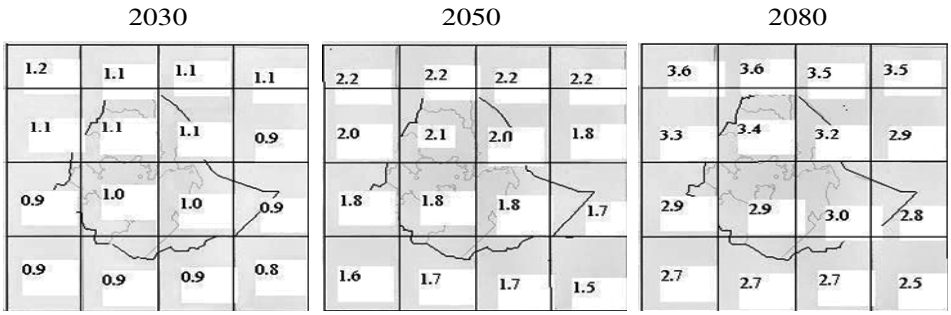
century. However, the Ethiopian National Meteorological Agency reports that the average countrywide annual rainfall pattern remained constant between 1951 and 2006 and projections suggest little change in the future (FDRE, 2007).[5] Most importantly, the impact of climate change on Ethiopia will largely be determined by the distribution of precipitation over the land surface. For instance, based on three decades of *Belg* and *Kiremet* rainfall observations, FEWS NET (2012b) highlights a 15-20% decrease across southern, south-western and south-eastern areas. This observed decline in rainfall overlaps with densely populated locations.[6] FEWS NET (2012b) particularly highlights the Rift Valley and Eastern Highlands, both of which have experienced a marked decline in rainfall. The rest of the country, and especially the Western Highland region, is likely to receive adequate amounts of rainfall which could potentially improve food security at the national level (if improved agricultural and water-management regimes are followed).

Figure 1: Composite (average of 19 Global Climate Models) change in temperature (ºC) relative to 1961-90 normal for A1B emission scenario



Source: FDRE (2007).

2.1 Autonomous adaptation to climate change

Adaptation measures in poor countries are a vital response to climate change as efforts to reduce carbon emissions are more or less bounded by tortuous political negotiations (Pielke et al., 2007). Autonomous adaptation refers to actions taken by individuals in the face of changing climatic conditions, such as a shift in rainfall, and can be contrasted with national-level planned measures that invest in technology and infrastructure across sectors (Prowse and Scott, 2008; Pelling, 2010). It involves *ex-ante* risk management, which in the livelihoods literature is distinguished from *ex-post* coping strategies. For example, Ellis (2000:45) asserts that *ex-ante* risk management refers to 'the way households respond over

5. It is uncertain how rainfall patterns will unfold in Ethiopia. The lack of robust climate simulations arises from the complex interactions of sea surface temperature, moisture sources and atmospheric particulates (Conway and Schipper, 2011).
6. Based on the assumption that observed trends in rainfall continue, it is projected that *Belg* and *Kiremet* rains will decline up to 150 mm in the most densely populated areas of western and southern Ethiopia, and across the south-central and eastern parts (affecting pastoralists and agro-pastoralists).

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the long-term adverse events, cycles and trends', while coping strategies involve spontaneous and often desperate reactions to unforeseen circumstances. Similarly, Scoones (1998:6) asserts that *ex-ante* risk management reflects 'long-term shifts in livelihood strategies while coping is temporary adjustments in the face of change'. Ellis (1998:13) states that risk management involves a premeditated decision to diversify income sources to avoid harm to household well-being in the event of income failure in one activity, whilst coping is 'ex-post consumption management in the wake of crisis'. This distinction between risk management and coping strategies is important as it frames our discussion of livelihood diversification as an adaptation strategy.

2.2 Livelihood diversification

Livelihood diversification is often defined as the process by which rural households construct a more diverse range of activities to survive and improve their standard of living. It involves the maintenance and continuous shifting of a range of activities and occupations. Diversification also refers to the balance between different sources (Ellis, 2000). According to Barrett et al. (2001), diversification is mostly measured by using income earned from different activities/sources. Income allows a clear interpretation of results as it comprises both cash and in-kind contributions to household welfare. Components include crop and livestock sales, wages, rents and remittances, as well as the consumption of own-farm produce, payments in-kind (for example, food) and transfers or exchange of items between households within rural communities or between urban and rural spheres (Ellis, 2000).

