

# Promoting Adoption of Improved Production Technologies among Smallholders in Ghana via Coupled Credit and Index Insurance Contracts

A Research Project Proposal Submitted to the  
BASIS Assets and Market Access Research Program:  
Building Resilience and Assets for Food Security

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## **Abstract**

The Ohio State University and the African Center for Economic Transformation, in collaboration with the University of Ghana, propose to undertake a three-year program of research, outreach, and education designed to promote the adoption of improved production practices among Ghanaian smallholders. OSU/ACET is committed to rigorously testing through randomized control trials and other relevant methods the hypotheses that coupling index insurance with production loans that require any indemnity payment to be first applied to outstanding loans will reduce the impact of widespread agricultural loan defaults on lenders during adverse systemic natural events, thereby allowing lenders to expand access to credit among smallholders and reduce the interest rates they charge on agricultural production loans. OSU/ACET will use as its laboratory the index insurance initiatives being introduced by the Ghana Agricultural Insurance Programme (GAIP), an organization of 19 Ghanaian insurance companies whose primary mission is to assist members in creating, designing, rating and implementing crop insurance products in Ghana. OSU/ACET will build capacity in Ghana through extensive outreach aimed at agricultural insurers, agricultural lenders, value chain participants, farmer groups, and agricultural policymakers and through educational initiatives involving the University of Ghana's PhD program in Applied Agricultural Economics and Policy.

# Project Description

## *Introduction*

The Ohio State University (OSU) and the African Center for Economic Transformation (ACET), in collaboration with the University of Ghana (UofG), are pleased to submit this research proposal to the BASIS Assets and Market Access Research Program in Building Resilience and Assets for Food Security. We are requesting \$811,085 of support to finance a three-year project.

Our plans call for research, outreach, and capacity building in Ghana, a US Agency for International Development (USAID) Feed-the-Future country, on issues listed predominantly under Theme 3 of the proposal solicitation, “Addressing Barriers to Technology Adoption”. These issues include: mitigating the risk confronting small-scale farmers; developing financial mechanisms to allow credit-constrained farmers to adopt improved technology; examining different technology adoption barriers; and evaluating interventions designed to address multiple constraints in a complementary way.

OSU/ACET is committed to rigorously testing financial technologies that promote the adoption of improved production practices among smallholders by using rainfall or area-yield index insurance to manage the default risk associated with agricultural production loans. Our primary hypotheses are that 1) exposure of lenders to the risk of widespread loan defaults due to recurring droughts, floods, and other adverse systemic natural events reduce the availability of agricultural credit and either raise the interest rates charged on agricultural production loans or lead to more restrictive non-interest credit rationing, thereby undermining the adoption of improved, investment-intensive technologies among smallholders; and 2) index insurance,

properly designed and integrated into lender credit portfolio management and loan policies, can reduce the risk of widespread agricultural loan defaults (or their impact on lender losses) during adverse systemic natural events, thereby allowing lenders to expand access to credit among smallholders and reduce the interest rates they charge on agricultural production loans, promoting broad-based adoption of improved production technologies among smallholders.

The effort will be led by established applied economics researchers from The Ohio State University Department of Agricultural, Environmental, and Development Economics. Mario J. Miranda, Andersons Professor of Finance and Risk Management, will serve as Lead Principal Investigator and will work closely with Associate Professor Abdoul G. Sam and Professor Emeritus Claudio Gonzalez-Vega. OSU researchers will also work closely with Assistant Professor Patricia Toledo of sister Ohio University.

OSU's African partner will be the African Center for Economic Transformation, of Accra, Ghana, whose principals include Yaw Ansu, Chief Economist; Nicolas Depetris Chauvin, Senior Advisor; and Francis Muamba Mulangu, Agricultural Economist. ACET is an internationally recognized economic policy institute devoted to the long-term economic transformation of African economies, with an established record of high quality applied economics research and substantive impact outreach to African citizens and policy makers. ACET will provide management for the implementation of the project in Ghana.

