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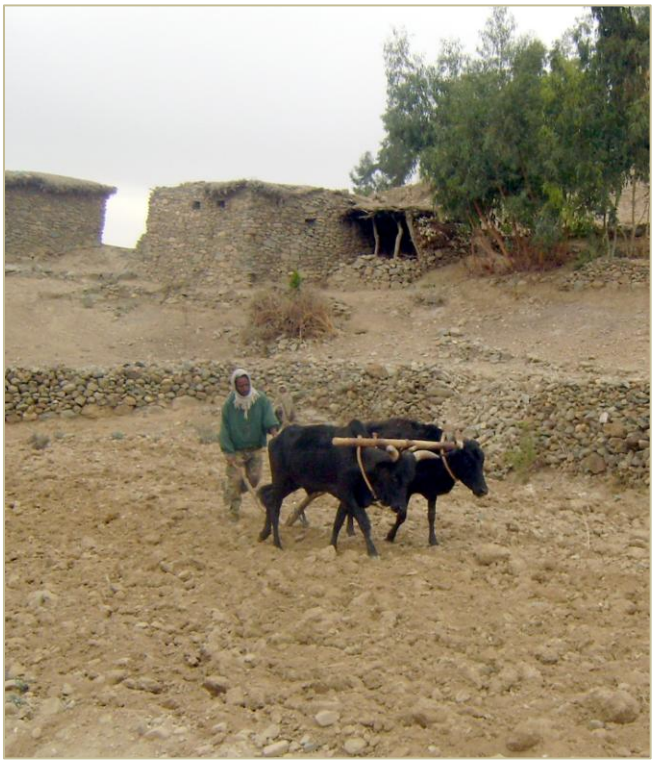

Resilience and Livelihoods Change in Tigray, Ethiopia

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October 2012

CDANR
Together for a Sustainable Development

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1. What is Resilience?

A. The Concept

Resilience is the ability of an individual, a household, a community or an institution to withstand a shock or setback of some type and recover, or "bounce back," after a setback. As such, it implies the ability to cope with adversity by adapting, learning and innovating. Resilience has become an important operational concept in chronically vulnerable or food insecure areas of the world. Humanitarian assistance or safety net programs may be able to prevent mortality or reduce malnutrition in the face of shocks or crises, but households, their communities and their institutions may still not fully recover from the effects of the shock. In a recent policy review, the UK Department for International Development (DFID 2011) defines resilience as "the ability of countries, communities and households to manage change, by maintaining or transforming living standards in the face of shocks or stresses—such as earthquakes, drought or violent conflict—without compromising their long-term prospects."

Particularly in the aftermath of major regional food security crises in the Greater Horn of Africa and the Sahel in 2011 and 2012, humanitarian and development communities alike have focused on the need to improve the resilience of affected communities, but resilience is hardly a new concept. The emphasis on resilience is multi-dimensional. At root, the question of resilience is nearly the same as the question of the sustainability of livelihoods, but with a greater emphasis on the ability to cope with—and recover from—shocks or disasters.

Just as understanding livelihoods requires an in-depth analysis of institutional and policy factors, many analytical lenses are required for a complete understanding of resilience. First and foremost, the nature of hazards or threats to livelihood security must be understood. Much of the discussion about resilience in recent times has focused on adaptation to climate change (Mercer 2010, Bahadur et al. 2011), but the hazards may be either "natural" or "man-made," and especially in the context of protracted crises, they can include both (FAO/WFP 2010). Second, the nature of livelihoods and the livelihood system must be understood (Frankenberger et al. 2012). Shocks can also be both exogenous and endogenous to the unit of measurement. Exogenous shocks, such as drought or price increases, are not influenced by the household or individual's own characteristics Endogenous shocks are influenced by the household or individual's own characteristics; for example, sickness is influenced by investments in health care or the household environment. This distinction is important when trying to address endogeneity concerns in estimation.

An equally important factor in assessing resilience is analyzing the way in which livelihoods change over time, and in response to what stimuli. Resilience is not a static concept—it implies a change over time. Embedded in the notion of resilience is the assumption that the change will be positive, but much of the empirical evidence is that the change is often for the worse. Third, factors of governance, leadership and collective action, equity, inclusion, and social cohesion are all discussed as important factors contributing to resilience (Bahadur et al. 2011, Twigg 2009). This implies an institutional analysis at both the micro- and macro-levels. Fourth, there have long been programs and policy initiatives aimed at improving

various components of resilience, and a constant challenge has been assessing the impact of these programs and policies on the enhancement of resilience.

Past programs that have focused specifically on resilience building as an objective have long fallen into something of a policy void between "development" and "humanitarian" funding streams. Livelihoods diversification, livelihoods improvement and the reduction of risk are fundamentally developmental problems, not humanitarian problems *per se*. But humanitarian agencies have long been the main intervention vehicle working in chronically at-risk areas, and humanitarian budgets were often the ones flexible enough to work in such contexts. As a result, until recently there was both a funding and a conceptual "blind spot" regarding programmatic interventions that address resilience. Every time there has been a major crisis, policy attention has turned to preventing the next one. In East Africa alone, there have been at least five major "crises" in the past twelve years—major drought crises in 1999–2000, 2002–03, 2005–06 and 2011–12, and the combination of drought and the global food price crisis in 2008. On the back of each of these crises, there has been an effort at improving resilience or reducing the likelihood of the next crisis.

Some major improvements have been achieved: probably the most significant was the development of the Productive Safety Net Programme (PSNP), a rural seasonal employment initiative aimed at creating productivity-enhancing community assets, in Ethiopia in the aftermath of the 2002–03 crisis (Devereux and Sabates-Wheeler 2006). Improved pastoral early warning systems also arose from the 1999–2000 crisis (Save the Children 2005) and improved guidelines for livelihoods response to such crises grew out of the 2005–06 drought (LEGS 2009), as did the empirical validation of the Integrated Phase Classification system (IPC Partners 2008). But it was really the PSNP that represented a major new initiative to address the question of resilience, both by guaranteeing a minimum level of food access to chronically food insecure groups (to prevent malnutrition and prevent distress sales of assets during the hunger season), and by offering livelihood-enhancing interventions (to improve longer-term opportunities) (Devereux and Sabates-Wheeler 2006).

Programmatically, resilience implies a link to both disaster risk reduction (DRR) and social protection (SP) interventions, though the two play slightly different roles. A recently launched "resilience strategy," jointly promoted by three UN agencies working in Somalia in the aftermath of the 2011–12 famine, has three pillars: (1) enhancing productivity (diversifying and intensifying productive activities at the household level); (2) improving access to social services (particularly health, education, and water, but also other services such as agricultural extension); and (3) providing predictable safety nets for social protection (conditional and unconditional transfers of food or cash to chronically or seasonally vulnerable households) (FAO/ UNICEF/ WFP 2012). Other programs emphasizing resilience may focus on improved market access or enhancing value chain inclusiveness, improved natural resource management, improved drought management and even improved conflict management (USAID 2012). Some resilience strategies tend to emphasize the safety net element, while others emphasize risk reduction. Both have improved resilience as their objective, and both focus on improvements in livelihoods.

B. Operationalizing Resilience

Academics and practitioners have yet to achieve a consensus on how to measure resilience. Only limited evidence exists that explains the determinants of households' ability to deal with setbacks. What makes households more or less resilient? DFID (2011) breaks down the analysis of resilience into three categories: exposure to a hazard, sensitivity to its effects, and the adaptive capacity to deal with shocks. An analysis of resilience thus involves an analysis of hazards in a given context, an assessment of which groups are the most exposed, and an understanding of the nature of their vulnerabilities.

Frankenberger et al. (2012), following DFID, operationalize resilience by identifying four different pathways after a shock (or *between* shocks, since recurrent shocks are a characteristic of nearly all these situations). These include an upward trajectory ("bounce back better"), a relatively flat trajectory ("bounce back"), a downward trajectory ("recover, but worse than before"), and a catastrophic decline ("collapse"). All of these imply a comparison not only with the *status quo ante*, but also some kind of pre-existing trajectory that is interrupted by a shock.

Exactly which changes should be measured is a complicated question. The conceptual framework offered by Frankenberger et al. (building on that of DFID), suggests a variety of household-level livelihood indicators and outcomes, as well as institutional factors and more conceptually complex measures such as exposure to hazards and the sensitivity of livelihoods to those hazards. At its core, resilience is measured in the trajectories of households or communities coping with setbacks, and the way such setbacks change those trajectories. Thus resilience is a dynamic measure: it is not just about measuring "outcomes," but about measuring changes in outcomes over time—and explaining those changes, particularly in light of specific programs or policies intended to enhance resilience.

Being able to track resilience is key: major programs and policy initiatives are now being developed and funded to address problems of chronic vulnerability with the aim of enhancing resilience. Monitoring and evaluating the progress of programs that attempt to address resilience, demonstrating which groups benefit from them and which do not, and seeing how livelihoods change over time, are all critical to the design and management of interventions. This study attempts to identify factors that play a role in livelihoods change—both positive and negative. But just as importantly, it attempts to pilot means of measuring resilience trajectories. Given the overwhelming focus on food security, this study examines changes—both seasonal and year-to-year—in food security outcomes. To capture the underlying changes in livelihoods, the focus is on household asset portfolios.

C. Livelihoods and Resilience: A Conceptual Framework

In this paper, we take a "livelihoods change" approach to study resilience. There are various conceptual frameworks for livelihoods analysis, but they all have several features in common. The classic approach (DFID 1999) consisted of a model that begins with assets (natural resources, physical assets, financial assets, and human and social capital) held by a household or other social unit. The model then traces the way these assets are used in various livelihood strategies to achieve certain outcomes. These strategies may be agriculture or livestock-based strategies, labor-based strategies, or trade-based strategies, and they include, for example, specific choices such as crop mix, the use or non-use of fertilizers and other inputs, the buying and selling of livestock and, critically, the allocation of labor. Outcomes include food security,

nutritional status, health, shelter, education, etc. This whole process is shaped by the "vulnerability context" (largely factors outside of human control) and by "policies, institutions and processes" (human-made factors, though outside the ability of affected households or communities to directly control). This is all conceived of—and measured—in a relatively linear way (most frameworks incorporate some feedback loops in a conceptual sense—but they are not frequently captured methodologically).

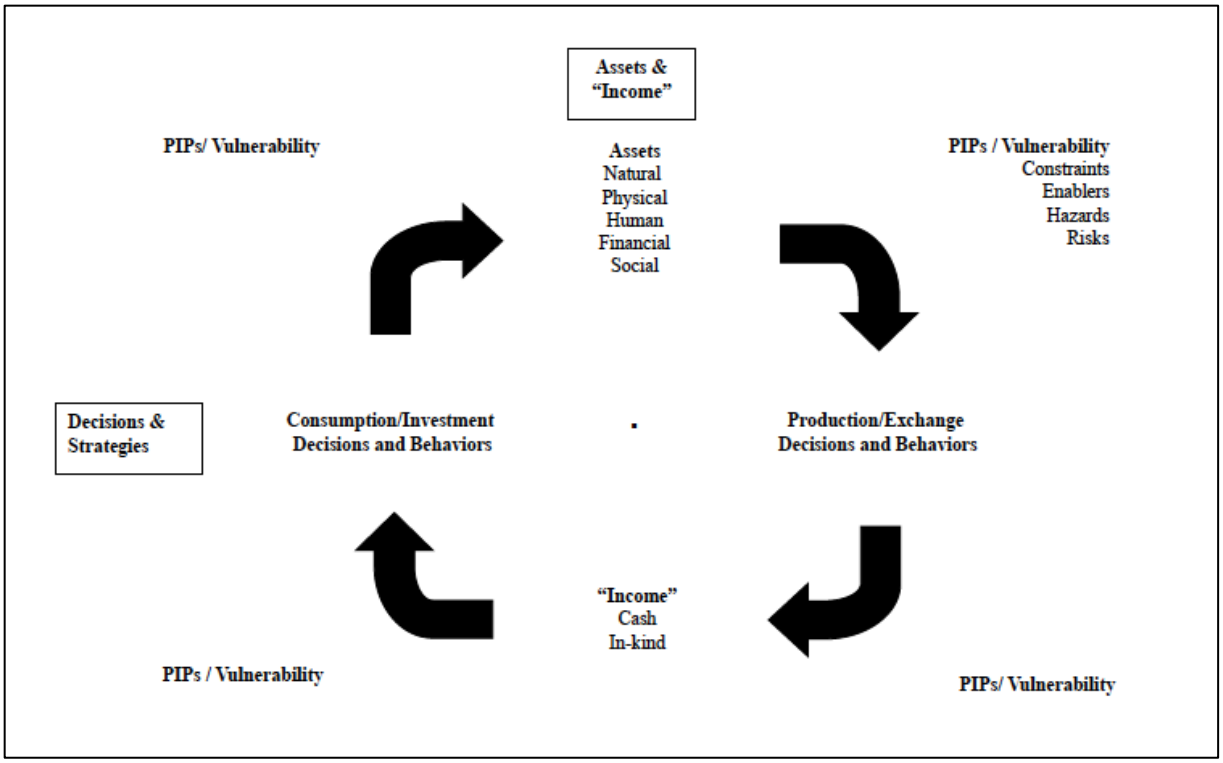
Typically, analysis considers *livelihood outcomes* such as food security and health as the objectives that people are trying to achieve. Assets and strategies are the means to the end of improved outcomes. Measures such as food security or health status reflect current conditions, but may be subject to rapid change. Other measures such as education capture longer-term outcomes and are less subject to rapid change—either positive or negative.

Most standard livelihoods analyses assess short-term correlates or causes of these livelihoods outcomes. This represents an important first step to understanding resilience itself: the ability of a household to bounce back from transient shocks to steadily progress towards a higher measure of both current and long-term welfare. However we argue that analysis of resilience must go further to track livelihoods over time, or multiple cycles of the livelihoods framework.

Tracking livelihoods over time in chronically risk-prone or crisis-affected communities also requires measures of change in *livelihood strategies*, and, critically, require measures of household *asset portfolios*—the total combination of assets held—and how these evolve in the medium term. In the medium to longer term, *livelihood policies and programs* directly affect changes in strategies and asset portfolios. Policies and programs are typically defined as efforts—usually by the state or governing body—to influence the choices and actions of individuals or collectivities of individuals towards some desired outcome. Typical examples of livelihood policies are the provision of credit or inputs at subsidized rates or the regulation of markets. Finally, *livelihood institutions* may change as well, enabling or constraining options at the individual, household, and community level. Institutions are usually defined as "the rules of the game" broadly accepted and acted upon by everyone involved. The classic example of a livelihood institution is land and natural resource tenure, since it governs access to a critical livelihood asset, but social obligations and even marriage institutions can be seen as shaping livelihoods as well.

Measuring livelihood change over time must therefore somehow capture all these dynamics, and requires a different conceptual framework. Figure 1 outlines such a "livelihoods cycle" framework. Like most livelihood frameworks, it begins with assets, and considers how assets are used in different activities or strategies to produce income—whether in-kind or cash—and then considers whether "income" is consumed, saved, or invested (and how people cope when income is inadequate to achieve adequate consumption). But the results of the consumption or savings (or coping) also directly shape the asset portfolio that the household or social unit holds in the following cycle. The critical difference about a livelihoods cycle framework is the way in which livelihood outcomes shape asset portfolios (the opposite of the relationship depicted in static analysis). Taken in sum, the "vertical axis" of the livelihood dynamics framework depicts assets and income (or "endowments" and "entitlements" in terms defined by Sen [1981]); the "horizontal axis" depicts strategies and choices that individuals or households make (or are forced to make). The right hand side depicts production choices, and the left hand side depicts consumption, savings, or coping choices.

