IDS WORKING PAPER
Volume **2016** No **465**

CSP WORKING PAPER Number 013

Can Social Protection Increase Resilience to Climate Change?

A case study of *Oportunidades* in rural Yucatan, Mexico

Ana Solórzano

March 2016

Centre for Social Protection

Institute of Development Studies

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CSP WP013

CSP Working Paper series editor: Stephen Devereux

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IDS Working Paper 465

ISSN: 2040-0209 ISBN: 978-1-78118-293-2

A catalogue record for this publication is available from the British Library.

Available from:
Communications and Engagement Unit, Institute of Development Studies, Brighton BN1 9RE, UK
Tel: +44 (0) 1273 915637
E-mail: bookshop@ids.ac.uk
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Can Social Protection Increase Resilience to Climate Change? A Case Study of *Oportunidades* in Rural Yucatan, Mexico

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Summary

This paper examines the linkages between social protection and resilience to climate change among poor rural households. To date there is a very limited understanding of the potential role of social protection programmes in contributing to an increase in resilience of the rural poor with respect to climate change. An improved understanding of these links can help to build the knowledge base that is needed to help the poorest members of the society to adapt to the impacts of climate change. This gap in understanding is addressed in this working paper through a case study of the conditional cash transfer programme *Oportunidades* in two rural communities in Yucatan, Mexico, a region highly exposed to hurricanes and droughts. Qualitative and quantitative data were collected by means of household surveys, life-history interviews, key informant interviews, group discussions and participant observation. The working paper found that the main role of *Oportunidades* is to provide a regular and predictable safety net that protects households from short-term risk, thus increasing households' coping capacity. The impact on the adaptive capacity of households is indirect and differentiated according to their respective poverty profiles. Furthermore, the research shows that certain features of the theory of change of *Oportunidades*, and its design, reduce the potential impact of the programme, creating trade-offs between coping and adaptive capacities. The working paper concludes by making a case for social protection to be complemented by other interventions in a systemic approach that should explicitly consider climate change, in order to increase resilience and achieve sustainable poverty reduction.

Keywords: climate change resilience; social protection; vulnerability to climate change; climate risks; rural poverty; agrarian change; conditional cash transfers; *Oportunidades*; Mexico.

Dr Ana Solórzano is a social scientist specialised in researching the linkages between social protection and climate change resilience. She recently finished a PhD in Development Studies from the Institute of Development Studies at the University of Sussex. She works at Oxford Policy Management.

Contents

Acknowledgements

This working paper draws from the findings of my doctoral thesis at the Institute of Development Studies in the University of Sussex: *Linking social protection and resilience to climate change: A case study of the conditional cash transfer programme Oportunidades in rural Yucatan, Mexico.* The thesis was developed with the support of my supervisors, Dr Stephen Devereux and Dr Lars Otto Naess, to whom I owe my appreciation. I am also very grateful to the Examining Committee, Dr Jeremy Lind and Dr Marisa Goulden.

I would also like to thank Dr Andrew Newsham from the Centre for Development, Environment and Policy at SOAS for peer reviewing this paper.

Finally, my sincere gratitude also goes to the Centre for Social Protection at the Institute of Development Studies for publishing this working paper.

1 Introduction

Social protection is increasingly considered as having an appropriate role in reducing poverty and poor people's vulnerability to climate change. Scholars have emphasised the importance of social protection as a means of protecting the most vulnerable members of society from the impacts of climate change (Davies *et al*. 2008; Heltberg, Siegel and Jørgensen 2009; Godfrey Wood 2011; Johnson *et al*. 2013). Likewise, 'resilience' is becoming one of the dominant policy narratives to deal with the impacts of climate change. The concept is being mainstreamed by governments and development organisations, and lies at the centre of different frameworks and strategies targeted at the poorest members of society (cf. Pasteur 2011; SDC and WFP 2011; World Bank 2013; World Vision UK 2013).

Advances in academic research in recent years include the development of conceptual frameworks to explore the synergies between social protection, climate change adaptation, and disaster risk reduction, such as the Adaptive Social Protection framework (Davies *et al*. 2009; Arnall *et al*. 2010); the Climate-Responsive Social Protection framework developed by Kuriakose *et al*. (2013); and the 3P&T-3D resilience framework developed by Béné *et al*. (2012a) which have also aided an understanding of the commonalities and differences between social protection; climate change adaptation; resilience; and disaster risk reduction.

The Adaptive Social Protection framework (ASP) (Davies *et al*. 2009) developed at the Institute of Development Studies was the first scholarly effort to explore the linkages between disaster risk reduction, climate change adaptation and social protection approaches. The framework aims to 'simultaneously tackle unsafe living conditions, counter the underlying causes of vulnerability, and promote people's ability to adapt to a changing climate' (Arnall *et al*. 2010:1). The ASP framework seeks to accommodate the social protection interventions that aim to support development and reduce vulnerability to climate change.

The World Bank Climate-Responsive Social Protection framework considers three main principles: climate-aware planning; livelihood-based approaches; and support for adaptive capacity building. These principles are then reflected in specific design features: 1) scalable and flexible programmes; 2) climate-responsive targeting systems; 3) investments in livelihoods that build resilience; and 4) institutional capacity and coordination for risk management. These design features will cover the preventive, protective and promotive social protection system functions (Kuriakose *et al*. 2013).

New thinking on ASP has recently used resilience to complement the ASP framework in order to achieve a more dynamic approach. In this light, Béné *et al*. (2012a) developed the 3P&T-3D analytical framework which links resilience with social protection. The authors provide an innovative analytical framework to evaluate the extent to which social protection programmes contribute to strengthening the resilience of their recipients to climate change. The framework moves from earlier simplified approaches of ASP to a more systematic framework that highlights the importance of a dynamic approach to resilience and social protection which considers time and scale issues.

Scholarly research progress has also been achieved in terms of building the evidence-base. For instance, different forms of social protection programmes have been related to their capacity to mitigating climate risk, such as public work programmes (Béné *et al.* 2012b; Adam 2015); crop insurance (Panda 2013); safety nets (Heltberg, Siegel and Jørgensen 2009; Coirolo *et al*. 2013); and agricultural programmes (Davies *et al*. 2013).

Nevertheless, important empirical gaps remain that might help to explain to what extent the agenda relating to social protection is compatible with plans dealing with resilience to climate

change. How does social protection affect long-term resilience and interact with the different factors and processes that contribute to risk, poverty and vulnerability? Are there any trade-offs in terms of different timescales over which the given policy interventions are operational? This also leads to additional questions about operational matters, such as: which design features of social protection programmes maximise or limit an impact on resilience? How does the theory of change that underpins social protection affect resilience? What other contextual factors favour, or limit, the impact of social protection upon the resilience to climate change of poor households?

This gap in the understanding of the potential of social protection to support climate change resilience is addressed in this working paper[1]. For this purpose, this work takes the form of a case study based on the conditional cash transfer *Oportunidades* programme in Mexico. It aims to improve our understanding about how to aid the poorest members of society, to cope with, and adapt to, a changing climate. Poor people are already struggling to deal with current climate variability, as has been well documented (cf. Stern 2006; Mitchell *et al*. 2012; Olsson *et al*. 2014). Given this, climate change will increase the current insecurities of these already vulnerable groups (Adger, Paavola and Huq 2006). This will also impose serious challenges to future generations of poor people and represent a serious concern in terms of the intergenerational transmission of vulnerability and poverty (Adger, Lorenzoni and O'Brien 2009; O'Brien *et al*. 2012).

1.1 The social protection-resilience analytical framework

Before explaining the social protection-resilience analytical framework, I will firstly review the concept of resilience in the context of development. Resilience is becoming a very popular concept to integrate development with climate change adaptation (Klein, Nicholls and Thomalla 2003; Béné *et al*. 2014). Several authors have documented the evolution of the term 'resilience' and its use in different fields (cf. Bahadur, Ibrahim and Tanner 2011; Martin-Breen and Anderies 2011; IFPRI 2013), but it is in the social-ecological systems (SES) literature that resilience started to have growing influence in development discourses (cf. Fischer and Kothari 2011; Béné *et al*. 2014). This approach identified three main characteristics of resilience (Tompkins and Adger 2004; Nelson, Adger and Brown 2007): the buffering capacity, which is the degree to which the system is susceptible to change while still retaining structure and function; self-organisation, which is the capacity of the system to adjust through interactions among its components; and the adaptive and learning capacity.

The importance of the SES approach for development is that resilience is not only about coping with change, but also about living with it. Therefore, resilience focuses on processes of change (Adger *et al*. 2011; O'Brien *et al*. 2012). This approach also integrated social structures and ecological systems, which are made up of many different parts that interact to form a more complex entity (Walker *et al*. 2006; O'Brien *et al*. 2007). This understanding of resilience emphasises systems thinking, helping to identify the different interactions between short-term and long-term changes that affect vulnerable people (Miller *et al*. 2010; O'Brien *et al*. 2012). The term is therefore used as a conceptual umbrella, facilitating integrated approaches that break the usual disciplinary silos (Martin-Breen and Anderies 2012). It has integrated the interactions between climate change, and other multiple sources of shocks and stresses. Resilience 'allows multiple risks, shocks and stresses and their impacts on ecosystems and vulnerable people to be considered together in the context of development programming' (Mitchell and Harris 2012:6).

[1] This working paper is based on the author's PhD thesis from the Institute of Development Studies at the University of Sussex. For an in-depth and detailed explanation of the conceptual framework, methodology, data collection sources, data analysis approach and full results see Solórzano (2015).

Resilience has been often criticised for not being a normative concept (Nelson 2009; Pelling 2011). In other words, resilience is 'neither good nor bad; or more precisely put, that it can be good but it can also be bad' (Béné *et al*. 2014:599). This is the case because the application of resilience assumed that social and ecological systems were similar, and the concept grew in isolation from social science development, excluding society and people from the focus of analysis (Cote and Nightingale 2012). Therefore, a resilience approach may lead to a focus on apolitical, and technocratic responses focused on hazards that come at the expense of social justice and social transformation (Cannon and Muller-Mahn 2010; Béné *et al*. 2014). Risk and vulnerability are therefore framed as an external source located in the ecological system, rather than taking an integrated view that includes social dimensions of vulnerability (Gaillard 2010; Miller *et al*. 2010).

From a development perspective this means that there may be trade-offs between resilience and wellbeing (Davidson 2010; Armitage *et al*. 2012). Béné *et al*. (2014) argue that resilience is not a 'pro-poor' concept, and therefore should be used with caution when trying to implement development actions. 'If applied uncritically, a resilience-based approach might end up leading us towards abandoning interest in the poor (est) for the sake of strengthening community or even (eco) system-level resilience' (*ibid*.:616). To a large extent, this critique is the consequence of an increasing interest by developing agencies and donors in the concept of resilience, where it has become a policy narrative, with little or no critical awareness of the potential negative implications of the term for poverty reduction. This is illustrated in the different resilience frameworks and strategies that have been developed by some of these agencies (cf. SDC and WFP 2011; World Bank 2013; World Vision UK 2013). These frameworks are usually based on a neoliberal and market-based approach to resilience. Rigg and Oven (2015) suggest that this 'liberal resilience' approach can lead to a growth-development-resilience 'trap', where economic growth is understood as development, and the latter being indicative of resilience, when in fact these relationships are not necessarily true and in many contexts can have the opposite effects.

Recent approaches to resilience in relation to climate change highlight the importance of transformation, understood as a fundamental physical or qualitative change in form, structure or meaning in the system that will enable it to be better suited to thrive within the context (Folke *et al*. 2010; Park *et al*. 2012). In the climate change adaptation literature, transformation is related to the structural social, cultural, economic and political causes of vulnerability (Pelling 2011). Transformation addresses the power imbalances in society, which underpin vulnerability (Kates, Travis and Wilbanks 2012).

Even so, the meaning of transformation in the discussion of resilience remains ambiguous (Brown 2014). On the one hand, resilience expands its meaning to the inclusion of social shifts (Chapin *et al*. 2010; Folke *et al*. 2010). For instance, Folke *et al*. (2010) present both adaptability and transformability as key components of resilience thinking. They expand the definition of resilience from persistence or buffer to a dynamic synergy between persistence, adaptability and transformability among multiple scales and attractors. They present the idea of 'resilience as transformation' where social change is essential for resilience, and adaptation facilitates learning and innovation, through interactions within and across scales. Bahadur and Tanner (2014) propose not to discard one concept for the other, but they argue for 'reimagining resilience as a concept that includes useful tenets from the body of knowledge on transformation (*ibid*: 12).

On the other hand, resilience focuses on the persistence of the system, working against profound change (cf. Pelling 2011; Wilson *et al*. 2013). Given this, Pelling (2011) argues that transformation remains as a different, and opposed, concept to resilience. Leach (2008), on the development arena, establishes that resilience usage is inherently conservative, since it focuses on the persistence of a system, underplaying the endogenous and social dynamics

in the system. Moser and Ekstrom (2010) indicate that transformation and resilience are different parts of an adaptation spectrum.

In the praxis, evidence shows that in the context of development action, resilience to climate change usually supports the latter, with bigger emphasis on 'business as usual' activity. For instance, Brown (2012) shows, in her review of policy discourses in the arena of climate change and development, that the application of resilience emphasises the status quo, rather than more profound and structural changes.

In this paper the definition of resilience that I use is: 'the ability to resist, recover from, or adapt to the effects of a shock or a change' (Mitchell and Harris 2012:2). Given this, it will be assumed that resilience is integrated by two main dimensions:

- the coping capacity, which in this research integrates: 'the ability to resist and recover from a shock or a change'; and
- the adaptive capacity, understood as 'the ability to adapt to the effects of a shock or a change'.

The conceptual underpinnings of the paper are based mainly on the complementarily of the concepts of vulnerability reduction and resilience to climate change. It will also be assumed that transformation is a separate concept that can be related to resilience. These conceptual underpinnings deviate from the understanding that since certain social protection interventions reduce vulnerability, then -by doing so- they could help people manage climate risks and support them as active agents in creating resilience. This assumption does not imply that the resilience and social protection literatures are describing the same issues, but that they complement each other.

Miller *et al*. (2010) suggest taking a 'bifocal approach', which draws from the virtues of both vulnerability and resilience approaches: from the resilience thinking there can be an assessment of the long-term biophysical system drivers and from the vulnerability literature there can be an integration of the contemporary local socioeconomic realities, such as issues of social justice and power distribution (Cannon and Muller-Mahn 2010).

In this working paper I take the position that the aim of social protection is to build resilient livelihoods, protect people against impoverishing shocks and stresses, and to eradicate the social origins of vulnerability (Sabates-Wheeler and Devereux 2008). Given this, I suggest that *Oportunidades* reduces some of the causes of vulnerability, since it is related to the material dimensions of social protection: protection, prevention and promotion (Devereux and Sabates-Wheeler 2004). Furthermore, it has short-term and long-term objectives: in the short-term *Oportunidades* protects incomes and consumption after a shock or stress. It is also provides social assistance to people living in poverty, preventing them from falling into further destitution. In the long-term the periodic delivery of cash transfers promotes the livelihoods of the poor, so they can escape poverty.

The paper explores how protective and preventive social protection affects the short-term coping capacity of the households that receive support through *Oportunidades*. It also attempts to shed light on the role of promotive social protection in the long-term adaptive capacity of these households. The paper thus examines which features of social protection are most supportive and over which timescale, as well as the different trade-offs that might exist between the coping and adaptive capacities. I developed two theoretical propositions that justify and describe these linkages in more in-depth (see table 1.1). The case study technique requires a previously developed theory that will be validated or modified by the empirical results. This theory can be in the form of theoretical propositions that are used as templates 'to determine whether a theory's prepositions are correct or whether some alternative set of explanations might be more relevant' (Yin 2003:40). It is important to

highlight that these theoretical propositions are used as templates to test and modify theory based on the empirical results, rather than being hypotheses to be rejected or confirmed.

1.1.1 Theoretical proposition for the protective and preventive social protection and coping capacity link

I propose that theoretically, the impact of *Oportunidades* in the coping capacity of households is twofold: firstly, after a climate shock *Oportunidades* provides relief by supporting short-term consumption needs. This takes place due to the protective feature of the programme, which protects the households' income. The cash also helps in the recovery of the asset base of the households after the climate shock, increasing their capacity for self-organisation. Secondly, the regularity and predictability of *Oportunidades* provides poor households with a level of basic income security, which prevents households from falling into deeper poverty. Poor households can start anticipating risk, which increases their coping capacity in the face of future shocks (Cipryk 2009; Davies *et al*. 2009; Jones *et al*. 2010). This capacity of resilience integrates the coping strategies that households use to buffer the impacts of shocks on their livelihoods and basic needs (Béné *et al*. 2014).

