Vice Presidency of Sectors and Knowledge
Research Department

Agriculture and Adaptation to Climate Change: The Role of Insurance and Technology Dissemination in Risk Management

(RG-K1219)

1. Background and Justification

Climate change (CC) has a variety of consequences relevant to agricultural production and rural development, including but not necessarily limited to the following:

- Decreasing agricultural productivity that will affect food security, export revenues and rural poverty.
- Changes in water quality, quantity and availability affecting agriculture and human consumption.
- Gradual replacement of tropical forest by savanna, a process eventually ending in desertification.

Although these effects have previously been the subject of economic study for the Latin American and Caribbean (LAC) region, each of these diverse areas calls for relevant analysis, and policy initiatives at the microeconomic level have not been extensively studied.

ECLAC and several countries have produced general appraisals of these issues, assessing agriculture's vulnerability to CC as well as estimating the economic costs of CC. A review of the existing literature suggests that exploration of the following topics is needed: i) risk management and agricultural insurance, ii) technological change and dissemination at the producer level, iii) land use change and CC, iv) rural poverty and v) food insecurity. The former two topics are particularly good candidates for research; the latter three have already been studied and/or their potential impact in the case of LAC remains uncertain.

Risk represents a particularly important aspect of agricultural production, which typically cannot be effectively hedged using only exchange-traded futures and options that cover for price risk but are unable to cover for production risk. Agricultural production risks, moreover, are generally not perfectly spatially independent, therefore, insurance markets do not work properly (i.e., positive spatial correlation in losses limits the risk reduction capacity obtained by pooling risks from different geographical areas). Another well-known problem is the existence of asymmetric information, since farmers may be better informed than other actors about their probability of distribution of losses. It is further widely recognized that changes in temperature will seriously affect crop yields and the availability of water for irrigation. In the latter case, the majority of LAC countries depend on rainfall for agricultural production. Thus, increases in intensity and variability of rainfall will result in flooding and drought, in turn leading to soil degradation. This situation poses new and difficult challenges to the design of policies and instruments to achieve effective ***risk management***.

As a vulnerable sector, agriculture must enhance its disaster risk management both at the macro/State and micro/producer levels. This creates a need for risk protection through insurance

that provides producers with coverage against catastrophic events. Since developing countries' markets for agricultural insurance are incomplete and exhibit deficient operation, CC adds a new dimension to an already complex and unsolved problem. Developing countries have nonetheless had positive experiences. Examples include India and, in LAC, Nicaragua and Mexico. In addition, Argentina has developed a market for hail insurance, and Galetto, Gastaldi and Lema (2009) have examined weather index insurance in the case of milk production. The full range of alternatives involving market solutions, individual or regional[1] instruments and the need for State coordination/intervention under certain circumstances has yet to be discussed. The same can be said regarding which products should be covered and what types of insurance should be provided. CC obviously aggravates the situation. With these considerations in mind, the following questions are relevant:

- Which kinds of presently available insurance instruments can be adapted to CC, and which kinds of new insurance instruments must be developed?
- What are the market conditions for the launch or further development of the market, and what is the State's role in this process?
- What is the profile of producers' demand? What instrument design will incentivize dissemination of insurance (or weather derivatives), and under what cost conditions will they do so?

Technological adaptation (and complementary no-regret mitigation) in livestock management, fertilizer use and farming methods have evolved in most LAC countries following market innovations. New technologies, however, might not be fully aligned with social demand for CC adaptation. Moreover, the workings of the technological markets for agriculture in the region have not been fully explored. Conflicts due to property rights involving new seeds and incomplete knowledge of the long-term consequences of certain agrochemicals represent only two prominent examples where incomplete markets, State failures and uncertain results provide a very complex scenario. Traditionally, agricultural extension services have played a role in the technological market through best practice dissemination, and they might also prove very useful in the present stage of adaptation to Climate Change. However, many LAC countries lack the necessary public and private investments in technology dissemination, and the traditional practice of agricultural extension, which proved extremely useful in the past, has recently been under scrutiny. Anderson and Feder (2003), for instance, analyze the complex set of factors and intra-agency incentives that explain why different extension systems' performance varies. Accordingly, the authors provide a conceptual framework outlining farmers' demand for information, the welfare economic characteristics of extension services, and the organizational and political attributes that govern the performance of extension systems under the modalities of "Training and Visit" extension, decentralized systems, "Fee-for-Service" and privatized extension, and Farmer Field Schools. The types of questions to be answered in this context are the following:

- How is agricultural technological dissemination organized? To what degree is CC awareness being transmitted to producers?
- What is the role of private/public institutions in technical dissemination, and how is producer demand for technical change under CC evaluated?