Figure 1. A simplified "Livelihoods Cycle" framework



Source: Maxwell and Wiebe (1999)

Typically, a single cycle might be the harvest-to-harvest period in an agricultural livelihood system (or it might be much shorter period in a livelihood system dominated by petty trade). However, livelihoods are rarely, if ever, totally dominated by a single strategy, particularly in highly risk-prone or crisis-affected areas. This makes the measurement issue particularly challenging, and typically forces analysis to revolve around a dominant livelihood strategy, even while attempting to capture all strategies. A typical example would be a livelihood system dominated by agriculture and livestock production, but incorporating significant reliance on non-farm labor activities for income at certain times of the year.

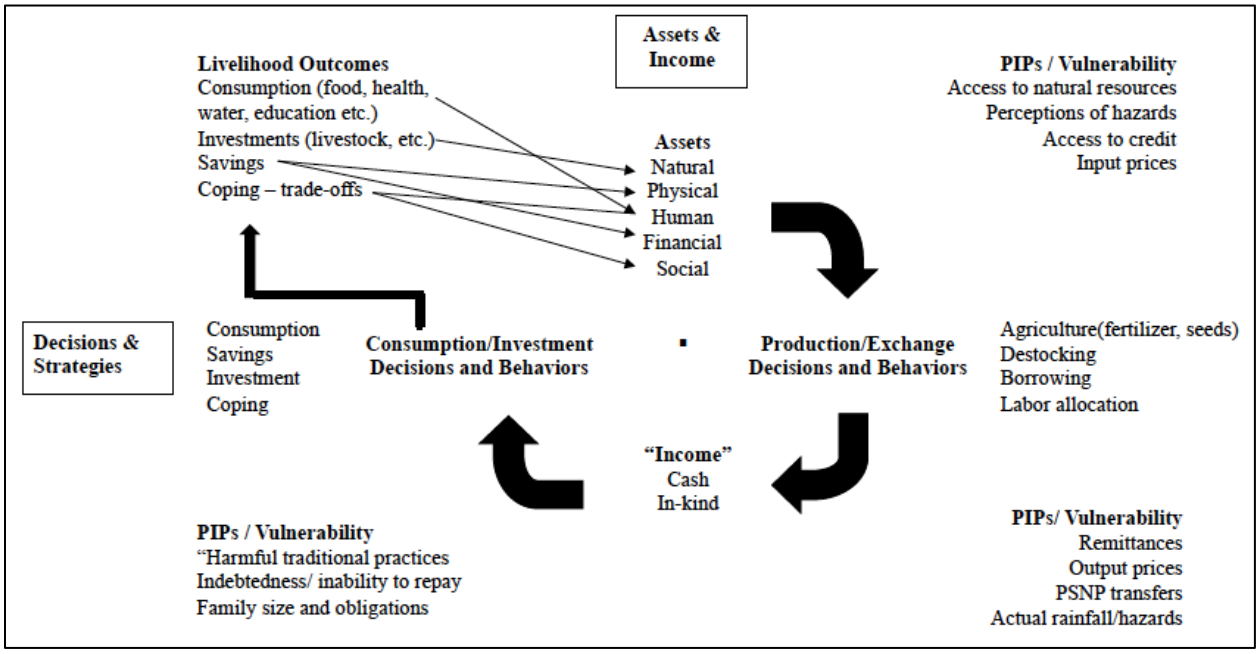
This cycle framework focuses attention on several analytical relationships. One is the direct feedback between consumption, investment and savings decisions, and assets. For instance, consumption decisions largely shape human capital in the asset portfolio in the subsequent time frame (T_2, if T_1 is conceived as temporally defining the first cycle). That is, adequate food consumption, health care, etc., determine health and nutritional outcomes, as well as the ability to work. Savings can be manifested in assets of various forms, typically physical or financial assets. Other forms of "investment" can be manifested in social solidarity or social "capital"—sharing of food or other resources, for example. Coping behaviors, on the other hand, may well diminish assets in T_2. If food consumption is cut to meet other needs, if children are forced to drop out of school because of lack of money to pay fees, or more directly, if assets have to be sold to meet consumption needs, then assets will be depleted in T_2. But the point is that measuring outcomes such as food security or health status in T_1, at best, only partially captures this dynamic. The other important element of outcomes is the asset portfolio in T_2. But these feedback loops

occur repeatedly throughout the process of livelihoods change, both within and across years, and hence are extremely difficult to measure.

Depicting livelihoods in cyclical terms makes the impact of various forms of vulnerability much more explicit in the model. Institutions and policies governing access to natural resources of various kinds typically influence production decisions such as crop and livestock mix, use of inputs, and so on (that is, they influence the upper right quadrant of Figure 1). Prices of inputs, access to credit and technology, and perceptions of hazards such as the likelihood of drought or limited rainfall also influence production decisions. All these factors shape the way various assets (land, labor, etc.) are used in production strategies. Actual levels of rainfall in an agricultural or pastoral livelihood system influence how much production is obtained from decisions made (lower right quadrant of Figure 1), and actual prices determine how much income is derived from production. An altogether different set of factors shape the way in which consumption and savings decisions are made. Debt obligations, other social obligations, and family size—as well as perceptions about longer-term hazards that may require short-term sacrifices—all shape these decisions (lower left quadrant). And finally—as already noted—choices about consumption, savings, and coping shape the asset portfolio in T_2. Similarly, programs and policies affect choices differently. Input or price subsidies would influence decisions about production; safety nets or social protection mechanisms would influence both income levels and (in the case of in-kind food support) directly affect outcomes like food security.

A more detailed depiction of the conceptual framework tailored to a specific context, incorporating many of the key factors discussed above, is shown in Figure 2.

Figure 2. A detailed "Livelihoods Cycle" framework, adapted for Tigray, Ethiopia



Measuring the various parts of the cycle—and particularly measuring the relationships among them precisely—would require massive amounts of data. First, as noted, the feedbacks (or the way in which one short-term outcome influences the next short-term decision or action) occur constantly throughout the cycle—they don't simply occur cumulatively at the end of the cycle as depicted in even the relatively detailed Figure 2. Second, people anticipate problems and know how to foresee at least some of the threats to their livelihoods, and thus take certain actions before actual shocks occur.

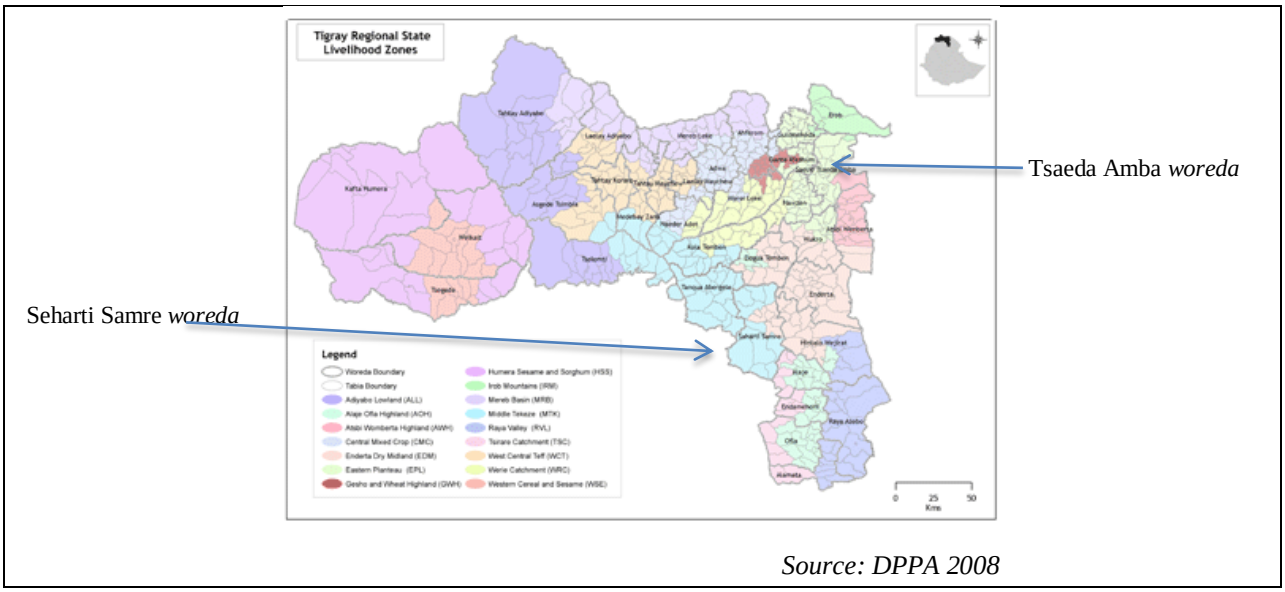
In terms of resilience, the challenge is to first gain an understanding of what the hazards or shocks are within or to a given system. The next step is to ascertain how shocks impact the various stages of the livelihoods cycle: how different types of assets are affected by a given shock; how production, exchange, consumption, and investment decisions are altered; how policies and programs mitigate the risk or impact of hazards, and so on. Lastly, we can use this improved understanding to identify which groups are the most exposed or the least resilient, and in what ways. The present study focuses on these issues and, as detailed in Section 3, constructs a model estimating relationships between initial asset endowments, the intervening variables illustrated in the cycle, and outcome measures of household resilience.

2. The Empirical Context: Eastern and South Eastern Tigray

A. Livelihoods

Since 2009 a team from Tufts University has been studying "livelihoods change over time" in Northern Ethiopia, focusing specifically on Eastern and South Eastern Tigray. The research objective has been to understand the determinants of livelihood change—whether for the better or the worse—over time in a relatively risk-prone context. Initially conducted in collaboration with World Vision, a research partnership (funded by the Swedish International Development Agency (SIDA) between the Feinstein International Center and researchers at the College of Dryland Agriculture and Natural Resources, Mekelle University in Tigray) has been conducting a multi-round survey on livelihoods change over time (LCOT). The earlier work with World Vision focused on disaster risk reduction programs, and provided much of the qualitative background information for the LCOT survey. The LCOT survey collects panel data twice a year, in the post-harvest period and during the peak of the hunger season, from a sample of 300 households in two locations in Eastern and South Eastern Tigray. Two rounds of data collection have been completed, the first in August 2011 and the second in February 2012. This paper presents an initial analysis of that data. Figure 3 depicts the two study areas included in the survey: Tsaeda Amba *woreda* (district) in Eastern Tigray and Seharti Samre *woreda* in South Eastern Tigray.

Figure 3. Map of Tigray Region, showing study sites



Source: DPPA 2008

Ethiopia has been one of the most food-insecure countries in the world, but only in the past decade or so has the food security problem been understood in terms of livelihoods, rather than simply as a food supply problem (Lautze et al. 2003). The World Bank notes that Ethiopia has had an average annual growth rate of 5–7 percent since the crisis of 2002–03, and has managed to keep inflation relatively low—at least until hit by the global food price crisis of 2008. However, while overall poverty levels have declined, the number of the chronically food insecure has grown in some areas, and remained the same in others (World Bank 2007, Oxfam/USAID 2009, Government of Ethiopia 2011). Rural populations in northern Ethiopia have long been vulnerable to droughts and other localized natural hazards. Of the major regional crises to affect East Africa mentioned above, the 2002–03 crisis and the 2008–09 crisis hit northern Ethiopia hardest—the others were more focused on the pastoral areas of the country.

Tsaeda Amba. Tsaeda Amba *woreda* is a chronically vulnerable district, located between the Irob Mountains on the border with Eritrea, the escarpment dividing Tigray and Afar regions, and other drought-prone highland areas of Eastern Tigray. It consists of three different livelihood zones, each with a different agro-ecology and topography but similar kinds of livelihoods; we concentrate in this study on the Eastern Plateau livelihood zone. It is one of the chronically food insecure *woredas* identified by the Government of Ethiopia. In 2009, over 73,000 of the roughly 150,000 residents of the district were included in the Productive Safety Net Program. In addition to the chronically vulnerable caseload, 25,000 people were identified as urgently requiring food assistance in 2008–09, meaning nearly two thirds of the people living in the *woreda* needed food assistance to survive without serious asset depletion at the outset of the study (DPPA 2008).

Livelihoods rely on raising highland crops (wheat, barley, and some maize) and livestock (particularly small ruminants and poultry, although some household have cattle for milk and meat as well as animal traction, and bee-keeping is increasingly the only production option open to landless households). Labor

migration is also an important part of livelihood strategies, as there are only limited possibilities for off-farm diversification of livelihoods within Tsaeda Amba.

Even well-off households are only able to produce about 60 percent of their food needs from farming, so have to rely on food purchase for the remainder; poor households rely on the market for up to 60 percent of their food needs, with 20 percent coming from food aid (mostly through the Productive Safety Nets Program). While better-off households get much of the income they need from the sale of livestock products, poorer households must rely on labor-based strategies (DPPA 2008).

***Seharti Samre*.** Seharti Samre *woreda* is in the Middle Tekeze livelihood zone in Southern Tigray. In contrast to the relatively higher areas of Tsaeda Amba, Samre *woreda* includes middle elevation areas (50 percent), lowlands (47 percent), and highlands (3 percent). The elevation in the *woreda* mostly ranges between 1,500 and 2,300 meters above sea level. Seharti Samre is one of the 22 drought-prone and chronically food-insecure *woredas* in the Tigray region. As such, it tends to have a dryland agro-ecology and is less densely populated than Tsaeda Amba. Expected rainfall is lower—in the range of 350–700 mm per year. Like Tsaeda Amba, rainfall is unimodal (the *Kiremti* rains, concentrated in June, July, and August).

The farming calendar is similar to Tsaeda Amba, and the crops grown are similar except that there is less barley and teff, which tend to be grown only at higher elevations. Other significant crops are sorghum, finger millet, and maize (corn). Livestock are important to the farming system, but lower-wealth groups are unlikely to hold cattle; all but the poorest wealth groups have small ruminants. The PSNP supplements income for the very poor, poor, and middle-income groups (DPPA 2006). Out of over one hundred fifty thousand hectares of land, the land use pattern shows about 27.6 percent cultivated, 38.2 percent wasteland, 43.5 percent forest and shrub land, and 5.3 percent grazing land. About 9 percent of the cultivable land is potentially irrigable (Government of National State of Tigray 2009). The total population of the *woreda* in 2009 was about 126,985 and since 1995 the area has shown a very high rate of population increase—close to 7.5 percent (REST 2009). Given the constraints to livelihoods, the population is highly dependent on program support (food for work and food aid), which is reported to be nearly 50 percent of all households in the *woreda*, and many households depend on seasonal out migration to nearby towns.

B. Main Hazards

The major livelihoods hazards in the study area can be broadly classified as "natural" and human-made hazards. Table 1 presents a community ranking of hazards from the preliminary fieldwork.

Table 1. Cumulative Hazard Ranking 2009–10

Hazard	Overall Rank
Drought	1
Food price inflation	2
Population pressure	3
Geographic isolation/inaccessibility	4
Livestock disease	5
Human disease (including HIV/AIDS)	6
Flooding	7
Crop pests and diseases	8
Local conflict	9
Indebtedness	10
Frost ("cold wind")	11
Hail	12

Source: 2009–10 fieldwork

Climatic and weather-related hazards. Drought is by far the most common weather-related hazard in the study area. These areas are characterized as chronically drought-prone. Other weather-related hazards include flooding and, in the higher elevation areas, hail and frost. Participatory assessment in the first part of the study indicated that weather-related shocks are becoming more frequent. Determining whether this is an effect of climate change was beyond the scope of the study, but numerous studies have tracked and projected the impact of climate change in Ethiopia—and climate change is a major influence on the Government of Ethiopia's disaster management policy (Oxfam/USAID 2009).