Furthermore, the regularity and predictability of *Oportunidades* provides poor households with a level of basic security from which they can start investing current consumption into future consumption (Anderson, Geoghegan and Ayers 2009). This means that if the cash transfers of *Oportunidades* are big enough, over time they can take people across an income threshold to escape the risk of poverty traps (Devereux 2002; Dorward and Sabates-Wheeler 2006).

In terms of resilience, preventive social protection is related to risk reduction and forward planning. Cash transfers from *Oportunidades* can then be accumulated as savings and as a self-insurance mechanism which can then be drawn upon and liquidated at times of crisis (Corbett 1988). In other words, *Oportunidades* can then support proactive strategies, understood as the 'adjustments that populations take in response to current or predicted change' (Nelson, Adger and Brown 2007:397). These are actions that poor households take in anticipation of climate impacts, so as to reduce risk and to improve the level of response (*ibid*.).

1.1.2 Theoretical proposition for the promotive social protection and adaptive capacity link

In a context of poverty, households usually have few means to develop more productive and less climate sensitive livelihoods. However, arguably, *Oportunidades*' impact on the asset profile of poor households can help to create different livelihood options for both current and future generations. This livelihood innovation helps them to adapt to climate change. This takes place when households learn to live with change and uncertainty (Marschke and Berkes 2006). Households start innovating so that some of their livelihood strategies encompass ways to adapt to this change (Armitage 2005).

Promotive social protection helps poor people to invest in productive assets and livelihood income-generating activities, and these make livelihoods stronger and more sustainable in the long-term (Devereux 2002; Sabates-Wheeler and Devereux 2013). The rationale behind this assumption is that the regular and long-term provision of cash transfers will eventually translate into productive investments (Sabates-Wheeler and Haddad 2005; Dorward and Sabates-Wheeler 2006).

In terms of resilience, this increased productivity can translate into more flexibility to engage in further adaptive strategies. This flexibility can be in the form of livelihood diversification or new livelihood options, helping households to build security against climate shocks (Davies

et al. 2009; Heltberg, Siegel and Jørgensen 2009; Niño-Zarazúa *et al*. 2012). The ASP literature argues that for livelihoods to be more resilient to climate change, they need to be less dependent on climate-sensitive activities (Davies *et al*. 2008). Therefore, theoretically it is expected that such adaptation of livelihoods will lead to less climate-sensitive livelihoods.

Moreover, the main focus of *Oportunidades* is the idea that the households will invest in the human capital and wellbeing for future generations. By providing the children with skills and knowledge through the conditionalities of education and health, future generations will ideally have more skills and abilities. These investments in human capital can help future generations to have more options and choices about their own future. 'Increased skills, higher levels of education, […] offer greater possibilities of being able to create or take up a broader range of options, thus signifying an increase in adaptability' (Sabates-Wheeler, Mitchell and Ellis 2008:5). Theoretically, over time these young adults will be able to access formal semi-skilled and skilled labour, which is also more secure and less climate sensitive.

Table 1.1 Conceptual linkages between social protection, vulnerability and resilience

Linkages	Social protection role		Reduction of material causes of vulnerability		Resilience benefits
Protective & preventive social protection-coping capacity link	Provides relief Prevents further deprivation	→	Provides relief Reduces the risk of poverty traps Provides minimum security	→	**Increases coping capacity:** Self-organisation & relief Capacity to plan for the future Livelihood adjustments
Promotive social protection-adaptive capacity link	Promotes income and capabilities	→	Increases productivity	→	**Increases adaptive capacity:** Stronger livelihoods Less climate-sensitive livelihoods

Source: Author

2 Methodology and field sites

Using the case study approach was an innovative way to address questions relating to timescales behind resilience and social protection, as well as to understand the dynamics between social protection and climate change and variability. It explained how social processes are affected by and in turn shape, responses to social protection. This approach also helped in the identification of other issues related to the governance of the social-ecological system that are determining access to assets necessary for adapting to climate change and variability.

2.1 Site selection

The field sites were located in the state of Yucatan, in the southeast of Mexico. The selection process had two main sources: 1) key informants; and 2) secondary sources such as census, government reports, and the register of *Oportunidades* recipients. Given this, two communities were chosen following the next criteria:

- exposed to climate shocks;
- contain households receiving *Oportunidades* as well as non-recipient poor rural households;

- have different livelihood settings: such as fishing and agriculture in order to allow a better understanding of the dynamics behind social protection in different local contexts;
- be places with less than 1000 inhabitants (coastal community 551; inland community 617), and suffer isolation, exclusion and high levels of poverty -making them a representative case of rural communities in Mexico;
- be located in Mayan municipalities, with the inland community having a stronger indigenous identity -this society has distinctive practices and traditions firmly embedded in their culture as a form of autonomous adaptation to the climate stress in the region.

In order to protect the identities of the respondents in the research the official names of the communities are confidential and hence, they will be referred to as the 'coastal community' and the 'inland community'.

2.1.1 Coastal community

The coastal community is located on the central coast of Yucatan in the Gulf of Mexico. The climate is classified as semi-arid with an annual precipitation of 600 mm. Annual evaporation is around 1800 mm per year and the annual mean temperature is 26 degrees Celsius. The dry season takes place during February, March and April. The rainy season takes place during July and August. The north-wind season is between June and November (Batllori-Sampedro, Canto-Polanco and Febles-Patron 2006). The coastal community has a surface area of 1,472 hectares, of which more than 60 per cent consists of wetlands (Batllori-Sampedro 2002a). The environmental landscape consists of coconut plantations, mangrove swamps (which includes red, white and buttonwood mangrove), 45 sinkholes, hypersaline waters and low deciduous forests *(ibid*.). These resources provide several ecological services to the population. Nonetheless, in the past 35 years, hydro- meteorological phenomena have changed the social-ecological relations in the coastal community (Batllori-Sampedro and Febles-Patron 2009). Hurricane Gilbert in 1988, classified as major hurricane reaching category 5 in the Saffir–Simpson Hurricane Scale and Hurricane Isidore, which reached category 3, had severe impacts on the vegetation and social infrastructure of the community. They accelerated the erosion process on the coastline, and they changed the coastal configuration in the watershed by breaching the sand bar, leading to changes in the composition of the wetland from a hypersaline-palustrine system to an estuarine- marine one (*ibid*.).

The coastal community has also suffered from environmental degradation in the form of deforestation due to natural processes, as explained above, but also to anthropogenic activity such as residential development and population growth that began in the late 1970s (Batllori-Sampedro, Canto-Polanco and Febles-Patron 2006). Between 1975 and 1998 the population grew almost four fold from 150 to 554 people (Batllori-Sampedro 2002b). This population growth not only resulted in an overexploitation of the natural assets in the community, but also led to a growing exposure of a larger population to an area affected by extreme events. Likewise, the reduction of the main marine resources, particularly related to octopus and grouper, highlights the overexploitation due to unsustainable fishing that has been taking place in the community.

The community is well connected by a coastal highway, where public transportation is available to reach other coastal villages and the capital city. More than 70 per cent of the households have basic services at home, including drainage service, electricity, and water faucet. However, over 57 per cent of the households have at least one of the following characteristics in their dwellings which render them vulnerable to hurricane and flood risk: a dirt floor with the roof and/or walls made of cardboard or asbestos sheets; waste; mud or daub and wattle; or palm tree.

Livelihoods in the coastal community –as in the rest of rural Yucatan- are quite complex and are based on several small-scale livelihood activities, with artisanal offshore fishing as the main livelihood activity (see table 2.1). Households regularly diversified, on average, into four livelihood activities, but some households had up to ten different livelihood activities.

2.1.2 Inland community

The inland community is located in the south of Yucatan. The weather in the region is classified as a dry tropical climate (As). The mean annual temperature is 26.3 degrees Celsius. It has a mean annual precipitation of 68.2 mm. The rainy season takes place during the summer and the dry season during the winter.

The environmental landscape includes medium sub-deciduous forest. The community has 10 hectares that constitute a protected natural reserve. There are no surface rivers. The ground is quite flat and is composed of soft limestone bedrock. This property makes the land very permeable and porous. Rainwater infiltrates through the calcareous ground, preventing the formation of surface water streams. In its place, underground rivers and karstic sinkholes known as *cenotes* are formed. These underground rivers and pools form the main hydrological basin in Yucatan, and are the main source of potable water of rural communities.

Less than ten years ago a highway was constructed to connect the inland community with the main part of the municipality. However, there is no public transportation from the inland community. People have to organise transportation for themselves to the centre of the municipality, located 6km away. From there, access to public transportation to the capital city and minor cities is accessible. This geographic isolation limits the access to major public services and markets.

Furthermore, 93 per cent of the 111 households are considered as deprived of basic services in their dwellings because they use wood or coal with no chimney inside the dwelling, while some households lack access to a water faucet in their dwellings. Nonetheless, electricity and drainage are available in all dwellings. However, 76 per cent of the households have no access to dwellings of quality, because they have a dirt floor; the roof is made of cardboard sheets or waste; and/or the walls are made of mud or daub and wattle; reed, bamboo or palm tree; cardboard, metal or asbestos sheets; or waste (see photo 2.1).

Livelihood activities in the inland community range between traditional livelihoods that depend on natural resources, and market-oriented activities, usually practiced in the cities (see table 2.1). The former activities not only provide in-kind production and, to some extent, income, but they also represent the basis for everyday life and ceremonial life (Rosales 2003). The latter activities provide the necessary income that modern life requires. On average, households diversified into five different livelihood activities, but some households had up to 11 different livelihood activities.

Photo 2.1 Typical dwelling in the inland community

76 per cent of the households in the inland community have poor quality housing, making them vulnerable to hurricane and flood risk.

Source: Author, taken August 2012.

Table 2.1 Livelihood activities in the coastal and inland communities

Type of livelihood activity	Households in coastal community practicing this activity	Income received per activity	Households in inland community practicing this activity	Income received per activity
Fishing	100%	Artisanal off-shore fishing: 200 pesos per day, plus consumption for the household	--	--
Agriculture	23%	Agricultural worker: 60 pesos per day Coconut plantation, backyard agriculture, small-scale rearing of coconut seedlings: mainly for the consumption for the household	84%	Timbering: 40 pesos per day. Agricultural worker: 60 pesos per day *Milpa*, backyard agriculture, subsistence production
Livestock production	45%	Small-scale poultry and pork for the consumption of the household	95%	Small-scale poultry and pork for the consumption of the household
Off-farm work	--	--	80%	Hammock weaving: 70 pesos and 90 pesos per week
Work in the city	--	--	48%	Helper of builder: 300 pesos per week Chief builder: 600 pesos per week Domestic worker: 700 pesos per week
Tourism	27%	Ecotourism in the sinkhole: 80 pesos per trip Maintenance of beach houses: 400 per month	--	--
Services	30%	Sewing and dressmaking: 200 pesos per complete piece Cooking: 30 pesos per meal Carriage services: n.a. Carpentry and builder: 400 per week	10%	Cooking: 20 pesos per meal Carriage services: 500 pesos per week
Small family business	18%	Restaurants: n.a. Convenience stores: 750 pesos per week Market stalls: 500 per week Car and bicycle workshop: n.a.	10%	Mills: 200 pesos per week Small convenience stores: 400 pesos per week Sewing *hipiles*: 350 pesos per two weeks

Source: Author based on household survey

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Source: Author based on household survey

2.2 Data collection and analysis

The data collection drew from a bottom-up approach, and considers what the members of the communities themselves considered to be their main sources of resilience and of vulnerability. It was based on a mix of quantitative and qualitative methods and sources in order to examine overlapping and different facets of the phenomenon under study, by triangulating the data (Garbarino and Holland 2009). This also allowed me to build a robust data set. The fieldwork was conducted between November 2011 and November 2012 and it had four main stages:

1. The vulnerability context was developed during the different stages of the data collection, triangulating the findings based on the information provided by the people. Participatory tools based on Participatory Rural Appraisal (PRA) were used to facilitate a dialogue and emphasise local people's point of view (Chambers 1994; 1997). Tools such as key informant interviews to local leaders and members of informal institutions in the communities were used at different stages of the research, in order to uncover the research context where I was working, and also to triangulate some of my preliminary findings. Likewise, six group

discussions and transect walks, provided contextual data and facilitated an understanding of both biophysical and socio-economic aspects of resilience.

These tools also aimed to identify the climate shocks that people themselves considered as main sources of risk. In this light, in the coastal community Hurricane Isidore in 2002, was identified as a main climate shock. In the inland community, the Hurricane Isidore in 2002 and the drought experienced in 2012 were the climate shocks studied in this research. In both communities, people's perception of climate variability was also considered (see Appendix 1 for a description of these climate shocks and perceived climate variability). In this research, climate shocks are understood as a single category of covariate shocks, and they are used as a proxy for climate change. Whilst high uncertainties remain about the linkages between hurricanes and droughts and climate change[2], the purpose of studying these specific climate shocks is to understand the 'adaptation deficit' in the region, in other words, how households have been responding to current climate conditions, and if these responses have been adequate (IPCC 2014).

2. I created a household survey to collect baseline information on assets, socio-demographic characteristics, livelihood activities, and actions taken before, during and after climate shocks. The questionnaire was systematised between the two communities, but it was also adapted to the social-ecological context of each community using qualitative tools, such as group discussions with community members, informal interviews with key informants, transect walks, and a secondary data review from previous research studies, census and surveys.

The survey was applied to all households in both communities giving a total of 212 households (see table 2.2). The survey analysis was mainly exploratory and descriptive and it was developed using the SPSS Statistics 18 software. It aimed to build the baseline data of the research, as well as to explore the different coping strategies implemented after a shock or stress. It also aimed at finding relationships arising from households' exposure to the financial benefits of the programme. For this reason, the analysis was stratified according to whether households were recipients of *Oportunidades* or not. Moreover, when data was available, the analysis also considered the poverty category of the household[3].

[2] The latest Working Group I contribution to the IPCC Fifth Assessment Report shows that there is medium confidence that droughts will intensify in some seasons in Mexico by up to the year 2100 (Stocker *et al*. 2013). Increases in intense tropical cyclone activity have 'low confidence' for the early 21st century and 'more likely than not' in the Western North Pacific and North Atlantic.

[3] Based on the official national poverty lines in Mexico (CONEVAL 2010): 1) The wellbeing income poverty line measures the population whose income is insufficient to cover their needs (food and no food) even if they devoted their entire income to this purpose. In rural areas this value was equivalent to 1,444 pesos (112 USD) per capita per month with price values of December 2011. 2) The minimum wellbeing income poverty line measures the population whose income is insufficient to cover their food needs, even if they devoted their entire income to this purpose. The value is equivalent to 755 pesos (59 USD) per capita.

Table 2.2 Surveyed households coastal community and inland community

		Oportunidades households			Non-*Oportunidades* households		Total
	Household *Oportunidades* profile	**Long term 1998**	**Medium term 2004**	**Short term 2007**	**Transfer suspended**	**Never received**	
Coastal community	Number of surveyed households	15	20	16	8	42	**101**
	Percentage		50.5%		49.5%		
Inland community	Number of surveyed households	39	22	5	3	42	**111**
	Percentage		59.5%		40.5%		
Total	Number of surveyed households		117		95		**212**
	Total Percentage		55%		45%		

		Households registered in Health Centre	**Surveyed Households**	**Deceased, temporary migration, considered as members of other households already interviewed or did not want to participate in survey**
Coastal community	**Households**	143	101	32
Inland community	**Households**	142	111	31

Source: Author based on household survey

3. Retrospective life history interviews were conducted to households identified in the survey. The sample for the life histories consisted of 56 individual interviews. The main objective of these interviews was to have an in-depth understanding of the capacity and key factors that surrounded households' resilience and wellbeing. They were based on the work of Davis (2010). The patterns of life trajectories were essentially based on people's perception of their own life conditions that change over time in a context of constant climate stress. I coded and analysed the content of the 56 life-history transcripts using Dedoose qualitative analysis software. More than 62 hours of interviews were recorded. The life histories were clustered in two groups following the next criteria:

- The first cluster was integrated with 28 respondents. These were selected from the vulnerability profile created with the household surveys. The criteria were to find long-term or medium-term recipient households, in order to assess the long-term effect of the programme, and an equivalent number of non-recipient households with a similar household profile.

- The second cluster was integrated with 28 respondents. These life history interviews were conducted with the children of the interviewees in the first cluster, in order to have a sample with the young adults who received the *Oportunidades* programme and had already graduated, or were about to graduate from school, along with their peers who were not recipients of the grant. When it was not possible to interview the children from cluster one (either because they were not available or because they did not want to participate), then the 'snowball sampling' technique (Mack *et al*. 2005) was implemented. In this method, participants with whom I had already made contact used their social networks to refer me to other young adults who could potentially participate in the life histories.