OSU/ACET will also work closely with the University of Ghana, particularly Professors Ramatu Mahama, Irene Egyir, and John Kuwornu of the Department of Agricultural Economics and Agribusiness, and Felix Ankomah Asange, Director of the Institute for Statistical, Social and Economic Research. Our project is committed to building research capacity at the University, including inter-university scholar and students exchanges, teaching by OSU faculty in the University

of Ghana's PhD program in Applied Agricultural Economics and Policy, and direct involvement of University of Ghana faculty and doctoral students in project-related research.

OSU/ACET research efforts will receive logistical support from the Ghana Agricultural Insurance Programme (GAIP), an organization of 19 Ghanaian insurance companies whose formation was facilitated by the German Agency for International Cooperation (GIZ) Insurance Products for the Adaptation to Climate Change (IPACC) initiative. GAIP's primary mission is to assist members in creating, designing, rating and marketing index insurance products in Ghana. GAIP launched a rainfall deficit index insurance product in 2011 and has plans to introduce area-yield index insurance in 2013. OSU/ACET will use GAIP's multiple index insurance initiatives as laboratories for assessing the impact of index insurance on Ghanaian smallholders and for the development and testing of new lending technologies that employ index insurance to manage the systemic credit risk faced by institutional lenders.

## ***Background***

Technological improvements in the agricultural sector are one of the most important pathways for reducing rural poverty in developing agrarian economies such as those in Sub-Saharan Africa (Bourdillon et al., 2002; Mendola, 2007; Kijima et al., 2008; Kassie et al., 2011). For many of these countries, agriculture provides the leading source of employment and contributes large fractions of the national income. In Ghana, agriculture is the most important sector of the economy, contributing about 40% of the Gross Domestic Product and employing 60% of the labor force (Breisinger et al., 2011; IFPRI, 2012). These figures suggest a comparatively low productivity of labor in agriculture and, therefore, a broad scope for improving rural standards of living through the adoption of productivity-enhancing technologies. Numerous studies have reported that adoption of improved agricultural technologies enhances household well-being in developing

countries (Bourdillon et al., 2002 in Zimbabwe; Mendola, 2007 in Bangladesh; and Kassie et al., 2011 in Uganda). However, sustainable livelihood impacts of improved production technologies in many Sub-Saharan African countries are hampered by low rates of adoption (Tripp and Rohrbach, 2001). For instance, an average farmer in Sub-Saharan Africa applies only about 8 kg of fertilizer per hectare, compared to 101 kg per hectare in South Asia and over 145 kg per hectare in the developed world (Morris et al., 2007; World Bank, 2010). Despite the potentially large benefits that technological innovations promise, numerous constraints to their adoption and retention have been documented (Feder, Just, and Zilberman, 1985; Sunding and Zilberman, 2001; Doss, 2006; Suri, 2011).

Our proposed research will focus on two interrelated factors that have been identified in the development economics literature as critical impediments to wider adoption of improved technologies in developing countries: lack of access to credit, particularly to overcome any lumpiness of investment, and the riskiness of agricultural returns, primarily due to significant rainfall variation. Subsistence farmers in developing countries, on the one hand, are either unable to obtain credit because they lack collateral or are reluctant to risk losing their assets pledged as collateral in case of an adverse shock, while their access to informal credit is not sufficient for the adoption of improved technologies (Hertz, 2009; Mude et al., 2009). Lenders in developing countries, on the other hand, are reluctant to supply loans to subsistence farmers because droughts and floods can cause many borrowers to default simultaneously, thereby exposing the lender to substantial undiversifiable systemic risk.

Index insurance has the potential to reduce loan defaults (or losses from such defaults) across many farmers simultaneously in the event of a widespread drought, flood, or other natural disaster. Thus, if properly integrated into a lender's portfolio risk management and loan policies, index insurance could dramatically reduce the lender's exposure to catastrophic risk and promote

the expansion of credit supply to subsistence farmers at lower interest rates, which in turn should spur increased adoption of higher-yielding agricultural technologies. Indeed, Stein et al. (2011) find that index insurance in India has resulted in a small but statistically significant increase in the use of improved seeds and cash crops.