Natural resource-related hazards. Environmental degradation is widespread in the study area, especially soil erosion, deforestation, and loss of ground cover. This has increased the losses of soil and ground water, making access to water a significant problem for both humans and livestock, and increasing the likelihood of run-off and flooding.

Disease-related hazards. The three main categories of disease hazards found in the study area are human diseases, livestock diseases, and crop pests. Human illnesses include a wide range of gastro-intestinal and respiratory diseases, and malaria at lower elevations. The prevalence of HIV is relatively low. The main livestock diseases include pasteurellosis, which affects mainly small ruminants, and blackleg, foot and mouth, and anthrax, which affect cattle. The major crop pests are rust, which affects barley and wheat, and shoot fly, which attacks teff and maize (DPPA 2006).

Economic hazards. The rapid price inflation of basic food commodities hit the study area—as well as the rest of Ethiopia—very hard in 2008 and again in 2011. Inflation had perhaps not previously been as significant a problem, but the recent volatility compounded previously existing high levels of indebtedness. A low level of base-line asset holdings exacerbates economic hazards—especially land but also livestock (these two categories, in addition to labor, make up the bulk of household productive assets). A high level of unemployment, particularly of landless youth, is the other frequently mentioned economic "hazard" (although technically unemployment would be an outcome, not a hazard).

Population-related hazards. The Tsaeda Amba population has continued to grow, putting pressure on existing natural resources. This includes some reverse migration back to the study area of groups that had previously left to seek their fortunes elsewhere. The population growth rate of Seharti-Samre is one of the highest in the region (Government of Tigray Region 2009).

Conflict-related hazards. The least mentioned category of hazards was localized resource conflicts. There is also the memory of the conflict with Eritrea—now twelve years in the past—and the displacement of people from the border area, and the return to the area of those who were expelled from Eritrea. The area has not been directly affected by conflict since the war against the Derg regime that ended in 1991. Table 1 depicts the cumulative results of the hazard ranking exercises done in 2009 and 2010 in Tsaeda Amba *woreda*. In the case of Seharti-Samre, the current situation is peaceful. However, it was one of the most war-affected areas during the 17 years of civil war in Tigray region. The *woreda* scores the highest number of air raids during the civil war and basic infrastructure was destroyed.

Note that most hazards listed in Table 1 constitute covariate risk—meaning these hazards threaten broad groups of the population at the same time. Others may threaten one individual, household or community while not posing a threat to others nearby (idiosyncratic risk). These would include risks to human health, and possibly livestock health, as well as indebtedness. Hail and frost affect only high-elevation communities; conflict is so localized that, in this context, it also constitutes an idiosyncratic risk. The major hazards noted in Table 1 are tracked in the LCOT survey.

C. Programs and Policies to Build Resilience

Building livelihoods resilient to economic and environmental threats has been the focus of recent development efforts such as the Productive Safety Nets Program (PSNP) and the Disaster Risk Management/Food Security Sector (DRM/FSS) program. While some risks are beyond the control of communities or local authorities, some are amenable to mitigation through program and policy action. Beginning in 2005, the Productive Safety Nets Program has been implemented to address the issue of chronic food insecurity on a programmatic basis (i.e., not on the basis of annual assessments, humanitarian appeals, and emergency response). Concurrently, evolution away from a disaster-response approach towards a disaster risk management approach has been the policy of the Government of Ethiopia. Much of the emphasis has been on using the PSNP to pursue risk reduction interventions that utilize public works to achieve those ends—infrastructure construction and soil and water conservation chief among them.

Alongside the PSNP are many programs intended to enhance livelihood security, including the "household package" program, promoted by both government agencies and some non-governmental organizations. These programs typically involve one or more standard intervention (improved crop production inputs, livestock fattening, bee keeping, etc.) along with a standard loan agreement with a government extension office, a cooperative, or a micro-finance institution (Coates et al. 2010). Some areas have specific DRR programs piloted by NGOs, but are often implemented by the local Disaster Risk Management/Food Security Sector office (DRM/FSS—formerly the Disaster Preparedness and Prevention Agency). These specifically aim at improving community-based preparedness, early warning, and community-based risk reduction. Recently, rainfall index-based micro-insurance programs have been introduced in some areas of Tigray (Oxfam 2010) in response to the observation that taking out a loan for

improved practices in itself constitutes a risk that many smallholders cannot afford to take. This highlights one form of risk not often mentioned in the literature—that of attempting to improve livelihoods.

3. Methods

The objective of the LCOT panel survey is to assess household resilience in the face of an annually recurring shock: the "hunger season." This time of year is defined by price inflation as the previous year's harvest stocks diminish, increasing grain prices. The increasing prices during the hunger season are coupled with increased illness prevalence during the months immediately preceding the harvest; key illnesses, especially malaria and acute respiratory infections, tend to be concentrated in the hunger season. Rates of acute undernutrition and other forms of morbidity increase, and often households are forced to sell key assets, especially livestock, to meet basic needs. Families also engage in a wide range of harmful behaviors to cope with hunger season difficulties.

To capture within-year as well across-year livelihood dynamics, we chose to collect panel data on our sample two times a year: at the height of the hunger season in August and September and in the middle of the postharvest season in February and March (three months after harvest). We expected the former time to be when households have the least amount of available income and food stocks, and the latter time when households have the greatest amount of income and food. Each survey round is concerned not only with gathering information on the situation prevailing at the time, but also asking retrospective questions on household decisions and experiences over the six-month period prior to the survey (i.e., since the last survey round). To date, we have collected and analyzed data from the 2011 hunger season (referred to below as Round 1) and the 2012 postharvest season (Round 2).

The survey seeks to arrive at sample means for given livelihood-related variables of the population of Tsaeda Amba (Eastern Tigray) and Seharti Samre (Southern Tigray) *woredas*. In each *woreda*, 150 households were selected, 75 from each of two *kebeles* (sub-district units). The sub-*kebele* (i.e., village-level) sampling units were gotten by systematic selection with a random start. The probability of each sampling unit being selected was proportional to the village's size. Within the village, sampling of households was done by random selection of transects within the sub-*kebele*.

A. Measuring Resilience

In this research, we propose using change over time of various indicators of household welfare to measure resilience. The twice-a-year panel allows us to look at resilience trajectories between the hunger season and the postharvest season *and* from year to year. As noted earlier, the hunger season brings various recurring shocks, e.g., food price inflation, illnesses, and so on.

For purposes of measurement, we focus on change over time of seven indicators of livelihoods outcomes and household well-being to measure resilience, three of which relate to food security. (For a more detailed discussion on how these indicators are constructed, see Appendix A.) They are as follows:

1. *Household Food Insecurity and Access Scale (HFIAS).* The HFIAS, developed by Coates et al. (2007), focuses on three dimensions of food access: *anxiety* about not being able to procure sufficient food, the inability to secure adequate *quality* of food, and the experience of insufficient *quantity* of food intake. Nine questions about these topics are used to calculate a score ranging from 0 to 27, with higher scores indicating greater food insecurity.

2. *Coping Strategies Index (CSI).* The Coping Strategies Index, developed by Maxwell (1996), looks at the behaviors exercised by households in order to cope with a food deficit. Questions about eleven types of behaviors—ranging from changes in dietary patterns to alternative strategies for obtaining food—and their frequency are asked of households, and the resulting score ranges from 0 to 108. The index combines the frequency and severity of coping strategies, so the higher the index score, the more food *insecure* the household is.

3. *Food Consumption Score (FCS).* The Food Consumption Score is a measure of dietary diversity developed by the World Food Programme (Wiessman et al. 2008, WFP 2009). It asks about frequency of consumption over the past month for cereals and tubers, pulses, vegetables, fruit, meat and fish, milk, sugar, and oil. The scale ranges from 0 to 64, with 0–12 considered poor food consumption, 12.5–20 considered borderline food consumption, and scores above 20 considered adequate food consumption. (Note that, unlike HFIAS and CSI, higher FCS indicates improved food security.)

4. *Illness Score.* The illness score is a measure of the number of days in the past six months that all household members have been unable to perform normal activities due to illness and injury. The score is expressed in per capita terms, and is on a scale of 1 to 5, with "1" being almost no days missed, and "5" representing more than 25 days missed per household member. At this stage of the research, illness score is our preferred measure of human capital, as other indicators (e.g., literacy, years of schooling, physical ability to perform work) are less likely to change over the time frames studied.

5. *Value of productive assets: land, livestock, and tools.* This indicator is the summed value of all productive assets owned by the household, defined as land, livestock, and tools. Land "ownership" values are imputed from rental rates, as technically all land in Ethiopia is owned by the government and there is no land market from which actual exchange value can be measured. Yet land is clearly the major productive asset in the livelihood system, so "value" is inferred from existing land rental rates. Productive asset value is our preferred measure of physical and natural capital.

6. *Net debt.* This is a measure of the household's outstanding debt obligations, minus any existing savings. We choose to include this measure for the reason that onerous debt is the one of the chief obstacles to households rebuilding after the experience of a shock, and thus low debt load is a key indicator of resilience.

7. *Income (with per capita daily expenditure as the best measureable proxy for income).* This variable takes into account all expenses reported by the household for the six-month period preceding the survey, divided by household size. The intent is to use per capita daily expenditure as a proxy variable for income; direct reporting of income is often plagued with measurement difficulties (Deaton 1997).

Shocks that test household resilience are both exogenous and endogenous to the household; they include the recurring annual climatic, price, and health shocks experienced during the hunger season. Our intent is

to interpret changes in the above indicators across years—that is, from hunger season to hunger season and from harvest season to harvest season—as representing the household's (in)ability to improve or maintain their food security and asset stocks.

At this point, we present data collected for only one hunger season (August 2011) and only one postharvest season (March 2012); therefore, in the absence of data from comparable periods, year-to-year changes cannot yet be assessed. Later rounds will allow us to include other asset variables that are likely to change over longer time frames, including literacy, years of schooling, strength of support network, participation in social organizations, access to safe water and sanitation, and intra-household equality.

Although we cannot yet assess resilience in terms of changes in livelihood outcomes over time in the face of shocks, we focus in this first paper on estimating the determinants of the Round 2 postharvest season *levels* of livelihoods outcomes indicators listed above. At this point we specifically look at the first four indicators of livelihoods outcomes: the three food security indicators as well as illness score. Using the livelihoods changes framework we presented above, we would expect that the "level" or current status of our livelihood outcome variables in Round 2 are influenced by both longer-term processes and idiosyncratic factors like shocks and program interventions. We should expect that longer-term processes would affect a household's average level of any given livelihood outcome, whereas idiosyncratic factors are more likely to impact the short-term trajectory of change. By controlling for asset and demographic characteristics using Round 1 data, we are able to control for some of the effects of longer-term processes.

The four variables selected for this preliminary analysis are indicators of short-term household welfare, and, controlling for initial asset and demographic conditions, levels of these are likely to be affected by shocks and other short-term processes. They thus give a preliminary sense of how the included dependent variables both from Round 1 and Round 2 are related with Round 2 livelihoods outcome levels. The next section outlines the model used for these "level" or current status regressions, as well as the resilience "changes over time" model that will be utilized in upcoming analysis, once Round 3 and Round 4 data become available.

B. Estimation Strategy and Variables Used

The sections below discuss the measurement and estimation strategy of the study. As noted above, in order to estimate the relationships below, two rounds of data collection will take place each year. The first is in August and September, at the height of the hunger season and shortly after the planting time, when key agricultural production decisions are made. This round is referred to as the *hunger season* round. The second data collection round is in February and March, during the postharvest season. This is the time of the year when household income receipts are concentrated and the majority of investment decisions are being made. This round will be referred to as the *postharvest* round. The data collection rounds are denoted by number; all odd numbers represent hunger season rounds and all even numbers postharvest season rounds. For now, data is available for Round 1 hunger season and Round 2 postharvest season.

The conceptual framework outlined in the previous sections suggests the following simplified relationship:

$$W^{II} = f(A^{I}, D_C^{II}, D_P^{II}, P_O^{II}, S^{II}, T^{II}) \qquad (1)$$

where household well-being (W^{II}) in Round 2 is a function of the household's asset stock in Round 1 (A^{I}), as well as household consumption decisions (D_C^{II}), household production decisions (D_P^{II}), output prices (P_O^{II}), livelihood shocks (S^{II}), and program transfers (T^{II}) in the months preceding Round 2. Note that the superscript refers to the round from which data is used.

As noted above, there are four measures of W^{II} to be employed in the current analysis: *household food access* (Y_1), as measured by the Household Food Insecurity and Access (HFIAS) scale, *coping strategies* (Y_2), as measured by the Coping Strategies Index, *dietary diversity* (Y_3), as measured by Food Consumption Score (FCS), and *illness score* (Y_4), a measure of the frequency of illness in the household, averaged across all members, in the six months preceding the survey date. (See Appendix A for a description of all variables and how they are constructed.)

Asset stock A is divided into five types: human capital, natural assets, physical assets, financial capital, and social capital. Each of these types of assets has various associated measurement variables. Human capital is measured by the variables *proportion of literate household members* (X_1), *average educational attainment of household members* (X_2), *average illness score of household members* (X_3), and *dependency ratio* (X_4). (Note that illness score X_3 here is a lagged value taken from Round 1 data, whereas the dependent variable Y_4 is taken from Round 2 data.) Natural assets are measured by *access to community resources* (X_5) and *access to improved water sources* (X_6). Physical assets are measured by a combination of the variables *total value of livestock, productive assets, and land* (X_7) and *access to improved sanitation* (X_8). Financial capital is measured by *net debt* (debt minus savings) (X_9). Social capital is measured by the variables *strength of support network* (X_{10}) and *social participation in community organizations* (X_{11}).

Household production decisions D_P are measured by *proportion of expenditure devoted to productive investments* (agricultural and livestock inputs as well as land rental) (X_{12}), *crop diversity* (X_{13}) and *input intensity* (X_{14}). Household consumption decisions D_C are measured by *proportion of expenditure devoted to food purchase* (X_{15}).

Output prices P_O are assumed to be homogeneous across households in a particular kebele (sub-district), and thus the variable is a kebele-year control variable. Hazards are measured in both a covariate and household-specific sense. Rainfall is the key covariate measurement variable and is captured in the livelihood zone dummy. *Livelihood shock impact* (X_{16}) is measured through the aggregate self-reported impact of various key hazards, including drought, agricultural and livestock pests and diseases, flooding, hail, frost, and human illness. Program transfers are measured by the *cash value of received program transfers* (X_{17}), primarily comprised of benefits from the Productive Safety Net Program (PSNP).

The basic estimation model suggested by Equation (1) and utilizing the measurement variables described in the previous paragraphs can be expressed in general form as follows:

$$Y_1 = \alpha_1 + \sum_{k=1}^{K} \beta_k X_{k,i} + \zeta_1; i = 1, \ldots n \qquad (2)$$

Where household food security is determined by some linear combination of variables, each denoted by X_k, where k takes on values between k=1,…K; α_1 is the scalar intercept term; i denotes households; β is a vector of the parameters of all included X variables; and ζ_1 is the error term, which is assumed to be normally distributed with mean zero and constant variance σ^2. The model is estimated using ordinary least squares. Note again that, in this round, Y is measured from Round 2 data, assets from Round 1 data, and the rest of the dependent variables from Round 2 data (with many of these questions being of a retrospective nature, asking about household behaviors and experiences between Round 1 and Round 2).

