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GREEN MICROFINANCE: A NEW FRONTIER TO INCLUSIVE FINANCIAL SERVICES



Green microfinance is a new research field that has emerged from the combination of two *a priori* distinct concepts: microfinance (MF) and climate change (CC). For many decades, climate change seemed a luxury that the microfinance industry could not afford or dream of (McKee, 2008, p. 2). However, the last decade witnessed a growing perception that “incorporating a climate change lens to microfinance is essential and urgent [...] as well as critical to the future of the sector” (McKee, 2008). In fact, due to their low adaptive ability, the millions of microfinance clients globally are the most vulnerable to climate variability and their “plight is linked to the ability of microfinance institutions (MFIs) to adapt to the consequences arising from climate change” (Dowla, 2009, p. 1). It is then in this *a priori* alien terrain that green microfinance comes to light as an attempt to supplement microfinanced products and services with tailored pro-poor climate change strategies with a view to enhancing the adaptive capacity of millions of MF clients worldwide. But should microfinance or, more broadly, inclusive financial services really be used to achieve such purposes? In other words, why should microfinance actors care about weather extremes and CC at all, and what can they do to alleviate the climatic burden on the poor, which are after all their main target?

Over the last decades, microfinance has gained momentum at the international stage as a financial market closely linked to [poor] local communities, working towards the needs of such communities while generating social empowerment—e.g. social capital and social trust—and allowing for innovative models to take place. As pro-poor financial actions perpetuate in poor corners, global warming and associated changes in Earth’s climate pattern appear as a new risk source for microfinance’s mission. Due to their geographic position in low-latitude regions, most developing countries and their populations already struggle with instances of climate extremes – e.g. torrential rains and storms, monsoons, severe droughts; and, as temperatures rise, such events will occur more

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frequently, placing an additional burden on the world's poorest populations. The Global Climate Risk Index 2015 suggests that "of the 10 most weather related affected countries through 1994–2013, nine were developing countries in the low income or lower-middle income country group" (Kreft, Eckstein, Junghans, Kerestan, & Hagen, 2014). It is likewise argued that substantial increase in precipitation variability will further reduce GDP and increase poverty in many developing countries (World Bank, 2010).

Paradoxically, those who contributed least to global warming happen to be most vulnerable to a changing climate (Ahmed, Diffenbaugh, & Hertel, 2009; Stren, 2007), in particular the rural poor (Food and Agriculture Organization of the United Nations, 2015). Because the poor rely greatly on natural and ecosystem resources for their livelihoods and have limited resources, assets, and coping mechanisms in hand, such as savings and insurance schemes, they have the lowest adaptive ability to cope with the effects of extreme weather events and, more broadly, climate change. Moreover, there is growing evidence that poor countries have slower asset, income growth, and human capital recovery ahead of climatic shocks (World Bank, 2010).

In Brazil alone, more than 16 million people living on less than one dollar a day [accounting for 8% of total population] (Instituto Brasileiro de Geografia e Estatística – IBGE, 2010) are very likely to be hit hard by climate change adversities, especially in the northern and north-eastern regions, as well as in poor settlements – in particular in the *favelas* – in all regions. The Centro Universitário de Estudos e Pesquisas sobre Desastres (CEPED) of the Universidade de Santa Catarina (UFSC) estimates that in the last two decades more than 120 million Brazilians were affected by weather-related events [either CC-related or not] which inflicted major life and economic losses, particularly due to droughts and flood events (CEPED-UFSC, 2013).

But, as economist Asif Dowla put it: "What do all these issues actually mean for microfinance institutions (MFIs)?" (Dowla, 2009, p. 9). Global climate change is likely to affect both directly and indirectly MFIs and their clients. The ecosystem and natural resources most MF clients depend on for their livelihoods will be hit hard by altered climatic conditions, and this will compromise their ability to pay back their loans. Likewise, increased incidence of tropical disease outbreaks, water scarcity in drought-prone areas, and injuries suffered during climate extremes will likely affect clients' health, making it harder for them to meet their financial obligations. In the lack of sound adaptation actions, climate-related asset losses and health issues may cause default rates to rise substantially, and if occurred in larger scales, may lead several MFIs to face solvency problems. Put simply, natural disasters, declined crop productivity, increased incidence of pests and tropical diseases, water scarcity, more frequent instances of climate extremes—long-lasting droughts, torrential rains, flooding, hurricanes—as a result of global warming are likely to endanger clients' health and their asset base—homes, crops, equipment, and livestock—and, ultimately, affect both directly and indirectly the financial performance of a number of MFIs.