The results of most index insurance pilot programs, however, have been disappointing, with significant uptake of index insurance among smallholders occurring only if it is heavily subsidized or coupled with other benefits, such as low-interest loans, and with the demand disappearing as soon as the subsidy is eliminated (Miranda and Farrin, 2012). Although coupling index insurance with credit contracts appears to have enjoyed minor successes in reducing loan defaults, the practice has proven far less effective in cases where borrowers have ready means to default on loan repayments without suffering major consequences. In particular, by indemnifying the farmer after a drought or other indexed event, index insurance could increase default rates on loans by implicitly reducing the severity of punishment associated with default (Clarke and Dercon, 2009). Index insurance, by effectively increasing the minimum welfare level a household can achieve should it default, can reduce incentives for repayment and, in turn, results in lenders having to cut back on the amount of credit they can profitably offer to clients.

Recent field experiments involving coupled credit and index insurance contracts also have failed to produce significant sustainable positive effects. For example, Malawian farmers' demand for credit is found to decrease when loans are coupled with a rainfall insurance contract, even though there is considerable risk of income loss due to drought (Gine and Yang, 2009). A randomized experiment offering insured loans to farmers in Ghana finds no significant difference in loan uptake among treatment and control groups (Karlan, Kutsoati, et al., 2011), although farmers in the treatment group are found to shift production to more perishable, and therefore riskier,



crops. Due to the disappointing results with recent index insurance initiatives, skepticism has been growing regarding the benefits of index insurance sold directly to farmers (Binswanger, 2011).

However, important alternative uses of index insurance remain largely unexplored. Recent contributions suggest that the benefits of index insurance on loan provision, and thereby on improved technology adoption, may be dramatically increased if the indemnity goes to the lender rather than to the farmer (Miranda and Gonzalez-Vega, 2011; Farrin and Miranda, 2013). When a lender requires all of its smallholder borrowers to purchase index insurance to obtain a loan, with the additional condition that any indemnity must first be awarded to the lender for repayment of an outstanding loan, with the residual passed to the smallholder, then the incentives for strategic default are curtailed, substantially reducing the negative impacts on lenders of widespread loan defaults in the event of an adverse systemic weather event. The immediate benefits of index insurance contracts employed in this fashion are expected to be greater to an agricultural lender (or any other value chain participant that agglomerates risk) than to individual agricultural producers because a lender effectively diversifies much of the idiosyncratic risks borne by its borrowers and thus can be expected to face lower basis risk than its borrowers individually.

By managing the systemic risk due to widespread weather shocks using index insurance, the lender should be able to provide more loans to smallholders at lower interest rates. Our vision of index insurance-contingent credit is akin to car insurance in the United States, in which auto lenders require the purchase of insurance before a car is driven off the lot as a condition for a car loan. In the event of a total loss on the automobile, the indemnity is assigned to the lender, who then passes it on to the owner after deducting the loan balance. In the same realm, the Malian Textile Company requires cotton farmers to purchase life insurance as a condition for a loan for input purchases in order to ensure that the agency will recover its loan even if the farmer dies

(Bellmare et al, 2012). This practice is widely used in microfinance, where traditional collateral is not frequently available.

Our understanding of agricultural credit supply and default behavior among smallholders rests on recent and on-going theoretical research undertaken at The Ohio State University on systemic risk, loan default behavior, index insurance, and technology adoption (Miranda and Gonzalez-Vega, 2011; Farrin and Miranda, 2013; Miranda and Wang, 2012; Collier, Skees, and Miranda, 2013; Guizar-Mateos, Gonzalez-Vega and Miranda, 2013; Diiro and Sam 2013). This research is generally characterized by the development and analysis of formal dynamic stochastic heterogeneous agent models of borrowers who may strategically default on loans and who must make technology adoption decisions in the presence of both systemic and idiosyncratic shocks. These structural models provide strong testable predictions of how aggregate rates of technology adoption and loan default depend on underlying market primitives such as the risk and returns associated with investment in different technologies, prevailing credit limits, market interest rates, lender debt restructuring policies, borrower risk aversion and asset holdings, and the relative levels of systemic and idiosyncratic risk embodied in agricultural production.