The model of resilience that measures changes over time, to be estimated after Round 3 data becomes available, replicates the logic of the levels model above, except that the dependent variable looks at changes between Round 1 (hunger season 2011) and Round 3 (hunger season 2012), as well as between Round 2 (postharvest season 2012) and Round 4 (postharvest season 2013). The change is again a function of lagged values—this time assets, shocks, decisions, and other processes from previous rounds:

$$R^{III} - R^{I}, R^{IV} - R^{II} = f(A^{I}, D_C^{x}, D_P^{x}, P_O^{x}, S^{x}, T^{x}) \qquad (3)$$

Where $R^{III} - R^{I}$ and $R^{IV} - R^{II}$ are the changes in household resilience between the Round 3 hunger season and the Round 1 hunger season as well as between the Round 4 postharvest season and the Round 2 postharvest season, as measured by changes in the seven dependent variables listed above. A^{I} is the initial asset endowment, and the other variables are taken from Rounds 2, 3, and 4 (i.e., x=[2, 3, 4]). Again, by focusing on changes rather than levels, we can expect short-term factors like climatic and price shocks and program interventions to have a greater impact on the dependent variable, particularly when analyzing the determinants of changes in asset stocks, debt, and income.

4. Descriptive Analysis

The following sections profile the study population. The first section depicts the independent variables listed in Part 3 above, and the second depicts the seven food security dependent variables, the three food security indicators as well as the four other measures of household well-being: illness, asset stocks, debt, and expenditure. The third section disaggregates the dependent variables by livelihood zone and wealth group. The last section examines household participation in the Productive Safety Nets Program and other development interventions.

A. Independent Variables

The following provides summary statistics for the independent variables; note that asset values may be from Round 1 or Round 2, as discussed in Part 2 above. (The round number is given in parentheses after each variables name.)

Table 2. Summary statistics for independent variables, entire sample

VARIABLE	Round	Min	Max	Mean	Standard Deviation
Number of HH members	1	1	15	5.73	2.44
% of adult HH members (>age 14) literate	1	0	100	45.94	28.55
Average years schooling/HH member	1	0	11	2.51	1.69
Illness score	1	0.22	5	1.67	1.05
Dependency ratio	1	0	5	1.17	0.92
Access to community resources	1	0	3	1.57	0.62
Total value of productive assets (ETB)	1	0	150860	26228	21778
Net debt	1	-23015	59580	1162	5107
Support network score	1	0	53	4.38	4.40
Social participation score	1	0	18	5.62	3.85
% of expenditure for productive investments	2	0	96	16.68	19.13
Crop diversity index	2	0	1	0.44	0.25
Input intensity	2	0	9	1.72	1.42
% of expenditure for food purchase	2	0	92	37.99	19.26
Aggregate impact of shocks	2	10	36	20.19	5.39
Value of PSNP benefits received	2	0	4203	659	734
% of households with improved water access	1			77.0%	
% of households with improved sanitation	1			45.3%	

The average household in the study population contains nearly six members, with dependent members (those under age 15 and above age 64) outnumbering non-dependents by 17 percent. Just under half of household members are able to read and write. Schooling levels are very low: per capita years of schooling equal just 2.51. On a scale of 0 (almost no illness/injury over past six months) to 5 (about 25 or more days of illness/injury in the past six months), households had a mean of 1.67. The total value of household productive assets equaled 26228 ETB, or about $3,694 in purchasing power parity (PPP) adjusted terms, including, on average, about 4.56 timad of land (one timad is roughly equivalent to one-fourth of an acre) and about $934 PPP worth of livestock. The value of net debt (debt-savings) was about $215 PPP. The support network score aggregates answers to questions about community assistance to the family in times of need and strength of community social bonds. It is measured on a scale of 0 to 11, with the high end representing an extremely strong social network; the mean for the study population is 4.38. The social participation score is also an aggregate figure looking at degree of household engagement with a wide range of community groups, measured on a scale of 0 to 27, with larger values indicating greater participation. The sample mean is 5.62.

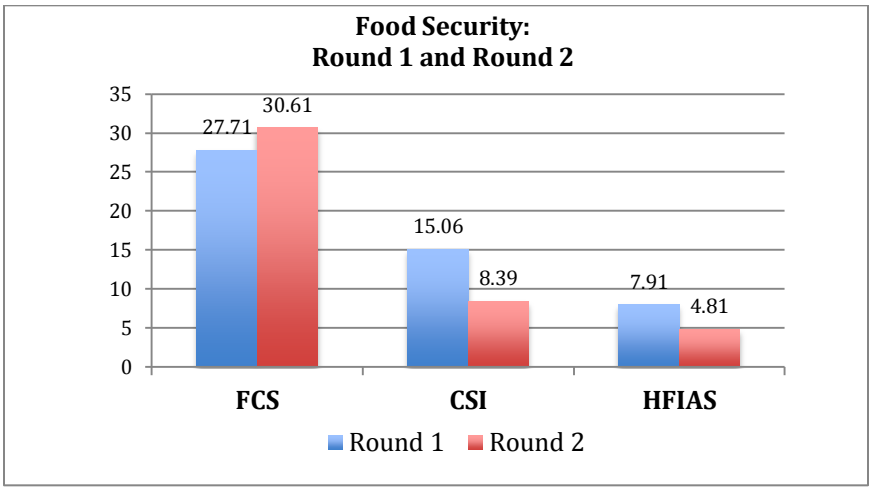
Households devoted on average about 17 percent of their total expenditure on productive investments like agricultural inputs, land, and livestock, and about 38 percent on food purchases. The crop dominance index measures cropping diversity: a score of 1 indicates a pure monoculture. The mean score for the sample population is 0.44, which suggests moderately to highly diverse agro-ecosystems. The shocks variable aggregates the impact of ten different kinds of shocks, ranging from drought to price inflation to illness, each on a scale of 1 (no impact) to 5 (worst ever experienced), for an aggregate range of 10 to 50. The mean value for the sample is 20.2. As expected, the Productive Safety Nets Program (PSNP) is an important source of income in the study areas, with the average household receiving 659 birr ($93 PPP) in the six months preceding the baseline survey. This equals over 12 percent of the reported total household expenditure over that period. Finally, 77 percent of households have access to a protected water source and 45 percent to improved sanitation.

It should also be noted that some of the variables have very high variance, especially asset stock value, net debt, expenditure decisions, support network score, and (as expected, given means-based targeting) PSNP benefits. On the other hand, households are more similar across the sample in terms of household size, literacy, crop dominance, and experienced shock impact.

B. Food Security, Asset, and Expenditure Dynamics

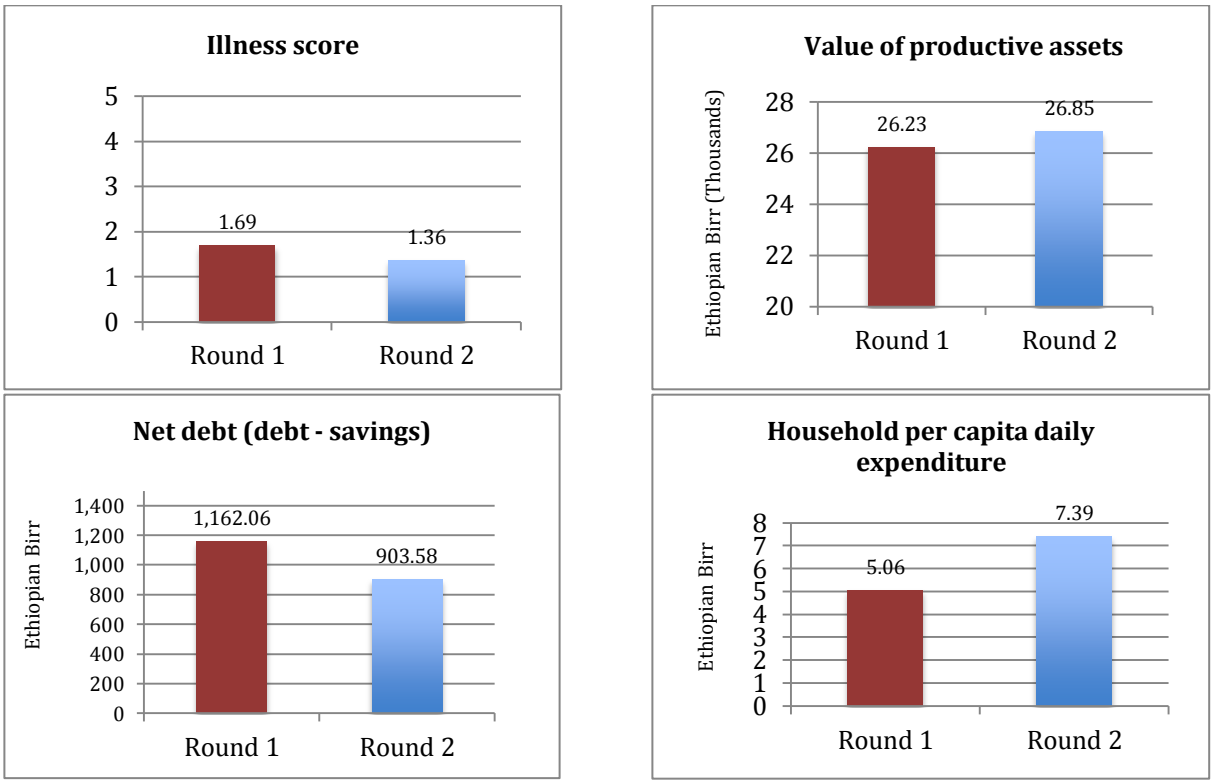
The differences in household well-being from Round 1 to Round 2 reflect expected variations between the hunger season and the harvest season. The chart below summarizes the changes in food security between the two rounds. The three operational measures of food security used in this research are shown: the Household Food Insecurity and Access Scale (HFIAS), the Coping Strategies Index (CSI), and the Food Consumption Score (FCS). All three improved significantly between the two rounds: HFIAS fell from 7.91 to 4.81; CSI fell from 15.06 to 8.39; and FCS increased from 27.7 to 30.6. (Note that higher HFIAS and CSI scores indicate *worse* food security, while a higher FCS score indicates *improved* dietary diversity; see Part 2A, "Measuring Resilience," and Appendix A for more details.) The HFIAS thus fell by 39 percent and the CSI by 44 percent from their baseline Round 1 values, and the FCS increased 10 percent; the improvement in general food access and decline in harmful coping behaviors is more dramatic than the expansion of dietary diversity. All three indicators suggest mild to moderate food insecurity averaged across the sample during the hunger season, improving to general food security in the postharvest season.

Figure 4. Food security indicators, entire sample, Round 1 and Round 2



Other types of asset portfolios saw changes in the expected direction. The household's illness score, averaged over all family members, improved by nearly 20 percent in the post-harvest season, which is to be expected given not only the greater availability of cash for health goods and services, but also because the most important diseases, especially malaria and acute respiratory infections, occur more frequently in the rainy season. The value of the household's productive assets—including land, livestock, and tools—increased slightly, by about 2.4 percent, as families were able to offset hunger season sales of livestock with post-harvest purchases. Net debt stock (debt minus savings) decreased by just over 22 percent to 904 ETB ($127 PPP), as households used their harvest income to pay down obligations incurred at the beginning of the agricultural season. Per capita daily expenditure in the post-harvest time exceeded hunger season expenditure by 46 percent, an increase from 5.06 ETB ($0.71 PPP) to 7.39 ($1.04 PPP).

Figure 5. Other well-being variables, entire sample, Round 1 and Round 2



C. Disaggregation by Livelihood Zone and Wealth Group

I. Livelihood Zone

As discussed earlier, we concentrate on two livelihood zones in this study: the Eastern Plateau zone of Tsaeda Amba woreda and the Middle Tekeze zone of Seharti Samre woreda. The table below revisits the same general household characteristics summarized above, but disaggregates for each livelihood zone. Following the theoretical model, data is taken from the same rounds as in the aggregated table above.

Table 3. Means for independent variables, disaggregated by livelihood zone

VARIABLE	Round	Eastern Plateau Mean	Middle Tekeze Mean
Number of households		152	150
Number of HH members*	1	5.50	5.97
% of adult HH members (>age 14) literate	1	43.27	48.64
Average years schooling/HH member	1	2.59	2.43
Illness score***	1	1.51	1.18
Dependency ratio	1	1.17	1.16
Access to community resources***	1	1.46	1.67
Total value of productive assets***	1	15307	37078
Net debt	1	674	1144
Support network score***	1	3.29	5.47
Social participation score**	1	5.01	6.24
% of expenditure for productive investments***	2	12.52	20.87
Crop diversity index*	2	0.47	0.41
Input intensity**	2	1.53	1.91
% of expenditure for food purchase***	2	41.66	34.18
Aggregate impact of shocks***	2	22.36	17.99
Value of PSNP benefits received	2	689	627
% of households with improved water access	1	76.0%	78.0%
% of households with improved sanitation**	1	46.7%	50.7%

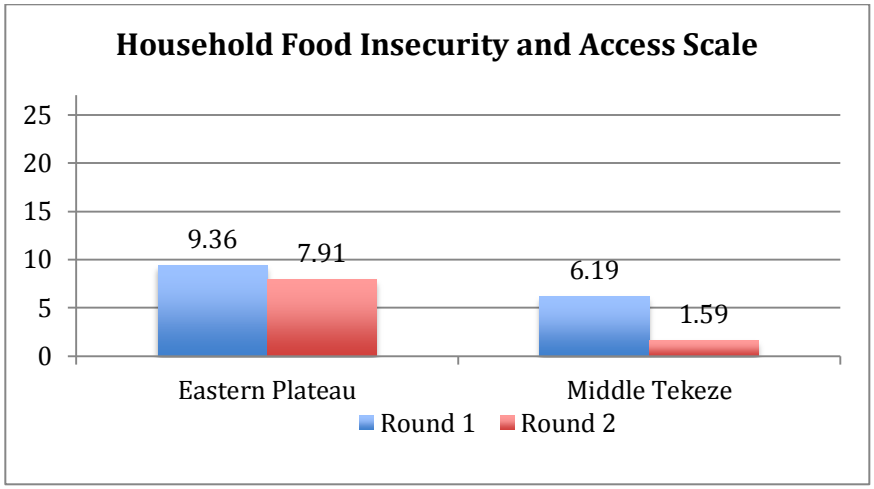
Asterisks indicate significantly different means at p=***<0.01, **<0.05, *<0.1.

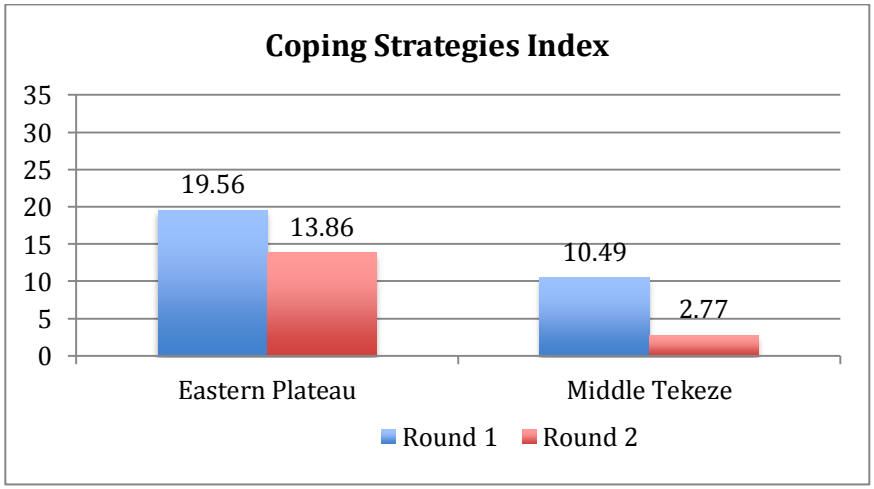
Households exhibit significant differences across livelihood zones, although they are similar in terms of dependency ratio, literacy, schooling, PSNP benefits, and safe water access. Most pronounced are differences in illness score, asset ownership, support network, and shock impact. In all of these, Middle Tekeze households are better off, having for example 142 percent greater asset value, a 66 percent higher support network score, and 20 percent less shock impact. In addition, Middle Tekeze households have slightly larger family size, greater social participation, and marginally more diverse agro-ecosystems. Production and expenditure decisions also differed between the two zones: Eastern Plateau households spent less on productive investments, more on food, and were able to apply fewer inputs in their agricultural systems.