As an attempt to address this salient issue from an academic viewpoint, a few authors, in particular in the Global North, have built on the linkages between the increased incidence of weather-related events and microfinance actions to better understand why, how and what microfinance can do to better respond to a new climatic reality (see for instance, Agrawala & Maëlis, 2010; Dowla, 2009; Hammill, Matthew, & McCarter, 2008; McKee, 2008; Rippey, 2012). From an empirical standpoint, a few examples of microfinance attempts to supplement its actions with adaptation and mitigation have also emerged, as in the case of a pilot programme in Cambodia aimed to increase re-

silience of poor rural households against extreme weather events by fostering savings, income generating activities, insurance in kind (rice), and technical assistance among clients (Forcella, 2013). Another example comes from EcoMicro, co-financed by the Multilateral Investment Fund (MIF) and the Nordic Development Fund (NDF), whose objective is to promote green finance products at the microfinance level so as to allow micro, small, and medium enterprises and low-income households in Central and South America to access cleaner energy, increase their energy efficiency, or adapt to climate change (Inter-American Development Bank, 2013).

In Brazil, albeit some practitioners already provide products and services imbued in environmental concerns, Brazilian scholars have been virtually absent in understanding the impacts of CC and extreme weather events on MF and its clients, as well as what MF actors can do in order to mitigate and/or alleviate such impacts, with a few exceptions (see, for instance, Gonzalez & Moser, 2015; Moser & Gonzalez, 2015).

The objective of this paper is, therefore, to frame the key issues and current knowledge in this new frontier to inclusive finance, bringing to light the Brazilian empirical experience, as well to provide inputs to practitioners, academicians and stakeholders so they can research deeper into this incipient, yet intriguing theme. With a booming microfinance sector and being in the frontline of the climate change phenomenon, we believe that Brazil can offer valuable insights into the combination of these two *a priori* apparently distinct realms.

In the first section, we address the prospects for microfinance in this new realm, while in the second section we frame and present the state of the art of green microfinance. In the following sections, we seek to understand the relevance of green microfinance to the Brazilian setting, exploring the impacts of weather events and climate change on Brazilian MFIs and their target, as well as poten-

tial synergies between the two realms, before concluding with some final remarks.

WHAT CAN MICROFINANCE ACTORS DO?

With regard to climate change and its associated disturbances, there are two core concepts: adaptation and mitigation. Adaptation refers to adjustments in natural and/or human systems in response to actual or expected climatic stimuli or their effects, with a view to moderating harms and/or exploiting benefits and opportunities arising from climate change (Intergovernmental Panel on Climate Change, 2001). In turn, mitigation involves human interventions to reduce greenhouse gas (GHG) emissions at their sources and/or enhance their removal from the atmosphere by sinks [e.g. forests, oceans, and plants absorbing CO₂] (United Nations Framework Convention on Climate Change, 2009).

Even though mitigation instruments perform better at the national and/or international level, MFIs can promote low-scale clean energy financing [e.g. biofuels, solar energy, etc.] and engage in the carbon credit market to finance site-specific mitigation projects, also by calling on specialised agencies for project preparation through strategic partnerships.

MFIs also have a stake in fostering adaptation strategies to clients. These actions combine both financial and non-financial services aimed at aiding families accumulate and diversify assets, as well as coping mechanisms over time [e.g. savings and microinsurance policies], whilst sharing knowledge and information to influence customer's behaviours towards more sustainable practices.

Core to such strategies is the development of a proactive approach to weather-related impacts. Various MFIs have already experienced instances of natural disaster whereby they had to deal with large-scale losses and covariate risks. With a few exceptions, these MFIs have developed a re-

active approach to natural disaster-related losses, i.e. limiting the scope of actions to respond to specific events and restore previous conditions. However, if MFIs are to secure and protect their assets and their borrowers from the adversities arising from a changing climate on a sustainable basis they need to adopt a proactive approach to climate change (Dowla, 2009, p. 17). Agrawala and Maëlis (2010) refer to this approach as a "climate-proof" strategy. According to the authors, climate-proofing microfinance products is imperative for MFIs to withstand environmental/weather risks as weather conditions worsen. MFIs can, for example, take forward plans and perform risk management assessments on their product portfolio in light of localised weather/climate change vulnerabilities and risks so as to devise targeted adaptation initiatives perceived as most relevant and urgent. Albeit this process may seem costly to many MFIs, management might consider it as an investment measure to avoid worse, more expensive consequences in the future (Dowla, 2009; Rippey, 2012).