The theoretical models developed at OSU have shed light on how lenders in developing countries could manage their portfolio credit risks through the use of index insurance contracts that indemnify based on the observed value of rainfall, temperature, or other weather variable. Analysis conducted with the models indicate that requiring individual borrowers to purchase index insurance in order to secure a loan, if the premiums reflect realistic loads to cover operational costs, can create disincentives for borrowers to repay loans, severely undermining lender profitability and equity growth. However, if lenders directly buy index insurance and use it to manage the systemic risk inherent in their portfolio, they can substantially stabilize equity growth, even if the insurance premiums are unsubsidized. The same effect can be achieved by requiring borrowers to

purchase index insurance and name the lender as the primary beneficiary, so that indemnities are first used to repay loans, with the residual, if any, going to the farmer. In general, coupling index insurance to credit and assigning indemnities to the lender is a form of contingent credit.

Similar to the findings of Janzen, Carter and Ikegami (2012), the theoretical work performed at OSU predicts that access to index insurance reduces household vulnerability to falling into poverty, and that households with access to coupled credit-insurance contracts are more likely to employ high-technology farming practices. In addition, insured household borrowers are expected to switch to high-technology farming practices at lower levels of wealth than uninsured households or farmers without access to loans. Similarly, insured household borrowers are able to cope with adverse shocks more effectively than uninsured households and, therefore, are willing to abandon the advanced technology, once they had already adopted it, only when a shock lowers their wealth below very low levels, compared to uninsured households. As a result, households that have been able to adopt and sustain the adoption of higher-productivity technologies show higher long-run consumption rates than those of traditional technology households.

### ***Project Implementation***

The proposed OSU/ACET research program is scheduled to run for three years, starting in August of 2013. During that period, OSU/ACET plans to perform a randomized control trial, implemented in three distinct stages, starting in the summer of 2014. The study is expected to generate analytical findings that will help determine the proper uses of index insurance to promote an expansion of the credit supply among smallholders in the developing world, leading both to policy prescriptions for developing countries and contributions to the scholarly literature.

OSU/ACET will build on the current and continuing activities of the Ghana Agricultural Insurance Programme (GAIP), a programmatic initiative that originated from the GIZ-facilitated Innovative Insurance Products for the Adaptation to Climate Change (IPACC). Under the GAIP project, which is being implemented in collaboration with the Ghana National Insurance Commission, a detailed agricultural insurance feasibility study was conducted in the first half of 2010 (Stutley 2010). The study found “a major need in Ghana to improve farmers’ access to rural finance if they are to invest in improved seed and fertilizer technology and to thereby increase their production and yields and farm incomes”. The study further proposed introducing “crop insurance as part of a coupled program with production credit, seeds and fertilizers and preferably with output marketing assistance”. The coupling of agricultural insurance with credit through rural banks, micro-finance institutions, input suppliers, exporters, processors, and cooperatives has thus become the focus of current and planned GAIP activities in Ghana.

GAIP was formed in May 2010 with 19 Ghanaian insurance companies providing their capacity under a pool coinsurance agreement and with a Technical Management Unit (TMU) responsible for creating, designing, rating and selling crop insurance products in Ghana. GAIP launched its first crop insurance product in Ghana in 2011, a rainfall deficit (drought) weather index insurance product marketed to commercial rural banks and non-governmental organizations (NGOs) lending to maize farmers. In the first year, over 3,600 farmers purchased drought insurance through five lenders, including three banks and two NGOs. More recently, GAIP has been developing area-yield index insurance for major food cereals, oil seeds, and root crops, with plans to start a pilot program for maize in the Upper West Region, Wa, Jirapa and Sissala West in 2013.

OSU/ACET, working directly with GAIP, and in collaboration with the University of Ghana, plans to carry out a three-year program of impact assessment and experimentation of GAIP index insurance initiatives. Our primary objective will be to investigate the impacts of crop insurance-

continent agricultural loans on the agricultural credit system and on the technological transformation of Ghanaian smallholders. Specifically, if the proposed research is funded, we will evaluate the impact of index-insurance-contingent loans on a) the incidence of loan defaults and of losses from default during droughts and other systemic events that reduce yields in the aggregate; b) the adoption of higher yielding agricultural technologies among smallholders, c) loan provision terms (interest rates and loan amount) offered by lenders to smallholders, and d) an expansion of rural lender portfolios, including provision of loans to customers who historically did not qualify for loans.