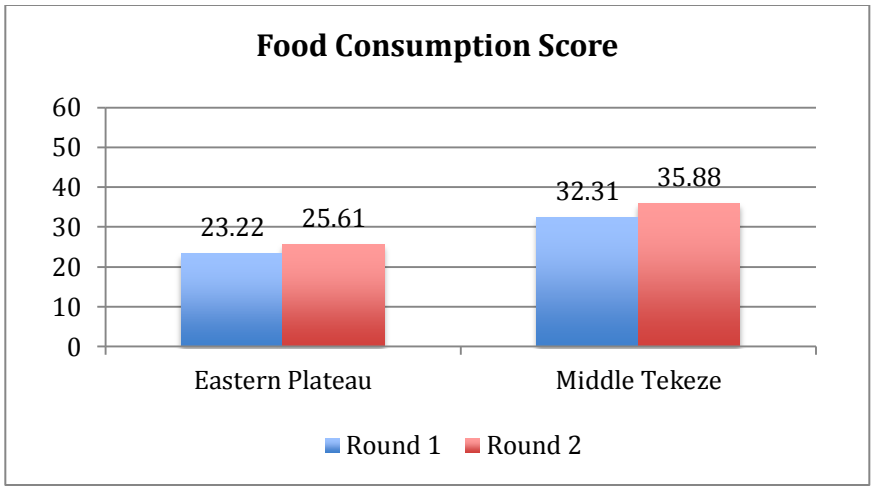
The following graphs depict levels of, and changes in, the operational measures of well-being—the three food security indicators, assets, and expenditure (changes in which will serve as measures of resilience

once Round 3 data is available)—across the two livelihood zones. The HFIAS scale and Coping Strategies Index both show the considerable difference in food security dynamics between the Eastern Plateau and the Middle Tekeze areas. Between the hunger season and the harvest season, households in the Middle Tekeze area improved HFIAS and CSI by 74 percent and 73 percent, respectively. In contrast, HFIAS and CSI scores decreased by a much more modest 15 percent and 29 percent in the Eastern Plateau; it's worth noting that, in terms of these measures, Eastern Plateau households remain in a situation of food insecurity even in the postharvest season. Changes in dietary diversity, measured by food consumption, were more similar, with a 10 percent improvement in the Eastern Plateau and an 11 percent change in Middle Tekeze.

Figure 6. Food security variables, disaggregated by livelihood zone







Changes in other household resilience measures were similar. Improvements in illness score, value of productive assets, and net debt were all relatively greater in the Middle Tekeze area. Illness score improved by 27 percent in Middle Tekeze versus 12 percent in the Eastern Plateau. Households actually *lost* 10 percent of their productive assets between the hunger and the harvest season in the Eastern Plateau, an indication of distress sales of assets during the pre-harvest months, while Middle Tekeze families increased their asset stock by 8 percent. Respondents in the Middle Tekeze livelihood zone managed to reduce their debt by nearly one-third, as compared to a 12 percent reduction in the Eastern Plateau. Improvements in daily expenditure were more similar across the two areas, with a 44 percent and 47 percent increase in the Eastern Plateau and Middle Tekeze zones, respectively.

Figure 7. Other well-being variables, disaggregated by livelihood zone

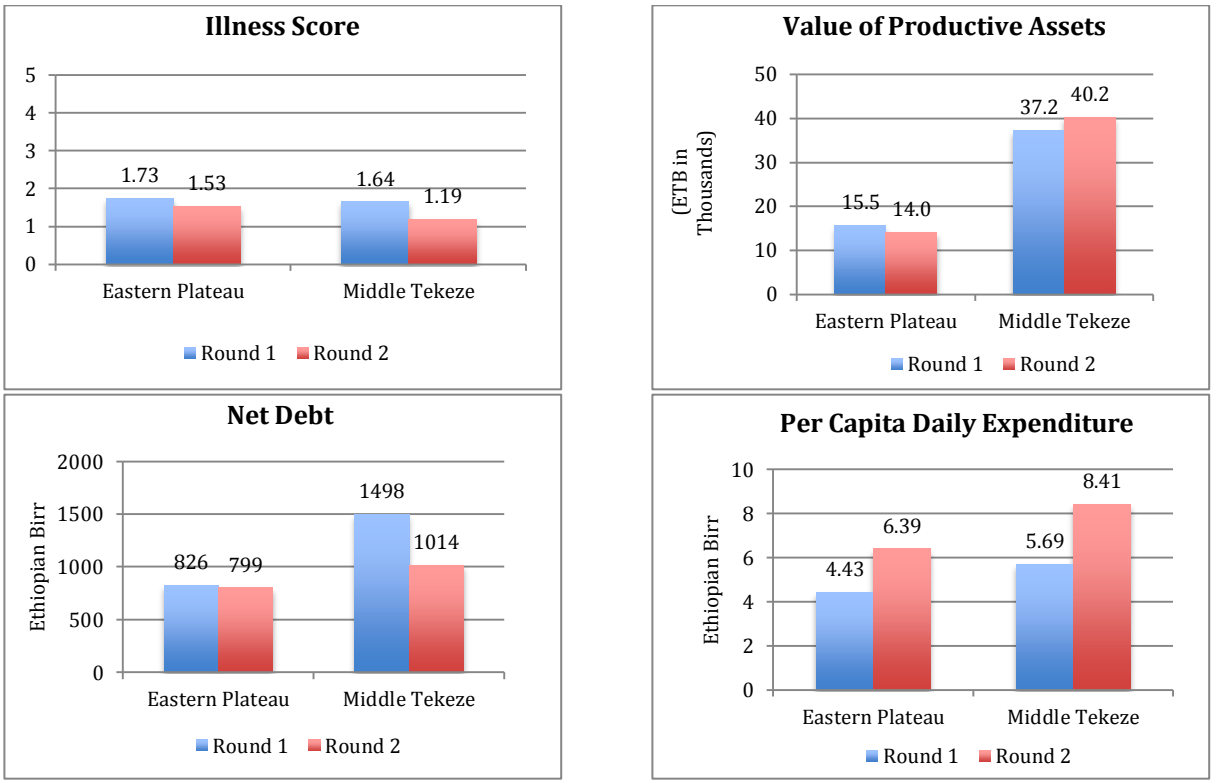
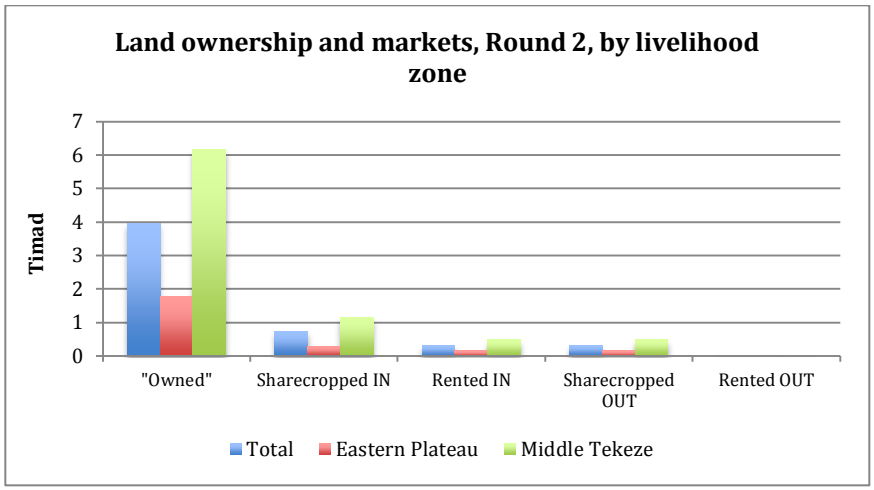
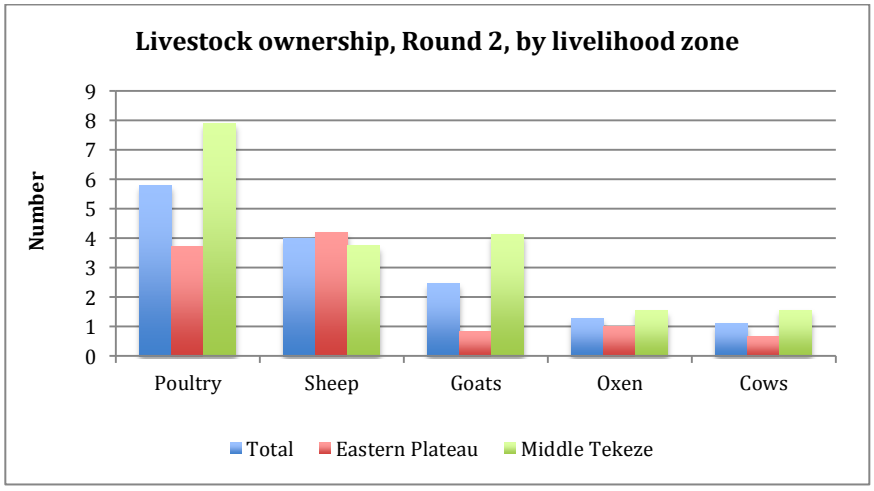


Figure 8 breaks down the productive asset portfolio and depicts land and livestock ownership across livelihood zones. The disparity is clear, with over three times as much average land "owned" in the Middle Tekeze[3]; as the graph shows, there is very little sharecropping and renting activity in either area.[4] Similar differences exist with respect to livestock ownership, with the exception of sheep ownership.

[3] Land values are given in *timad*, equivalent to approximately one-fourth of an acre.
[4] In Ethiopia, land property is officially owned by the state, with farmers granted long-term usufruct rights.

Figure 8. Land and livestock ownership, Round 2, by livelihood zone





Overall, disaggregation by livelihood zone exposes some critical differences in household characteristics and changes in welfare between Round 1 and Round 2. Middle Tekeze households generally have a larger asset portfolio and are able to obtain greater gains from the hunger season to the harvest season.

II. Wealth Group

Disaggregation of variables by wealth group also shows some differences. Wealth groups are categorized by looking at the total value of household productive assets—livestock, tools, and land. The "very poor" group is defined as having less than 15,000 ETB worth of productive assets, or about $997 in PPP-adjusted terms. The "poor" group has more than this amount but less than 30,000 ETB ($1,993 PPP); the "middle" group more than 30,000 but less than 45,000 ($2,990 PPP); and the "better off" group more than 45,000 ETB.

Table 4. Means for independent variables, disaggregated by wealth group

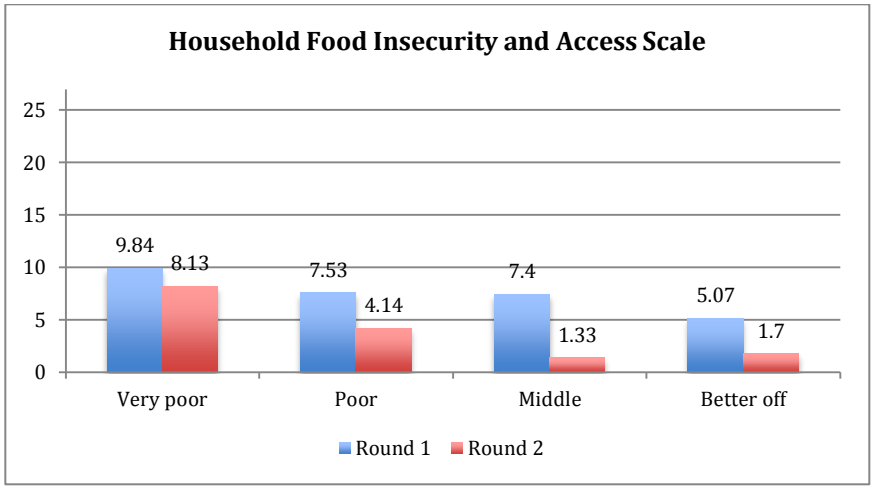
VARIABLE	Very Poor (<15,000 ETB)	Poor (15,000–29,999 ETB)	Middle (30,000–44,999 ETB)	Better off (≥45,000 ETB)
Number of households	99	112	47	43
Number of HH members	4.64[a]	6.21[b]	6.19[b]	6.47[b]
% of adult HH members (>age 14) literate	35.91[a]	49.07[b]	55.35[b]	49.9[b]
Average years schooling/HH member	2.26[a]	2.61[a,b]	2.80[b]	2.47[a,b]
Illness score	1.53[a]	1.33[b]	1.12[c]	1.33[b]
Dependency ratio	1.25[a]	1.24[a]	0.94[b]	1.02[a,b]
Access to community resources	1.16[a]	1.73[b]	1.87[b]	1.73[b]
Total value of productive assets	8,174[a]	21,773[b]	36,721[c]	67,931[d]
Net debt	679[a]	925[a]	1,532[a]	370[a]
Support network score	3.09[a]	4.74[b]	5.09[b]	5.67[b]
Social participation score	4.57[a]	6.14[b]	5.81[b]	6.58[b]
% of expenditure for productive investments	12.5[a]	17.1[b]	19.9[b]	20.6[b]
Crop diversity index	0.47[a]	0.44[a]	0.39[a]	0.43[a]
Input intensity	1.54[a]	1.84[a]	1.80[a]	1.68[a]
% of expenditure for food purchase	45.2[a]	35.1[b]	34.7[b]	33.2[b]
Value of PSNP benefits received	601[a,b]	749[a]	508[b]	718[a,b]
Aggregate impact of shocks	22.02[a]	20.18[b]	18.6[c]	17.84[c]
% of households with improved water access	0.79[a]	0.77[a]	0.77[a]	0.77[a]
% of households with improved sanitation	33.33[a]	48.21[a,b]	51.06[a,b]	53.49[b]

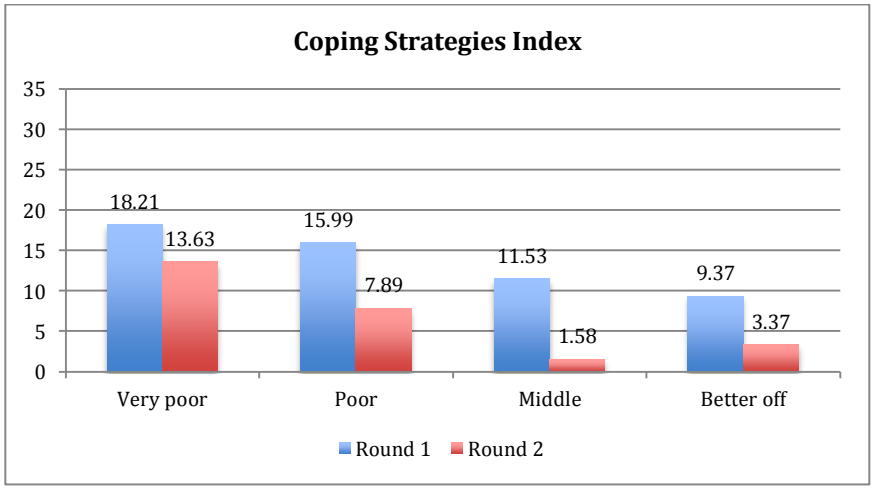
Different superscript letters (a,b,c,d) indicate significantly different means at p=<0.1 for any two compared groups. Shared letters indicated statistically insignificant differences in means.