[1] The Caribbean implemented the CCRIF, a type of insurance for catastrophes shared by that region's countries as a whole.

- Do the countries under study have experience with alternative models of extension? If so, what are the costs and benefits of each in relation to the new demands imposed by CC?

Finally, in regard to the remaining subjects mentioned in our initial list, one extensively studied topic is the relationship between ***land use change and Climate Change***. Dale (1997) points out that change in land use is related to climate change as both a causal factor and a major way in which the effects of climate change are expressed. As a causal factor, land use influences the flow of mass and energy, and as land-cover patterns change, these flows are altered. Projected CC will produce changes in land-cover patterns at a variety of temporal and spatial scales, although human uses of land are expected to override many effects.

Along these lines, Mendelsohn and Seo present in a group of three papers a rigorous analysis of land use choice at the microeconomic level. Mendelsohn and Seo (2007a) first explore how Latin American farmers adapt to climate by changing crops. They develop a multinomial choice model of farmer's choice of crops. Estimating the model across more than 2,000 farmers in seven countries, they find that both temperature and precipitation affect the crops that Latin American farmers choose. For instance, farmers choose fruits and vegetables in warmer locations and wheat and potatoes in cooler locations. They conclude that global warming will cause Latin American farmers to switch away from some crops towards those best adapted to the effects of CC.

In a second paper, Mendelsohn and Seo (2007b) extend the analysis of the multinomial choice model to Latin American livestock producers. Estimating the model across more than 1,200 livestock farmers in seven countries, they find that both temperature and precipitation affect the species chosen, and they conclude that CC will cause farmers to switch to beef cattle at the expense of dairy cattle.

Finally, Mendelsohn and Seo (2007c) address irrigation decisions, estimating a model of a farm that treats the choice of crops, livestock, and irrigation as endogenous. The model is composed of a multinomial choice of farm type, a binomial choice of irrigation, and a set of conditional land value functions. The model is estimated across more than 2,000 farmers in Latin America. The results quantify how farmers adapt their choice of farm type and irrigation to their local climate.

It should be noted, however, that these analyses do not include price effects, and that switching decisions are assumed to be feasible and costless.

Moreover, what is true for average farmers may mean a very different outcome in ***the case of the rural poor and Climate Change.*** In fact, they may have limited adaptation choices at the same time that they are particularly vulnerable to agricultural disruptions and lack access to improved technologies such as drought-resistant livestock and seed varieties or crop insurance. In this case the difficulties involved in implementing climate change adaptation suggest the need to complement CC policy initiatives with actions to reduce social vulnerability.[2] For instance, ***food insecurity*** might be a source of vulnerability for the rural poor in LAC, but a limited focus on this hazard might ignore interactions among multiple dimensions of the problem, thus reducing policy effectiveness. One instrument often mentioned when discussing the solutions for the rural poor is the ***availability of microfinance***. Agrawala and Carraro (2010) make the case of microfinance for

[2] Eakin et al. (2010) identify three distinct influential approaches to climate policy are emerging in the climate change literature: implementing climate change adaptation, reducing social vulnerability, and managing ecosystem resilience.

the rural poor in Bangladesh and Nepal, where microfinance has a long tradition. The case of LAC could be interesting in this regard, but in most LAC countries microfinance has not yet spread beyond certain (mostly urban) areas, effectively limiting the potential importance of microfinance in the rural sector.

2. Objectives

The objective of this project is to increase knowledge on the effects of climate change on agricultural production and the role of alternative instruments for risk management, particularly insurance and technology diffusion, in LAC countries.

3. Scope and Methodology

Since agricultural problems resulting from climate change are not well expressed by political borders, considering contiguous regions of more than one country may be desirable. Policies and institutions underlying insurance markets or extension services, however, depend on each country's definitions. Additionally, the inclusion of too many cases might not permit detailed and rigorous treatment. Thus, a possible trade-off may be the inclusion of a few similar cases. For example, a study might encompass two or three countries (or comparable sub-regions) and one or two agricultural sub-sectors, such as cattle, milk, or selected crops. Ideally, lessons for one country could be drawn from the experience of the others.