In order to undertake our project, we have met on numerous occasions with GAIP principals in Ghana, from which we have secured commitments from GAIP to cooperate with OSU/ACET to advance our project's research and educational objectives. More specifically, OSU/ACET's plans call for using GAIP's network of commercial and rural lenders order to conduct its experiments. As per our discussions, GAIP will handle the marketing of the insurance via its established marketing chain. GAIP has also agreed to grant OSU/ACET access to its financial data at the insurer, lender, and farmer levels; facilitate OSU/ACET efforts to administer field surveys and a randomized control trial study among farmers that borrow and purchase index insurance; facilitate OSU/ACET efforts to interview GAIP insurers and their lender clients regarding their risk management practices; work with OSU/ACET to explore new financial technologies that employ index insurance as a risk management instrument at the insurer, lender, and farmer level; and help OSU/ACET organize outreach and educational activities aimed at insurers, lenders, farmers, and government policymakers. In return, OSU/ACET has agreed to guarantee full confidentiality of individual data; guarantee full disclosure of OSU/ACET findings to GAIP; assist GAIP members and clients explore new financial technologies that employ index insurance as a risk management instrument; and help

educate GAIP members and clients regarding proper uses of index insurance as a risk management instrument.

Based on conversations with GAIP, we will initially work with farmers covered by the USAID Ghana Agricultural Development and Value Chain Enhancement (ADVANCE) by Concerned Universal, an NGO currently selling drought insurance in the Northern Region, Upper East Region, Upper West Region, and Brong Ahafo, and whose plans call for introduction of area-yield index insurance pilot programs in these regions in May 2013. ADVANCE has established a marketing chain that includes 2,868 small commercials and smallholder farmers, approximately 400 of whom have purchased index insurance in recent years. ADVANCE does not require borrowers to insure, nor does it directly market insurance. Rather, ADVANCE offers loans and encourages their clients to purchase index insurance by educating them about the potential benefits of index insurance and making the insurance marketed by GAIP available for purchase by its clients at the time the loan is offered. ADVANCE is a five year project that ends in 2014. The Chief of Party of the ADVANCE Project, however, has agreed to allow OSU/ACET to adopt ADVANCE's established marketing chain to allow us to conduct its work and so deepen impact of ADVANCE's past work. Under our agreement, ADVANCE will provide OSU/ACET access to essential information regarding its clients and will provide needed introductions that will allow OSU/ACET to reach those clients.

In proposing our research program, we hope to complement recent work on index insurance in Ghana by Dean Karlan and Chris Udry of Innovations for Poverty Action, as well as related work on index insurance in Ethiopia by McIntosh and Sarris, in Burkina Faso by Bellemare and Guirkingner, and in Tanzania by the Vision Fund. Although we have not been in direct with any of these researchers, we are well aware of their work and plan on reaching out to them to explore the potential for collaboration, should our project be funded. It should be noted, however, that the overarching objectives of our project differ in significant ways from those of IPA. Our project is

primarily focused on the development of sustainable and scalable markets for index insurance and thus must avoid offering subsidized index insurance. IPA's work, in contrast, has offered insurance products that are partially and in some cases fully subsidized by donors. Although we recognize that valuable insights that have been gained from IPA's work, we are concerned that their efforts may not lead to the development of a sustainable marketing framework, and that IPA's contributions to the development of index insurance markets could be lost once IPA completes its research project.

### ***Capacity Building***

OSU/ACET is committed to building institutional capacity in Ghana in two ways. First, OSU/ACET intends to develop technical capacity among Ghanaian and African policymakers, GAIP and other insurer groups, and the lender and smallholder groups serviced by GAIP and other insurers by implementing an aggressive outreach and education program to raise public awareness about the proper use of index insurance to backstop financial contracts. The educational program will be geared to a wide range of stakeholders, including smallholders, producer groups, implement dealers, input suppliers, cooperatives, exporters, processors, government officials, insurance companies, commercial banks, microfinance institutions, NGOs and donor organizations. The program will attempt to educate these groups regarding current best financial risk management practices employing index insurance.