Total household income is disaggregated into categories and sub-categories which reflect the different features of the resources required to generate them, and their seasonality, accessibility and location. Clearly, within communities different households possess different entitlements to access alternative activities (ibid.). A basic division is between natural-resource-based activities and non-natural-resource-based activities.[7] Following Ellis (1998; 2000) this articles utilises the following diversification schema (see Figure 2).

Farm income: Income generated from one's own farming, whether on owner-occupied land or leased land, and includes livestock as well as crop income.

Off-farm income: Off-farm income partly refers to temporary 'wage or exchange labour on other farms within agriculture' (Ellis, 1998:5). This, in most instances, involves working on other farms for wages or other arrangements such as sharecropping or the exchange of labour in-kind. Off-farm income is strictly defined as income generated from working outside one's own farm through participating in ploughing, weeding or harvesting on another farmer's land. Moreover, as discussed by Ellis (2000), we also consider income from local environmental resource extraction such as firewood collection, charcoal production and gathering of wild fruits as off-farm income.

7. Natural-resource-based activities include collection or gathering, food cultivation, non-food cultivation (e.g. export crops), livestock keeping, and pastoralism. They also include non-farm activities that depend on natural resources such as brick making, weaving, thatching and so on (Sharp et al., 2003; Degefa, 2005). Non natural-resource based activities or income sources include rural trade (marketing of inputs and outputs), other rural services (e.g. vehicle repair), rural manufacturing, remittances (urban and international), and other transfers such as pensions deriving from past formal employment.

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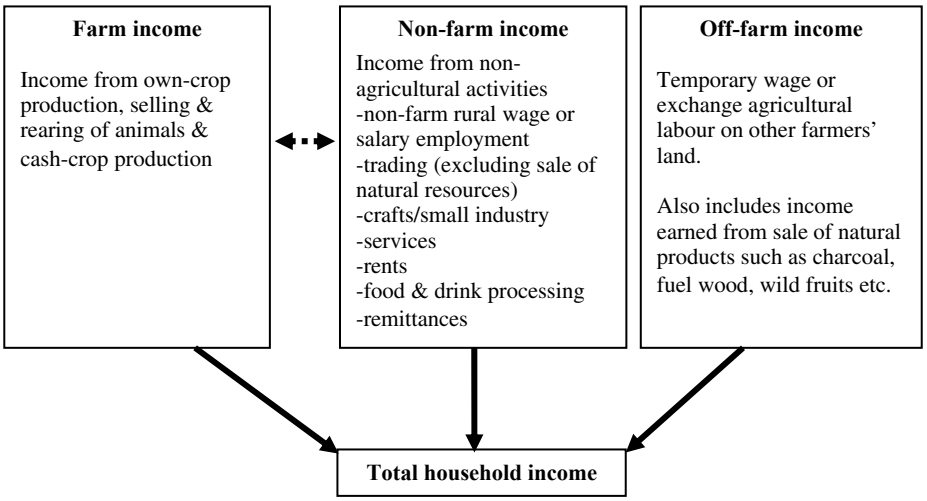
Non-farm income: According to Barrett et al. (2001), non-farm income comes from activities in secondary and tertiary sectors. It also includes salaries or remittances from formal (rural) employment (Ellis, 1998). This article uses Ellis's (2000) classification to take account of typical non-farm activities that are pursued by rural households in Ethiopia: non-farm rural salaried employment; non-farm rural self-employment (sometimes called business income); rental income obtained from leasing land or property; urban to rural remittances arising from within national boundaries; other urban transfers to rural households (for example, pension payments and international remittances arising from cross-border migration).[8]

Figure 2: Classification of income by livelihood activities



Source: Ellis (2000).

2.3 Diversification in Ethiopia

Although agriculture remains the main source of income and employment, rural non-farm income is gaining importance in most rural areas in developing countries. As a result, 35–50% of rural incomes were attributed to the rural non-farm economy in developing countries at the start of the new millennium (Haggblade et al., 2010). A figure frequently

8. Migration is recognised as one of the most important forms of diversifying income for rural livelihoods (Ezra and Kiros, 2001). However, there seems to be a lack of consistency in the terms used to classify migration in the literature. For instance, some writers consider migration as a diversification strategy in its own right separate from the categories outlined above (Sabates-Wheeler et al., 2008), while others directly or indirectly treat it as part of non-farm activities (Ellis, 1998; Reardon, 1997). For analytical purposes, this article leans towards the latter classification and treats migration as part of non-farm activities. However, and as stated above, the dataset used here does not include sufficient information on income from labour migration and remittances.