Likewise, added to encouraging crop and income diversification, rural MFIs can also promote targeted loans for hybrid or more weather resistant crops at lower interest rates. For example, financing maize crops in a drought-prone area may be counterproductive in the long term once maize is known to be highly sensitive to dry climates, and as such, may lower the adaptive ability of clients.

As for savings schemes, although many MFIs do offer compulsory savings schemes coupled with loan products, most of them impose withdrawal restrictions on such savings schemes during large-scale shocks or crisis. In Bangladesh, for instance, the Grameen Bank faced liquidity problems in the wake of the 1998 flooding due to a rising tide of withdrawals, and decided to prohibit compulsory savings withdrawals during crisis. Dowla (2009) argues that MFIs need instead to foster voluntary savings from bor-

rowers so that they can use these funds whenever climate-related shocks arise.

Remittance services can also be used by MFI clients as a countercyclical safety net during shocks. Latest World Bank data indicate that developing countries have received over US\$410 billion in remittances in 2013, representing an increase of 6.3% compared to 2012 (World Bank, 2013). Among families receiving remitting earnings from migrants are several MFI clients in the global south. However, this represents an incipient arena for many MFIs worldwide, still leaving 30 to 40% of their remittance-recipient clients receiving these funds from costly outside sources (International Fund for Agricultural Development, n.f.). The IFAD argues that MFIs have a comparative advantage in offering remittance services to their clients. Firstly, they have local knowledge and thus understand the needs of their clients. Secondly, they are trusted by local communities, and thirdly, they can act as a "recycling channel" through which remittances are either stored or reinvested in income-generating projects (IFAD, n.d.).

Scholars such as Bhattamishra and Barrett (2008) and Skees and Barnett (2006) have shown the great potential for developing community-based risk management arrangements and products to alleviate idiosyncratic and/or covariate risks with aims of, ultimately, mitigating poverty traps after climate shocks. From an MF viewpoint, this would include, for instance, the provision of index-based insurance schemes. These are schemes whose payouts are triggered according to established local weather thresholds, or indexes, with a view to avoiding problems related to individual misbehaviour such as moral hazard (Wang, Karu-aihe, Young, & Zhang, 2013). In other words, weather-based insurances are indexed in localised climate patterns or trends—e.g. rainfall or temperature—recorded in a specific weather station over a certain period of time. From such observations, a threshold and a limit for that specific weather event are established so as to create a range for

insurance claims (Barnett & Mahul, 2007). Accordingly, whenever the threshold is exceeded, policyholders automatically receive an indemnity up to the amount insured and to the established limit.

In a nutshell, examples of adaptation actions that can be delivered at the customer-level [i.e. at the microbusiness and household level] include climate-proofed products, flexible contracts ahead of disaster events, asset and resource diversification and accumulation, savings boosting and the promotion of index-based insurance schemes, targeted and environmental conditional loans, awareness raising, dissemination and exchange of local best practices such as in sustainable agriculture and eco-friendly microbusiness management, capacity-building and training for clients concerning how to best adapt to CC, as well product innovations such as remittances services.

MFI's also can be used as a distributional channel for donors to deliver adaptation to millions of poor people worldwide, especially women which are particularly vulnerable to climate change impacts (Agrawala & Maelis, 2010; Hammil et al., 2008), as in the case of EcoMicro in Latin America.

Also, at the managerial level, there are many ways in which microfinance providers can promote climate change actions. For instance, management can assess an MFI's own ecological footprint in order to estimate its impact in terms of Greenhouse Gas (GHGs) emissions and, upon that, devise offsetting strategies (Dowla, 2009). MFIs can also promote risk management plans, such as environment-based SWOT analysis, in order to unveil its strengths and weaknesses in terms of environmental impacts and shocks with a view to better responding to and benefiting from climate change. Further, they can strengthen personnel capacity to deal with climate change and weather-related shocks through training activities. One could also argue that MFIs have a more intrinsic impetus steering them to engage in different approaches towards en-

vironmental protection, e.g. ethical responsibility. In fact, the mission of most MFIs worldwide is anchored in social and ethical values (see, for instance, Schmidt, 2010). Environmental protection has been increasingly presented as a moral obligation and a fundamental ethical duty in the attainment of the well-being and development of communities and societies – e.g. the notion of sustainable development and the triple bottom line approach: people, planet and profit. Allet and Hudon (2013), studying data from over 160 MFIs worldwide, showed that the most proactive in environmental management among these MFIs were primarily motivated by social and ethical responsibilities, with the primacy of the more social-oriented MFIs.