Second, OSU/ACET is committed to building institutional capacity in Ghana by connecting its field research and outreach activities to the University of Ghana (UofG), Legon Campus, Department of Agricultural Economics and Agribusiness (DAEA) research and educational missions. More specifically, OSU/ACET will support development of a new University of Ghana doctoral program in Applied Agricultural Economic and Policy. The new doctoral program, which is

being implemented with major funding from the Alliance for a Green Revolution in Africa (AGRA), is slated to begin in 2013 with approximately one-dozen students from Ghana and other Western African countries in its inaugural class.

OSU will serve as the UofG's external academic partner for its new PhD program and will support it in two ways. First, OSU faculty members will teach short-courses or modules in existing DAEA graduate courses in their fields of expertise as they relate to project objectives. Areas of instruction that are consistent with the OSU team's teaching expertise and DAEA programmatic needs include general mathematical programming, computational economics, dynamic economics, econometrics, impact evaluation, rural finance, microinsurance, and food security, just to name a few. OSU would offer at least one short-course/module per year, perhaps more, depending on the duration and scope of the short-course/modules. The short courses will be incorporated into established courses as modules. OSU and the UofG will also explore opportunities for distance education, which could permit DAEA PhD students to take select courses offered at OSU (this practice has been successfully implemented at OSU with Tanzania in the past).

Second, OSU would like to support UofG DAEA PhD programs by mentoring students and involving them in project-related research. For some DAEA PhD students, the involvement might be limited to serving as interviewers on survey teams. However, we envisage a deeper involvement for a few qualified UofG doctoral students who elect to conduct doctoral dissertation research on topics related to the project, in which case an OSU faculty member would serve on their dissertation advisory committee. Students committing to dissertation research on project related topics and possessing the requisite technical background will be invited to spend a semester or full academic year taking courses or conducting research at Ohio State during the latter stages of their studies. ACET has agreed to provide unpaid summer internships to two qualified DAEA doctoral students working on the project in each of the three years of the project.



The OSU and ACET research team will use the University of Ghana as a base from which to conduct field research. OSU faculty members and doctoral students will visit Ghana annually for extended periods to teach and conduct field research. More specifically, the two OSU principal investigators will visit Ghana each year for extended periods of two weeks to one month; in the second and third year of the project, the two PIs will be accompanied by two OSU doctoral students, who will stay for periods of up to two or six months conducting field research. ACET will share in the expenses associated with these visits by providing modest office space for the visitors. The University of Ghana will supply modest accommodations in university dormitories and visiting faculty housing.

During its visits, the OSU team will work closely with the Department of Agricultural Economics and Agribusiness (DAEA) and Institute of Statistical, Social, and Economic Research (ISSER) to conduct field research and surveys in spring/summer of 2014, 2015, and 2016. During our visits, OSU will also work closely with ACET to host meetings and workshops with groups of Ghanaian smallholders, lenders, insurers, processors, exporters, and government policy makers to disseminate findings and policy prescriptions. Direct involvement by one or more UofG DAEA faculty members and qualified DAEA doctoral students would help ensure success of these outreach efforts.

Last, most of GAIP's staff are either part time doctoral students working in index insurance as their dissertation topic or are aspiring to further their education by pursuing a doctoral education in the economics of index insurance. These aspirations were expressed formally and informally during the various meetings we have had with GAIP. The proposed project will, to that effect, provide a platform for these budding scholars to polish their on-going and future research.

## *Research Questions and Strategy*

Index insurance pilot projects have answered some questions about the cost-effectiveness of index insurance, but have also raised new ones. As such, there is still a need for additional work before we can fully establish whether index insurance can help address the catastrophic risk management problems faced by the poor living in the developing world. Formal impact assessment studies based on standard benefit-cost principles, conducted using appropriately designed survey instruments or controlled randomized field experiments could provide answers to a myriad of pressing questions pertaining to the large-scale viability and the value of index insurance.

The GAIP project, which is on the verge of expansion, provides an exceptional opportunity for an evaluation of index insurance. The opportunity arises because product design and distribution have largely been settled, but the proper use of these instruments in holistic risk management remains an unsettled question. Outcomes and impacts of the coupling of credit and index insurance will depend on changes in lender and smallholder behavior. Index insurance will change the lender's terms of access to credit, but it is still the case that how the smallholder responds to index insurance will drive the level of effect. Consequently, outcome indicators at the level of the smallholder will serve as proxies for behavioral responses at the level of the lender.