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cited for Ethiopia is 36% (Degefa, 2005), and a recent report by the World Bank estimates 25% of rural households participate in the non-farm sector (World Bank, 2009).[9]

The importance of non-farm activities in Ethiopia varies by region (Carswell, 2002) and livelihood zone (LIU, 2011). The most important source of cash income for most rural households is crop sales in the cropping livelihood zone (broadly comprising Tigray, Amhara, Beneshangul Gumuz, Gambella, South Region and the western and northern parts of Oromiya) and livestock sales in the pastoral and agro-pastoral zones (roughly corresponding to Somali and Afar). Migrant labour is common in the parts of Amhara and Tigray that were the epicentre of famines in the 1970s and 1980s. In these areas, income from migrant labour ranges between 31% and 54% of total household income. Income from non-farm and off-farm activities such as petty trading and self-employment constitutes up to 60% of households' income in some parts of the country. For instance, petty trading is significant in densely populated areas of the SNNPR. The collection of firewood and grass for fodder sales (defined as self-employment by LIU, 2011) is common in the lowlands and pastoral areas. Income from firewood and charcoal sales contributes more than 9% of total cash income in Western Tigray, Southern Amhara, Southern Afar and the southern foothills of Hararge (LIU, 2011).

2.4 Diversification and adaptation

Diversification can have both positive and negative impacts: positive if livelihoods are more secure and if the adverse impacts of seasonality are reduced (through consumption smoothing, risk reduction, complete use of available household labour and skills, and cash generation for investment). However, diversification can result in negative effects if it increases households' vulnerability (Ellis, 1998). Regarding adaptation, a common argument is that diversifying into non-farm activities is preferable to activities tied to farming (see Sabates-Wheeler et al., 2008). For example, most non-farm activities have different risk profiles from farming (such as trade, or remittances from migration) and can improve food security as they provide income during the lean seasons caused by weather variability (World Bank, 2009). For instance, the positive role of non-farm activities and income is also suggested by Bryan et al.'s (2009) study on the determinants of adaptation to climate change in Ethiopia and South Africa. Next to basic household and demographic characteristics (mainly education and age), non-farm income is identified as having the most positive effect in encouraging adaptation options in agricultural livelihoods. A more extreme version of this argument is that 'diversification within natural-resource use may be regarded as reinforcing vulnerability to climate change'(Thomas and Twyman, 2005: 118). But such a position does not take account of changing practices within natural-resource use, such as within farming.

Following a frequent distinction between diversification of necessity and diversification by choice (Hart, 1994, cited in Ellis, 1998), we define the relationship between diversification and climate adaptation in a tripartite manner. We regard increased non-farm income as positive adaptation. Secondly, we regard increased farm income as a neutral form of adaptation (as greater income from farming tells us nothing about

9. These figures are likely to include off-farm activities, as the literature on diversification lacks a standard way of classifying non-farm and off-farm activities (see Barrett et al., 2001).

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diversification or commercialisation within farming). For example, greater income from farming can either increase or decrease exposure to climate variability. Finally, by applying a strict definition of off-farm activities as temporary farm-wage or in-kind employment, as well as collection of natural resources, we consider an increase in off-farm income as an indicator of distress and therefore a negative form of adaptation. Such a categorisation is intended to assess adaptive capacity only in the very short term. Clearly, more severe medium- and long-term climatic changes easily render such a schema obsolete (Betts et al., 2011).

3 Adaptive SP and the PSNP

As highlighted above, the recent literature suggests that SP programmes can be an effective way of supporting adaptation to climate change as they can reduce vulnerability to climate-induced shocks (for example, see Bayer, 2008; Siegel et al., 2011; Davies et al., 2013). Indeed, one way in which SP can contribute to adaptation is by supporting existing strategies pursued by local people to manage risks better. For example, Johnson and Krishnamurthy (2010) indicate that conditional transfers from SP programmes in Mexico and Nicaragua have been shown to have significant impacts on household investment decisions and to encourage strategies such as migration. More broadly, safety-net measures can provide an effective means of protecting livelihoods against natural hazards.

To understand the channels through which such schemes can support adaptation, it is helpful to present Devereux's (2006:2) explanation of how SP schemes can address specific types of entitlement failure:

1. *Production-based entitlement failure*. Agricultural risks such as harvest failures or persistent food-production deficits can be the sources of production-based entitlement failure. Suitable SP responses include transfers in the form of fertiliser subsidies and starter packs. Such forms of support can increase farm income and enhance production entitlements.
2. *Labour-based entitlement failures*. Limited employment opportunities coupled with a decline in real wages can trigger labour-based entitlement failures. Possible policy responses include public works programmes as well as setting minimum wage legislation.
3. *Trade-based entitlement failure*. Market failure and a decline in the terms of trade can cause the failure of exchange entitlements. Here, pricing policies, such as food price subsidies, as well as resolving market failures can be considered.
4. *Transfer-based entitlement failure*. The failure of informal safety-nets or emergency food aid or the absence of SP can be major sources of vulnerability.