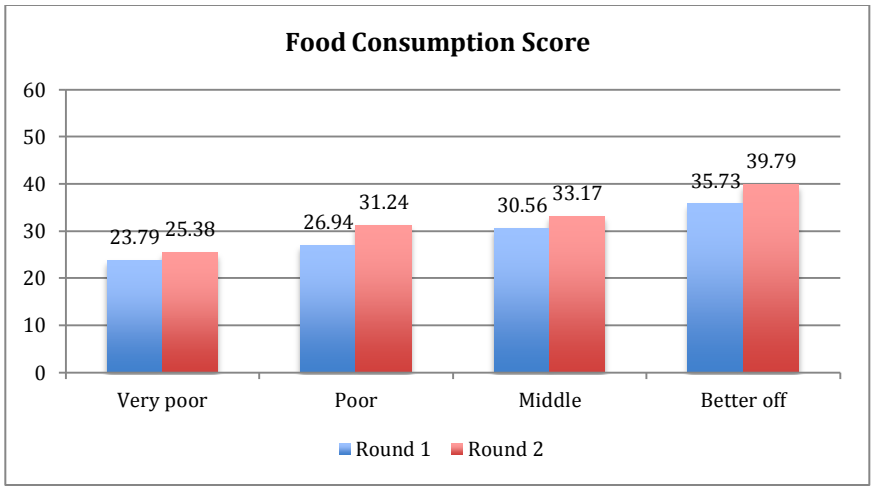
The very poor group differs significantly in several aspects, as expected: household size is smaller, literacy and years of schooling are lower, less land and livestock are owned, the support network and social participation is reduced, and shock impacts are greater. However, water access is approximately similar to the other groups, as are PSNP benefits and dependency ratio. Several other interesting results emerge from the comparison. First, other than asset ownership, few characteristics differentiate poor, middle, and better-off households. Household size, literacy, support network, social participation, crop dominance, and access to water are broadly similar; there are small differences in dependency ratio and shock impact. In addition, PSNP targeting is apparently not successfully identifying the asset poor; the value of PSNP transfers does not vary significantly between the very poor, poor, and better off.

These patterns are also evident when looking at changes in food security. The graphs below show that most of the gains in HFIAS, CSI, and FCS between the hunger and the harvest season are picked up by the middle, better off, and (to a slightly lesser extent) poor groups; the improvements are considerably smaller for the very poor. HFIAS gains were 66 percent, 82 percent, and 45 percent for the better off, middle, and poor, respectively, but just 17 percent for the very poor. CSI improved by 64 percent, 86 percent, and 51 percent for the first three wealth groups, and 25 percent for the very poor; both the poor and very poor remain in a state of food insecurity during the postharvest season. Dietary diversity gains were closer in magnitude across wealth groups, but again the very poor experienced the least relative positive change.

Figure 9. Food security variables, disaggregated by wealth group

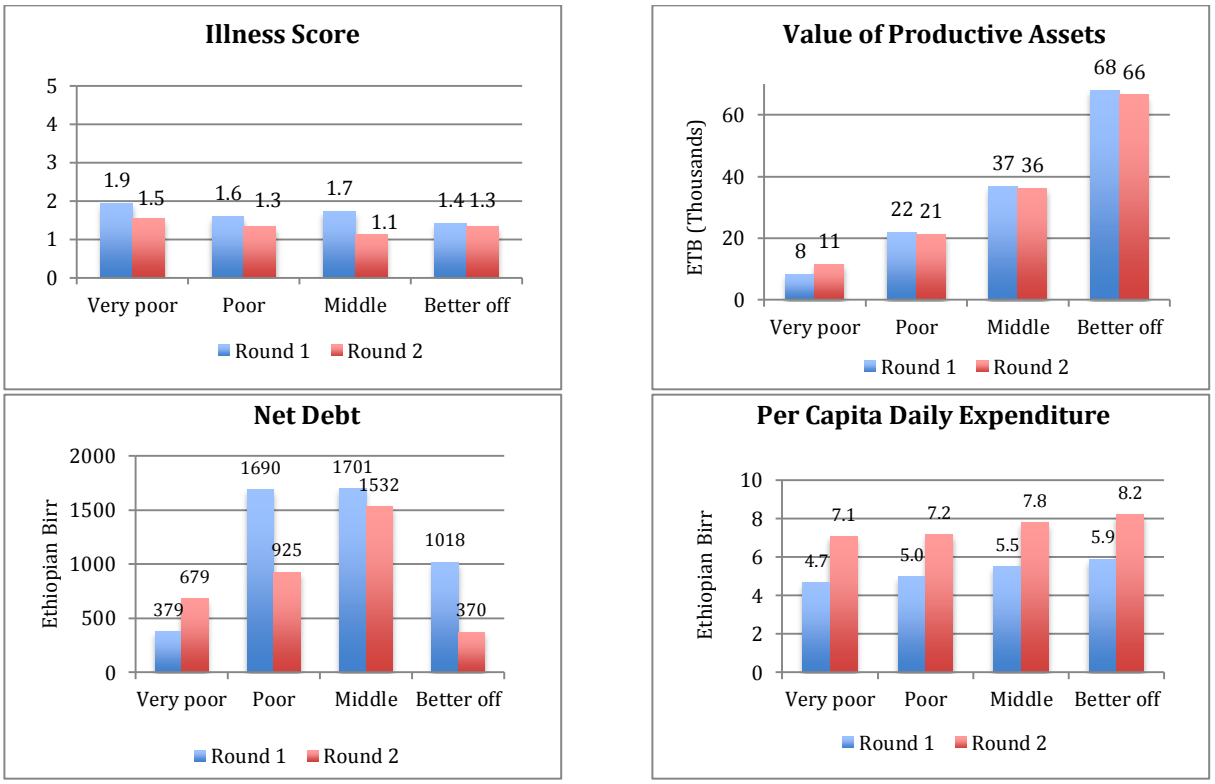






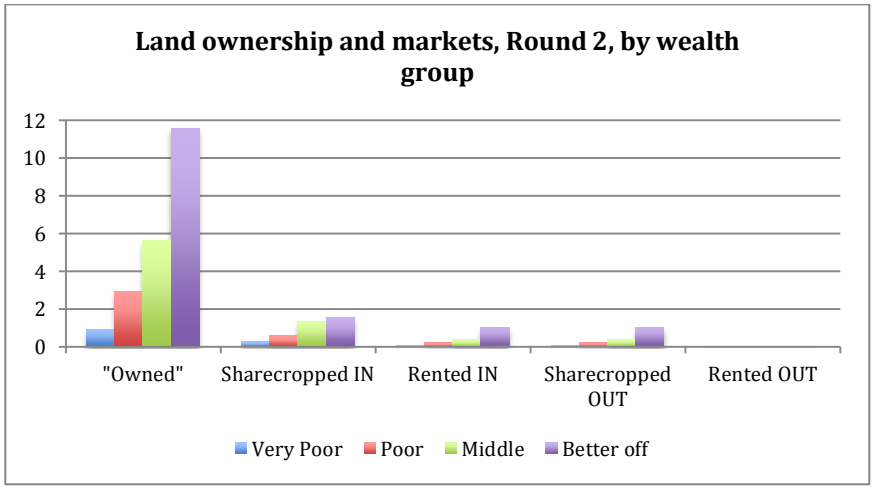
The trends with respect to other household well-being variables are considerably different. As shown in the graphs below, the very poor actually experienced the greatest gain in productive asset values (and in fact was the only one of the groups with any positive change in this variable) and per capita daily expenditure, and were second only to the middle wealth group in illness score improvement. Between the 2011 hunger season and 2012 post-harvest season, the very poor saw a 20 percent decrease in illness, a 40 percent increase in productive assets, and a 52 percent increase in expenditure. However, the very poor did see their debt stock rise by 79 percent, while the other three groups decreased their debt considerably: the poor by 45 percent and the better off by 64 percent.

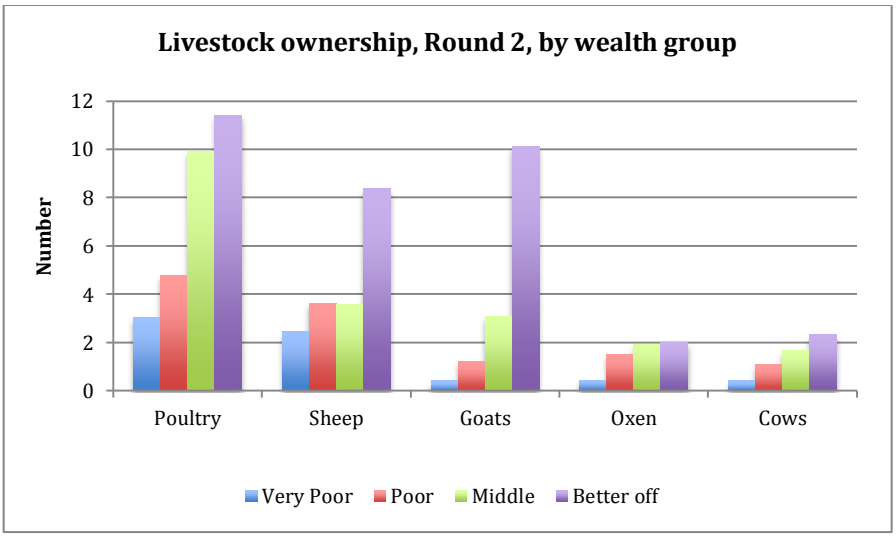
Figure 10. Other well-being indicators, disaggregated by wealth group



Again, we can disaggregate productive asset ownership by wealth group. The degree of inequality between wealth groups differs based on the type of asset—for example, there is far less disparity between the lower three groups with respect to sheep ownership than other livestock assets.

Figure 11. Land and livestock ownership, Round 2, by wealth group



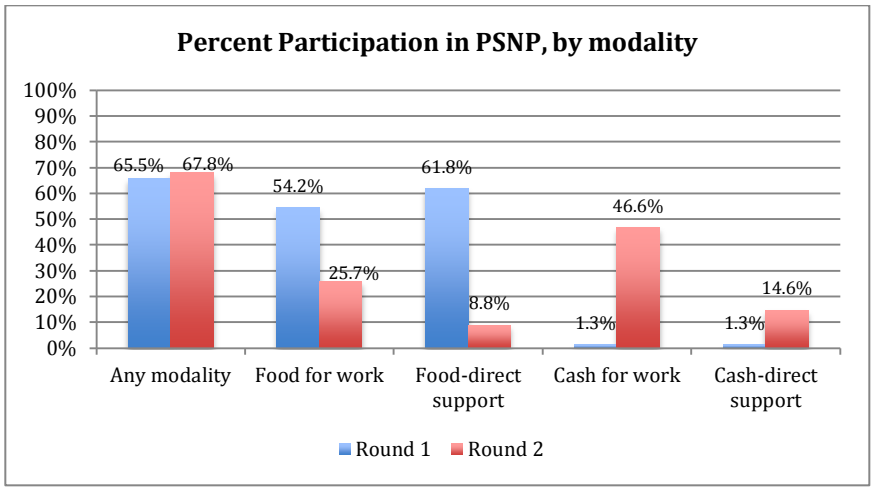


Overall, disaggregation by wealth group shows that the very poor have distinct characteristics, and their livelihoods have a markedly different trajectory between the hunger and harvest season. Although improvements in food security were concentrated among the three wealthier groups, the very poor did experience much greater gains in productive assets and expenditure.

D. Program Participation

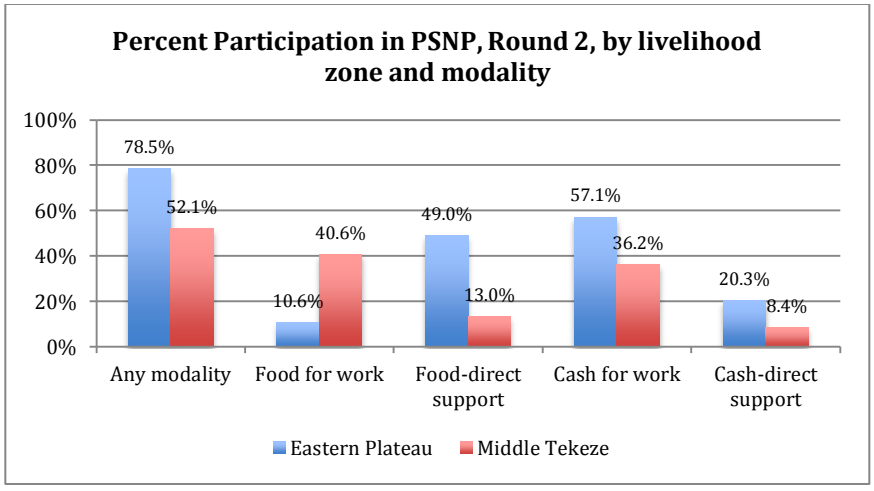
This final section presents descriptive graphs pertaining to program participation, variables of strong policy interest. The Productive Safety Nets Program (PSNP) is the most important rural livelihoods intervention in operation in Ethiopia and, as such, the reported income from the PSNP is a variable inserted directly into the regression models in the next section. Benefit levels of the PSNP during Round 2, in total and disaggregated by livelihood zone and wealth group, were presented in earlier tables. The first graph below shows the proportion of households participating in Round 1 and Round 2, by total participation ("any modality") and by the different types of benefit offered.

Figure 12. Participation in PSNP, Rounds 1 and 2, by transfer modality



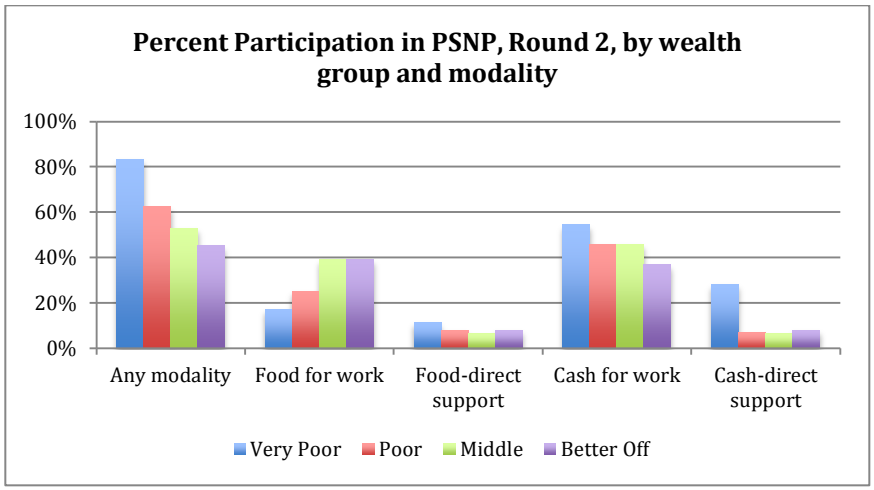
Round 1 and Round 2 participation levels were roughly the same, at just over three-fifths of households, but the modality shifted from being exclusively food in Round 1 to a mixture of food and work in Round 2, with cash dominating transfers.