Based on Davis (2006), each participant was asked at the end of each life history interview to identify the two or three most important causes for an improvement and decline in their

wellbeing throughout their lives. The former are considered as sources of resilience and the latter as sources of risk. Wellbeing has been used as a proxy of resilience in previous research (cf. Armitage *et al*. 2012; Goulden *et al*. 2013). Moreover, I used a subjective assessment of wellbeing in terms of what the communities themselves defined. This helped me to integrate a social dimension to resilience that was pro-poor and bottom-up.

I complemented the analysis with an assessment of the trajectory patterns based on the different episodes of crises that respondents had described as having impacted negatively on their livelihoods, as well as the episodes of recovery and improvement in their wellbeing. These allowed me to identify secondary sources of resilience and risk that may have been underestimated by the respondents. The sources of risk are mainly in the form of stresses to the households and rapid and slow onset shocks. Appendix 2 presents the frequencies of these main sources of resilience and risk.

I developed a poverty trajectory typology that worked as a heuristic device to systematically analyse the life histories based on the life conditions described by the respondents. Adapted from the poverty category system developed by Hulme, Moore and Shepherd (2001), I distinguished three main categories of poverty trajectories based on the level of assets during the life trajectories. I assessed poverty in terms of four asset benchmarks: 1) household is destitute, 2) household has basic assets to perform daily activities, 3) household is able to save, and 4) household is able to invest in productive activity. In order to identify these benchmarks, I frequently asked the respondents to refer to their level of assets in the different periods of their life trajectories (see table 2.3).

Table 2.3 Poverty trajectories adults and young adults

Poverty trajectory category	Description	Adults	Young adults
Usually poor	The general life conditions of the respondent along his or her life history were of destitution. The respondent has few episodes where the household increased their level of assets and was even able to save.	11	12
Churning poor	The overall trend in the life history is that the respondent has the basic assets to perform daily activities, and has had some episodes where she or he was able to save and invest in productive activities. The life history also shows some episodes of destitution.	12	10
Occasionally poor	The trend in the life history is that the respondent was able to save and to invest in productive activities, but had few episodes in her or his life history where the level of assets diminished.	5	6
Total		28	28

Source: Author

4. Participant observation was used as a tool that allowed me to be immersed in the social life of the research sites, understanding the meaning people gave to certain events and dynamics. This ethnographic method 'emphasises the legitimacy of a researcher's interpretation of observed cultural phenomena from their participation and immersion in this phenomena' (Brockington and Sullivan 2003:65).

Participant observation took place on normal days in everyday activities, in order to capture relevant information related to how people relate to the climate, how they develop and organise their livelihood activities, including how domestic work is organised, among other issues. This method also helped me to understand certain cultural factors to take into consideration when applying the other research methods, such as the life histories or the household surveys.

3 Results

3.1 Coping capacity and *Oportunidades*

Climate shocks in the communities directly affect households' access to food. For this reason, households mainly pursued strategies to protect both their consumption and the income generating process. The main coping strategies identified in the analysis were: share losses, change location, prevent effect, diversification of income sources, change use, and encourage behavioural change (see table 3.1). The type of strategy used depended on several factors such as the type of shock (income or asset shock), impacts during and after the shocks, and the resilience sources available (see Appendix 3).

Table 3.1 Type of coping strategies found in the coastal and inland communities and role of *Oportunidades*

Type of coping strategy	Description	Example	Role of *Oportunidades*	Type of shock
Share losses[1]	Involves sharing the losses among a wider community	Relief support: in-kind transfers, Seguro Popular, PET programme, help from family and friends, reciprocity	--	Hurricane, non-climatic shocks
Change location[1]	Change the location of economic activities	Temporary migration to the city, sow in different areas of community land	--	Hurricane, drought & climate variability
Prevent effect[1]	Involves steps to prevent the effects of climate change and variability	Use savings, ask for loans, change sowing patterns and crop management	Supports these strategies	Hurricane, drought & climate variability
Diversification of income sources[2]	Income generating activities are diversified	Diversification with off-farm work	--	Drought & climate variability
Change use[1]	Where the threat of climate change makes the continuation of an economic activity impossible or extremely risky, consideration can be given to changing the use	Changes in farming practices: replacement of polyculture with monoculture, mainly in the form of maize cultivation.	--	Climate variability
Educate, inform, and encourage behavioural change[1]	Behavioural change is achieved through education and public information campaigns	Emergency preparation, keeping valuables safe, organisation of routes of evacuation	--	Hurricane

Source: Author based on household survey and life history interviews.
[1] Burton, Smith and Lenhart 1998
[2] Agrawal 2010

Oportunidades was a source of resilience by providing a certain immediate liquidity that helped poor households to protect their short-term consumption during and after climate shocks. For instance, by the time Hurricane Isidore hit the region, about 34 per cent of households in the inland community, and 14 per cent in the coastal community, were receiving *Oportunidades*. Two out of every three of these households declared that the transfer was particularly helpful to them recovering their wellbeing following the impacts of the hurricane. The federal government brought the date of delivery of the transfer forward, and this helped in the post-shock recovery of the households.

The evidence is indicative that *Oportunidades* protected households from more irreversible strategies, such as pawning, by providing short-term liquidity necessary during times of crisis. For instance, only the non-recipients pawned some of their consumer durables to

cope with the 2012 drought (7 per cent of the households), while only the *Oportunidades* households used their savings to cope with the shock (8 per cent of the households). Likewise, the life history interviews showed that during the 2012 drought recipient households used the transfer to buy maize. For instance:

> 'We used the money we were able to save from the cash transfer of the children [*Oportunidades*] to cope with the drought and buy maize. We usually need money for the household expenses, but now with the drought we need it to buy maize'. 39 year-old recipient woman, churning poor, inland community. Life-history interview.

The literature on climate change argues that buffers for coping capacity are built during episodes of stability (Folke, Colding and Berkes 2008; Béné *et al*. 2014). In this light, life trajectories presented episodes with strategies that anticipated risk mainly in the form of savings or investments in livestock. For instance:

> 'We only saved during the octopus season in the summer to be able to cover the expenses during the seasons when the fishing was low. It was my mother-in-law who taught us to save for the bad times.' 40 year-old recipient woman, churning poor, coastal community. Life-history interview.

> 'There are some men that go to work as builders before the droughts. You have to move forward, think about the future. You do not know that the drought will come but you are already prepared.' Male, inland community. Age and other categories not provided. Group discussion with peasants.

Respondents described a savings and working culture learned throughout their lives where people constantly tried to build an asset portfolio to buffer against shocks. These strategies showed how households have developed a learning capacity from previous crises, and that they developed strategies to cope with uncertainty and future shocks. For instance, group discussions in the coastal community showed that Hurricane Isidore was a benchmark in terms of their awareness about the importance of preparing for these climate risks[4]. In other cases, this anticipation of risk was part of the education received by their parents or parents-in-law. To some extent, these social systems have meant that people learned to live with change and uncertainty and that they counted upon some resilience sources.

However, this capacity to plan for the future is not exclusive to dealing with climate risk. Households develop preventive strategies to 'deal with the bad times' no matter what is the nature of the crisis. These strategies are mainly to cope with future hurricanes and droughts; seasonality such as the north-wind season; future expected expenses such as pregnancy; unexpected household expenses such as sickness; or as buffers to deal with emergencies (see table 3.2). This is due to the fact that climate risk is perceived as a main cause of ill-being but to a lesser extent than illness and lack of job opportunities (see Appendix 2). This shows that for poor households climate change is embedded in a broader context of risk, with different factors reinforcing one another and increasing their contextual vulnerability (Eriksen, O'Brien and Rosentrater 2008; Leichenko and O'Brien 2013).

[4] Participants in the group discussions said that after Hurricane Isidore people began to prepare more for these eventualities. Usually these activities were based on emergency preparation such as the organisation of routes for evacuation, keeping valuables safe, and identifying local authorities' signaling in relation to the degree of emergency.

Table 3.2 Anticipation of risk episodes found in the life histories

Cause	Resilience sources	*Oportunidades*	Age	Type of Community	Poverty trajectory
Pregnancy	Farm work to invest in livestock	Yes	65	Inland agriculture	Usually poor
Pregnancy	Farm work to invest in livestock	No	38	Inland agriculture	Usually poor
For emergencies	Farm work	Yes	53	Inland agriculture	Usually poor
Seasonality	Farm work to invest in livestock	No	38	Coastal fishing	Occasionally poor
Pregnancy	Farm work to invest in livestock	No	40	Coastal fishing	Churning poor
Seasonality	Farm work	Yes	40	Coastal fishing	Churning poor

Source: Author based on life history interviews

Households relied on their income-generating activities, mainly farm work, to develop these preventive strategies. Whilst *Oportunidades* is not directly related to these strategies, the analysis showed that the programme multiplied these capacities by stabilising households' short-term consumption. In this light, the life history analysis showed that in the absence of shocks, *Oportunidades* provided a bimonthly income that households mainly used to deal with household expenses, such as groceries and school expenses. This indirectly helped households to redirect their farm income to save it 'for the bad times', instead of spending it on present consumption needs of the household.

The following quotes from adult recipients illustrate this dynamic. For instance:

> 'With the transfer we manage to buy more food than only for 'today'. We manage to buy sugar, milk, beans, soap and cocoa.' 63 year-old recipient woman, usually poor, inland community. Life-history interview.

> 'For me the programme means a peace of mind. It is a support to buy food and sometimes clothing.' 54 year-old recipient woman, occasionally poor, inland community. Life-history interview.

The survey results showed that whilst few households save in both communities, recipient households tend to save more than non-recipients. The most common purpose of saving reported in the surveys was to be prepared 'for the bad times', mainly in microfinance banking, which showed the use of precautionary savings. Food, healthcare and school expenses are the second causes for savings, according to the household survey (see tables 3.3- 3.6).

These results highlight the relation between the preventive feature of *Oportunidades* and the anticipation of risk. Nonetheless, the management rules of the programme explicitly limit the savings of transfers: 'The cash transfers will be indefinitely suspended when the beneficiary receives the programme's bank deposit and does not make any movement on the bank account for two or more consecutive bi-monthly periods.' (SEDESOL 2011:13). This disincentive to save also limits the preventive feature of social protection by restricting saving services that help as buffers in times of stress.

Table 3.3 Households savings and loan status, in the inland community

	Currently have savings				Asked for a loan in the last six months			
	Yes	%	No	%	Yes	%	No	%
Recipients	10	16%	51	84%	23	38%	39	62%
Non-recipients	2	5%	40	95%	11	26%	31	74%

Source: Author based on household survey

Table 3.4 Main uses of savings and loans, in the inland community

	Main uses of savings		Main uses of loan	
	Households	%	Households	%
For the bad times	7	58%	5	7%
Food, healthcare and school	3	24%	44	59%
Productive activity	2	16%	5	7%
Dwelling	-	-	8	11%
Pay debts and pawn	-	-	8	11%
Transportation	-	-	3	4%
Clothing	-	-	1	1%

Source: Author based on household survey

Table 3.5 Households savings and loan status, in the coastal community

	Currently have savings				Asked for a loan in the last six months			
	Yes	%	No	%	Yes	%	No	%
Recipients	17	34%	33	66%	29	57%	22	43%
Non-recipients	10	20%	40	80%	27	54%	23	46%

Source: Author based on household survey

Table 3.6 Main uses of savings and loans, in the coastal community

	Main uses of savings		Main uses of credit	
	Households	%	Households	%
For the bad times	14	45%	1	2%
Food, healthcare and school	9	29%	15	32%
Productive activity	4	13%	11	23%
Dwelling, dress, transport	4	13%	10	21%

Source: Author based on household survey

3.2 Livelihood diversification

Livelihood diversification in different income generating strategies increases adaptive capacity in the sense that households are able to spread risk and adjust their livelihoods in the face of climate variability. The analysis showed that households developed livelihood diversification to deal with some climate shocks by intensifying one or two economic activities, creating a range of livelihood diversification strategies (see table 3.7).

Climate variability is generally perceived in terms of there being more extreme seasons. These climate stressors mainly affected the income generating activities of the households. Households relied on the same livelihood activities they developed regularly, mainly in the form of 'temporal livelihood diversification', whereby households 'change from doing one activity to another' (Goulden *et al*. 2013:908).

In particular, in the inland community poor households that diversify their livelihoods in order to deal with the erratic rainfalls and the changes at the start and end of the seasons, go more frequently to the city of Merida or Cancun to work in the construction industry. However, this strategy is more common for non-poor households (33 per cent of households above the wellbeing poverty line). This might be the case since extreme poor households are already maximising this livelihood strategy as part of the diversification of income sources, while for the wealthy households this diversification is temporal. This livelihood diversification strategy was also developed to cope with the 2012 drought. Other households, usually better off households, also intensified temporary migration to the city to cope with perceived climate variability, but their diversification strategies include more secure livelihoods such as small business.

In the coastal community 41 per cent of the households diversified their livelihoods as a strategy to deal with perceived climate variability. The ethnographic data showed that this diversification was mainly in off-farm activities such as working in tourism activities, growing coconut seedlings or casual work in the *ejido*[5] as electricians, plumbers or masons. Few households practiced temporary migration.

Households combined these strategies with consumption smoothing activities such as using savings (26 per cent of the households) or asking for a loan (12 per cent of the households), in order to cope with the lack of income and lack of food from the reduction of fishing activity associated with climate variability. These trends are relatively similar among extreme poor, minimum wellbeing and non-poor households. Even so, the survey analysis showed that recipients do the former to a greater extent, while non-recipients do the latter. This might be due to the fact that recipient households have more access to liquidity due to the cash transfer. Given this, *Oportunidades* mainly supported prevent effects strategies. These results are indicative of the idea that the programme supports short-term consumption needs of households, as happened during the drought and Hurricane Isidore.

[5] The *ejido* is the unit of rural development in the country and of communal identity. It was the agrarian unit of the land reform that took place during the 20th century after the Mexican revolution, and it has a mix of private and communal property. In the collective *ejido*, land is held and worked cooperatively. In individual *ejidos*, farmers work their land apart from other *ejidatarios*. The *ejido* is also an organisation that can deal with problems common to all the individual landholders (DeWalt 1979).

Table 3.7 Types of livelihood diversification strategies in the inland and coastal communities

Diversification strategy	Community	Type of shock	Impact on adaptive capacity
Mixes temporary migration to the city to work in the construction industry with hammock weaving	Inland community	Climate variability Drought	Spreads risk Low productivity Provides secure source of income Emotionally challenging Short-term solution Limited impact on future wellbeing
Mixes small-business with temporary migration to the city to work in the construction industry	Inland community	Climate variability Drought	Spreads risk Provides secure source of income Emotionally challenging Requires some initial capital Moderate impact on future wellbeing
Mixes intensification of fishing with casual off-farm activities	Coastal community	Climate variability	Spreads risk Seasonal and unstable strategy Requires networks with *ejidatarios* Short-term solution Limited impact on future wellbeing
Mixes intensification of touristic activities with casual off-farm activities	Coastal community	Climate variability	Spreads risk Seasonal and unstable strategy Requires networks with *ejidatarios* Short-term solution Limited impact on future wellbeing

Source: Author based on household survey

When analysing the data by poverty category, the results showed that the majority of non-poor households in the coastal community (80 per cent of households above the wellbeing poverty line) diversified their livelihoods as a response to climate variability, while less than a quarter of the extreme poor developed this coping strategy (24 per cent of the households below the extreme poverty line). These dynamics highlight how unequal governance arrangements affect the coping capacity of households, by influencing the access to key assets.

There is unequal access to the communities' resources due to different land property rights among the members of the community. The *ejido* increases the collective management of natural resources. It also mediates the relation between the social and the ecological components in a social-ecological system (Barnes 2009). The *ejido* structure has also been recognised as a source of resilience as it has shown an ability to maintain its structure despite strong macroeconomic shocks (Eakin 2006; Barnes 2009). However, peasants have incomplete land property rights.