The PSNP is the largest SP arrangement in sub-Saharan Africa, with an estimated 8.3 million participants, roughly accounting for 10% of Ethiopia's population and covering the majority of the 500 districts in the country (Devereux and Guenther, 2009; DFID, 2009; MoRAD, 2009). It has two components: labour-intensive public works and direct support. Households with able-bodied adults participate in public works to enhance community assets, such as building schools, health posts and roads, before receiving the transfers. During most of 2008, the public works programme paid individuals from targeted

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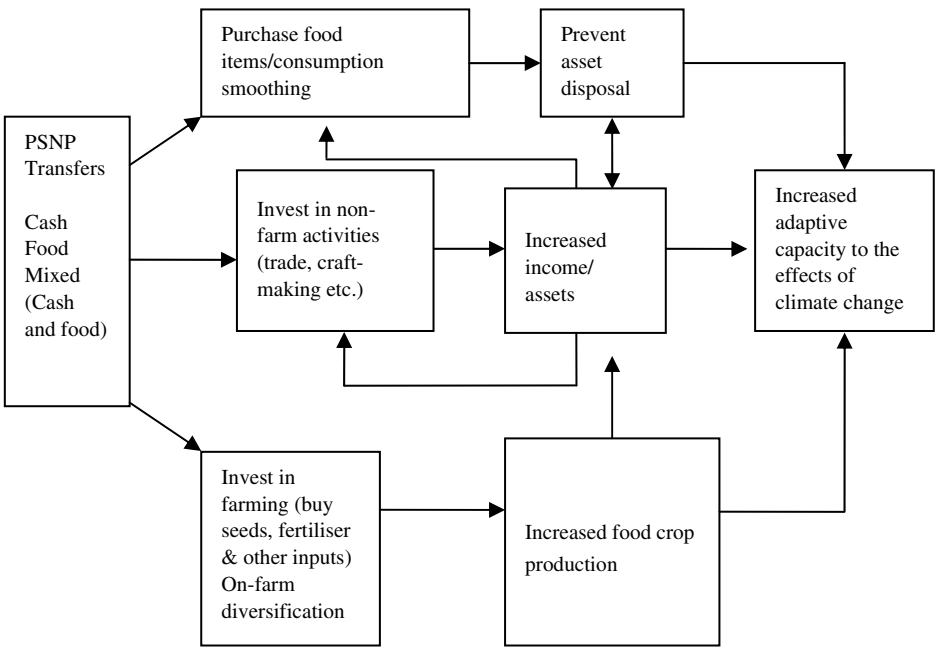
households 10 Birr per day or food of equivalent value, equating to roughly US$1 (FAO/WFP, 2009). Households with little labour (the aged, disabled, chronically ill) are exempted from public works and receive direct transfers in the form of either food or cash (FDRE, 2004). The programme is targeted to serve households identified on the basis of the following criteria (World Bank, 2011):

- chronically food-insecure households that had continuous food shortages (three months of food gap or more) in the previous three years and who had received food assistance;
- households that, in the last one or two years, suddenly became more food-insecure as a result of a severe loss of assets and were unable to support themselves; and
- households without family support or other means of SP.

The majority of the beneficiaries of the programme (86.1%) are public works participants (DFID, 2009). In this component, households are allocated a labour quota of up to 30 days of work per year. The PSNP is also designed to be accompanied by a number of food-security interventions that form the Other Food Security Programme (OFSP), including credit, extension, irrigation and water harvesting schemes (Hoddinott et al., 2009). In view of the above, the PSNP appears to be designed to address transfer-based and labour-based entitlement failures (Sabates-Wheeler and Devereux, 2010).

Figure 3: Analytical framework on possible impacts of PSNP on livelihood diversification in Ethiopia



Source: Adapted from Devereux (2002).

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Devereux and Guenther (2009) identify both direct and indirect positive effects of the PSNP on livelihoods. The direct effects are felt through improved food security, the creation of employment as well as rural infrastructure such as 'small-scale irrigation, micro-dams and soil and water conservation measures' that have the potential to increase agricultural productivity (ibid.: 9). The indirect effect largely hinges on the regular and predictable nature of cash transfers. Such transfers, they argue, raise the consumption levels of households, enhance their risk-managing ability, increase investment in agriculture and facilitate the development of rural markets. All these direct and indirect effects of the PSNP can enable households to diversify activities. Thus, income earned from participation in public works can be invested in improving and broadening one's agricultural output through intensification or extensification. Participation in the PSNP can also facilitate non-farm activities by making available a predictable stream of income that underwrites risks in small businesses. Thus, the PSNP can serve as insurance and encourage smallholders to take more risks in certain non-farm activities such as trading and craft-making (Andersson et al., 2011).[10] The possible channels through which the PSNP can impact on livelihood diversification are illustrated in Figure 3.