However, MFIs should not be seen as silo agents in the promotion of climate change adaptation and, to a lesser extent, mitigation. “It is important to look at microfinance coupled with education, or coordinated with other country growth strategies or market interventions that promote a longer-term view to sustainable economic development” (Hammil et al., 2008, p. 115). In fact, as CC is multidimensional and cross-sectoral, MF will need to partner and promote synergies with other public and private institutions and programmes to forge tailored CC products and actions.

GREENING MICROFINANCE IN BRAZIL

The integration of CC with microfinance is particularly relevant to Brazil. On the one hand, being home to the ‘world's lung’, Brazil is both a prominent actor in the fight against climate change and a major victim of its adversities (see, for instance, Loisel, Graham, Goerck, & Ribeiro, 2010; Marengo, Jones, Alves, & Valverde, 2009; Marengo et al., 2010). In fact, the Amazon rainforest plays central role in the maintenance and conservation of natural ecosystems in the South American continent since it absorbs

and recycles nearly half the total rainfalls of the whole region (Chou et al., 2011, p. 11), and, as such, any alteration in that system [e.g. land use change, decreased precipitation] would impact weather patterns all over South America. At the same time, Brazil is ranked among the world's top 10 greenhouse gas emitters, particularly due to land-use change (Ge, Friedrich, & Damassa, 2014), placing the country as a central player in the fight against CC.

On the other hand, Brazil's microfinance sector has experienced a boom in the last couple of years, ignited mainly by governmental actions. The prominent role played by governmental institutions, such as development banks [e.g. Banco Nacional de Desenvolvimento Econômico e Social (BNDES [National Bank for Economic and Social Development]) and the Banco do Nordeste do Brasil (BNB [Bank of Northeast of Brazil])], is the main feature of the Brazilian microfinance ecosystem. As a whole, outstanding loans increased from some US\$27 million in 2001 to around US\$ 2.9 billion and the number of borrowers jumped from nearly 100,000 in 2001 to around 3.1 million in the last couple of years (Mix Market, 2014). Yet, with 4,96 out of 21.5 million micro-entrepreneurs still working in the informal sector and some 10 million informal microenterprises still lacking credit access in the country (Sebrae, 2010, 2013), much of the potential for microfinance to expand still remains untapped in Brazil.

When these two realms are combined, they offer an attractive and yet overlooked vehicle to deliver climate change strategies [adaptation and mitigation] to the poorest segments of Brazil's society, paving the way for a salient Brazilian green MF industry to flourish.

Impacts of climate change on Brazilian MFIS and their target

As previously discussed, the Atlas Brasileiro de Desastres Naturais (ABDN) estimates

that from 1991 to 2012 more than 120 million Brazilians have been affected by natural and climate-related disasters in the country, mainly due to drought episodes (CEPED-UFSC, 2013), although linkages between such events and climate change are not certain. In 2005, for instance, northern states in the Amazon region recorded two long-lasting droughts which inflicted several life and economic losses all over the region (Marengo & Valverde, 2007), and more recently, the State of Rondonia saw its main river, *Madeira*, reach 20 meters from a regular lower than 17 m threshold, affecting more than 12,000 people. Also, in the last decade, southern and south-eastern regions experienced flooding and drought episodes as well as the first tropical cyclone to ever make landfall in South America, causing extensive damages to local communities, agriculture, as well as cattle and dairy productivity.

In semiarid Northeast, increased frequency and intensity of droughts and associated stresses in water access will inflict major risks to the livelihood of many poor households and smallholder farmers, putting added pressure on already high levels of regional rural poverty (Painel Brasileiro de Mudanças Climáticas, 2013). In south-eastern and southern regions, higher incidence of flooding and precipitation variability, as well as extreme weather events [e.g. cyclones and storms] will bring entire low-income communities [such as the *favelas*] to their knees. This was precisely what happened in 2011 when torrential rains and landslides in mountainous towns near Rio de Janeiro killed about 300 people and left over 1,000 people homeless (Phillips, 2011). The event was considered one of Brazil's worst and deadliest natural disasters ever recorded.

Albeit it may be early to associate the water crisis in Sao Paulo with the climate change phenomenon, this event did show the extent to which even Brazil's major and

richest cities are exposed to climate-related impacts, affecting mainly poor areas.