The land reforms established in 1992 aimed to individualise the *ejido* sector in order to facilitate the use of the land as collateral. While these changes aimed to bring certainty to the legal situation of the land-holders, the reforms also affected the resource use and social organisation in the communities and *ejidos.* For instance, in the coastal community land property is mainly in the form of smallholders. However, 30 people earned their property rights as *ejidatarios* in approximately 1,400 hectares that cover the mangrove and the swamps. This has represented an unequal access to community resources that has translated into a social tension between the *ejidatarios* and the rest of the members of the community (Pech 2010). In the inland community 67 per cent of the population have *ejidal* rights, equivalent to 72 *ejidatarios*. This process has contributed to an unequal access to the natural resources in the social-ecological system, leading to an increase of the contextual vulnerability of the non *ejidatarios*. In the group discussions, participants highlighted an unequal access to the off-farm activities in the community, which mainly depend on the *ejido*:

> 'The jobs that the *ejido* provides are not enough for everyone. Not all of us can be electricians, plumbers and masons.' Male, coastal community. Group discussion with fishermen.

In the inland community households across all poverty categories but with *ejidal* lands have different endowments, which allow them to develop different coping strategies to deal with climate variability. Some of these activities involve changing the sowing area, and also the use of the agricultural subsidy Procampo[6], only provided to *ejidatarios*, to invest in the productivity of the land.

Farming households usually develop strategies within the *milpa,* a rotational form of agriculture based on natural vegetative processes in order to restore soil fertility, in order to cope with the erratic rainfall, increased hot spells during the day, and changes at the start and end of season. Even so, a large number of farmers live in marginal areas of very low productive potential mainly due to bad agricultural practices. Accordingly:

> 'Nowadays, even when it rains well, the plantations are not growing to the same extent as they used to. Nowadays, even with good land and good rain the crops are not growing. Possibly the land has already lost its capacity.' Male, inland community. Group discussion with peasants.

According to Moya *et al*. (2003) the sustainability of the *milpa* in Yucatan is threatened by six main drivers: 1) the reduction of the fallowing period; 2) reduction of polyculture; 3) erratic rainfall patterns; 4) low maize prices due to the trade liberalisation; 5) top-down agricultural policies that aim to homogenise agricultural practices; and 6) the individualisation of the land, which weakens the *ejido*. These drivers are all present in the inland community. When the *milpa* is practiced without the traditional techniques, the necessary fallowing periods, and the necessary diversity and appropriate crops, then it becomes a predatory activity since it cannot guarantee that the biodiversity and the soil's nutrients will be regenerated (Ramírez 2010). This process also illustrates how the viability of these traditional Mayan systems is under pressure given the broader processes of agrarian change that have been occurring in Mexico.

During the 1990s Mexico went through several structural reforms that affected the rural sector. These reforms were part of the North American Free Trade Agreement treaty (NAFTA) with the United States and with Canada. The neoliberal reforms privatised farm services agencies, deregulated agricultural markets, and withdrew protectionist policies to focus on the macro fundamentals and to promote the role of market forces. With the aim of supporting farmers with commercial potential, these reforms negatively affected smallholders and subsistence farmers, which were considered 'unviable' (Eakin 2005). It was assumed that deagrarianisation would reduce poverty, increase employment and raise incomes (Rigg 2006). In 1992 the agrarian reform that had been redistributing lands to peasants since the aftermath of the Mexican Revolution in the beginning of the 20th century, was officially terminated. With this set of reforms, post-revolutionary agrarian politics in the country ended. By 1995, the economic crisis, the low prices, the budgetary cuts to direct supports and subsidies to the rural population, taken together, all intensified the deterioration of the rural sector (Warman 2001).

Although practices and ways of Mayan- Yucatecan culture organization are kept, the communities are subject to a strong influence of the 'modern' capitalist culture with contents of discrimination against the Mayan (Rosales 2012). For instance, the exogenous and top-down model of education is completely disjointed from the local traditions and needs, imposing a stigma towards traditional knowledge. In the words of Faust (2001): 'schools,

[6] The Direct Support to the Country Programme (Procampo), is the most important agricultural subsidy in the country in terms of its coverage and budget: it covers more than half the country's cultivable surface, and it targets 2.4 million producers through a transfer per hectare grown in the base period. It pays 1000 pesos (78 USD) per hectare, and up to 100 hectares per farmer every agricultural cycle. It is highly regressive, 10 per cent of the producers receive 45 per cent of the resources, since it does not aim to reduce poverty, but to support the transition of agricultural producers to the free market (CONEVAL 2010).

while preparing youth for life in the modern world, also generally result in a denigration of the oral knowledge of the elders' (Faust 2001:163). Moreover, the influence of the mass media has risen, leaving little appreciation for the local culture, especially among the young adults and children. Among other things, this crisis of traditional systems contributes to the loss of primary vegetation and biodiversity, due to the loss of local knowledge and traditional practices that are sustainable. Given this, traditional activities such as the *milpa* are sustainable practices that have helped to conserve the forests and the natural resources are being lost.

3.3 Livelihood innovation and productive investments

A more in-depth analysis based on the retrospective life history interviews showed that some households developed certain adjustments to their livelihood strategies, in the form of productive investments. Whilst these strategies are not recognised as direct adaptations to climate change or variability, respondents emphasised that they aimed to have more secure livelihoods, in contrast with their main livelihoods that were more volatile. Table 3.8 shows the different investments of the households and their main sources of income as found in the retrospective life history interviews.

These households had an entrepreneurial background, which motivated them to find different ways of promoting, and innovating upon, their livelihood strategies. They described this as a 'personal motivation to progress in life', and identified it as a main cause of their wellbeing (see Appendix 2). Respondents reported to have learned this attitude from their parents or parents-in-law. They also explained that this motivation came from a will to improve for their children. Accordingly:

> 'Teachings from my father about work, to progress in life, to seek solutions for problems.' 40-year old non-recipient woman, churning poor, coastal community. Life-history interview.

> 'Motivation and effort to progress for my children.' 40-year old non-recipient woman, churning poor, coastal community. Life-history interview.

The analysis showed that these households had a strong power position in the community, which helped them to access more significant transfers, such as remittances from family members, and promotive projects from the local government. These transfers were used to invest in productive activities that would lead them to more secure and less climate-sensitive livelihoods.

Oportunidades only helped them to stabilise their consumption. The case of respondent number 8 in table 3.5 illustrates these strategies. This respondent explained that the main livelihood in the household was fishing, but they wanted to develop a secure source of income that was not affected by the weather. Therefore, the husband and older son applied for the *Fomento Agropecuario* programme, a transfer from the local government that supports new productive investments. They aimed to invest this transfer in a car and bicycle repair workshop. The husband was friends with the municipal president and eventually got the transfer, equivalent of 6,500 pesos (508 USD)[7]. The household was receiving *Oportunidades*, which was mainly used to cover daily household expenses and the education of the younger son.

[7] Estimated figures using an exchange rate of 12.80 Mexican Pesos per US Dollar, February, 2012 (Banxico).

Table 3.8 Livelihood innovation, coastal and inland communities

Respondent	Productive investment	Synergies/ resilience sources	Oportunidades recipient	Age	Community	Poverty trajectory
1	Diconsa store	Remittances, promotive social protection, farm work	No	42	Coastal community	Occasionally poor
2	Transportation services	Remittances, work in the city	Yes	54	Inland agriculture	Occasionally poor
3	Convenience store	Waged job	No	38	Coastal community	Chronic poor
4	Cooperative of women handcrafters	*Fomento Agropecuario* (government transfer for productive projects)	No	38	Coastal community	Occasionally poor
5	Cooking and selling food	Gift from father	Yes	54	Coastal community	Occasionally poor
6	Small convenience store	Farm work	No	67	Inland agriculture	Chronic poor
7	Cooking and selling food; mill	Remittances	Yes	45	Inland agriculture	Churning poor
8	Bicycle workshop	*Fomento Agropecuario* (government transfer for productive projects)	Yes	47	Coastal community	Churning poor
9	Liquor shop	Inheritance	Yes	50	Coastal community	Occasionally poor
10	Builder workshop	Farm work	No	40	Coastal community	Churning poor

Source: Author based on life history interviews

The life history analysis showed that very few households used *Oportunidades* transfers to directly invest in a non-climate sensitive productive activity. These households were in a period of economic stability due to either a lack of crises and/or the presence to access to a more secure income from farm and off-farm work. Moreover, the synergies between different informal and formal social protection transfers, plus farm work were key to triggering the promotive feature of *Oportunidades*. This was the case because the value of the *Oportunidades* transfer on its own was not big enough to lead to the accumulation of the necessary capital for the investment in a small business.

Respondents explained that they diversified their livelihoods not to progress, but to stabilise their consumption, and to cope with household expenses. These investments were very small in scale and productivity, and they did not represent a real path into more secure livelihoods (see table 3.9). Therefore, these investments increase their coping capacity rather than their adaptive capacity. For instance, respondent 1 in table 3.9 started a small business undertaking embroidery and sewing. For the initial investment in the business, she used income from the apiculture activity developed by her husband, and also from the transfer of *Oportunidades*. Her husband had to stop working due to some eyesight problems.

Nowadays, when she receives the bimonthly transfer she uses the money to buy the thread. She explained that the income that she receives from the small business is used to cope with the daily expenses of the household.

To a certain extent, this livelihood analysis suggests that the income returns of *Oportunidades* do not lead to a major and more evident livelihood progression into sustainable, less climate-sensitive livelihoods. The transfer value is too small, since its aim is to cover the children's food and education expenses and not to build strong livelihoods. This tension is explained in the following quote:

> '*Oportunidades* is very important and necessary. It helps us to buy maize and to continue working with the children. But usually we have already spent it before we get the payment. It does not build capacities. It is only a support for the domestic work. It is a programme for the children not for the mothers.' Woman, inland community. Group discussion with women.

In a context of climate change these livelihoods are very vulnerable to changes in the weather patterns, which represent serious challenges to their subsistence. This is due to the fact that households experience severe constraints to accessing more productive activities, leaving only low-return activities available to the poor. For instance, participants in the group discussions identified investment in a small business as an activity that makes them less vulnerable to climate variability. However, participants highlighted the difficulty of obtaining credit for this investment. This was why they relied on their daily livelihood activities, which are extremely vulnerable to the weather. The following quote illustrates this issue:

> 'Nowadays it is very difficult to get a credit. Not anyone can get it since they investigate you and they require you to have a guarantor'. Male, coastal community. Group discussion with fishermen.

This lack of livelihood opportunities is related to other major political economy issues that underpin the vulnerability of poor rural households in Yucatan.

Table 3.9 Livelihood innovation using *Oportunidades*, coastal and inland communities, based on life histories

Respondent	Investment objective	Synergies	Community	Age	Poverty trajectory
1	Embroidery and sewing small business	*Oportunidades* and farm work	Inland community	60	Usually poor
2	Small convenience store	*Oportunidades*, Conafe and SEP (Education grants), children working	Inland community	65	Usually poor
3	Credit for motor boat	*Oportunidades*, compensation for dismissal payment, farm work	Coastal community	40	Churning poor
4	Small convenience store	*Oportunidades*, farm work	Coastal community	50	Churning poor
5	Cooking and selling food	*Oportunidades* and farm work	Coastal community	40	Churning poor

Source: Author based on life history interviews

3.3.1 A tale of two Yucatans

There is a big asymmetry between the capital city of Merida and the rural areas of Yucatan. Given this, the variation in livelihoods in Yucatan is comparable to the gap between Switzerland and Morocco (OECD 2007). Merida concentrates the political and economic power in the metropolitan region, while the rural localities are usually highly dispersed and isolated, affecting the access and quality of services and markets. As a consequence there is a high inequality in terms of employment opportunities, income distribution and human development.

Furthermore, Merida is the primary destination of both permanent and temporary migration of tens of thousands of rural inhabitants of Yucatan -about 80 per cent of all indirect job creation takes place within Mérida- (OECD 2007). The neighbouring state of Quintana Roo is also recipient of tens of thousands of Yucatecan migrants, mainly in the touristic destinations of Cancun and Cozumel. International migration mainly to the United States also takes place. These migrants are looking for economic, education and employment opportunities. This process has been taking place since the 1970s after the collapse of the sisal industry. For 150 years the state's economy was sustained in the agricultural sector, and in the last stage of this period, it was predominantly in the monoculture of sisal or henequen fibre. However, in the 1980s the sisal production collapsed. Despite several efforts to activate the economy in rural areas, attempts to consolidate the diversification of economic activities failed and peasants mainly rely in the temporary or permanent migration in tourist centres in the peninsula.

The emerging fishing activity was also magnet of the *ex-henequeneros,* for whom training courses were designed by the government. However, this fishing bonanza lasted less than 30 years, and in the late 1990s fishing stagnated, due to more competition over the resources, affecting mainly artisanal fishermen (Fraga *et al*. 2008). Nowadays, the fishing industry faces a more difficult situation, with more fishermen migrating to the construction industry in the city, and a faint hope for a tourism activity that produce little economic welfare.

3.3.2 Female participation in the income generating activities

Households have adapted to these economic pressures by increasing female participation in the income generating activities. As household needs increase and the main traditional livelihoods are increasingly affected by climate variability, female engagement in income generating activities has become essential for the households. Group discussions showed that the members of the communities perceived women's economic participation as a key aspect in achieving household and community wellbeing, especially during times of crises:

> 'Women did not use to work. Nowadays they even own small businesses. If what the husband brings is not enough [to deal with the household expenses], then we [women] have to help them.' Woman, inland community. Group discussion with women.

> 'Women's work is usually in the households but their work is important since they are able to sew hammocks when there is not enough money when there is a crisis. Money doesn't come from the *milpa* and they help with the expenses.' Male, inland community. Group discussion with peasants.

These activities took place together with the husband and are considered as some sort of 'team work'. This support through a husband is considered a main cause of wellbeing to some of the respondents, especially usually poor and/or non-recipients of *Oportunidades*. The next quote illustrates this:

> ‘I taught my husband how to do the hammock weaving, but firstly he was ashamed because he is a man. What we were seeking was to achieve a better nutrition. To have certainty that we would have something to eat tomorrow. To be able to save to eat. We now work as a team. We work in the hammock weaving together and if we go to the *milpa* we go together too. I usually weed. Usually it’s a job the man does but I go anyway.’ 63 year-old recipient woman, usually poor, inland community. Life-history interview.

Scholars in the social protection literature have argued that conditionalities in cash transfers place additional demands on women’s scarce time, and they are expected to manage even further their multiple paid and unpaid work activities (Molyneux 2007). Following this train of thought, the pressures to meet the care conditionalities of the programme might decrease women’s labour force participation, which has been perceived as an autonomous adaptation strategy. This statement from a non-recipient illustrates this dynamic:

> ‘We only once applied for *Oportunidades* but we did not get it. Later we realised that we would make a better use of our time if we worked in the maintenance of beach houses. The recipients have to spend time on *fajinas* [community work without remuneration] and have to go to the health centre. Also, there are people that are not using the money to help their children. They don’t save the money for their children. In contrast, for us, our ‘savings’ is our investment on our children. Some recipients rely completely on the programme and then they don’t do anything else to work for money.’ 40 year-old non-recipient woman, churning poor, coastal community. Life-history interview.

This statement also illustrates the common practice of *fajinas* imposed on the recipient women as a conditionality of the programme. The *fajina* is a common practice in rural communities, where periodically members have to do community work without remuneration. It is a practice that aims to build social trust and social cohesion. However, informally the intermediaries of the programme have established the *fajina* as part of the conditionalities of the programme, reducing recipients’ scarce time even more.

Furthermore, the conditionalities restrict some coping strategies in the face of shocks. For instance,

> ‘In 2007 I got sick for six months and I couldn’t go to the meetings of *Oportunidades*. I showed them the papers from the doctor but still I got expelled from the programme. I managed to deal with the health expenses with the Seguro Popular and with some savings from my son who wanted to buy a car and my husband who was working in a gas station in Cancun […] We couldn’t save, everything was for the expenses for my health and for the children.’ 38 year-old non-recipient woman, usually poor, inland community. Life-history interview.

3.3.3 Human capital investments and livelihood innovation

In terms of the human capital investments of *Oportunidades* and their potential in increasing young adults’ livelihoods options that are more secure and less climate sensitive, the data showed that school grants and *Oportunidades* were the main causes of young adults’ wellbeing (see Appendix 2). Young adults declared that going to senior high school helped them to develop certain skills that were useful in their work, such as a proficiency in the Spanish language (in the case of the Mayan young adults); the development of self-confidence; and IT skills such as the use of Office and the internet. They identified

Oportunidades and Pronabes[8] as the main source of their wellbeing. Table 3.9 shows the cases where young adults managed to graduate from senior high school and accessed higher education.