4 Methodology and results

As households enrolled into the PSNP are selected on the basis of predefined criteria, this rules out the use of randomisation to evaluate the programme. This article uses propensity score matching (PSM) as a quasi-experimental technique to overcome selection bias by controlling for relevant observable characteristics (Abadie and Imbens, 2006). Various comparisons made between experimental methods and PSM have suggested that PSM can produce reliable and low-bias estimates if: (i) treatment and control groups are drawn from the same data source; (ii) treatment and control groups are exposed to similar economic incentives such as access to markets; and (iii) there are enough variables that can be used to explain outcomes and identify programme participation (Heckman et al., 1998; Bryson et al., 2002; Austin, 2011).

PSM involves constructing a counterfactual comparison group in order to address the evaluation problem. It uses a probit model to generate the probability of each household participating in the programme (the propensity score). It then matches beneficiary and non-beneficiary units that have similar propensity scores. Specifically, PSM estimates the average impact of programme participation on participants by constructing a statistical comparison group on the basis of the probability of participating in the treatment T conditional on observed characteristics X, given by the propensity score: $P(X)=Pr(T=1/X)$ (Khandker et al., 2010:55).

The approach operates with the following two assumptions:

10. Moreover, the PSNP can influence household decisions on migration. For example, Johnson and Krishnamurthy (2010) mention the role of transfers in covering household and labour migration expenses during agricultural slack seasons as one way in which SP can help to promote domestic and international migration. Since migration is a major source of non-farm income in some parts of Ethiopia, it follows that the programme could promote seasonal labour migration and open up new income-earning opportunities (not least as migrants could afford to travel longer distances).

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$$E(Y_0 \mid X,\ T=1) = E(Y_0 \mid X,\ T=0), \text{ and} \quad (1)$$

$$0 < P(X) < 1 \quad (2)$$

The first assumption, conditional mean independence, is that after controlling for *X,* mean outcomes of non-beneficiaries would be identical to outcomes of beneficiaries if they had not received the programme. The second assumption is the assumption of 'common support' given by expression (2). Common support ensures there is sufficient overlap in both treatment and control propensity score distributions (Khandker et al., 2010). Units that fall outside the region of common support area are dropped.

Our analysis fulfils the conditional independence assumption by including variables in the probit model that cover the eligibility criteria for the programme (especially food insecurity) but which cannot be directly affected by programme participation (see Table 1). Moreover, in order to control certain community and district-level characteristics that might affect programme participation, such as access to markets, eight *woreda*-level dummy variables are used in the probit model. The results are presented in Table 2. They show household size, food insecurity in 2005 and annual income (excluding any transfers or payments from the PSNP) have statistically significant coefficients. Out of the eight *woreda* dummy variables, Derashe, Borcha and Enderta *woreda* dummies show statistical significance.

The assumption of common support is also fulfilled by dropping units whose propensity scores lie outside the area of overlap between treatment and control groups. Since the nature of the data used in this study is such that there are more participants than non-participants, a Kolmogorov-Smirnov test for equality of distributions for both treatment and control groups was implemented. The distribution of the final propensity scores among the treatment and comparison groups is depicted in Figure 4. All results presented are based on specifications that passed balancing tests.

Table 1: Probit estimations of variables used in the PSM

	PSNP participation		PSNP participation
Household size	-0.136*	Borcha district dummy	-0.457*
	(-2.08)		(-2.46)
Age of household head (age squared)	-0.102	Chiro district dummy	-0.328
	(-1.22)		(-1.66)
Manpower status	0.00953	Fedis district dummy	-0.309
	(0.10)		(-1.52)
Gender of household head (F=1, M=0)	0.129	Enderta district dummy	0.712***
	(0.96)		(3.39)
Household's life (in years)	0.0111	The no. of dependants in the household	0.147
	(1.76)		(1.39)
Drought shock dummy	0.0868	Dependency ratio	-0.0771
	(0.66)		(-0.83)
Flood shock dummy	0.0844	Shortage of food in 2005 dummy	0.842***
	(0.62)		(5.54)