As cyclical variations in past temperature and rainfall patterns are confirmed and intensified over the 21st century, the ever-changing climate will bring further natural and socioeconomic impacts to Brazil. Throughout the country, abrupt oscillations in seasonal temperature and precipitation distribution, as a result of expected CC, may ignite major climatic events—e.g. increased incidence of consecutive dry days, hot waves, drought, floods, as well as extreme weather events such as cyclones, typhoons, and storms—that will exacerbate the climate change burden upon Brazil's society and its rich natural biodiversity (PBMC, 2013). In addition, 40% of Brazilian coastal areas are vulnerable to an 89cm sea level rise resulting from global warming projected by the Intergovernmental Panel on Climate Change (IPCC), being the cities of Recife and Rio the most vulnerable (Muehe, 2006).

From a microfinance viewpoint, sea level rise, long-lasting droughts, flooding, extreme weather events, as well as high rainfall variability are likely to endanger the assets—such as homes, crop yields, micro-businesses, and livestock— and health of many microfinance clients throughout the country. Figure 1 depicts, on a schematic manner, how climate change and weather-related events may impact Brazilian MFIs and their target. As the Earth warms up, natural and human systems will be hit hard by changes in the climate system, in particular by an increase in intensity and recurrence of weather extremes such as droughts and floods. Among these systems are water resources, crop production, forests, coastal zones, human health, societal settlements, specially the poor ones. Albeit these systems have different levels of vulnerability to CC, thus varying from region to region and by socioeconomic and environmental setting, they are particularly sensitive to cli-

mate variations, and as such, may undergo important and irrevocable damages.

Because microfinance clients usually depend heavily on natural ecosystems and lack actions aimed at mitigating their vulnerability to CC, a reduction in quality and quantity of water sources compounded with increased incidence of vector-borne diseases and declined crop yields, for instance, would affect directly the health and eventually wealth of Brazilian MFI clients, both in rural and urban areas and in all regions. Moreover, greater stresses on natural resources in climate extreme-prone areas, such as the Northern and North-eastern regions, may lead to forced migration and perhaps impact several MFI clients in these regions.

Ultimately, if no adaptation strategy is put in place, climate change may well affect, both directly and indirectly, the portfolio of many Brazilian MFIs, particularly the smallest Brazilian MFIs, and even the government itself. As clients struggle to meet their financial obligations ahead of repeatedly and intense climatic shocks, default rates will eventually go up, bringing about liquidity problems to a number of MFIs, particularly the private-led ones, undermining then their financial sustainability. For some of Brazil's major public microfinanced programmes, even though they might not see their default rates soar abruptly, because the government will eventually step in to provide emergency loans and bailouts, this practice may fall short if extreme events occur more frequently and with more intensity over time.

The portfolio of three of the 'Big Five' Brazilian MFIs, i.e. Agroamigo, Central Cresol Baser, and Cresol Central, would be highly exposed to climate change adversities as their financing is markedly concentrated around agricultural products, i.e. one of the most weather-sensitive product types (see, for instance, Gonzalez & Moser, 2015; Moser & Gonzalez, 2015; Moser et al., 2015).

In Brazil’s microfinance hub, the North-eastern region, warmer and drier climate and associated runoff decline in the *São Francisco* basins will likely place greater stress on the livelihood of the 2.2 million clients of the two major Brazilian microfinance providers, namely Crediamigo and Agroamigo. The latter, particularly, operating in a climate-change hot spot and in financing rural activities, is exceptionally exposed to impacts arising from climate change (Moser & Gonzalez, 2015). In fact, during the 2011-2013 intense droughts, the BNB, Agroamigo’s host institution, had to reschedule maturing loans and grant an 80% debt write-off for clients living in semiarid zones, as well allocate about R\$3.5 billion [about US\$ 1.49 billion] in emergency loans to help clients cope with hazy climatic conditions and to prevent default rates from soaring abruptly. As the region heats up and becomes increasingly drier, agricultural and dairy cattle productivity is likely to decline accordingly, which exacerbates food security and livelihood concerns for several Agroamigo’s clients and their families, potentially affect-