Table 3.9 Non-climate sensitive livelihoods, young adults, coastal and inland communities, based on life histories

Respon-dent	Main livelihood young adults	Gender	Synergies	Main level of school	Type of commu-nity	Age	Poverty trajectory
1	Skilled worker with salary	Female	*Oportunidades*, Pronabes, father's farm work, mother' small business, remittances from older siblings, accommodation from family members	Finished BA	Inland	22	Usually poor
2	Full time student	Female	*Oportunidades*, father's fishing, mother's work as domestic worker	Applying to BA	Coastal	18	Churning poor
3	Full time student	Female	*Oportunidades*, Pronabes, father's fishing, mother's work as domestic worker and farm work	Finishing BA	Coastal	22	Churning poor
4	Informal commerce employee	Female	*Oportunidades*, father's fishing	Finished senior high	Coastal	20	Churning poor
5	Full time student	Female	*Oportunidades*, Pronabes, transfers from uncles	Finishing BA	Coastal	20	Churning poor
6	Informal services employee	Female	*Oportunidades*, mother's small business, father's fishing	Finished senior high	Coastal	21	Churning poor
7	Formal services employees with benefits	Male	Father's fishing, transfers from siblings	Senior high	Coastal	21	Churning poor
8	Full time student	Male	School grant from local government, mother' small business, father's fishing	Applying to BA	Coastal	18	Occasionally poor
9	Full time student	Male	School grant from local government, mother' small business, father' salaried job	Applying to BA	Coastal	18	Occasionally poor
10	Informal commerce employee with salary	Male	*Oportunidades*, father' salaried job, transfers from siblings	Two-year technical degree	Coastal	20	Occasionally poor
11	Full time student	Male	*Oportunidades*, father' small business, remittances	Applying to BA	Inland	18	Occasionally poor
12	Full time student	Male	*Oportunidades*, Pronabes, parents' small business, transfers from aunt	Studying BA	Coastal	24	Occasionally poor

Source: Author

Poverty plays a fundamental role in shaping the impact of the programme in the young adults. In the life history analysis the usually poor young adults usually have more difficulties in benefiting from the human capital investments when compared to the transient poor. This is the case because this group faces certain restrictions that mark an unequal access to services, markets and social infrastructure.

[8] The Pronabes programme provides a grant for higher education. It provides support for four years with bigger grants as the students are progressing in their studies. Oportunidades graduate students that are accepted into public universities have priority in receiving the Pronabes scholarship.

For instance, all young adults from occasionally poor households were studying or applying to higher education. These young adults had the economic support from their parents, covering their basic needs such as food, accommodation, and transportation costs. Some of them had other family members that acted as sponsors, such as an uncle or a sibling that migrated to the city or to the United States. To a certain extent the access to these social networks reflected the social status of the households linked to these poverty trajectories, which gave them a high power-resource position. These social networks also supported the young adults in accessing accommodation in the city or in bigger villages, which was crucial in the transition from senior high school to higher education.

The churning poor are the group that experienced more occupational mobility, compared to their parents. The life histories of their parents showed that the access to education transfers such as *Oportunidades*, SEP and Pronabes helped these households to cope with the school expenses. In more than one case parents did declare that without the support of *Oportunidades* their children would not have been able to study. Accordingly:

> 'In 1998 I started to receive *Oportunidades* which is quite helpful for the school expenses, uniforms and food for my girl. Thanks to the programme I have not had a difficult situation. My husband has barely known anything about the school expenses.' 40 year-old recipient woman, churning poor, coastal community. Life-history interview.

However, especially for senior high school and higher education the young adults had to engage in low skilled economic activities in order to complement the expenses for their studies. For instance:

> 'I have been receiving the *Oportunidades* programme since I was in the 4th year of primary school. I kept it up to senior high, but especially for senior high it was not enough to pay my expenses including transportation, copies and lunch at school. Since I was in junior high school I sometimes go fishing to have spare money especially for my personal expenses.' 25 year-old sponsored young man, occasionally poor, coastal community. Life-history interview.

In contrast, the young adults that abandoned school in junior high school or before were almost all from usually poor households (except for two churning young adults), which were based on the inland community. The lack of income affected the schooling of the children, since they did not have their basic needs covered. This was reflected in the fact that these young adults identified the lack of money as a main restriction to their wellbeing (see Appendix 2). The analysis showed that *Oportunidades* helped these young adults with the school expenses, but that the grant was not big enough to cover the school expenses of all the children in the household. These two quotes illustrate this aspect:

> 'I studied only up to 6th year of primary school. There was no tele-high school in the community and since my parents were poor they did not have money to pay my studies, but I did want to continue studying. None of us [the children] studied junior high. We did have *Oportunidades* but that did not make any difference.' 22 year-old sponsored young woman, usually poor, inland community. Life-history interview.

> 'When I finished junior high I decided that I would not continue to study in senior high. I preferred to start working to earn some money. I would have to pay for exams in Cobay [senior high school], 300 pesos every month [23.43 USD][9]. The scholarship was not enough. I also needed to pay for copies and computer and cover the expenses in food and transportation […]. When I decided to drop out my parents tried to convince me but I had already made up my mind because I saw how my parents

[9] Estimated figures using an exchange rate of 12.80 Mexican Pesos per US Dollar, February, 2012 (Banxico).

were doing a big effort and how poor they were, they barely had something to eat. I also thought that since my brother was about to start junior high the expenses would be very high.' 19 year-old sponsored young man, usually poor, inland community. Life-history interview.

This group showed no occupational mobility compared to their parents. To a certain extent they showed horizontal mobility, meaning that the young adults performed the same activities, but with a different intensity. According to the life histories of the parents, this generation intensifies *milpa* and uses the work in the construction industry as a coping strategy in case of need such as an illness or a drought. In the case of the younger generation, the livelihood strategy is the opposite. They intensified their work as builders in the city and when they cannot work because it is the rainy season or because there are no contracts then they diversify with some agricultural work in the *milpa*, usually on their parents land. The analysis shows that this livelihood shift is not due to an increased access to different livelihoods, but to the fact that traditional livelihoods are already less viable for this generation. Fisheries in the coastal community are overexploited and agriculture in the inland community has a low productive potential mainly due to bad agricultural practices. In this light, these activities are not sustainable for these young adults.

Furthermore, these households have limited access to alternative income generating activities from which adults can diversify their income. Skilled formal work in the city is not an option for these young adults since they do not have the required schooling, therefore, they can only rely on the construction industry in the city and the hammock weaving in the community, just like their parents. The next quotes from a recipient adult and a young adult illustrate this dynamic:

'Nowadays [it] is getting more difficult to work in the *milpa* because the sun is more intense. In the *milpa* you have to sweat a lot if you want to produce something. Before, young people only did *milpa*. Now, young people don't like the *milpa* anymore. They prefer money also because it is getting hotter. In one week they can get 1000 pesos, so why wait for the *milpa.*' Male, inland community. Group discussion with peasants.

'It is not the same to do *milpa* compared to study because the sun is very intense. The *milpa* is easier than the construction since the latter requires that you carry heavy stuff but you earn some money since you are not always able to eat from the *milpa* since the production is lost and then that is when you have to go out to work.' 27 year-old non-sponsored young man, usually poor, inland community.

In general terms, young adults aim for livelihoods that are more secure than those of their parents. The aim for a secure salary is equal for both skilled young adults and those who dropped out of junior high school and it is related to the uncertainty that comes with more traditional livelihoods in the communities. For instance:

'One of the things that helps me not to drop out [of higher education] is thinking about the importance of having a secure salary and not a job that is uncertain due to the climate.' 25 year-old sponsored young man, occasionally poor, coastal community. Life-history interview.

'I would like to work in the government since they pay very well due to the social benefits and due to the fact that they have a permanent wage.' 20 year-old sponsored young man, occasionally poor, coastal community. Life-history interview.

However, not all the young adults had the same access to these more secure livelihoods. Mexico's economic development predominantly favours skilled labour, from where the usually poor are generally excluded. Likewise, the communities did not offer major livelihood

opportunities, due to their underdeveloped and less dynamic labour markets. For this reason, skilled young adults usually have to abandon their communities and migrate to the capital city or to the Riviera Maya to work in the tourism sector, in order to find secure and formal employment.

The labour market dynamics have hindered the rural poor by favouring skilled and urban labour, creating almost no opportunities of employment for the rural poor both in and outside the communities. Moreover, poor macroeconomic performance has resulted in high unemployment rates, informality, and bad labour conditions. Given this, people in the communities have to migrate to access informal and low skilled jobs in the cities, which most of the time does not represent significant improved welfare. Not only do these dynamics affect the potential impact of *Oportunidades* in the adaptive capacity of households, but also social protection has not helped to challenge or reconfigure these power dynamics.

Oportunidades was designed originally with the idea that it would be complemented by other programmes that would use the same targeting mechanisms to plan and direct their actions in the same locations (Rodríguez and Pasillas 2008). However, there has not been an integrated scheme to tackle the different structural causes of poverty and vulnerability. From this perspective, *Oportunidades* is hardly going to help poor workers to move away from their structurally disadvantaged positions. Despite increased years of school for future cohorts of poor workers associated with *Oportunidades*, due to labour market structure, firms are unlikely to offer formal and secure jobs to poor workers. The next quotes illustrate this idea:

> ‘There is no way I could develop myself [working in the coastal community]. There are no opportunities to grow even if you have studies. This is why now I am not motivated to study a BA, since there are no job opportunities. None of my cousins are working on the subject they studied, so why study if you are not going to practice your professional career? The labour supply is very bad and you get de-motivated. You are not going to get anything.’ 21 year-old non-sponsored young man, churning poor, coastal community. Life-history interview.

Furthermore, the theory of change that underpins *Oportunidades*’ design presents a trade-off between the coping and adaptive capacities. Households diversify their livelihoods with traditional livelihoods that encompass a variety of risk-spreading strategies to cope with climate shocks. *Oportunidades* emphasises young adults’ poverty reduction through access to formal and skilled work in urban areas. This has reinforced the current crisis of the traditional value of the *milpa*. For instance, in the inland community the lack of knowledge of traditional livelihoods, has been identified as a disadvantage, since young adults found themselves more dependent upon, and vulnerable to, external food production:

> ‘Going to school was very helpful but I would have liked to learn to work the land too, to have a good harvest. It is like having a reserve. The secret is not to depend on only one thing. It is important to produce your own food because you can save money and have food for you and the livestock. You become self-sufficient. It is a matter of organising yourself in order to have the two things.’ 18 year-old sponsored young man, occasionally poor, inland community. Life-history interview.

> ‘Young people do not work on the land because they think the land doesn’t give them money. But in fact they don’t think about the fact that the money only lasts for one week while, for instance, 20 *mecates* of maize [400 metres] gives them enough food for one year.’ 82 year-old man key informant, inland community.

If the cities have a limited capacity to absorb the educated rural workforce, and the communities have almost no opportunities for this workforce, then these traditional livelihood

activities at least represented a source of resilience will be lost. Rosales (2012) shows that in 2009 work supply in the tourist area of the Riviera Maya decreased and the young adults returned to their hometowns to do *milpa* after not finding jobs. These young adults would then diversify their livelihoods in informal and casual work in and outside the communities. These arrangements might represent increased income for some households, but they may also experience increased risk and vulnerability, in the degree to which they are prepared for climate change (Rigg and Oven 2015). For instance, changes in the constitution and structure of livelihoods can create further inequalities. Diversification can lead to the atomisation of livelihoods into small activities with very low productivity. This has reduced the current adaptation deficit of the poor, but might by insufficient in the face of future climate change.

4 Discussion

In this paper I addressed resilience as a dynamic system integrated by two main capacities: coping and adaptive; and by two different timescales: short-term and long-term. The results showed that *Oportunidades* had a stronger effect in the coping capacity and in the short-term scale, mainly through the protective and preventive features. The results also showed that preventive and promotive social protection measures had a strong relationship. This synergy is most relevant for adaptive capacity, in the sense that it supports innovation. As established by Sabates-Wheeler and Devereux (2008), most preventive interventions have promotive effects 'in the sense that risk reduction enables people to take advantage of opportunities that they would otherwise not have been unable to do' (*ibid*: 72).

Given this, a predictable minimum income provided by the preventive feature of social protection helps poor households to achieve a level of basic security. Over time this provides households with the necessary stability to incrementally adjust their livelihoods through innovation. This shows how adaptive capacity requires robust preventive social protection that can be used in the short-term to cope with shocks and, in times of prosperity, can be accumulated in synergy with other formal and informal transfers. Other promotive transfers in the form of productive projects are very relevant for innovation, but if they are implemented on their own, the preventive element of social protection could be lost, thus affecting households' coping capacity. These promotive programmes sacrifice stability for change, when stability is crucial for this adaptive stage in the face of climate change. This can be generalised to all social protection programmes that have promotive objectives, in terms of their trade-offs between an effective, comprehensive and permanent safety net versus investing in livelihoods and entrepreneurship for poverty reduction and economic growth.

The empirical results also show how adaptive capacity will be enhanced mainly within the timescale upon which the social protection intervention focuses its theory of change. In the case of *Oportunidades*, the theory of change is focused on the intergenerational timescale, where it expects to break the intergenerational transmission of poverty through the human capital investments of the younger generation.[10] Overall the particularities of conditional cash transfers that emphasise intergenerational human capital investment are: strong conditionalities and monitoring, the emphasis on efficient targeting, and verified means testing. Hence, income poverty relief of recipient adults is secondary. This limits some of the immediate promotive potential of the transfer that could increase the adaptive capacity of households. For instance, the targeting mechanism and mid-term means testing are based

[10] According to the management rules of Oportunidades, its overall objective is to "facilitate the development of education, health and nutrition capabilities of the beneficiary families in order to break the intergenerational cycle of poverty" (SEDESOL 2011:3).

on the adults' income poverty status, and this is not permitted to improve without risking entitlement. In other words, recipients have to remain below the minimum wellbeing line, limiting their potential productivity, and increasing households' graduation avoidance behaviour. Likewise, the limitation on the transfers' savings limits households' resilience by affecting anticipation of risk behaviour. The strong conditionalities relating to the behaviour of the household may obstruct the autonomous adaptation strategies that households might be developing to adapt to climate change and variability.

Addressing resilience as a system also showed how *Oportunidades* presents a trade-off between different components of resilience. Households diversify their livelihoods with traditional activities that encompass a variety of risk-spreading strategies to cope with climate shocks. These traditional strategies provide a source of resilience as coping capacity. However, *Oportunidades* emphasises young adults' poverty reduction by concentrating on their access to formal and skilled work in urban areas. This design increases their adaptive capacity, but also undermines more traditional livelihoods, which were found to increase the coping capacity of households. This can be generalised to all social protection programmes that have promotive objectives, in terms of their trade-offs between an effective, comprehensive and permanent safety net versus investing in livelihoods and entrepreneurship for poverty reduction and economic growth.

The idea of 'less climate-sensitive livelihoods' found in the literature (cf. Davies *et al*., 2009; Wiseman, Domelen and Coll-Black 2009; Johnson *et al*. 2013) as a proxy for resilience reinforces this idea by highlighting that the path out of poverty and vulnerability is found outside traditional livelihood systems. This approach follows the liberal resilience paradigm, where resilience is increased through market-based economic growth (Rigg and Oven 2015). Even so, this perspective fails to explain why these livelihood systems are vulnerable to climate change in the first place. This narrative negatively affects the most deprived members in the society, such as the indigenous groups, since they depend on traditional livelihood systems that are considered 'climate-sensitive'. In this working paper the evidence shows how these traditional systems provide sources of resilience to the households. The empirical results also showed that young generations sought livelihoods that were diverse, and not exclusively connected with formal urban labour.

Whilst the undermining of traditional livelihoods is related to broader process of agrarian transition due to the neoliberal policies applied during the 1990s, *Oportunidades* was also a consequence of these policies and it also reflects this market imperative paradigm.

Conventional forms of social protection frame poverty reduction as an outcome of increased access to formal urban labour in a market and service economy. The approach that underpins this rationale is that through the implementation of structural adjustment programmes and the policies of the Washington Consensus, rural poverty reduction would be achieved through rural-urban migration combined with these transfer programmes (Rodrik 2006). Social protection is 'commodified', and the poor have to rely on the market in order to progress and be more productive. However, given the poor macroeconomic performance in Mexico, the majority of the young poor are incapable of finding formal and secure jobs in the cities, as it has been explained earlier. In contrast, they find informal working arrangements with very low productivity, which in certain contexts may represent new risks and increased vulnerability. Parallel to this process, these young adults have fewer capabilities to work in the traditional livelihoods, which provided some source of resilience, due to the emphasis of *Oportunidades* in increasing formal urban work skills. This leads to a 'human capital trap', where young adults with increased human capital cannot access market-based livelihoods and, at the same time, they cannot maximise the traditional livelihoods that are resilient.

