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Landraces as an adaptation strategy to climate change for smallholders in Santa Catarina, Southern Brazil

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ABSTRACT

Adapting to climate change has become a pressing and urgent issue given the alarming rapidity with which climate changes is taking place. Agriculture is strongly conditioned by climatic factors, but subsistence agriculture is particularly vulnerable because smallholders do not have adequate financial resources to adapt to climate change. Agrobiodiversity provides one option for smallholders to adapt to climate change. Landraces developed in the western region of Santa Catarina State, Brazil, are part of a deliberate strategy by smallholders to achieve a state of food sovereignty and independence from commercial sources of hybrid seed. The ability of smallholders to collectively conserve climate-adapted landraces indicates the depth of local knowledge and capability within local communities that can be drawn on to meet the future challenges of climate change.

Introduction

Changes in climate have promoted and motivated cultural transformations in different periods of evolutionary history. Evidence of these changes has been observed in agriculture because it is strongly conditioned by climatic factors (Fagan, 2009). Individuals and societies dependent on agriculture have been vulnerable to climatic hazards and extreme events, and this vulnerability can act as a driver for adaptive resource management (Adger, 2003).

Adaptation is an essential response option worthy of research and assessment in order to reduce the vulnerability of people to the impacts of climate change and to minimize the costs associated with these impacts (Grothmann and Patt, 2005). This is especially so given expected future changes in climate (IPCC, 2007).

The uncertainty surrounding anthropogenic climate change has led to controversy over the magnitude of its potential impacts. This uncertainty is of little practical consequence when it comes to the survival of communities who are vulnerable to extreme events whether they originate from natural climate variability or longer term climate change (Bonatti, 2011). Extreme weather events have caused losses in many places in the world and predictions of their increasing frequency have raised the importance of adaptation in agriculture as a scientific and political issue (Otto-Banaszak et al., 2011). This uncertainty can be proactively management through robust adaptation strategies that preserve flexibility to respond to diverse future climate conditions (Lempert and Collins, 2007).

Agricultural production remains the primary focus of livelihoods for most rural communities, particularly in developing countries. Predictions of significant climate variability and change mean that adaptation is fundamental to protecting the livelihoods and food security of vulnerable communities (Bryan et al., 2009). It is generally assumed that subsistence agriculture practiced by smallholders is particularly vulnerable to climate change because they lack the financial resources to cope or adapt their production systems (Glantz et al., 2009; FAO, 2011).

One mediating factor to this general perception is that the farming practices of smallholders are characterized by the cultivation of a wide diversity of crops. This agrobiodiversity remains an important raw material for adapting agroecosystems to cope with climate change, because it provides germplasm from which plant breeders and farmers can select resilient and climate ready traits (Ortiz, 2011). Landraces not only tend to have high levels of genetic variation, but that variation is already tightly coupled with the environmental variation presented in a region (Mercer et al., 2012). Despite this potential, agrobiodiversity has rarely been considered as a source of strategies to cope with the impacts of a changing climate (Pautasso et al., 2012).

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Recent research shows that many smallholders around the world cope with and prepare for climate change by minimizing crop failure through the increased use of drought tolerant local crop varieties, water harvesting, mixed cropping production systems, agroforestry, soil conservation practices, and the adoption of a range of other traditional farming techniques (Altieri, 2009). Observations of agricultural performance after extreme climatic events in the last two decades have revealed that resilience to climate disasters is closely linked to the level of agrobiodiversity (Altieri et al., 2012).

Agriculture in the southern Brazilian State of Santa Catarina is based on smallholder production. According to IBGE (2006), 87% of farm in the region have been managed by family holders for generations. The western region of Santa Catarina has been under severe pressure from extreme weather events, mainly from increasingly frequent and intense droughts and rainfall extremes. This combination of smallholder farming and climate extremes is contributing to an increase in the vulnerability of agricultural production systems to climate change in the region (Bonatti, 2011).

One response to this vulnerability in western region of Santa Catarina has been the use of landraces by smallholders to maintain low but stable levels of agricultural production despite the growing impact of climate extremes. This paper presents two case studies[1] carried out in the municipalities of Anchieta and Guaraciaba to investigate the use of landraces by smallholders as part of their evolving adaptive agroecosystem to cope with extreme climate events.

The purpose of the research is to document the history and reasons why landraces have been adopted as a climate adaptation strategy by smallholders in this region with a view to informing future participatory interventions of this kind.