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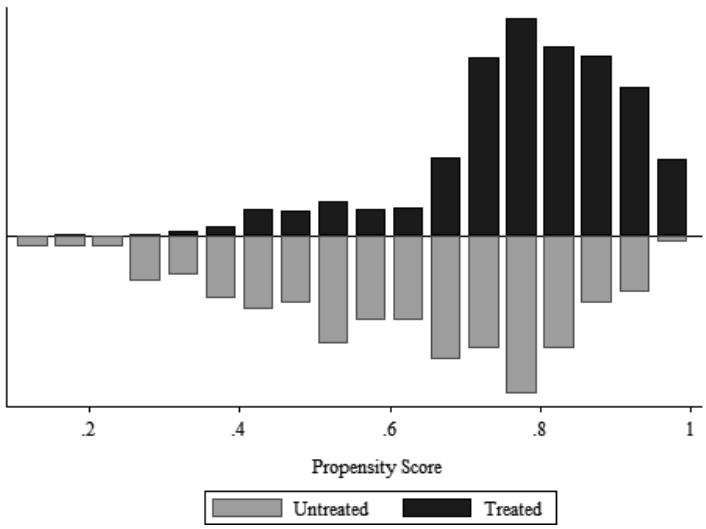
Table 1: Cont'd

	PSNP participation		PSNP participation
Highest grade completed	-0.0382	Total annual income in 2007	-0.130***
	(-1.32)	(excluding public works income)	(-3.46)
Livestock loss dummy	-0.109	_cons	1.763***
	(-0.85)		(2.94)
Bugna district dummy	-0.134	N	798
	(-0.66)		
Derashe district dummy	-1.116***		
	(-6.07)		

Notes: t statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Kalu district dummy is dropped.
Source: Authors' calculation, PSNP 2008 dataset.

Figure 4: Propensity score distribution among treatment and comparison observations



Source: Based on PSNP 2008 dataset.

4.1 Indicators of average impact of PSNP on diversification

To estimate the effect of the PSNP on household diversification, we utilise three outcome variables constructed from 45 livelihood activities that correspond with the definitions of diversification discussed in Section 2:

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1. *Farm income*. Income derived from crop production and rearing and selling of animals. This includes income earned from commercial woodlots and beekeeping. We regard increases in farm income as a neutral adaptation strategy.

2. *Off-farm income*. As indicated, this article follows Ellis's (2000) categorisation and considers income from temporary wages or exchange of labour on another farmer's land, and from the sale of natural products, as off-farm income. It is viewed as an indicator of distress and a negative adaptation strategy.

3. *Non-farm income*. This includes income earned from salaried employment, trading, crafts/small industry, services and food and drink processing. It is viewed as a positive adaptation strategy. Income from remittances and migration are not included. Income from public works is separated from other non-farm income sources.

Table 2 shows that the amount of income derived from farm activities exceeds other types of income (45%). The contribution of non-farm income (19%) to total household income is less than from public works (30%). This figure for non-farm income is also less than national estimates. Off-farm income constitutes the remaining 6%.

Table 2: Summary of rural income data, 2008

Source of income	Mean annual income (Birr)	Share of income from total (%)
Farm	1269.95	44.8
Off-farm	172.4	6.1
Non-farm	549.14	19.35
Public works	846.1	29.8
Total	2837.5	100

Source: PSNP 2008 dataset.

The analysis utilised three matching methods: Nearest Neighbour Matching; Radius Matching and Kernel Matching. Nearest Neighbour Matching links each treatment unit to a comparison unit with the closest propensity score (which is then unavailable for further matches). Radius Matching links each treatment unit with a number of comparison units within a pre-defined radius of the treatment unit, and uses the mean figure of these comparison units. Kernel Matching again links each treatment unit with a number of control units within a pre-defined radius, but this time each unit within this radius is allocated a weight inversely proportional to the distance from the treatment unit when the mean figure is calculated.

In order to check the robustness of the mean estimates, Direct Nearest Neighbour Matching (Direct NNM) was also performed. This is a non-parametric estimate which does not need to rely on the probit model used in estimating the propensity score (see Gilligan et al., 2009).[11] In the following section, both the PSM and Direct NNM results are reported on each of the outcome variables.

11. The method shares the assumptions of conditional mean independence and common support.

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4.2 Results

The PSM estimators suggest that, on average, the PSNP is likely to decrease farm income. The three matching methods show a range of 36.5% to 44.7%, with the Kernel estimate significant at the 10% level. Direct NNM also suggests that the average estimated impact of the programme on farm income is negative (see column 3 of Table 4), and that it decreases farm income by 61.3 %, significant at the 5% level.

