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# Climate Change and its Impacts on Family Farming in the North/Northeast Regions of Brazil

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Climate change has increasingly been recognised as the main challenge facing humanity in the coming decades. The starting point of this study is the consideration of future climate change scenarios and the uncertainties they bring. First, global projections available in the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) are presented. Second, they are compared with regional scenarios (downscaling) developed by the Brazilian National Institute for Space Research (INPE), focusing on the two main IPCC scenarios (RCP 4.5 and RCP 8.5)<sup>1</sup> and the two main global models (MIROC and Hadley Centre) for the periods 2011–2040 and 2041–2070, to identify the main trends in terms of changes in temperature and precipitation for the North and Northeast regions of Brazil (more specifically, in the Amazon, Semi-arid and Cerrado biomes).

It is expected that the Centre-West region of Brazil will experience the highest increase in average temperatures over the next few decades. However, until the end of the century, there will be an expansion of this trend to the North and Northeast regions as well, mostly in the central areas of those regions. For the summer, projections estimate an increase in mean temperatures of about 3°C to 8°C in the North region and a more moderate increase of about 2°C to 6°C in the Northeast region by the end of the century.

Moreover, the north of Brazil will also experience an increase in interannual variability, with increasing differences between maximum and minimum temperatures. The North and Northeast regions should also experience more interannual variability of rainfall during the rainy season (December–February). There is a general trend in Brazil of less rainfall in the rainy season (summer), although this trend is stronger in the Southeast and Centre-West regions of the country. On the other hand, the north-eastern part of the Northeast region is expected to experience an increase in precipitation rates for the summer. The North region should also experience less rainfall during autumn, and the north of the region will also have less rainfall in winter. Overall, most of the reduction in rainfall is expected to occur in the north.

In assessing the possible climate change scenarios and related impacts on family farming across Brazil's North and Northeast regions, the main point that emerges is that smallholder farmers will have to adapt to circumstances of increasing climate variability. The challenge is both to understand, with a certain level of confidence, how the main crops of the regions are expected to be affected by climate change, and to provide recommendations on how to increase the resilience of family farming in those regions.

Despite the lack of literature and more refined studies on the topic in Brazil, the study strives to present an overview of potential climate change impacts on the production of a specific list of crops present in the North and Northeast regions. The selection of those crops takes into consideration the products that are among the most relevant for smallholder farmers in the selected regions, and the impacts on their production that are expected to have detrimental outcomes in terms of food security, mostly for poor rural communities.

Crops assessed in the Semi-arid and Cerrado biomes are: cotton, pineapple, banana, cocoa, coffee, cashew, coconut, bean, cowpea bean, manioc and corn/maize. In addition to these crops, more specifically for the Amazon region, the *açaí* berry and *cupuaçu* are also considered.

Unfortunately, the main findings are not encouraging. The areas cultivated with most of these crops will be significantly reduced in the Brazilian Northeast and North regions, leading to a significant projected loss of production. The whole area corresponding to the Northeast semi-arid region and the region of north-eastern savannas— southern Maranhão, southern Piauí and western Bahia— are expected to be hit the hardest. Soybeans and coffee might lead the losses in production. Sugar cane and manioc will suffer less than other crops (Assad et al. 2008).

Therefore, the impacts of climate change are likely to pose a big threat to food security in rural communities that rely on such crops. Nevertheless, it is important to clarify that this study attempts to assess the potential impacts of climate change on selected crops in the 'Business-as-Usual' (BAU) scenarios, which is usually the methodology employed when an assessment is made from the perspective of climate change.

Despite possible negative future scenarios for many of the crops assessed, the study indicates that, with early planning and innovative techniques, it is possible to reduce vulnerabilities and increase resilience, now and for the future.

However, before presenting the response options for family farming to the adverse impacts of climate change, including techniques and technologies, it is crucial to better understand the problems already affecting producers (through the lens of the three dimensions of sustainable development: social, economic and environmental) and which could be aggravated by changing temperatures and precipitation rates and/or extreme weather events. The study, therefore, assesses these current challenges.

Many are the problems already faced by family farmers in the Northeast and North regions of Brazil, especially those related to poverty and its effects: landholding problems; population movements, including migration to cities; fragmentation of landholdings; illiteracy; disruption of knowledge transmission; environmental degradation caused by population and poverty; monocultures or subsistence agriculture; and health problems reducing household labour supply and the capacity for food production. The current social vulnerabilities of these populations are likely to increase if the expected impacts of climate change occur in these regions. Thus, a comprehensive understanding of the main social drivers that affect the lives of family farmers is important so that actions might be taken to increase their resilience.

In addition to social problems, there are also many environmental and natural resource management problems (e.g. fragile crops; processes affecting animals, monocultures or subsistence cultures; wild plant gathering; biodiversity loss; soil degradation; pest, disease and weed manifestation; and water resources, drought, other precipitation problems and desertification) faced by family farmers in the regions with Cerrado, Semi-arid and Amazon biomes.

Understanding the biodiversity of the Semi-arid, Cerrado and Amazon biomes, including the biotic and abiotic processes that affect their biota, is the first step towards ensuring the sustainable utilisation of their resources, reducing environmental degradation and improving the quality of life of their inhabitants (INSA 2011). Realising how these biomes and the agricultural activity therein may counterbalance the negative effects of climate change on Brazilian climatic conditions, soil and management is a way to reconcile food production and the quality of the environment.