The municipalities of Anchieta and Guaraciaba

The case studies were carried out in the municipalities of Anchieta (26°33′ S and 53°18′ W) and Guaraciaba (26°33′ S and 53°33′ W) (EMBRAPA, 2004) in the western region of Santa Catarina State, Brazil (Fig. 1). These municipalities have populations of 6587 and 10,604, respectively, most living in rural areas (IBGE, 2010). The average farm size is 30 ha, utilized mainly for subsistence crops including maize, soybean, wheat and cassava (data available at www.sidra.ibge.gov.br. Last access: July 25, 2012).

According to the Köppen climate classification, the climate is Cfa subtropical temperate, humid, and mesothermal with warm rainy summers. The annual average temperature is 18 °C, with the occurrence of frosts as well as temperatures up to 33 °C (Canci et al., 2004). An intensification of extreme weather events has been observed in the region, and the first tornado recorded in Brazil occurred in Guaraciaba in 2004 (Pezza and Simmonds, 2005). Adverse climatic conditions, such as decreases in average precipitation, more frequent intense precipitation and increases in extreme temperatures have impacted this region in recent decades (INPE, 2009). An increased frequency of droughts, heat waves, torrential rains and thunderstorms is threatening the region with more frequent heat stress, scarcity of drinking water, decrease driver flows, and increased flooding that damage agricultural production and rural properties (Mattedi et al., 2009).

The vulnerability of agriculture in Anchieta and Guaraciaba to extreme climatic events has been exacerbated by the social and economic constraints facing these municipalities (Bonatti, 2011). These constraints include the small area of farms, a reliance on family labor, low levels of agricultural mechanization and limited financial resources. Subsistence agricultural production is an essential element of food security for most household, since limited opportunities for wage earning restrict their capacity to purchase food.

Faced with this growing vulnerability, smallholders across these municipalities have learned from experience that agricultural production can be maintained using the landraces identified over successive generations as tolerant of climate extremes, especially drought. Observation of this local knowledge motivated the development programs by the Rural Extension Service and Research Corporation of Santa Catarina State (EPAGRI) and Federal University of Santa Catarina (UFSC) to conserve landraces in the municipalities of Anchieta and Guaraciaba.

In Anchieta, a local on-farm maize breeding program was started by EPAGRI and UFSC in 1996 based on landraces sown in the area for more than 30 years. In Guaraciaba, a similar program for conserving landraces started in 2005 in response to growing concern over the falling number of smallholders using landraces on their farms. At the time, the smallholders cultivated and maintained 34 main species of landraces for their own consumption with considerable intra-species diversity totaling more than 200 local varieties (clones) (Canci et al., 2004). The landraces produced in Anchieta and in Guaraciaba result from the selection and breeding of plants more adapted to local soil and climate conditions. These varieties have never been sown on a large commercial scale (Canci et al., 2004).

Method

Semi-structured key informant interviews were conducted with smallholders in the municipalities of Anchieta and Guaraciaba who cultivate landraces on their farms and with agricultural technicians from EPAGRI who assist those smallholders. We took the approach to this interview technique of Sautu (2005), who described it as “a systematic conversation that aims to obtain, to retrieve and to record everyday life experiences of farmers or their concepts”.

The interviews focused on three main aspects of agriculture in these municipalities: (1) features of current local climate, (2) intensification of extreme climate events, and (3) strategies adopted by smallholders to adapt to climate adversities. The interviews were audio taped with the permission of the interviewees, without noting their names. Each interview was divided into three parts: (a) introduction, (b) general questions about the local climate (variability and change) and its influence on agricultural production, and (c) the history of landrace cultivation, and important events associated with it. The average duration of each interview was 45 min.

Two parameters set the number of respondents: (a) the proportion of families in each community that cultivate landraces (50% in Anchieta and 30% in Guaraciaba); and (b) the number of answers obtained through the interviews that were necessary to identify patterns in meaning, symbolic systems, codes, values, attitudes and ideas. The interviews were discontinued once nine families and two agricultural technicians had been interviewed in Anchieta and after ten families and two agricultural technicians had been interviewed in Guaraciaba. The interviewees aged between 30 and 70 years old, with an average of 45 years old, and all interviewed smallholders owned their properties.

For both sets of interviews, data were analyzed by: (a) transcribing the responses and identifying key words emerging in the dialog; (b) diagnosing apparent contradictions, recurrent statements; (c) examining and cross-referencing rhetorical statements and subtle detail (silence, doubt and hesitation); and (d) comparing responses between the municipalities of Anchieta and Guaraciaba.

[1] These case studies were part of the CLARIS LPB Project (“A Europe South America Network for Climate Change Assessment and Impact Studies” from the European Community's Seventh Framework Program – FP7/2007-2013) that aimed at predicting the regional climate change impacts on La Plata Basin, in South America.