Table 3: Average impact of the PSNP on income diversification

Matching method	Estimated impact on diversification outcomes				
	Farm income	Non-farm income	Off-farm income	Sale of natural resources	Temporary agricultural labour
ATT(Nearest neighbour %)	-36.5	-4.5	21.6	43.7****	-20.0
N treated	643	643	643	643	643
N control	152	152	152	152	152
Standard error	0.325	0.396	0.217	0.126	0.181
t	-1.124	-0.113	0.997	3.454	-1.103
ATT (Radius%)	-37.2	-29.9	39.0**	34.2***	4.8
N treated	344	344	344	344	344
N control	154	154	154	154	154
Standard error	0.293	0.359	0.192	0.128	0.147
t	-1.269	-0.833	2.032	2.662	0.328
ATT(Kernel%)	-44.7*	-17.9	26.7	33.6***	-5.5
N treated	643	643	643	643	643
N control	215	215	215	215	215
Standard error	0.232	0.331	0.169	0.111	0.123
t	-1.927	-0.542	1.580	3.028	-0.444

Note: Statistically significant at the * 10%, ** 5% , *** 1% and **** 0.1% level.
Source: Authors' calculations, PSNP 2008 dataset.

Importantly, the lower farm income among participants could be explained by the lack of certain variables in the matching procedure. For example, since the PSM did not take account of crucial assets such as landholding size and draft power such as oxen, the result could reflect their absence, as such assets are crucial in determining farm production. These results on farm income need to be interpreted with caution. According to our schema, where an increase in farm income reflects a neutral adaptation strategy, the reduction in

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farm income presented is neither a weakening nor strengthening of adaptive capacity: what is more important is the nature of agricultural production.

The PSM matching methods also suggest a reduction in non-farm income ranging from 4.5% to 29.9%, but these reductions are not statistically significant. The Direct NNM estimates show annual non-farm income is reduced by 37.9%, but again this is not significant. These findings suggest that the PSNP may not be supporting positive adaptation into non-farm activities, despite the intention of promoting livelihood diversification by making predictable and regular transfers available.

The impact of PSNP participation on off-farm income is found to be positive and ranges from 21.6% to 39%, with the Radius estimate significant at the 5% level. Direct NNM shows an increase of 8.6% but without significance. However, when off-farm income is broken down into income from temporary wage labour and the collection and sale of natural products, the results are much more striking. They show an increase in income from the sale of natural resources from 33.6% to 43.7%, significant from the 5% to 0.1% level for all matching methods including Direct NNM. Income from agricultural wage labour showed mixed results with no significance.

Table 4: Average impact of the PSNP on income diversification: Direct Nearest Neighbour Matching

	(1) Annual farm income	(2) Annual non-farm income	(3) Annual off-farm income
SATT	-0.613*	-0.379	0.0859
	(-2.26)	(-0.97)	(0.34)
N	798	798	798

Notes: t statistics in parentheses; * $p < 0.05$.
Source: ibid.

Table 5: Effect of PSNP participation on beneficiaries' off-farm income: Direct Nearest Neighbour Matching

	(1) Income from sale of natural products	(2) Income from agricultural wage labour
SATT	0.398**	-0.290*
	(2.08)	(-1.65)
N	798	798

Notes: *t* statistics in parentheses;* $p < 0.10$, ** $p < 0.05$.
Source: ibid.

5 Discussion

Recent studies show that even though the PSNP has been effective in protecting people from hunger, it has not brought any lasting impact on promoting livelihoods (Devereux et al., 2008; Devereux and Guenther, 2009; Gilligan et al., 2009; Andersson et al., 2011). For

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instance, Andersson et al. (2011) found that participation in the PSNP does not appear to help households when they are faced with major climatic shocks, since households tend to sell livestock because of a lack of alternative income sources. Similarly, Devereux and Guenther indicate that during critical shocks, or during the hungry season, the PSNP does not seem to keep many households from selling productive assets (as the small transfers and late deliveries do not meet households' needs). Our results concur with the argument that the PSNP may protect households in the short term, but is not building resilience to risks in the longer term.

Our results suggest that the PSNP is not promoting investments in agriculture. These results are broadly consistent with previous studies. For instance, Devereux et al. (2006), using a 2006 PSNP dataset that generated information from the same households, indicate that cash transfers had limited impacts on on-farm investment in terms of the purchase of inputs. For instance, they state that out of 768 participants surveyed in 2006, 11.5% used cash transfers to purchase seeds while only 3.4% purchased fertilisers.[12] Moreover, the lack of increased farm income shown in our analysis could also be explained by demand for household labour in public works reducing availability for other activities – the crowding-out effect (Andersson et al., 2011). Competition for labour between public works and farm activities is especially grave if the timings for both activities overlap. Some empirical evidence suggests that the PSNP can interfere with household labour for both farm and non-farm activities (for example, see Devereux et al., 2006; Slater et al., 2006). A study by Devereux et al. (2008) reported this problem in Chiro, Fedis Kalu, Lasta and Kilte Awlalo *woredas* where there was a direct overlap in the timing between the agricultural work season and the provision of public works.