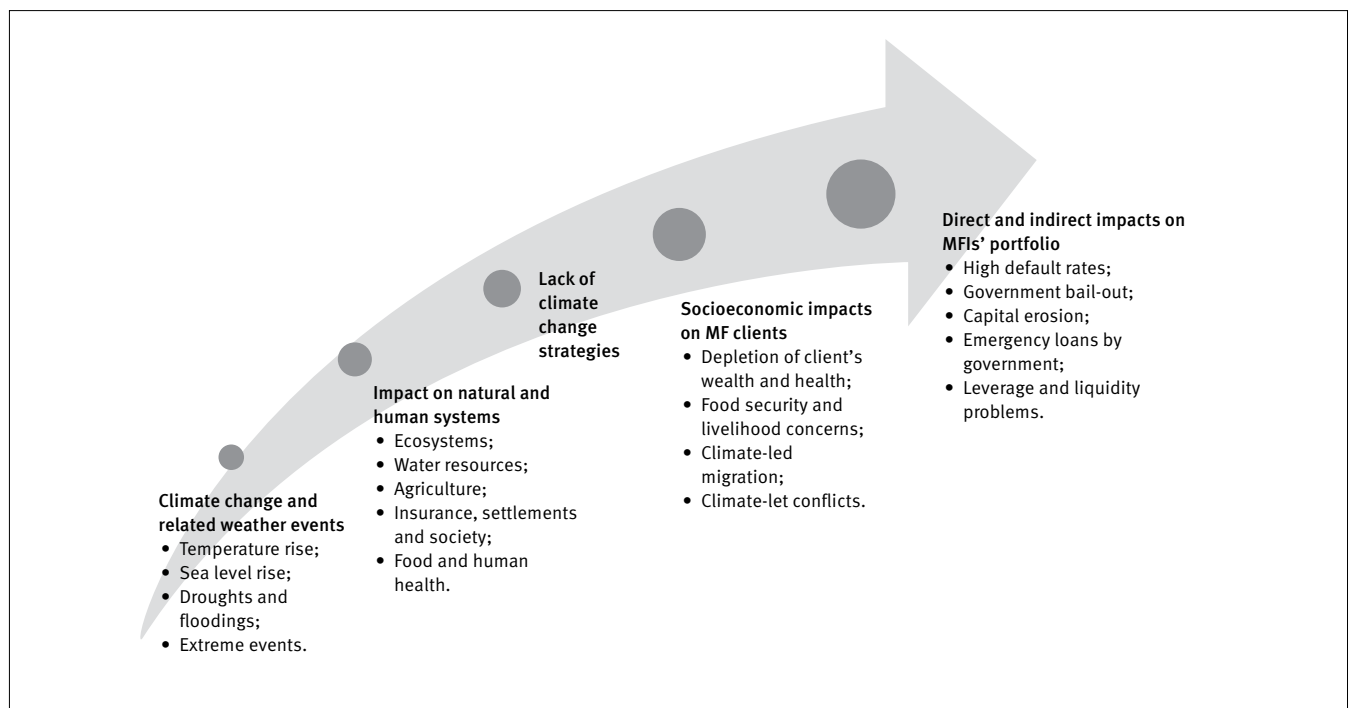
ing the Programmes’ financial sustainability pillar.

In the southern and south-eastern regions, increased incidence of heavy rains and natural disasters may directly affect the physical infrastructure—such as offices, records and information systems—owned by MFIs, as well as clients’ significant assets—e.g. homes and equipment—in particular those living in informal settlements constructed on unstable hillsides or near dump/ sewage canals. Examples of large-scale economic and life losses such as Rio de Janeiro’s 2011 landslides are but one instance of what could be like if, in the absence of adaptive measures, climate extremes become more frequent and intense in the future. From a microfinance perspective, among the victims of such drastic events there could be hundreds of Brazilian MFI borrowers.

Another two areas worth attention in terms of vulnerability to CC are the potential impacts of tides of savings withdrawals and insurance mechanisms on an MFI’s financial performance after climate shocks.

As clients deliberately turn to their micro-savings as a self-protection mechanism against weather shocks, e.g. smoothing livelihood consumption needs ahead of a weather extreme event, MFIs, which use a portion of collected deposits to increase their credit outreach, may undergo liquidity issues. Likewise, covariate risks, especially when related to family farming activities, may prove troublesome and costly for microinsurers to bear, ultimately causing insurance rationing for those who most need to be insured. However, evaluating the level of vulnerability of Brazilian MFIs to CC in these two realms needs caution. Although most recent data estimate that Brazilian MFIs have collected USD 450 million in savings, equivalent to 15% of total loan portfolio, i.e. USD 2.9 billion (Mix Market, 2015), various MFIs in the country are bound by statutory legislation that restrict savings collection by certain types of MFIs. As for microinsurance, with the exception of governmental crop insurance schemes, the sector still represents an incipient terrain for most Brazilian MFIs.