In a context of climate change, livelihood innovation facilitated by social protection must provide a means to facilitate contexts to take up or create different livelihood options, rather than reducing the options for young adults through pathways that undermine their traditional livelihood strategies. In the words of Eriksen (2013:371): 'strengthening people´s ability to choose and achieve their aspirations entails empowering individuals and communities to make decisions about their own adaptation outcomes'. Given this, conventional forms of social protection require a more systemic approach, in order to increase both the coping and adaptive capacities.

Furthermore, social protection should be flexible about recipients' use of the transfer in order not to obstruct the autonomous adaptation strategies that households might be developing. It should also facilitate the participation of those most affected by climate shocks. It would thus be sensitive to the different needs of households. This includes the removal of the limitation on the transfers' savings and a softening of the households' mid-term means testing. This would also reduce the graduation avoidance behaviour. Likewise, social protection should avoid using conditionalities relating to the behaviour of the households, and that it should be as flexible as possible in order to let household adjust their livelihoods and hence develop their own autonomous adaptation strategies.

To a certain extent the findings presented in this working paper also reflect a major theoretical contradiction between the social protection and climate change literatures. In the Introduction, I argued that by means of the vulnerability reduction outcomes of social protection (through its protective, preventive and promotive features), the capacities of resilience (coping and adaptive capacities) would be increased. Even so, the empirical findings and the analysis developed in this paper have shown that vulnerability reduction through social protection is not enough to build resilience to climate change. This is the case because the two literatures have different motivations, as will be explained below. Furthermore, these findings also confirm that whilst resilience and vulnerability are complementary approaches, they also have fundamental differences (Cannon and Muller-Mann 2010; Miller *et al*. 2010).

Social protection comes from a development and welfare economics tradition. Its focus is based on the local scale, where the maximisation of households' assets in relation to its vulnerability context and the institutional structures is sought (Ellis 2000). In contrast, climate change is presented as a global crisis and hence, the literature focuses mainly on the national and supranational scales, and its different feedback loops (Adger, Arnell and Tompkins 2005; Ostrom 2009). It is framed as a global cross-cutting problem, which requires an international institutional architecture in order to limit the atmospheric green gas concentrations to the levels that will avoid dangerous climatic change, as well as to adjust human and natural systems to climate stimuli (Tanner and Allouche 2011).

The different approaches in both literatures have other implications such as the unit of analysis and the time perception (Sabates-Wheeler, Mitchell and Ellis 2008). Social protection draws from a linear perspective, where multiple individuals, with actions based on their self-interest aim to maximize their asset profiles and livelihoods in the short-term, depleting the shared natural assets of the communities in the long-term, without any consideration of the feedbacks to the environment. Given this, conventional forms of social protection such as *Oportunidades* do not frame vulnerability as part of the wider and global process that underpin climate change. They are 'business-as-usual' development programmes that implicitly accept the development paradigm. This paradigm has been criticised for its potential impacts on ecosystems and to sustainable development, by maintaining that the pathway to poverty reduction is exclusively through urban labour in a market and service economy, based on fossil-fuel intensive systems, which have let to the current climate crisis (Lemos *et al*. 2007; Eriksen and Brown 2011; IPCC 2014). In other words, social protection's paradigm supports maladaptation in the form of 'increasing

emissions of greenhouse gases' (Barnett and O'Neill 2010). These are actions that address needs in the short-term, but that also create a positive feedback by increasing emissions of greenhouse gases, hence increasing the chance of further adaptation needs in the long-term.

Furthermore, the fact that the results of this research show that social protection has limited impacts on the adaptive capacity of households is very relevant for long-term climate change scenarios. For instance, it should not be expected that households will develop strong and secure livelihoods in order to adapt to climate change as a consequence of productivity enhancing safety nets. Adaptive capacity is dependent on other factors over which social protection has very little influence. In this light, increasing awareness of climate change should be highlighted in order to increase vulnerability reduction efforts and avoid potential maladaptative outcomes, understood as the actions that tend to increase vulnerability (Burton, Smith and Lenhart 1998; Barnett and O'Neill 2010). Given this, if it aims to increase resilience, the development paradigm underpinning social protection should evolve from isolated interventions to reduce poverty into a systemic approach that also considers vulnerability reduction at different scales.

4.1 Moving to holistic social protection systems

Having a holistic social protection system in place would guarantee that the promotive aim of social protection is not lost, while, at the same time, it would ensure that households hold a basic and universal safety net – thus helping them to manage risk and supporting them as active agents in creating resilience. It would also recognise that one social protection intervention cannot achieve everything on its own. Coordinated synergies with disaster risk reduction, climate-proofing projects, and other more radical policy and technological approaches would be necessary if unprecedented levels of climate change are reached (McGray *et al*. 2007).

Moreover, social protection systems need to recognise the political structure and dynamics underpinning the resilience of households, in order to reduce vulnerability. The results show how power relations and structural inequalities in different geographical scales, lead to different adaptation outcomes. For instance, power relations in the communities have affected the access to the different socio-ecological entitlements, ultimately affecting the resilience of households. Results also show how poverty and inequality explains the access to certain resources that are crucial to develop certain coping strategies. At the regional scale, the historical economic exclusion of these rural communities has also hindered the availability of livelihood options that could help households cope and adapt to climate change. This social exclusion is also reflected on the limited provision of services, access to roads and markets and in the distribution of public resources. These are all aspects that increase vulnerability and reduce both coping and adaptive capacities.

Given this, wider development strategies should consider ways of tackling the accumulation of disadvantage of these households, in order to potentiate the resilience strengthening functions of social protection. Failure to consider the different power structures and political dimensions that underpin local adaptation can lead to an exacerbation of people's vulnerability (Eriksen and Lind 2009).

A systemic view of social protection also recognises the economic context where it operates. While increasing productivity and access to highly skilled formal labour should be a long-term development goal in Mexico, this may not be realistic. With insufficient employment creation in the cities, high discrimination and unequal power relations in Mexico, informal employment (including illegal activities in drug cartels), and illegal migration to the US remain the real long-term options for the young rural poor. An upfront and clear recognition

of this context should be central to the development paradigm that underpins social protection.

In this light, increasing the earned incomes of the rural poor should be pursued as part of a transition strategy. Initiatives that aim to raise rural incomes through the creation of employment options in agricultural and fishing value chains, increase access to rural non-farm income (de Janvry 2010), and they thus provide support for innovating upon the activities that households are already developing so as to reduce poverty in the short-term. At the same time, these measures will help to increase people's resilience. This can be achieved by linking subsistence farming and artisanal fisheries to markets, as well as by: increasing their access to productive inputs; financial services; land rights; irrigation systems; and increasing their capabilities to achieve productive rural livelihoods in a sustainable way. State government should initiate community development projects and training in the communities, for example in tourism-related activities. At the same time, fiscal and labour reforms should also be established, in order to reduce discrimination in the labour market and inequality in the long-term.

5 Conclusions

Climate change scenarios in North America are projecting mean annual temperature changes of 2°C in the mid-21st-century period, and 4°C in the late-21st-century period (Romero-Lankao *et al*. 2014). According to the IPCC Fifth Assessment Report (AR5) chapter 13 'Livelihoods and Poverty', climate change will lead to an increase in poverty, exacerbate inequalities and create new vulnerabilities. By the end of the century it will create new poor people and will jeopardise sustainable development (Olsson *et al*. 2014). Given this, climate change adaptation raises critical issues of social justice since the people that will suffer the most from the negative impacts of climate change are also those who have tended to contribute the least to greenhouse gas emissions. In this light, it is important to understand the potential role of social protection in relation to these projected climate changes.

The empirical results reveal that the interaction between *Oportunidades* and resilience to climate change and variability is limited. The role of the programme is mainly preventive, by increasing self-insurance mechanisms. This paper has shown how social protection helps to increase relief and recovery from the impacts of hurricanes or drought, and this is of utmost importance in a context of climate uncertainty. The paper has also showed that social protection can increase anticipation of risk behaviour if it is delivered in a predictable and regular way. Whilst this was a key feature for resilience as coping capacity, the findings also show that the role of complementary programmes, services and other sources of income was fundamental.

The paper also explored the different processes and dynamics that allowed (or restricted) the progression into stronger livelihoods of young adults, and the role of social protection in those dynamics. Drivers such as the poverty trajectory of the household and the lack of jobs in the labour market shaped the potential way *Oportunidades* affected the adaptive capacity of young adults. In this light, the programme did increase the human capital of young adults but it needs to engage with other interventions- such as the provision of services of quality, and fiscal and labour reforms to reduce the discrimination in the labour market- if it aims to increase the livelihood innovation of young recipient adults. Enhancing productivity depends on the performance of macroeconomic activity, the success of developing a dynamic labour market, and the provision of different labour opportunities for poor households.

The empirical findings also show that certain aspects of *Oportunidades*' theory of change, and consequently of its design, explicitly reduced its impacts on resilience such as the

exclusive focus on poverty reduction in the intergenerational scale through the human capital investments, because it excluded the income poverty reduction of the adult recipients. Likewise, this rationale undermines traditional livelihoods that have been found to increase the resilience of households.

Therefore, it cannot be expected that business-as-usual social protection approaches will trigger resilience to climate change and variability on their own. However, the preventive role of social protection is fundamental in order to provide the necessary stability in the household that then allows other factors to play an effective role in the potential adjustment of livelihoods. Those other factors to help adaption to climate change include transformative activities that tackle the structural causes of vulnerability and poverty, and explicit climate change mechanisms.

The dilemma for social protection if it's to support climate change resilience is how to shift into a more systemic approach where such programmes can include both the enhancement coping and adaptive capacities, the different timescales and their associated feedbacks. Such schemes need to do this in a way that people are protected from risk, where they can increase their productivity, and at the same time protect the ecological sustainability of their communities.

Knowledge on how social protection can increase resilience to climate change and achieve poverty reduction is key to pursuing policies that frame adaptation in terms of social justice. This paper may have some important insights to inform both the academic community and policy makers in governments and international organisations.

Supplementary data

Appendix 1 Main climate shocks and perceived climate variability in the coastal community and inland communities

In this section I will analyse the main climate shocks that affected the communities identified during the group discussions: Hurricane Isidore in 2002, the drought in 2012, and perceived climate variability. As explained in chapter 3 'Methodology', these climate shocks and stressors are used as a proxy of climate change.

A1.1 Hurricane Isidore

Yucatan is highly exposed to hydro-meteorological phenomena. For instance, between 1970 and 2009, 21 hurricanes affected the Yucatan Peninsula (see table A1.1), and increases in the occurrence of high intensity hurricanes in the Gulf of Mexico and the Caribbean Sea have already been identified as Dominguez, quoted in INECC-SEMARNAT (2013), shows. Moreover, hurricanes are considered one of the most devastating of the climate shocks. They cause loss of life, destroy and damage physical, natural and financial assets. In this research I studied the impacts of Hurricane Isidore in 2002 on the livelihoods of the people in the coastal and inland communities, since people in the communities themselves identified this as a highly significant point of reference in their lives.

In 2002 Hurricane Isidore reached category 3 and had an inland impact 9 km away from the coastal community. It destroyed mangrove swamps, coconut plantations, roads, dwellings and facilities (Batllori-Sampedro and Febles-Patron 2009). Households in the coastal community suffered several impacts, which meant a severe decline in their wellbeing. According to the household survey more than half of these households had their dwelling completely destroyed, and 86 per cent of the households lost their main livelihood activity. Moreover, plagues such as yellow fly appeared, threatening agricultural production.

In the inland community, 90 per cent of the households lost all their crops, 82 per cent partially lost their livestock or beehives, and 80 per cent of the households suffered severe impacts to their dwellings. According to Rosales (2003), 95 per cent or 356 hectares of sowed land in the inland community were affected by the hurricane. This is equivalent to an estimated figure of 417 tons of maize, a volume that would be enough to guarantee the annual consumption of the majority of the households, including their livestock. Apart from the impact on the consumption of the households, the loss of the agricultural production also represented a huge economic impact for the households. Shortly after the hurricane, Rosales calculated an estimated economic loss of 673,255 pesos (52,598 USD[11]) for the total maize production, or 1,870 pesos (146 USD) per hectare. If the production of beans, pumpkins, sweet potatoes and the lima beans is included, then the value per hectare rises from 1,870 pesos towards 5,000 pesos (390.6 USD) (ibid.).

[11] Estimated figures using an exchange rate of 12.80 Mexican Pesos per US Dollar, February, 2012 (Banxico).

Table A1.1 Hurricanes that affected Yucatan during 1970- 2008

Year	Name	Cate-gory*	Wind speed (km/h)	Place on inland impact	Affected states	Period
1970	Ella	TD(H3)	55 (195)	Akumal, Quintana Roo	Quintana Roo, Yucatan, Tamaulipas, Nuevo Leon	8-13 Sep
1970	Greta	TD	55 (45)	Telchac Pto, Yucatan	Yucatan, Campeche, Tamaulipas, San Luis Potosi, Nuevo Leon	26 Sep-5 Oct
1972	Agnes	TD	45	Tekax, Yucatan	Yucatan, Quintana Roo	14-23 Jun
1973	Brenda	TD(H1)	148 (93)	Cancun, Quintana Roo	Quintana Roo, Yucatan, Campeche, Chiapas	18-22 Aug
1974	Carmen	H4	222	Punta Herradura, Quintana Roo	Quintana Roo, Campeche, Yucatan	29 Aug-10 Sep
1975	Eloise	TS	85	Puerto.Morelos, Quintana Roo	Quintana Roo, Yucatan	13-24 Sep
1988	Gilbert	H5 (H4)	287 (215)	Puerto.Morelos, Quintana Roo	Quintana Roo, Yucatan, Tamaulipas, Nuevo Leon, Coahuila	8-20 Sep
1990	Diana	TS (H2)	110 (158)	Chetumal, Quintana Roo	Quintana Roo, Yucatan, Campeche, Veracruz, Hidalgo, San Luis Potosi, Queretaro, Guanajuato, Jalisco, Nayarit	4-8 Aug
1995	Opal	TD	55	B. Espiritu Santo, Quintana Roo	Campeche, Yucatan, Quintana Roo, Tabasco	27 Sep-2 Oct
1995	Roxanne	H3 (TD)	185 (45)	Tulum, Quintana Roo	Quintana Roo, Yucatan, Campeche, Tabasco, Veracruz	8-20 Oct
1996	Dolly	H1(H1)	110 (130)	F.C. Puerto, Quintana Roo	Quintana Roo, Yucatan, Campeche, Veracruz, Tamaulipas, San Luis Potosi, Zacatecas	19-24 Aug
1998	Mitch	TD (TS)	45 (65)	Cd. Hidalgo, Chiapas	Chiapas, Tabasco, Campeche, Yucatan	21 Oct-5 Nov
1999	Katrina	TD	45	Chetumal, Quintana Roo	Quintana Roo, Campeche, Yucatan	28 Oct-1 Nov
2000	Gordon	TD	55	Tulum, Quintana Roo	Quintana Roo, Yucatan	14-18 Sep
2002	Isidore	H3	205	Telchac Puerto, Yucatan	Quintana Roo, Yucatan, Campeche	14-26 Sep
2003	Claudette	TS (TD)	90 (55)	Cancun, Quintana Roo	Quintana Roo, Tamaulipas, Nuevo Leon, Coahuila, Yucatan	8-15 Jul
2005	Cindy	TD	55	Felipe Carrillo Puerto, Quintana Roo	Quintana Roo, Yucatan	3-6 Jul
2005	Emily	H4 [H3]	215 [205]	Tulum, Quintana Roo	Quintana Roo, Yucatan, Tamaulipas, Nuevo Leon	10-21 Jul
2005	Stan	TS (H1)	75 [130]	Felipe Carrillo Puerto, Quintana Roo	Quintana Roo, Yucatan, Veracruz; Oaxaca, Campeche, Chiapas	
2005	Wilma	H4	230	Cozumel, Playa Del Carmen, Quintana Roo	Quintana Roo, Yucatan	15-25 Oct
2008	Dolly	TS [TS]	85 [65]	Nichupte, Quintana Roo	Quintana Roo, Yucatan, Tamaulipas, Nuevo Leon, Coahuila, Chihuahua	20-25 Jul

Source: SMN

*Based on Saffir–Simpson Hurricane Scale: TD: tropical depression; TS: tropical storm; H1: Hurricane Cateogry 1; H2: Hurricane Category2; H3: Hurricane Category 3; H4: Hurricane Category 4; H5: Hurricane Category 5

A1.2 Drought 2012

Drought has played a significant role in the human history of the Yucatan Peninsula. It has been argued that drought may have played a role in the collapse of the Mayan civilisation during the 9th century (Liverman 1999). Drought is common and it is experienced as soil moisture drought (also known as agricultural drought), which refers to a deficit of soil moisture (IPCC 2012) (see table A2.2). In the Yucatan Peninsula the rainy season usually takes place in the summer. However, the region is exposed to the weather phenomenon of summer drought, where a relative decrease of the rains is observed during the rainy period, originated by regional atmospheric processes (Orellana *et al*. 2009).