If the timing of public works reduces the supply of labour for other activities this might make households more dependent on the PSNP (decreasing streams of income from wider activities). In particular, since farm income is often a crucial determinant of investment in non-farm activities (as it often provides start-up capital, see Woldehanna, 2002), a reduction in farm income could influence the ability to diversify.

Our results do not provide any evidence of positive adaptation into non-farm activities. Similar findings have also been reported in Devereux et al.'s (2008) study where only 2% of PSNP beneficiaries invested in business activities, compared with 16% who used the cash transfer to pay off debts. Possible factors for the lack of investment in non-farm activities include the existence of entry barriers through a lack of skills, the small amount of cash transfers, as well as high food prices and inflation in the Ethiopian economy at the time of the survey (Kebede, 2006; Devereux et al., 2008; Sabates-Wheeler and Devereux, 2010). There is also the clear possibility that if the PSNP is not stimulating greater levels of farm income, there is neither the start-up capital nor the requisite level of demand to support non-farm rural enterprises.

The difficulty for SP schemes such as the PSNP in stimulating diversification into non-farm activities in coming decades is two-fold. First, the influence of climate impacts on demand. It is fair to say that diversification into non-farm activities will occur to the greatest extent when demand for goods and services at the end of agricultural cycles is regular. However, the only certainty regarding climate change is increased variability of

12. Devereux et al. (2006) suggest that the main reasons for such low investment in agriculture include the low value of cash transfers and the increasing cost of food items (leaving little for investment).

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temperature and precipitation, implying that agricultural growth patterns, and demand more broadly, will become more capricious. To what extent are SP schemes able to ameliorate the problem of fluctuating and unpredictable demand for non-farm goods and services?

Second, how can diversification into non-farm rural enterprises be supported without relying on increases in farm incomes as a driver? Smallholder-driven agricultural growth is assumed to increase demand for goods and services, as smallholders are assumed to use locally-hired labour, and distribute income within nearby locales, thus creating multipliers. But would such multipliers also occur from alternative sources of growth? Migration and remittances, trade and wage employment offer alternatives, but to what extent can these income streams be realised at scale? And if so, how can they be supported by the PSNP?

A further key finding from our analysis is the surprising and striking increase in off-farm income from natural-resource collection. Whilst households generate only 6% of income from off-farm sources, the recourse to natural-resource extraction can only be interpreted as a negative adaptation strategy and one that may increase households' vulnerability in the longer term. It is well known that environmental resources can make a significant contribution to the incomes of poor households and at times serve as safety-nets (for example, Cavendish, 1999; Reddy and Chakravarty, 1999).[13] These results suggest the programme may be perpetuating dependence on activities that can aggravate environmental problems such as deforestation and land degradation, thus undermining longer-term agricultural productivity.

6 Conclusion

Following the 'adaptive social protection' framework discussed by Davies et al. (2013), it can be argued that the PSNP should strive to meet the following two conditions if it is to contribute to climate-change adaptation: (i) a focus on transforming productive livelihoods along with protecting households; and (ii) a long-term perspective that takes into account the changing nature of shocks and stresses. The first condition suggests that the programme could shift more attention from livelihood protection to helping households to invest in productive ventures. The second condition stipulates the need to fully incorporate climate-change risks in the PSNP or other future SP programmes in Ethiopia. Supporting climate adaptation in SP schemes requires more positive forms of income diversification than we have found in this analysis.

Finally, as in the case of every research output, the specific methodology employed is likely to influence findings. Extending this work could help to overcome one of the inherent trade-offs when using quasi-experimental approaches: that in attempting to eliminate one methodological problem (namely, selection bias) researchers invariably introduce others (in this case, the possible exclusion of core variables in probit models). We believe the results from our initial analysis merit further investigation. For example, triangulating panel data analysis with qualitative methods, and utilising other indicators of

13. To check the robustness of findings, authors conducted the same matching procedures with a sub-sample of public works participants. Analysis with this restricted dataset showed no significant changes for farm and non-farm income, but continued to show striking and significant increases in income from the sale of natural products for all matching methods.

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diversification, such as numbers of farm, non-farm and off-farm activities and assessing diversification within agriculture.

first submitted September 2012
final revision accepted April 2013

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