Figure 1. Potential climate change impacts on Brazilian mfis and their target



Synergies between Brazilian MFIS actions and climate change

As discussed elsewhere, Brazilian MFIs already offer important synergies with climate related actions. Under the Programa Nacional de Fortalecimento da Agricultura Familiar (Pronaf [National Programme for Strengthening Family Farming]), most of Brazilian rural microcredit institutions already provide loans directed to environmental protection projects. These are subsidised rural credit lines designed to meet environmental financing and mitigation/adaptation activities, such as renewable energy, forestry, water storage, etc., at below market interest rates to smallholder farmers. Pronaf Eco, for example, finances techniques that minimise impact of rural activities on local environment, Pronaf Agroindústria provides loans for investments in micro agro-industries, Pronaf Floresta finances tree planting and silviculture systems, and Pronaf Agroecologia finances agro-ecological production and/or organic systems.

Coupled with Pronaf's lending is the Programa de Garantia da Atividade Agropecuária (Proagro Mais [Programme for Guaranteeing Agricultural Activity]), a governmental crop insurance scheme. Proagro Mais is aimed at providing smallholder farmers with a low-cost insurance mechanism so that they can cope with basic livelihood needs after eventual harvest losses. Livestock investment loans, however, are not covered by these public insurance schemes, being limited to cover agricultural working capital/investment loan losses. In 2013, more than R\$ 190 million (approximately USD 60 million) were paid to smallholder farmers as indemnity claims (Banco Central do Brasil – BACEN, 2015).

Brazil already has several mechanisms that can help rural MFIs finance more adapted crops without increasing administration costs. Under Pronaf, for instance, Brazilian rural MFIs have free access to agricultural zoning on more adapted crops for specific

geographic areas. Also, the Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA [Brazilian Agricultural Research Corporation]) has an extensive body of study on adapted and more resilient/tolerant crops that can be accessed free of charge by Brazilian microfinance providers intended to boost targeted conditional loans.

The “Big Five” Brazilian MFIs, i.e. CrediAmigo, AgroAmigo, Central Cresol Baser, Cresol Central and Santander Microcrédito, already offer environmental education and training for clients, and credit unions and cooperatives, such as Cresol Baser and Cresol Central, already include in their pool of products Pronaf's eco-friendly credit lines. Also, the Big Five MFIs in the country already include in their product range low cost voluntary savings.

In the northeast, Agroamigo, during initial sessions with prospective clients, perform environmental training on how to best employ and practice sustainable agriculture and farming production, such as the use of organic fertilisers and on measures to limit soil degradation. Such initiatives can promote greater environmental responsibility among clients and, as such, constitute an additional and cheap tool in terms of climate change actions that can be offered by MFIs.

Some smaller MFIs, such as the case of Empresta Capital, in Sao Paulo, have been studying ways to implement and finance residential energy efficiency projects to poor households. Donor institutions have also started to implement products attached to environmental concerns, such as the case of Oikocredit, an international cooperative and social investor. More specifically, they have set up a funding programme specifically designed to finance non-GMOs farming production to smallholder farmers.

FINAL CONSIDERATIONS AND FUTURE RESEARCH

In attempting to respond our initial query, one could also reckon what microfinance,

or more broadly, inclusive finance can do to realise its linkages with CC actions. For instance, synergies between the various governmental microcredit lines – e.g. Pronaf B, the Programa Nacional de Microcrédito Produtivo Orientado (PNMPO [National Programme of Oriented Productive Microcredit]), the CRESCER [which provides microloans capped at an annual interest rate of 8% and operationalised *via* public financial institutions] and the Microcredit Programme of the BNDES – and microfinance actions could be realised and strengthened towards the promotion of a vibrant Brazilian green microfinance industry. More specifically, Pronaf's eco credit lines could be extended to benefit poor agrarian reform settlers and rural smallholder farmers living on less than USD 6,000/year, allowing a “third wave” revolution in pro-poor rural financing in Brazil to take hold. The terminology “waves” in pro-poor agricultural financing in Brazil was brought up by the director of the Banco do Nordeste (Bank of the Northeast of Brazil), as an allusion to the milestones achieved since the establishment of Pronaf – first wave – in 1996. The second wave refers to innovative microfinance methodologies that were incorporated into Pronaf's lending since the creation of Agroamigo in 2005 that contributed significantly to reduce default rates and to forge products more commensurate with clients' needs. During the first International Seminar on Green Microfinance in Brazil held in Sao Paulo, in 2015, it was discussed that a third wave in Pronaf may stem from the linkage between weather related actions, aimed at mitigating CC related impacts and enhancing the adaptive capacity of clients and MF providers, with Pronaf's lending. The government too could play a vital role in delivering environmental capacity building for microfinance providers.