The land in Yucatan is very permeable and porous, making soil-moisture quite low. Agriculture is therefore quite dependent on a good distribution of rainfall. There is no irrigation system on the inland community, therefore any delay or decrease in rain implies a severe shock for poor rural households that depend on subsistence production. Summer drought is associated with water and food scarcity, crop failure and increases in the price of basic commodities (Mendoza, Villanueva and Adem 1997). It mainly affects the *milpa,* horticulture, beekeeping and livestock production. While the survey was being conducted, the country was experiencing a spell of summer drought, which also affected the region of Yucatan. The 2012 drought was considered one of the most intense droughts in the country during the last fifty years (INECC-SEMARNAT 2013). This was quite severe mainly in the North of the country. The Yucatan Peninsula was also affected but in a lesser extent. In the coastal community droughts do not have a major impact since the livelihoods of people mainly depend on fishing activity.

Given this, according to the household survey 85 per cent of the households in the inland community reported impacts upon their agricultural production, and 71 per cent of these households said they had lost all their production due to the drought. Moreover, 37 per cent of the households reported experiencing at least two spells of drought in the last five years. Key informant interviews with peasants also showed that the droughts that took place in 2008, 2009 and 2010 seriously affected the production in the *milpa*.

A1.3 Perceived climate variability

Based on the analysis developed by the Research Centre of Environmental Geography (CIGA) for the Special Climate Change Programme for Yucatan, climate change projections for Yucatan show an increase on the mean annual temperature between 0.5 and 0.8 Celsius degree for the period 2010 to 2039, depending on the emission scenario. It is also expected a substantial increase on extreme hot days. Moreover, a decrease in the mean annual volume of precipitation is also expected. This reduction ranges between 15.3 and 1 per cent by the end of the century (CIGA *et al*. 2013) (see table A1.2).

Table A1.2 Climate change projections for Yucatan

		Horizon		
	Actual mean values	**2010-2039**	**2040-2069**	**2070-2099**
Increase of mean annual temperature	25.9C	0.5-0.8	0.5-1.8	0.6-2.8
Variation of annual precipitation	1,091.5mm	Range from reduction of 14.9% to a rise in 1%		
Increase in extreme hot days per year	36.5 days per year	7-12	9-51	10-78

Source: CIGA *et al*. 2013

In the coastal community, the climate is perceived as changing, generally in terms of more extreme seasons (dry, rainy and north-winds). Based on data of the closest weather station of Telchac, the coastal community is already experiencing a tendency of climate variability mainly in the form of increasing monthly maximum temperatures (CIGA *et al*. 2013). The months with a stronger increase of maximum temperature are June, July, September and October.

Moreover, during the winter the north-winds have increased the mean sea level (Batllori-Sampedro 2002a). The salt intrusion in the soil, due to the sea level rise has already affected agriculture and horticulture in the community, by decreasing the access to fertile land. Climate variability mainly affects offshore fishing, the main livelihood in the community, by impeding fishermen's ability to go to sea. Households have had to remain on land for up to three days without being able to go fishing in the face of more intense and prolonged north-winds. This also affected tourism activities. The impacts on households of this limited fishing activity are two-fold: households will face a nutritional impact with a lack of fish consumption due to the limited fishing activity, and an economic impact by not having the income they earn by selling the surplus from fishing production. The following quotations illustrate these impacts:

> 'The weather has changed a lot during the last 10 years. Before, in July, the winds were calmer but nowadays they are more abrupt. Before you knew when the winds would come; now they come without notice. This affects the fishing activity. Before you had to go only 3 fathoms [5 metres] to fish, now you have to go to at least 12 fathoms [21 metres]. Before one fisherman brought 50 kg per fishing day, now you are happy if you manage to bring 4 kgs'. Male, coastal community. Age and other categories not provided. Group discussion with fishermen.
>
> 'Fishing is not as abundant as it used to be. The resources [fisheries] were overexploited and now it is very scarce. Beforehand in the four months of the octopus season [from August to December] you had a continuous fishing activity. Nowadays these are months of uncertainty'. Male, coastal community. Age and other categories not provided. Group discussion with fishermen.

In the inland community households reported having more hot spells during the day-time, more erratic rainfall and changes at the start and end of seasons. Based on the closest weather station of Tixmehuac, climate change scenarios project an increase in the number of days of erratic rainfall in the inland community, and a decrease in rainy days (CIGA *et al*. 2013).

Appendix 2 Frequencies of the main causes wellbeing & ill-being based on life histories by poverty trajectory

A2.1 Adults

Main cause of wellbeing reported by the respondent	Usually poor	%	Churning poor	%	Occasionally poor	%	Total
Children working	7	**50**	6	**43**	1	**7**	**14**
Personal motivation/ Entrepreneurial	0	**0**	6	**60**	4	**40**	**10**
Oportunidades	4	**50**	3	**4**	1	**12**	**8**
Support with husband	2	**40**	2	**40**	1	**20**	**5**
Migration	1	**25**	1	**25**	2	**50**	**4**
Secure and waged job	1	**25**	3	**75**	0	**0**	**4**
Procampo	4	**100**	0	**0**	0	**0**	**4**
Help from family and friends	0	**0**	3	**100**	0	**0**	**3**
Small business	0	**0**	1	**33**	2	**66**	**3**
Farm work	0	**0**	2	**100**	0	**0**	**2**
Off farm work in the community	0	**0**	2	**100**	0	**0**	**2**
Capacity to plan for the future	1	**50**	0	**0**	1	**50**	**2**
Female work in income generating activity	0	**0**	2	**100**	0	**0**	**2**
Savings (as preventive)	1	**50**	0	**0**	1	**50**	**2**
Social capital/reciprocity	0	**0**	0	**0**	1	**100**	**1**
Seguro popular	0	**0**	1	**100**	0	**0**	**1**
Work in the city	1	**100**	0	**0**	0	**0**	**1**

Secondary causes of wellbeing	Usually poor	%	Churning poor	%	Occasionally poor	%	Total
Off farm work in the community	2	50	2	50	0	0	4
Work in the city	4	67	2	33	0	0	6
Farm work	0	0	1	50	1	50	2
Raise sell livestock	3	75	0	0	1	25	4
Loan	0	0	5	83	1	17	6
Help from family and friends	3	20	9	60	3	20	15
Humanitarian aid	3	25	6	50	3	25	12
Savings	2	50	1	25	1	25	4
Reduce consumption	2	100	0	0	0	0	2
Pawn	2	100	0	0	0	0	2
Oportunidades	7	35	10	50	3	15	20
Seguro popular	2	50	2	50	0	0	4
Social security	0	0	3	100	0	0	3
Children working	6	54	4	36	1	1	11
Loans	1	25	1	25	2	50	4
Inheritance/gifts	3	23	4	31	4	31	13
Marriage	6	33	8	44	4	22	18
Other preventive SP	1	25	2	50	1	25	4
Remittances	1	33	0	0	2	66	3
Savings threshold	8	35	10	43	5	22	23
Social capital/reciprocity	8	44	6	33	4	22	18
Personal motivation	6	50	3	25	3	25	12
Farm work	10	48	8	38	3	14	21
Other promotive SP	0	0	2	50	2	50	4
Procampo	4	100	0	0	0	0	4
Pronabes	0	0	2	100	0	0	2
Capacity to plan for the future	9	53	5	29	3	18	17
Credits or loans	0	0	2	100	0	0	2
Female work in income generating activity	10	42	9	37	5	21	24
Migration	3	23	6	46	4	31	13
Off farm work in the community	9	50	8	44	1	6	18
Secure and waged job	2	22	4	44	3	33	9
Small business	4	27	6	40	5	33	15
Support with husband	7	70	2	20	1	10	10
Work in the city	3	23	5	38	5	38	13
Cheap living costs	5	83	1	17	0	0	6

Main causes of ill-being	Usually poor	%	Churning poor	%	Occasionally poor	%	Total
Illness/death	7	**50**	4	**28**	3	**22**	**14**
Hurricanes	1	**10**	5	**50**	3	**30**	**9**
Lack of jobs and opportunities	3	**30**	5	**50**	1	**10**	**9**
Income poverty/economic crisis	3	**50**	2	**30**	1	**20**	**6**
Education expenses	0	**0**	4	**100**	0	**0**	**4**
Not going/children dropping out of school	3	**75**	0	**0**	1	**25**	**4**
Migration	1	**50**	0	**0**	1	**50**	**2**
Low holiday season	1	**100**	0	**0**	0	**0**	**1**
Lack of social security	1	**100**	0	**0**	0	**0**	**1**
Drought	1	**100**	0	**0**	0	**0**	**1**
Stopped productive activity	0	**0**	0	**0**	1	**100**	**1**
Transportation expenses	1	**100**	0	**0**	0	**0**	**1**
Medical expenses	1	**100**	0	**0**	0	**0**	**1**

Secondary causes of ill-being	Usually poor	%	Churning poor	%	Occasionally poor	%	Total
Hurricanes	9	**36**	11	**44**	5	**20**	**25**
Pregnancy	8	**34**	12	**50**	4	**16**	**24**
Not going dropping out of school	9	**39**	12	**52**	2	**8**	**23**
Illness/death	9	**45**	8	**40**	3	**15**	**20**
Education expenses	6	**40**	8	**53**	1	**7**	**15**
Child labour	6	**43**	6	**43**	2	**14**	**14**
Stopped productive activity	3	**23**	7	**54**	3	**23**	**13**
Drought	6	**85**	0	**0**	1	**15**	**7**
Gender discrimination	4	**67**	2	**13**	0	**0**	**6**
Environmental degradation	3	**60**	1	**20**	1	**20**	**5**
Divorce/split	1	**25**	2	**50**	1	**25**	**4**
Domestic violence	1	**33**	2	**66**	0	**0**	**3**
Lack of social security	0	**0**	2	**66**	1	**33**	**3**
Transportation expenses	1	**33**	1	**33**	1	**33**	**3**
Income poverty/economic crisis	0	**0**	0	**0**	2	**100**	**2**
Lack of jobs and opportunities	1	**50**	0	**0**	1	**50**	**2**
Migration	1	**50**	1	**50**	0	**0**	**2**

A2.2 Young adults

Main cause of wellbeing reported by the respondent	Usually poor	%	Churning poor	%	Occasionally poor	%	Total
Parents support for education	2	**17**	6	**60**	3	**50**	***11***
Economic help from family	2	**17**	3	**30**	5	**83**	***10***
Work in the city	5	**42**	3	**30**	0	**0**	***8***
Hammock weaving	6	**50**	1	**10**	0	**0**	***7***
Entrepreneurial/personal motivation	1	**8**	3	**30**	2	**33**	***6***
***Oportunidades*/Pronabes**	0	**0**	5	**50**	0	**0**	***5***
Have a formal job				**0**			***4***
Economic support with wife/husband	1	**8**	1	**10**	1	**17**	***3***
Help from older siblings	1	**8**	0	**0**	0	**0**	***1***
Social networks	1	**8**	0	**0**	0	**0**	***1***
Curiosity about city life	1	**8**	0	**0**	0	**0**	***1***
Motivation from friends	0	**0**	0	**0**	1	**17**	***1***
Capacity to plan for the future	0	**0**	0	**0**	1	**17**	***1***
Religion	1	**0**	0	**0**	0	**0**	***1***
Temporal agricultural work outside community	1	**0**	0	**0**	0	**0**	***1***
State transfer	0	**0**	0	**0**	1	**17**	***1***
Seguro Popular	1	**8**	0	**0**	0	**0**	***1***
Work in milpa	1	**8**	0	**0**	0	**0**	***1***
Work in ejido	0	**0**	1	**10**	0	**0**	***1***
Going to school	1	**8**	0	**0**	0	**0**	***1***
Migration	0	**0**	1	**10**	0	**0**	***1***

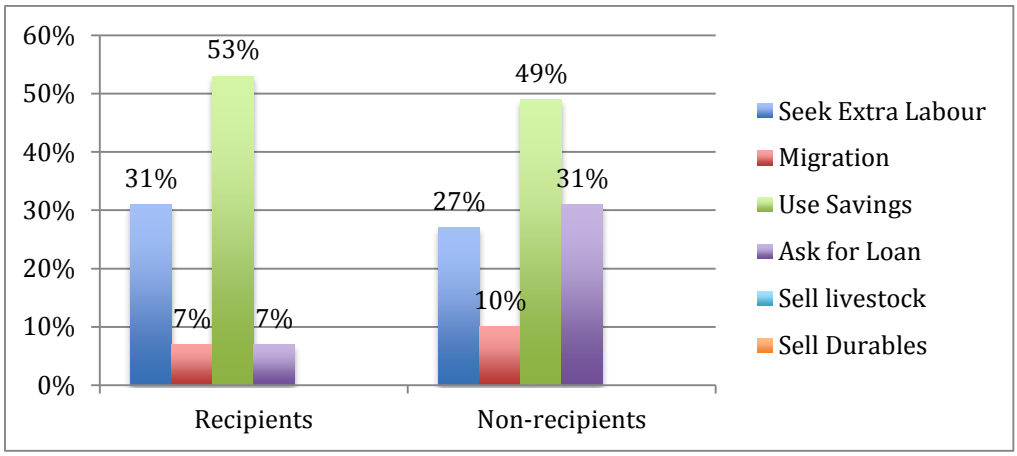
Secondary causes of wellbeing reported by the respondent	Usually poor	%	Churning poor	%	Occasionally poor	%	*Total*
Education as investment in the future	4	**33**	4	**40**	6	**100**	***14***
***Oportunidades*/Pronabes**	4	**33**	6	**60**	3	**50**	***13***
Parents support for education	3	**25**	4	**40**	3	**7**	***10***
Work in the city	2	**17**	6	**60**	0	**0**	***8***
Entrepreneurial/personal motivation	2	**17**	3	**30**	3	**50**	***8***
Economic help from family	2	**17**	3	**30**	2	**33**	***7***
Social networks	3	**25**	3	**30**	2	**33**	***7***
Migration	3	**25**	3	**30**	1	**17**	***7***
Economic support with wife/husband	4	**33**	2	**20**	0	**0**	***6***
Seguro Popular	4	**33**	0	**0**	1	**17**	***5***
Use of skills	1	**8**	2	**20**	2	**33**	***5***
Support from children that are lagging behind	2	**17**	1	**10**	1	**17**	***4***
Curiosity about city life	2	**17**	2	**20**	0	**0**	***4***
Help from older siblings	1	**8**	1	**10**	3	**50**	***4***
Guidance/inspiration from friend family	1	**8**	2	**20**	1	**17**	***4***
Other education grants	0	**0**	0	**0**	2	**33**	***2***
Capacity to plan for the future	1	**8**	1	**10**	0	**0**	***2***
Procampo	1	**8**	0	**0**	0	**0**	***1***
***Oportunidades* school expenses**	4	**33**	4	**40**	3	**50**	***11***
***Oportunidades* motivation to study more**	1	**8**	4	**40**	2	**33**	***7***
***Oportunidades* points**	0	**0**	4	**40**	0	**0**	***4***
***Oportunidades* not big enough**	3	**25**	2	**20**	1	**17**	***6***

Main causes of ill being reported by the respondent	Usually poor	%	Churning poor	%	Occasionally poor	%	*Total*
Lack of jobs and opportunities	6	**50**	2	**20**	1	**17**	***9***
Illness	5	**42**	2	**20**	1	**17**	***8***
Income poverty/lack of money	1	**8**	3	**30**	3	**50**	***7***
Droughts	6	**50**	0	**0**	0	**0**	***6***
Envy from others	0	**0**	1	**10**	2	**33**	***3***
Climate variability	1	**8**	0	**0**	0	**0**	***1***
Lack of access to school resources	0	**0**	1	**10**	1	**17**	***2***
Bad influences/ addictions	0	**0**		**0**	2	**33**	***2***
Not going/dropping out of school	0	**0**	1	**10**	1	**17**	***2***
Religious discrimination	1	**8**	0	**0**	0	**0**	***1***
Feels unproductive	1	**8**	0	**0**	0	**0**	***1***
Loneliness	0	**0**	0	**0**	1	**17**	***1***
Hurricanes	0	**0**	0	**0**	1	**17**	***1***
Transportation expenses	0	**0**	1	**10**	0	**0**	***1***
Lack of support from government	1	**8**	0	**0**	0	**0**	***1***
Lack of guidance in school	0	**0**	0	**0**	1	**17**	***1***
Robbery	1	**8**	0	**0**	0	**0**	***1***
Lack of skills	1	**8**	0	**0**	0	**0**	***1***