Studies should have a clear theoretical framework, outlined in the proposal, and use data from LAC to motivate the analysis. The studies should include an empirical section that advances a rigorous measurement of some of the aspects involved in the analysis. Econometric testing is welcome but not necessary. Cost-benefit analysis of interventions or policies, either using a calibrated version of a model or through econometric analysis, is desirable.

The collection of new data for at least a regional/sector case at the producer level or the compilation of recent available data for these new purposes is encouraged.

4. Selection Criteria

Either research institutions or individual researchers may present proposals for this project. The IDB is looking to produce up to three (3) studies and will contribute up to **US$20,000** for each study, depending on the scope of the work proposed. An additional **US$10,000** may be available for specific data collection efforts for one or more papers, though the proposal should clearly distinguish between the study and data collection products. Researchers may therefore present two proposals: one with the data collection and one without it. The final number of proposals accepted will depend on the quality and the proposed budget of the proposals received. We strongly encourage researchers to present proposals covering more than one country. Projects that cover one topic in several countries are preferred over single-country studies covering several topics.

Proposals should include a detailed background section and literature review, sources of data to be used.

Final papers will be considered for dissemination as IDB working papers and may be included in a book.

5. Proposal Registration

Research institutions and individual researchers interested in submitting a proposal should pre-register before **July 11, 2011** by **clicking here**. If unable to pre-register before the due date for proposals, please send an email to red@iadb.org. Proposals are due **August 1, 2011:**

Proposals should be submitted using the **Web Submission Form**. **Please note that there are two options within the submission form: one for institutions and another for individual researchers. Please make sure to choose appropriately.**

The following information will be required for submitting your proposal:

- The proposal with all the technical aspects and methodology proposed involved in the development of the study, based on the Terms of Reference outlined in this Call for Proposals.
- A budget indicating the time and resources that will be used within the context of the research work plan. **The proposal and corresponding budget *must* be sent in separate files.** The budget proposed should disaggregate items financed by the IDB contribution and those financed by the research institution or by the team of individual researchers. The budget should distinguish among amounts assigned to professional honoraria, "overhead" and other major categories of research expenditures.
- The name and *Curricula vitae* (three pages maximum per researcher) of the research leader and other researchers involved. The research team should demonstrate its ability to meet the objectives of the project, including relevant experience. Please note that for proposals submitted by institutions, subsequent substitutions for researchers originally specified in the proposal may be made with prior approval from the project coordinators, but the research leader (of each subject) should lead the entire project until its full completion.
- Institutions must provide the name and contact information of its legal representative, with authority to sign contracts with the IDB, if selected to conduct the study.

Note: ALL proposals and research papers must be submitted in English.

6. Coordination and Schedule

The project will be administered by the Research Department (RES) under the technical coordination of Sebastián Miller. Omar Chisari (Instituto de Economía UADE) and Sebastián Galiani (Washington University in Saint Louis) will serve as External Advisors for the project.

The tentative schedule of activities is as follows:

- **July 11, 2011:** Due date for **pre-registration** (**click here**)
- **August 1, 2011:** Due date for **receiving proposals.** Institutions and researchers should ensure that complete documentation is submitted through the **Web Submission Form.**
- **August 8, 2011:** Announcement of **selected research proposals**.
- **September 26, 2011:** Due date for receiving a **first draft** of research papers.
- N**ovember 15, 2011:** Due date for receiving a **second draft** of research papers.
- **December 15, 2011:** Deadline for a **final version of the research papers,** including a summary that discusses policy lessons and delivery of the datasets utilized by the study to the IDB.
- **December 30, 2011:** Deadline for receiving an **edited version** of the research papers, following the guidelines of the Bank's Publications Protocol, for publication as a Working Paper.

7. Financial Contribution

The IDB will contribute up to **US$20,000** for each study, depending on the scope of the work proposed. An additional **US$10,000** may be available for specific data collection efforts for one or more papers, though the proposal should clearly distinguish between both products.

The payment schedule is as follows:

- 35 percent within 30 days of signing the formal agreement between the IDB and the respective research center or researchers.
- 15 percent within 30 days of presenting and approving the first draft of the research paper.
- 15 percent within 30 days of presenting and approving the second draft of the research paper.
- 35 percent upon approval by the Bank of the final research paper and upon delivery of the datasets utilized by the study to the IDB.

8. References

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