Figure 13. Participation in PSNP, Round 2, by livelihood zone and modality



The PSNP was far more active in the Eastern Plateau, with nearly 80 percent of households participating, as opposed to just over half in the Middle Tekeze. The pattern of participation varied by livelihood zone as well; for example, in Round 2, nearly all of the participating households in the Middle Tekeze received food-for-work benefits, while very few did so in the Eastern Plateau.

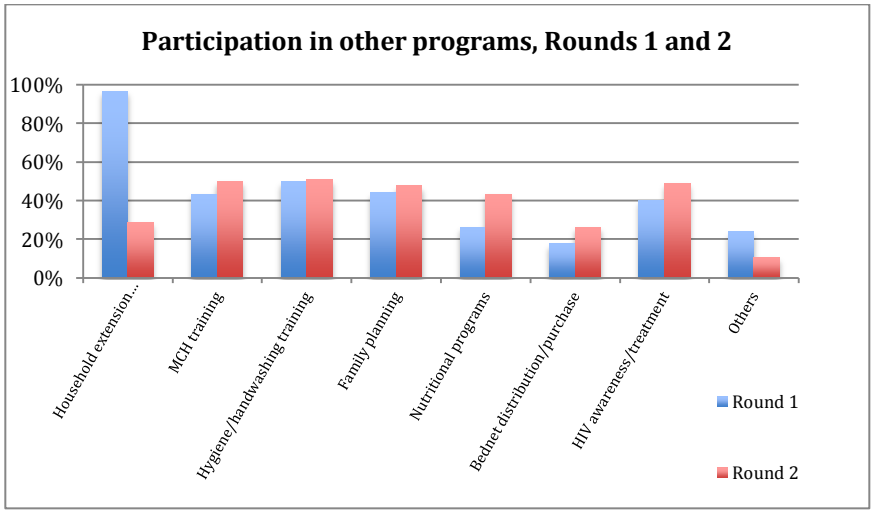
Figure 14. Participation in PSNP, Round 2, by wealth group and modality



As would be expected, the PSNP was progressively targeted, with participation decreasing as asset wealth increased. (Note, however, that the same does not hold true for level of PSNP benefits, as Table 4 showed.) The difference was driven largely by disparities in cash-for-work and (especially) cash direct support participation; in fact, wealthier groups were more likely to participate in food-for-work, a pattern largely driven by the prominence of food-for-work in the Middle Tekeze.

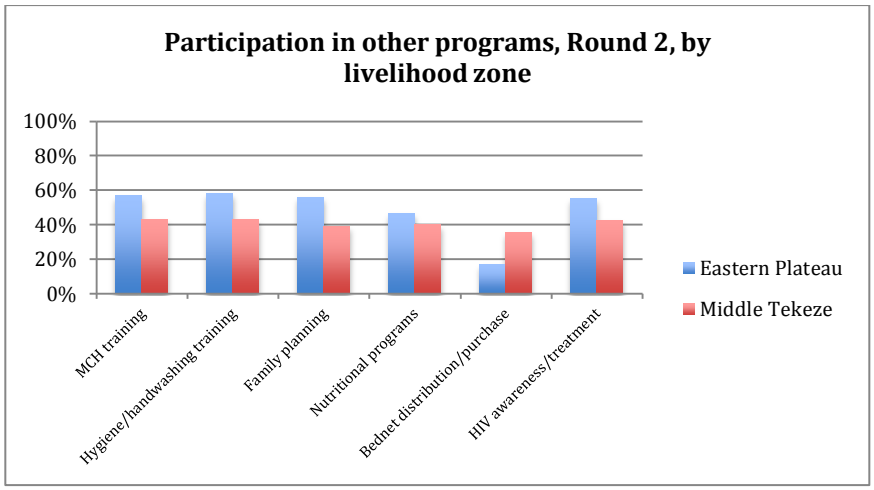
The next two graphs present information about other types of program interventions active in the Eastern Plateau and Middle Tekeze livelihood zones: the household extension package program, which provides inputs on credit for rural households, as well maternal and child health (MCH) training, hygiene and handwashing training, family planning interventions, nutritional programs, bed net distribution, HIV awareness and treatment programs, and others.

Figure 15. Participation in other programs, Rounds 1 and 2



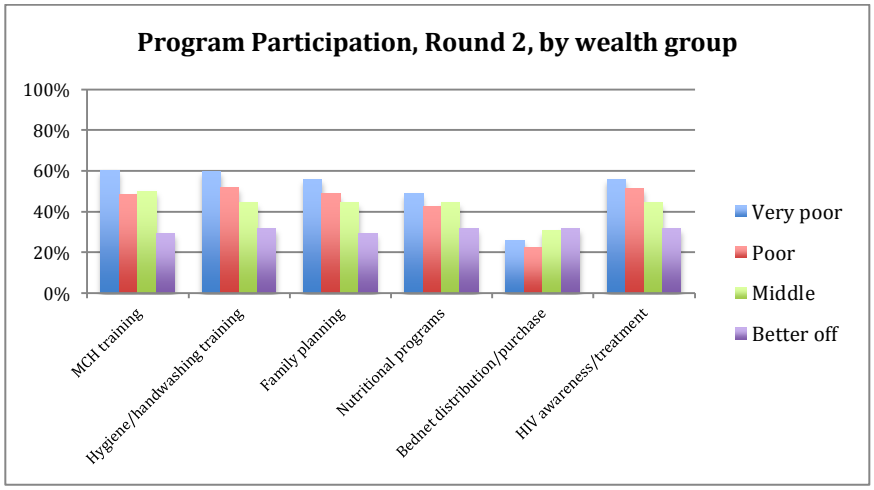
Household extension packages were nearly ubiquitous in the six months prior to Round 1 data collection, when the majority of agricultural and other rural livelihood activities are initiated (and thus inputs are required). Round 2 participation fell to a little less than 30 percent. For all other activities, participation increased from Round 1 to Round 2. For all programs, however, participation was limited to less than half of households.

Figure 16. Participation in other programs, Round 2, by livelihood zone



Programs were more widespread in the Eastern Plateau, an unsurprising finding given the deeper levels of poverty in that area. The exception is bed net distribution; malaria risk is greater in the Middle Tekeze zone, given lower elevations.

Figure 17. Program participation, Round 2, by wealth group



Poorer households were more likely to participate in programs, but in a less progressive distribution than might be expected. (Enrollment in the household extension package program is not shown, as

participation was nearly universal during Round 1). For all programs except bed net distribution, participation among the three poorer groups is between 40 percent and 60 percent.

5. Multivariate Models: Determinants of Current Status

The multivariate models in the following section explore the determinants of "current status" measures of well-being, as captured by four variables: household food access, coping behavior, dietary diversity, and illness score. The first section presents the estimation results of the models presented in Part 3, and the following section discusses these results.

A. Results

The table below summarizes the results for the four household well-being models.[5]

Table 5. Multivariate models, results

Model	HFIAS	CSI	FCS	Illness
(Constant)	-0.808	-4.254	36.692	1.365
Livelihood zone dummy (1=Middle Tekeze)	5.271***	9.693***	-5.985***	0.269***
% of adult HH members (>age 14) literate	-1.926*	-3.294	5.532***	-0.587***
Illness score (Round 1)	0.059	0.245	-0.149	0.106**
Dependency ratio	0.311	0.054	1.526**	-0.123***
Access to community resources	-0.472	-0.797	-0.559	-0.042
Total value of productive assets	0.015	0.028	0.028	0.003
Type of toilet	-0.125	0.045	0.323	0.002
Net debt (savings-debt)	0.334**	0.920***	0.179	0.003
Support network score	0.011	0.033	-0.214	0.010
Social participation score	-0.060	-0.111	0.321**	-0.025**
% of expenditure for productive investments	-3.768**	-7.059*	5.275	-0.454*
Crop diversity index	-0.661	0.673	6.956***	-0.043
Input intensity	-0.556**	-0.751	2.777***	-0.028
% of expenditure for food purchase	0.635	-0.682	-2.997	-0.349
Aggregate impact of shocks	0.279***	0.512***	-0.393***	0.021***
Value of PSNP benefits received	0.320	1.335	-2.659***	0.024
Adjusted R^2	**0.399**	**0.302**	**0.410**	**0.184**

We examine the three food security models first. An initial glance at the results suggests some broad patterns. First, the explanatory power of the model introduced in Section 3 is relatively high; between 30 percent and 41 percent of the variation in the food security measures is explained with the set of chosen independent variables. Second, the significant determinants of food access and coping behavior are quite

[5] Note that, of the independent variables listed in Section 3, average educational attainment and access to safe water were omitted due to collinearity with other included variables and concerns about data quality.

similar, but differ somewhat from those variables that explain dietary diversity (FCS). Third, unobserved geographic effects associated with livelihood zone persist even when controlling for initial household wealth, suggesting that rainfall, price, and other factors may be affecting household resilience through pathways other than income.[6] Eastern Plateau households have a 5-point higher score on HFIAS, 10-point higher score on CSI, and 6-point lower score on FCS independent of the effects of other variables. These are quite strong impacts: a 5-point higher HFIAS score represents about 19 percent of the variable's total possible range, a 10-point higher CSI score 11 percent, and a 6-point higher FCS score 9 percent.

A closer examination of the results reveals that literacy is significant for HFIAS and FCS, with a 50 percent increase in household literacy associated with an approximate increase of three FCS points. The same is true for input intensity, which improves food access and dietary diversity but has no effect on coping. Given that these correlations control for household wealth and other variables that take into account a household's *ability* to increase inputs, the input intensity variable could be interpreted as a measure of the household's *willingness* to do so. Dependency ratio, social participation, crop diversity, and—crucially—PSNP benefits are all predictors of FCS but not HFIAS or CSI. A one-unit increase in social participation score (equivalent to about 18 percent of the variables mean) leads to a 0.32 increase in FCS. A movement towards less agro-ecological diversity is associated with lower dietary diversity, as are higher PSNP benefits, a counter-intuitive conclusion given the earlier finding that poorer households are not receiving greater transfers from the program.

Conversely, productive investments and debt affect food access and coping behaviors, but not dietary diversity. A ten-percentage-point increase in total expenditure devoted to productive investments (i.e., agricultural inputs, and livestock) is associated with a slight improvement in both lack of food access (-0.4 HFIAS points) and coping strategies (-0.7 points). A 1,000-birr increase in debt also leads to a deterioration of food access (+0.3 HFIAS points) and coping (+0.9 points). Livelihood shocks are also significant predictors of all three food security variables. An increase of one point on the livelihood shock scale (which has a possible range of 10 to 50) is correlated to a 0.3–0.5 point impact on food security, quite a strong magnitude of association.

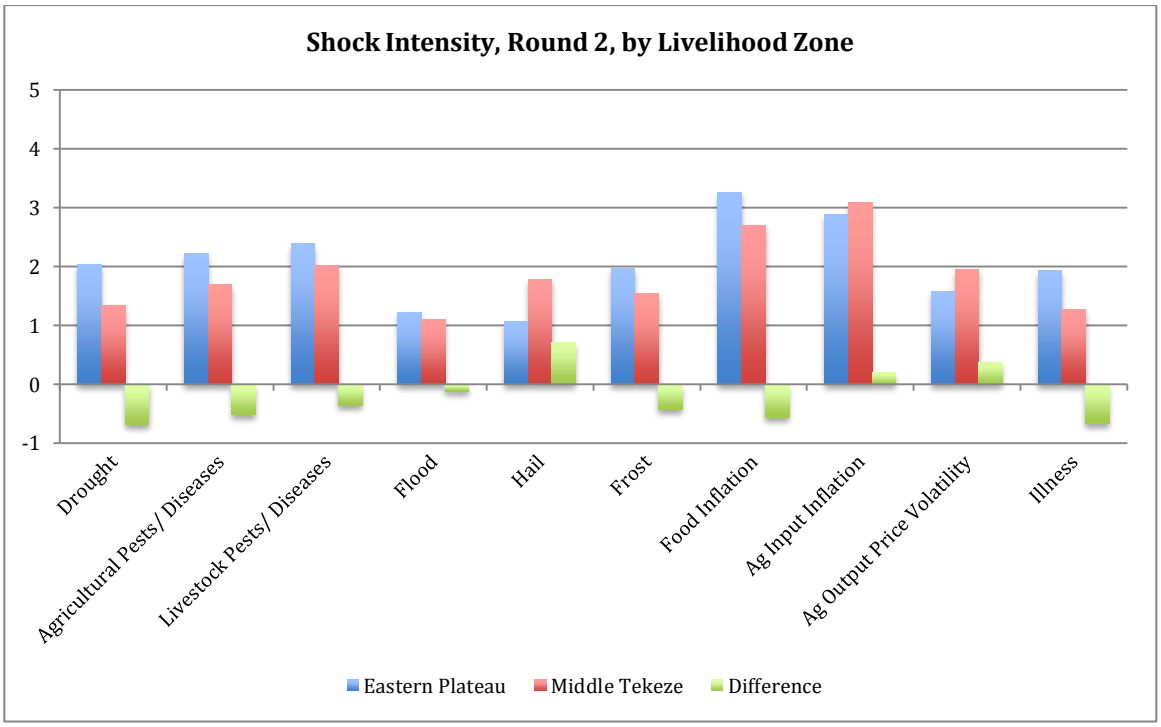
Turing now to illness score, we see that livelihood zone is once again an important explanatory, with Eastern Plateau households having a 0.26-point higher health score, controlling for all other variables. Higher literacy is also associated with lower illness, but the magnitude of impact is small: a 10 percent increase in household literacy leads to a .06-drop in illness score. As would be expected, the illness score for Round 2 is correlated with the illness score from Round 1, but the magnitude of association is surprisingly weak. A one-point higher Round 1 illness score—20 percent of the range—leads to only a 0.1-point higher Round 2 illness score. As with dietary diversity, dependency ratio and social participation are significant, although the direction of association for the former is counter-intuitive: a higher dependency ratio is correlated with lower illness, although the magnitude of association is quite small. Increased expenditure on productive investments is linked to lower illness, as is reduced shock impact. PSNP benefits are uncorrelated with illness.

[6] *Kebele* (sub-district) level dummy variables were also tested, but were found to be insignificant. Livelihood-zone level effects persisted when *kebele* dummies were inserted.

As noted earlier, when Round 3 data becomes available, we will be able to run change regressions for the variables above; that is, we will look at the determinants of change between Round 1 and Round 3 values. We will also run similar models for changes in the value of productive asset stocks, total debt, and per capita daily expenditure.

Before moving on discuss on these results and the descriptive analysis in the previous section, we quickly provide a picture of the different kinds of shocks experienced by households, given the importance of the shocks variable in all of the regressions above. The two graphs below show shock impact from Round 2 data, disaggregated by livelihood zone and by wealth group. The scale runs from 1 (no impact) to 5 (worst ever experienced) for each type of shock.

Figure 18. Shock intensity, Round 2, by livelihood zone



The graph shows that the difference in shock intensity varied moderately between the livelihood zones. In particular, drought, agricultural and livestock pests/diseases, frost, food price inflation, and illness were significantly in the Eastern Plateau, while the opposite was true for hail and agricultural output price inflation. The differences between the zones with respect to flooding and agricultural input price inflation were not significant.

Differences in shock intensity between wealth groups are presented below in table format.