In addition, the concept of Productive-Oriented Microcredit adopted by the Brazilian microfinance industry, anchored on proximity finance, offers a valuable in-

strument in the promotion of adaptation and mitigation strategies. By establishing a productive, trustful relationship with clients, and by performing regular monitoring and supervision during the entire loan term, prerogatives of such approach, Brazilian MFIs, via their credit agents, are placed in a strategic position to share knowledge and best [local] practices, and leverage information to influence customer's behaviours towards the establishment of specific adaptation and, to a lesser scope, mitigation initiatives, on a case-by-case basis. Brazilian smallest MFIs also have a major role in promoting environmental sustainability and CC actions particularly because of their ability to reach out the poorest of the poor.

Nonetheless, there remain tradeoffs to be considered in microfinance actions in terms of climate change. While microfinance seems to thrive in the provision of financial and non-financial services to the active poor, it struggles to reach the poorest of the poor, which are, after all, the most vulnerable to climate change. This is in fact a major challenge for the sector in Brazil as smaller MFIs, combined, have an outstanding loan portfolio that accounts for less than 6% of the market share, and takes up approximately 10% of total active borrowers (Mix Market, 2014). Scaling up their outreach would be of utmost importance in the delivery of CC actions to Brazil's poorest MF clients. Also, differently from other contexts, microfinance in Brazil has evolved mainly due to public stimulus and public banks, and therefore, innovation has usually emerged from the public sector, e.g. the rural microfinance methodology developed by Agroamigo. However, a more proactive role from the private sector should also be enhanced since reliance on governmental incentives to boost the sector may represent discontinuity in the delivery of MF programmes, particularly sensitive for the establishment of green programmes that run over the medium to long-terms. Recent examples of private banks downscaling their services to the poor, such as the Santand-

er Microcrédito, showed the enormous potential for this segment to enter massively the sector in Brazil, and so to promote green products and services to the poor.

Brazilian MFIs will need to weigh up the balance between short-term microfinance and developmental/livelihood needs and the long-term costlier actions needed for adaptation and mitigation (see, for instance, Hammil, Matthew, & McCarter, 2008; Rippey, 2012; Forcella, 2013). Additionally, client over-indebtedness due to recurrent emergency loans may increase the climate burden on customers, and as such, place added pressure on their adaptive ability (Hammil, Matthew, & McCarter, 2008). Besides, climate change actions at the customer and MFI/institutional level may also entail risks for MFIs' portfolio as they seek to adapt products and forge new competencies in terms of adaptation and/or mitigation (Rippey, 2012). Lastly, a climate-proof MFI would require additional skills and capacities that many MFIs, especially the smallest ones, simply lack.

Therefore, in responding to climate change, Brazilian MFIs will need to balance between costs and benefits entailed in fostering CC strategies, always bearing in mind that their actions in this new realm are certainly no panacea but may be taken into account as part of institutions' strategic planning.

Future research

This article introduced a new frontier for scholars and practitioners of microfinance and pro-poor financial services to explore. As an incipient arena, green microfinance offers new opportunities both for scholars and practitioners to deepen understanding of how the sector can have a positive effect on mitigating the plight of millions of microfinance clients suffering from weather shocks. Scholars, in particular, have much to investigate about the impact of microinsurance on alleviating climate-related losses and how it can be scaled-up to help se-

cure the poor's assets ahead of covariate risks. The same holds true for impact studies on the contribution of microsavings as potential *ex-post* coping mechanisms to weather related shocks. More specifically, shedding light on mechanisms in which MFIs can scale up savings schemes to clients, in particular to the most vulnerable, so that they can, *ex-ante*, save up money to be potentially used as a buffer in bad times, *ex-post*. Also, in the Brazilian agricultural microfinance, scholars may consider advancing research on how the rural microfinance sector can downscale their actions to embrace the environmental pillar, paving the way for the third wave in rural microfinance to unleash its potential.

In addition to these nodes, there is also the need to better develop and structure a broadly accepted theoretical framework for green microfinance. To date, only a handful of academicians have dealt with the combination of climate change and microfinance, with most studies being of a qualitative nature. Accordingly, as the sector evolves, we hope quantitative and impact studies in this field will become more attractive to scholars, helping ultimately consolidate a theoretical understanding of potential linkages between the two. Therefore, in unfolding this new, incipient, and somewhat alien field, microfinance scholars will bring further light on the opportunities and challenges for MFIs in promoting adaptation and mitigation to climate change and weather-related events.

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