In the regions covered by this study, some economic activities (large-scale agribusiness, large-scale animal rearing, mining

activities) have gained ground at the expense of family farming, leading to issues of sustainable management (significant price increases for some agricultural crops, difficulties in accessing seed markets and trade difficulties). These negative effects could potentially be amplified in the context of climate change.

Response options are addressed in general terms for all the regions and biomes, but any specific circumstances related to the specific regions and biomes are clearly pointed out.

First, the study explores the policies and actions aimed at addressing social vulnerabilities (e.g. programmes related to combating poverty in rural areas, increasing security of land tenure, combating illiteracy, providing technical assistance, capacity-building and training, as well as ensuring healthy lives). Nevertheless, despite the efforts that have been made over the previous decade, there are still great regional disparities within the country, especially in the rural areas of the North and Northeast regions—the focus areas of this study—which exhibit the lowest Human Development Index in the country.

In the most optimistic part of this study, many strategies for adaptation to environmental and natural resource management problems are assessed, taking into account the extent to which they could increase the resilience of family farmers to the adverse effects of climate change. In this regard, adaptive response options (including other economic alternatives for the families) are explored in the study, including the feasibility of adopting agro-ecological technologies, managing practices, and other technologies that improve natural resource management in the Semi-arid, Cerrado and Amazon biomes. Options are considered in such a way as to combine the adaptation and mitigation aspects of the assessed activities.

One important conclusion is that, through agro-ecological and other sustainable approaches to agriculture (e.g. multiple cropping and polyculture systems; agroforestry systems; home gardening; wild plant gathering; use of local genetic diversity; soil enhancement, including organic matter; preventing pest, disease and weed manifestation; genetic improvement; managing water; drought-tolerant plants; biomass-producing plants; and others), smallholder and small-scale family farmers could play an important role in offsetting certain elements of the present environmental crisis, as well as those related to the future threat of climate change. These approaches commonly involve the maintenance or enhancement of biodiversity, and represent a viable long-term strategy to improve agro-ecosystem resilience to the effects of climate change.

As stated by the Food and Agriculture Organization of the United Nations (FAO), the main challenge to achieving widespread agro-ecological approaches is not technical but, rather, political. It involves the need to overcome the political, economic and ideological power of agribusiness and governments driving the continued expansion of the industrial farming model. Family farming holds the promise of developing productive, sustainable, responsive, innovative and dynamic agricultural systems and contributing to resolving the food, finance, fuel and climate crises prevailing in the world today (FAO 2014).

One particularly noteworthy conclusion of this study is that family farming in Brazil is responsible for producing most of the food consumed domestically. Thus, it is fundamental that producers increase their resilience to adverse effects of climate change, whether through economic instruments (e.g. food security instruments, innovative financing, labelling, enhancement of social work, adding value to products, among others) or the diffusion of new technologies and programmes (e.g. genetic improvement, biomass-producing plants etc.) in the private and public sectors. To this end, the adoption of policies to address market failures is fundamental.

Regarding existing institutions and public policies in the context of climate change in Brazil, the space for discussion of issues related to agriculture is quite limited. As far as family farming is concerned, such a space is marginal or virtually non-existent. A recently observed significant increase in the share of greenhouse gas emissions in Brazil attributable to agricultural activities may result in the adoption of new or the refinement of existing public policies to address issues related to agricultural activities in the context of climate change. Nevertheless, if this scenario is in fact verified, it is likely to pertain to issues related to commercial farming, especially as far as mitigation aspects are concerned.

It has yet to be seen how (and if) the special context of family farming will be reflected in public policies and programmes, especially if adaptation is to be taken into consideration. Thus, for the interests of the sector to be reflected in such potential policies and regulations—including the mobilisation of funding—increased awareness and participation of the sectoral stakeholders are fundamental.

Another main conclusion that can be drawn from the study is that there is a significant lack of literature regarding

family farming and climate change, not only at the national but also at the global level. One significant example is the fact that the latest IPCC report—the most comprehensive literature review on climate change, from its groups on vulnerability and adaptation (Working Group (WG) II) and mitigation (WG III)—includes very few references to family farming production. Usually, literature regarding climate change and agriculture addresses the impacts of changes in temperature and precipitation on agricultural commodities.

Furthermore, this lack of literature in Brazil regarding agriculture in the Semi-arid and Amazon regions seems to be a result of this focus, given that most of the agricultural commodities are produced in the country's South, Southeast and Centre-West regions. When the impacts of climate change are added to the equation, the available material becomes truly scarce.

Beyond agribusinesses and the export of food products, national and international communities must realise that there are millions of people living off the revenues generated by family farming or exclusively through subsistence agriculture. They are the true mechanism of development.

Thus, investment in people is fundamental. Not only investment in infrastructure or energy where investment could generate profits but, rather, investing precisely where people who do not have infrastructure and energy live. If inequality in the world is to be reduced, national and international communities need to invest in people who live in rural areas—who happen to be the poorest and most vulnerable—and who will also be disproportionately affected by climate change.



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## Note:

1. For the IPCC's Fifth Assessment Report, AR5 (2013), the scientific community has defined a set of four new scenarios, denoted Representative Concentration Pathways (RCPs). For more information, see: <<https://www.ipcc.ch/report/ar5/>>.

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