Table 6. Shock intensity, Round 2, by wealth group

TYPE OF SHOCK	Very Poor	Poor	Middle	Better off
Drought	1.87[a]	1.79[a]	1.28[b]	1.38[b]
Agricultural pests/diseases	1.88[a,b]	2.05[a,b]	2.19[a]	1.68[b]
Livestock pests/diseases	2.23[a,b]	2.22[a,b]	2.36[b]	1.88[a]
Flooding	1.10[a]	1.24[a]	1.17[a]	1.05[a]
Hail	1.14[a]	1.39[b,c]	2.08[c]	1.58[c]
Frost	1.83[a]	2.02[a]	1.58[b]	1.13[a,b]
Food price inflation	3.28[a]	3.19[a]	2.75[b]	1.95[c]
Agricultural input price inflation	2.8[a]	3.28[b]	3.28[b]	2.33[c]
Agricultural output price volatility	1.58[a]	1.83[b,c]	2.17[b]	1.65[a,c]
Illness	1.78[a]	1.71[a]	1.39[b]	1.03[c]

Different superscript letters (a,b,c,d) indicate significantly different means at p=<0.1 for any two compared groups. Shared letters indicated statistically insignificant differences in means.

While two types of shock, food price inflation and illness, follow the expected pattern of monotonically increasing shock impact for poorer groups, the others do not. In fact, for the majority of shocks—agricultural pests and diseases, livestock pests and diseases, flooding, hail, input price inflation, and output price inflation, middle wealth group households have the highest shock impact score. This may be because income sources other than own production mitigate somewhat the impacts of shocks on better off and poor/very poor households—in the case of the better off, off-farm income, and wage labor for poor/very poor families.

B. Discussion

This study measures both current livelihood status and livelihood change over time. The recent literature on resilience depicts four different trajectories for resilience and vulnerability in the face of both seasonality and other shocks. At the end of the study, the analytical strategy will entail examining the change from year one to year two in the seven resilience variables listed earlier as the dependent variables. We will also identify households that fall into these different trajectory categories and analyze the determinants of change for each of the four groups separately ("bounce back better"; "bounce back"; "recover, but worse than before"; and "collapse"). These groups will be identified by both change in asset portfolios and by change in current food security status.

This paper has been devoted to the "current status" measures, given the data collected to date. It will be possible to examine the "change" measures once data for the 2012 hunger season and 2013 post-harvest season are available. While seasonal shocks explain most of the change depicted between the 2011 hunger season and the 2012 post-harvest season, our hypothesis is that some of the policy and program variables will be stronger determinants of year-to-year change.

It is notable that most of the determinants of current status are either relatively "static" factors (with the geographic advantage of certain livelihood zones having the seemingly largest effect), or else factors that are relatively difficult to manage, such as the impact of shocks. Debt clearly plays a role in determining current status, but that role is not exactly clear—the correlation of high debt with worse food security and greater coping would imply that only better off households are using credit to their advantage. Much of the earlier qualitative work showed debt playing an important role in the collapse of some livelihood options and a downward spiral for some households. Interestingly, even current asset holdings do not show much relationship with current status outcomes. It should be noted as well that there is a relationship between longer-term causal factors like education and "current status" outcomes. But few of the programmatic variables show any relationship with "current status" outcomes.

Given the nature of the analysis in this paper, it is difficult to draw very many conclusions related to policies or programs at this stage. But two hypotheses emerge from the literature and from the analysis in this paper:

- The first hypothesis is that the impact of program participation will be more visible as determinants of the "change" measures than of the "status" measures highlighted in this paper.
- The second is that the way these factors play out will be different depending on the trajectory of change experienced by households.

That is to say, for example, that "access to credit" may have very different impacts across wealth groups and "trajectory groups," and trying to determine the impact of access to credit for the whole sample may simply aggregate these mixed effects and show little overall relationship. Breaking the effects down, either according to different *ex ante* wealth categories or *ex post* categories of resilience and vulnerability trajectories, may be far more revealing about the overall impact of livelihoods programs that rely on access to credit.

Likewise, the impact of the PSNP, particularly if the program is well targeted, may be very difficult to depict in "current status" analysis—as indeed it seems to be with the results of the analysis in this paper. But the impact may well be far more apparent in the "change" analysis.

Given that there is not an active land market in Ethiopia, and household labor is relatively fixed in the short-term (with the exception of the death of one or more productive members of the household), we expect that the major category of change in asset holdings will be in livestock numbers—particularly smaller livestock (small ruminants and poultry). Together with changes in current food security status and health status, we expect that this will be the most robust medium-term measure of resilience in this context. Analysis of year-to-year changes (between Rounds 1 and 3, and between Rounds 2 and 4) will be the basis of testing these hypotheses.

Appendix A: Description of Variables

- **HFIAS.** The Household Food Insecurity and Access Scale is constructed using the answers to the following nine questions, asked with respect to the 30 days preceding the survey:
    1. Did you worry that your household would not have enough food due to a lack of resources?
    2. Were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources?
    3. Did you or any household member have to eat a limited variety of foods due to a lack of resources?
    4. Did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food?
    5. Did you or any household member eat a SMALLER MEAL than you felt you needed because there was not enough food?
    6. Did you or any household member eat FEWER MEALS in a day because there was not enough food?
    7. Was there ever no food at all in your household because there were not resources to get more?
    8. Did you or any household member go to sleep at night hungry because there was not enough food?
    9. Did you or any household member go a whole day without eating because there was not enough food?

  For each, responses are scored "0" if the answer is "never," "1" if "rarely" (1–2 times), "2" if "sometimes" (3–10 times), and "3" if "often (>10 times). The responses are then summed to create the HFIAS score used in the data set.

- **CSI.** The Coping Strategies Index is constructed by asking, "If there have been times in the past 30 days when you did not have enough food or enough money to buy food, has your household had to . . ."
    1. Rely on less preferred or less expensive food? (1)
    2. Borrow food, or rely on help from a relative? (1)
    3. Purchase food on credit? (2)
    4. Gather wild foods, gather "famine foods," hunt, or harvest immature crops? (2)
    5. Consume seed stock that will be needed for next season? (3)
    6. Send household members to eat elsewhere? (3)
    7. Send household members to beg? (4)
    8. Limit portion size at mealtimes? (2)
    9. Restrict consumption by adults in order for small children to eat? (3)
    10. Reduce number of meals eaten in a day? (2)
    11. Skip entire days without eating? (4)

  The responses to the questions are scored "0" (Never), "1" (Hardly at all; <1 time/week), "2" (Once in a while; 1–2 times/week), "3" (Pretty often; 3–6 times/week), and "4" (Always; every day). They are then multiplied by the weights given in parentheses following each question above, and summed to construct the CSI score.

- **FCS.** The Food Consumption Score, a measure of dietary diversity, is constructed by asking, "In the past 30 days, how often have you eaten . . ."
    1. Any food made from grains—injera, teff, millet, sorghum, maize, rice, wheat, bread, biscuits, or any other grain product—or any food made from tubers—potatoes, sweet potatoes, carrots, or other foods made from roots or tubers? (2)
    2. Any pulses (beans, lentils, peas)? (3)
    3. Any vegetables? (1)
    4. Any fruits? (1)
    5. Any eggs or meat: beef, lamb, goat, wild game, fish, chicken, or other birds, liver, kidney, or other organ meats? (4)
    6. Any dairy products—milk, cheese, yogurt (not including butter)? (4)
    7. Any sugar or honey? (0.5)
    8. Any oil, fat, or butter? (0.5)

  The responses to the questions are scored "0" (Never), "1" (Hardly at all; <1 time/week), "2" (Once in a while; 1–2 times/week), "3" (Pretty often; 3–6 times/week), and "4" (Always; every day). They are then multiplied by the weights given in parentheses following each question above, and summed to construct the FCS score.

- **Illness Score**. The illness score is constructed by asking the following question for each household member: "How many days since the last survey (6 months) has this household member been unable to perform normal activities due to illness or injury?" The responses are scored as "1" (almost none; very healthy), "2" (5 or less; rarely sick/injured), "3" (6–15; occasionally sick/injured), "4" (16–25; frequently sick/injured), and "5" (more than 25; major illness/injury episodes). The responses are then summed over the entire household and divided by the number of household members to generate an average household illness score.

- **Value of productive assets.** This variable is the summed value of all land, productive tools, and livestock. The prices used for analysis are taken from the second round survey time, February and March 2012, several months after the initiation of the harvest and before the onset of the hunger season. Prices were gathered from a variety of markets in both livelihood zones, and the average was used for all households. Because there are no land sales markets, land value is imputed based on the expected long-term rental value.

- **Net debt.** Net debt is measured by summing the value of all outstanding household loans and subtracting cash savings kept in both formal and informal locations.

- **Income (measured by per capita daily expenditure).** Income is proxied by per capita daily expenditure. Households were asked about expenditures for the last three months for all items other than agricultural and livestock inputs, for which they were asked about the last six months. The three-month expenditures were then summed and multiplied by 2, and then added to the six-month input expenditures. The total figure was then divided by 182.5 (the number of days in six months) and then divided again by the number of household members to arrive at per capita daily expenditure.

- **Literacy.** The respondent was asked about the literacy of each household member. Literacy was expressed as the simple percentage of household members who could read and write.

- **Schooling.** The respondent was asked about each household member's years of formal schooling. Average household schooling was expressed as the sum total of these years divided by the number of household members.

- **Dependency ratio.** The dependency ratio is the ratio of all household members under the age of 15 and above the age of 64 (considered dependents) to all household members between ages 15 and 64. A ratio above one thus indicates more dependents than non-dependents in the household.

- **Access to community resources.** The access to community resources score was constructed by asking the household about the quality of access to community-owned (not privately held) farmland, grazing land, water sources, and woodlots. Responses to each were coded "0" (no access), "1" (poor access; usually restricted), "2" (moderate; occasionally restricted); and "3" (consistent access; can access as needed). The scores for each type of resource were then summed to construct the score.

- **Support network score.** The support network score was constructed by asking the following two questions:
    1. About how many *close* friends (<u>not relatives</u>) do you have these days? These are people you feel at ease with, can talk to about private matters, or call on for help.
    2. If you suddenly faced a long-term emergency such as the death of a breadwinner or harvest failure, how many people beyond your immediate household could you turn who would be *willing* to assist you?

  The answers to the latter question are coded "0" (no one), "1" (one or two people), "2" (three or four people), and "3" (five or more people). The support network is then constructed by adding this value to the raw value of the first question above.

- **Social participation score.** Respondents are asked about household participation in the following types of associations: farmer's group, agricultural/other labor-sharing group, religious group/church, neighborhood/village cultural association, political group, marketing cooperative, credit or savings group, women's group, funeral cost-sharing group, water users group, and youth association. For each, degree of participation is scored "0" (no one in the household participates in the group), "1" (at least one household member is somewhat active), "2" (at least one household member is very active in the group), and "3" (a household member is a leader of the group). The sum of this value for all types of groups is the social participation score.

- **Crop diversity index.** The crop diversity index is constructed by taking the percentage of total land devoted to a single crop, squaring that value, and then summing the squared values for each group grown. The resulting value falls between 0 and 1, with 1 representing a monoculture and lower scores greater crop diversity.

- **Input intensity.** For each crop grown, households are asked if the crop was planted with improved

varieties, whether it was irrigated, whether commercial pesticides and herbicides were used, and whether fertilizer was applied. One point is given for each "yes" answer to any of these questions, with two points given if both organic (i.e., compost or manure) and inorganic fertilizer is used. The scores are summed for all crops and then divided by the total number of crops grown to given an input intensity value.

- **Shock impact.** For each type of shock—drought, agricultural pests/diseases, livestock pests/diseases, flooding, hail, frost, food price inflation, agricultural input price inflation, agricultural output price inflation, and human illness—households were asked to assess the severity of impact, with possible responses being "1" (no impact), "2" (slight impact), "3" (moderate impact), "4" (strong impact), or "5" (worst ever experienced). The aggregate shock impact is the simple sum of these responses with respect to each type of shock.

- **Value of PSNP benefits received.** The value of PSNP benefits is the sum of all cash received plus 4.67 birr per kilogram of grain received, which was an average of major grain prices during the 2011 hunger season.

- **Improved water access.** Households are asked about the primary source of domestic water in the current season. Following World Health Organization guidelines, piped household water, public taps/standpipes, tube wells/boreholes, protected hand-dug wells, and protected springs are considered improved sources, while rainwater collection, unprotected springs/wells, and unprotected surface water sources are not.

- **Improved sanitation.** Households are asked about the type of toilet to which they have access. Following World Health Organization guidelines, flush toilets and pit latrines with a slab or platform are considered improved facilities, while pit latrines without slabs/platforms, bucket/hanging latrines, and open defection are not.

References

Deaton, A. 1997. *The Analysis of Household Surveys: A Microeconometric Approach to Development Policy*. Baltimore: Johns Hopkins University Press.

Department for International Development (DFID), UK. 2011. "Defining Disaster Resilience: A DFID Approach Paper." London: DFID.

Devereux, S. and R. Sabates-Wheeler. 2006. *Ethiopia's Productive Safety Net Programme (PSNP). Trends in PSNP Transfers within Targeted Households*. Brighton: Institute for Development Studies.

Disaster Preparedness and Prevention Agency. 2008. *Saesie Tsaeda Amba Woreda*. Report from the Livelihoods Information Unit of the Disaster Preparedness and Prevention Agency (DPPA). Addis Ababa: DPPA.

Disaster Preparedness and Prevention Agency. 2006. *Livelihood Profile Tigray Region. Middle Tekeze Livelihood Zone*. Report from the Livelihoods Information Unit of the Disaster Preparedness and Prevention Agency (DPPA). Addis Ababa: DPPA.

Frankenberger, T., M. Langworthy, and T. Spangler. 2012. "Enhancing Resilience to Food Security Shocks." White Paper (Draft). Tuscon: TANGO.

Government of National State of Tigray. 2009. Linking South East and Mekelle Zone on the Basis of Growth Pole and Growth Corridor as an Economic Development Strategy, Mekelle, Tigray, Ethiopia (Unpublished in Tigrigna).

Government of the Federal Republic of Ethiopia. 2011. "Country Strategy Paper, 2011–2015." Addis Ababa: Government of the Federal Republic of Ethiopia.

LEGS. 2009. *Livestock Emergency Guidelines and Standards*. Rugby: Practical Action.

Maxwell, D, and K. Wiebe. 1999. "Land Tenure and Food Security: Exploring Dynamic Linkages." *Development and Change* Vol. 30(4): pp. 825–849.

Mercer, J. 2010. "Disaster Risk Reduction or Climate Change: Are We Reinventing the Wheel?" *Journal of International Development*, Vol. 22: pp. 247–264

Oxfam America. 2010. *Horn of Africa Transfer for Adaptation (Harita)*. Boston: Oxfam America.

Oxfam/USAID. 2009. *Conference Report: National Conference on Disaster Risk Management in Ethiopia*. Conference held at the UNECA, February 12–13, 2009. Addis Ababa: Oxfam and USAID.

PC Global Partners. 2008. *The Integrated Food Security Phase Classification*. Rome: FAO.

Relief Society of Tigray. 2009. Household Livelihoods Adaptation Strategy in Drought Prone Areas: The Case of Seharti Samre Woreda of Tigray Region. REST Policy Research Unit, Mekelle, Ethiopia.

Save the Children-UK. 2005. Pastoral Early Warning System. Project Implementation Manual Developed for PCDP. Addis Ababa: Save the Children-UK.

Twigg, J. 2009. Characteristics of a Disaster-Resilient Community. A Guidance Note. Version 2. Available at: www.abuhrc.org/research/dsm/Pages/project_view.aspx?project=13.

World Bank. 2007. *Ethiopia: Accelerating Equitable Growth.* Country Economic Memorandum. Washington: World Bank.

World Food Programme (WFP). 2009. *Comprehensive Food Security and Vulnerability Assessment.* Rome: WFP.