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Indicators for Assessing the Vulnerability of Smallholder Farming to Climate Change: the Case of Brazil's Semi-Arid Northeastern Region

by Diego Pereira Lindoso and Juliana Dalboni Rocha,* Nathan Debortoli,** Izabel Cavalcanti I. Parente and Flávio Eiró,*** Marcel Bursztyn and Saulo Rodrigues Filho****

Political uncertainties about the global capacity to keep greenhouse gases within safe concentration limits along with new evidence from science showing that some degree of climate change is unavoidable have drawn international attention to the urgency of considering adaptation measures as important as mitigation actions. As a result, many efforts have been made to provide decision-makers with integrated systems of vulnerability assessment that can guide policy action towards mainstreaming adaptation on the governmental development agenda.

In Brazil the semi-arid region in particular is a climate vulnerability hotspot. It is historically known for the socio-economic setbacks and agricultural failures caused by dry spells and severe droughts associated with deficits in political-institutional capacities. In this context, Lindoso et al. (2011) propose and discuss a set of indicators to assess the vulnerability of smallholder agriculture in Brazil to drought. As a case study, the State of Ceará and seven of its municipalities located in the Brazilian semi-arid micro-region of Quixeramobim (MRSQ) were selected to apply the system of indicators. The system was based on the concept of vulnerability, which is a function of three attributes: *sensitivity*, *exposure* and *adaptive capacity*. The proposal has the goal of developing a vulnerability assessment tool with the following characteristics: simple, easily handled by the decision-makers on different scales and at the same time, and sufficiently representative of reality.

Relevant socio-economic, institutional and climate indicators were identified and distributed among the three attributes of vulnerability (see Table). The results point to the heterogeneity of vulnerabilities among the spatial scales analysed and that, in addition to the climate determinants, smallholder farming's vulnerability is also influenced by socio-economic and political-institutional drivers.

Building adaptive capacity by improving socio-economic conditions and strengthening formal and informal institutions is one key strategy in reducing local vulnerabilities. Brazil already has a political-institutional framework that is ready to support smallholder farmers to adapt to climate change. The challenge is to understand the local reality in a transverse and multidimensional manner, articulating institutions and policy instruments that are currently harboured in different spheres of government. Another challenge is to form and strengthen research and innovation networks.

In this sense, an important element is the promotion of dialogue between institutions and researchers that work on related topics, aiming at complementarity of studies and research, as well as further collective advances by sharing experiences and results.

Indicators of the Three Attributes of Vulnerability of Smallholder Farming

	Attribute of Vulnerability	Indicator
Vulnerability of smallholder farming	Sensitivity (S)	Dependency of smallholder farm income on the crop and animal production (%)
		Municipal population occupied in smallholder agriculture (%)
		Establishments with access to water (%)
		Establishments with rainfed farming (%)
	Adaptive capacity (AC)	Smallholder system product diversification (%)
		Establishments in which the producer is the landowner (%)
		Establishments in which the administrator can read and write (%)
		Establishments in which the producer is a member of an association or union (%)
		Establishments that receive technical assistance (%)
	Exposure (E)	Aridity Index (AI)
Annual distribution of rainfall		

Source: IBGE (SIDRA) and FUNCEME, 2011.

Notes:

- * PhD at the Center for Sustainable Development at the University of Brasilia (UnB).
- ** Postdoctoral fellow at the Center for Sustainable Development at UnB.
- *** Master's student at the Center for Sustainable Development at UnB.
- **** Professor at the Center for Sustainable Development at UnB.

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