Secondary causes of ill being reported by the respondent	Usually poor	%	Churning poor	%	Occasionally poor	%	*Total*
School expenses	6	**50**	6	**60**	2	**33**	***14***
Limited access to schools	8	**67**	4	**40**	1	**17**	***13***
Child labour	8	**67**	3	**30**	1	**17**	***12***
Work and study	2	**17**	7	**70**	2	**33**	***11***
Early marriage	5	**42**	3	**30**	1	**17**	***9***
Lack of jobs and opportunities	3	**25**	3	**30**	2	**33**	***8***
Transportation expenses	2	**17**	4	**40**	2	**33**	***8***
Pregnancy	**7**	**58**	**0**	**0**	1	**17**	***8***
Lack of quality in school	2	**17**	5	**50**	1	**17**	***8***
Education lag	4	**33**	3	**30**	1	**17**	***8***
Lost motivation	4	**33**	3	**30**	0	**0**	***7***
Feels unproductive	2	**17**	3	**30**	2	**33**	***7***
Drought	7	**58**	0	**0**	0	**0**	***7***
Help younger siblings to go to school	3	**25**	3	**30**	1	**17**	***7***
Income poverty/lack of money	5	**42**	2	**20**	0	**0**	***7***
Gender discrimination	2	**17**	3	**30**	0	**0**	***5***
Lack of access to school resources	2	**17**	1	**10**	1	**17**	***5***
Ethnic discrimination	3	**25**	0	**0**	1	**17**	***4***
Loneliness	0	**0**	4	**40**	0	**0**	***4***
Lack of support of children that are lagging behind	4	**33**	0	**0**	0	**0**	***4***
Illness	1	**8**	1	**10**	1	**17**	***3***
Lack of support of parents for education	2	**17**	1	**10**	0	**0**	***3***
Bullying	1	**8**	1	**10**	1	**17**	***3***
Bad influences addictions	0	**0**	0	**0**	2	**33**	***2***
Hurricanes	0	**0**	2	**20**	0	**0**	***2***
Not going/dropping out of school	9	**75**	5	**50**	2	**33**	***16***

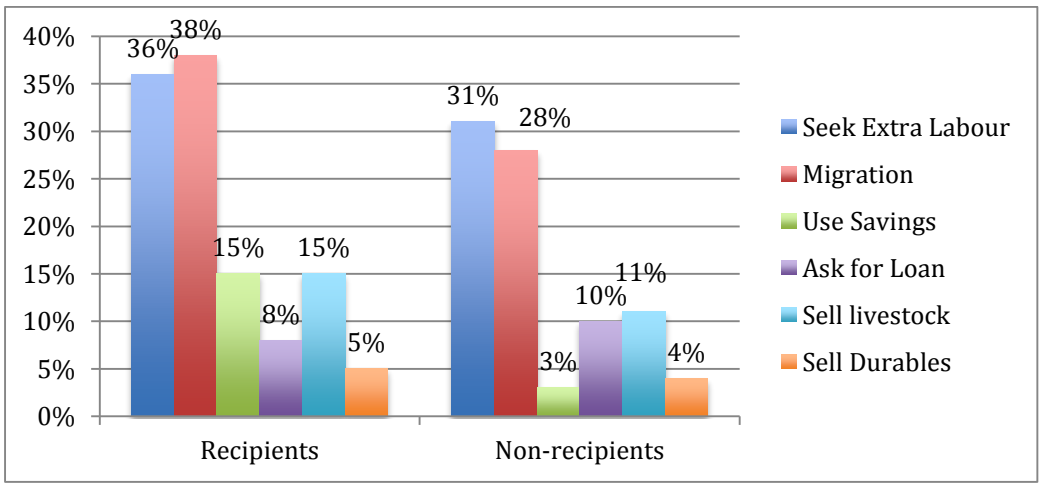
Appendix 3 Coping strategies

Figure A3.1 Coping strategies related to Hurricane Isidore in the coastal community



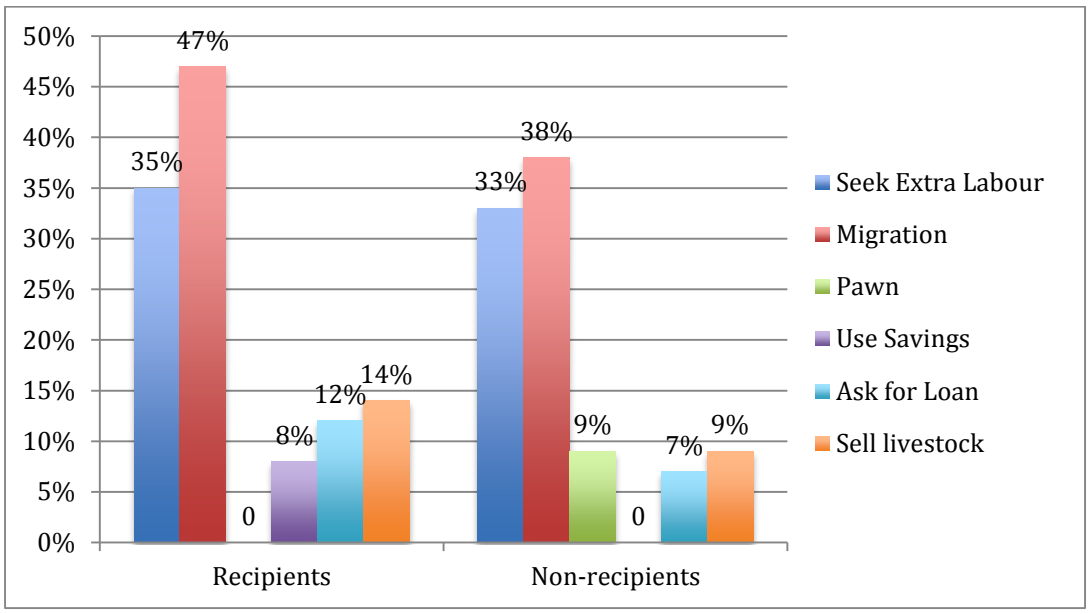
Source: Author
1 Only long-term recipients since these were the only households that were receiving the cash transfer when Isidore hit the community.

Figure A3.2 Coping strategies Hurricane Isidore in the inland community



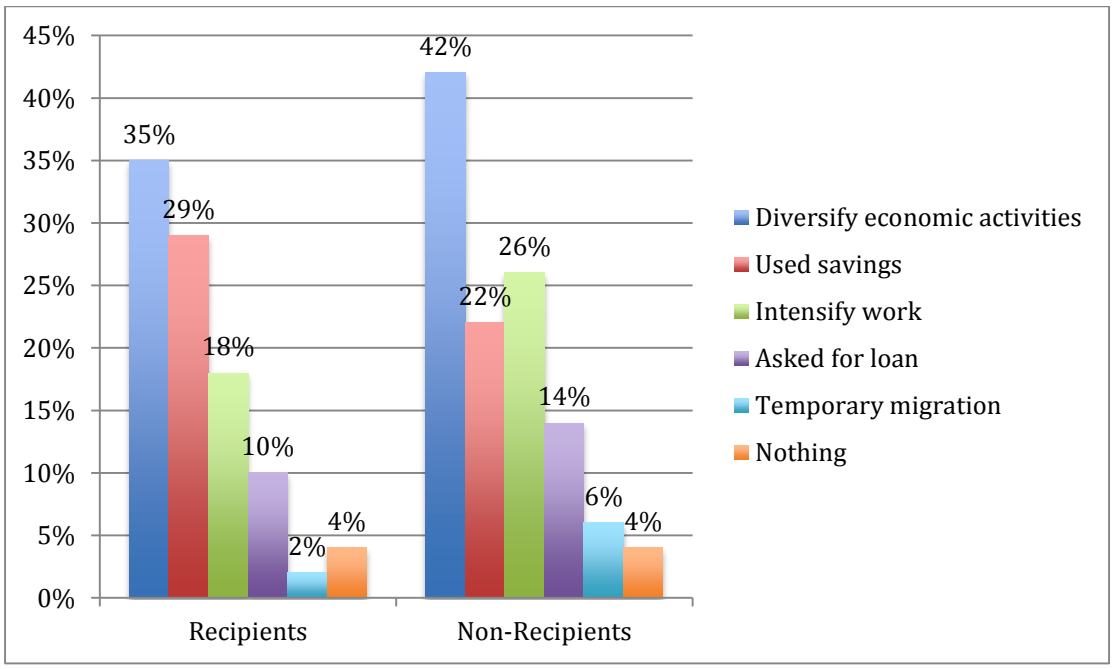
Source: Author based on household survey
1 Only long-term recipients since these were the only households that were receiving the cash transfer when Isidore hit the community.

Figure A3.3 Coping strategies during the drought of 2012, inland community



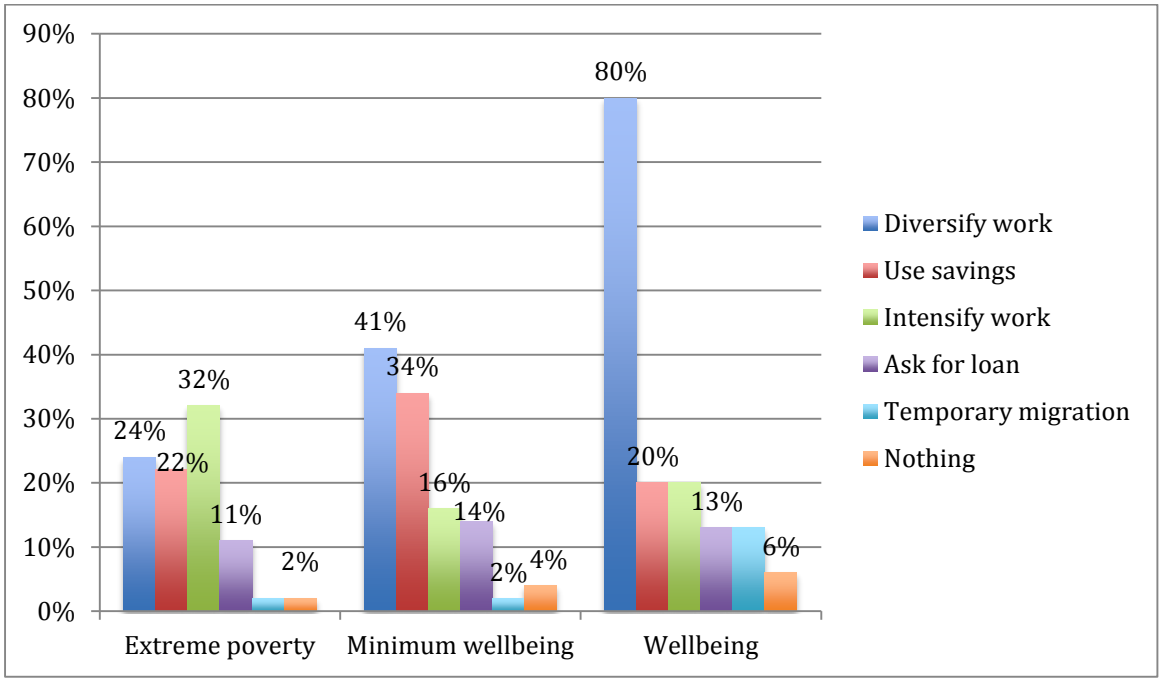
Source: Author based on household survey

Figure A3.4 Coping strategies, perceived climate variability



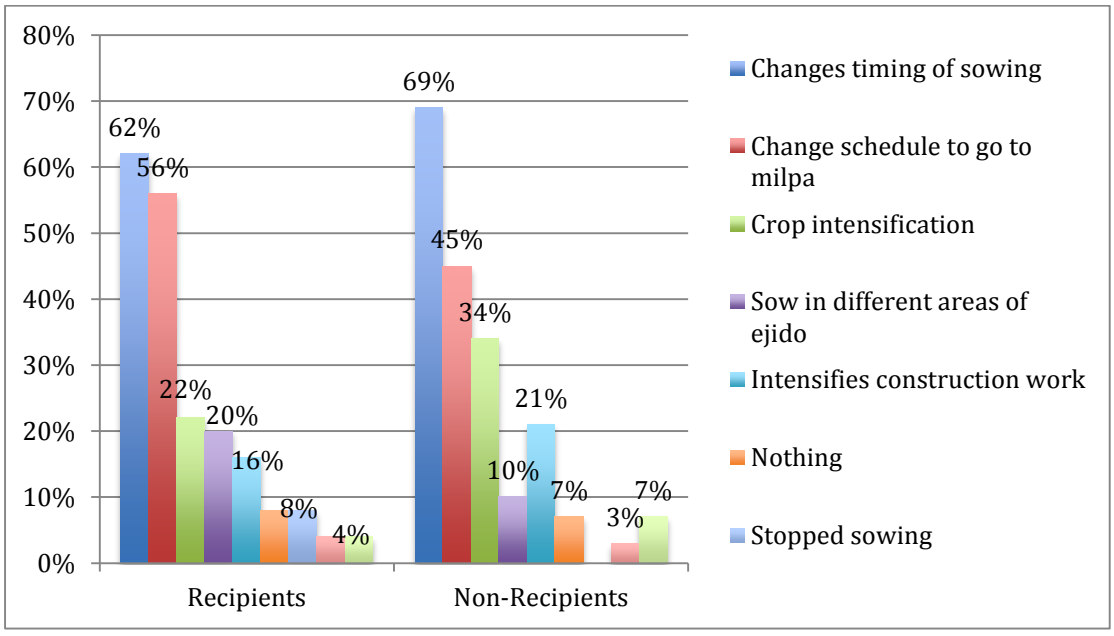
Source: Author based on household survey

Figure A3.5 Coping strategies, perceived climate variability, by poverty category, in the coastal community



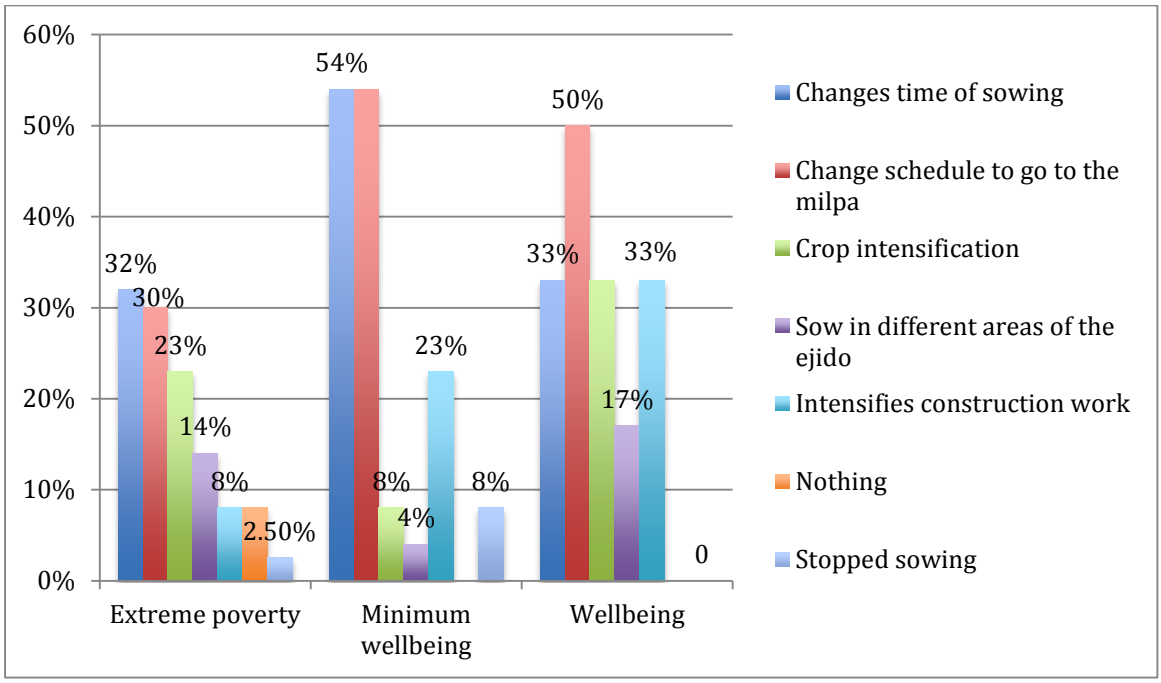
Source: Author based on household survey

Figure A3.6 Coping strategies, perceived climate variability, recipients and non-recipients, in the inland community



Source: Author based on household survey

Figure A3.7 Coping strategies, perceived climate variability, by poverty category, in the inland community



Source: Author based on household survey

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