Questions we intend to address through our research in Ghana include:

- Does index insurance reduce the aggregate rate of loan defaults during widespread catastrophic weather events?
- Does index insurance increase lender profitability?
- Does index insurance reduce and stabilize lender loan portfolio risk?
- Does index insurance encourage lenders to expand their rural loan portfolios?

- Does index insurance encourage lenders to lower interest rates?
- Does index insurance encourage lenders to alter loan recovery and principal repayment scheduling practices?
- Does index insurance strengthen the lender-borrower relationship in tangible ways?
- Do smallholders with access to coupled credit-index insurance contracts adopt improved, investment-intensive technology at higher rates than those without access?
- Do smallholders with access to coupled credit-index insurance contracts avoid the abandonment of improved production technologies more often than those without access?
- Does index insurance by itself or coupled with credit allow farmers to increase their average profitability?
- Does index insurance allow farmers to reduce income risk?
- Do the benefits of index insurance depend on production practices and opportunities, education, geographical location, proximity to weather stations, degrees of access to financial markets, and the farmers' asset base?
- Does index insurance affect the smallholder's wealth and saving and consumption behavior?

Our primary hypothesis is that how loans and index insurance are coupled can have a profound impact on lenders and on farmers. As such, we propose to compare the impact of index insurance under the following three scenarios:

1. Control: No index insurance. Smallholders are offered conventional loans, but not index insurance, and lenders do not purchase index insurance to manage their systemic weather risks directly.

2. Treatment 1: Loans are offered along with mandatory index insurance, with the indemnities assigned to the smallholder.
3. Treatment 2: Loans are offered along with mandatory index insurance, with the indemnities assigned to the lender. We are considering three subtreatments, depending on whether the indemnity is 50%, 75%, or 100% of the borrower's debt obligation

Based on the predictions from our theoretical models, we would expect two sets of outcomes. First, Treatment 1, compared to the Control, should generate a measureable but modest impact on behavior. Having index insurance will make it easier for a smallholder to repay a loan during a catastrophe, but the temptation to use the indemnity to finance consumption rather than to repay the loan during hard times remains, potentially diminishing the positive impact of insurance on loan repayment rates. This may be particularly true if the smallholder expects the deployment of other types of public assistance, including a repayment moratorium, in times of catastrophic events. Further, if there are no positive effects on loan recoveries, we do not expect lender behaviour to change and loan terms and conditions to improve. Thus, impacts on smallholder behaviour should be minimal. Indeed, using a randomized controlled trial in India, Stein et al. (2011) report slightly higher adoption rates of improved seeds among farmers who purchased index insurance.

Second, Treatment 2 should generate more dramatic benefits than Treatment 1. Having index insurance repay part or all of the borrower's debt obligation should enhance the borrower's repayment performance and thus help sustain the lender-borrower relationship. This, in turn, should protect the smallholder's future access to credit (as the lender avoids losses from default) and therefore prevent the abandonment of an improved technology by the otherwise delinquent borrower. Moreover, having index insurance cover part of the borrower's debt obligation will promote, though not necessarily guarantee, borrower compliance with the loan contract terms,

since the borrower now has to repay a smaller portion of the loan out of current income and, thereby, must sacrifice less current consumption. The temptation for the smallholder to use the indemnity during hard times to finance consumption, rather than repay his or her debt, is thus eliminated.

Under Treatment 2, the borrower will be fully informed at the time the loan contract is consummated that an index insurance contract will be attached to the loan, and that any indemnity provided by the insurance contract will be paid directly to the lender for the purposes of retiring an equal portion of the borrower's debt. Under the formal terms of the loan contract, the lender will be required to use the indemnity exclusively to retire part or all of the borrower's debt. If and when an indemnity is paid, the lender will be required to notify the borrower in a timely way that an indemnity has been paid and inform him or her of the reduced remaining balance on the borrower's debt obligation.

In Treatment 2, interesting questions may be addressed by varying the size of the indemnity in relation to the borrower's debt obligation. Would a borrower be more or less likely to repay what remains of his or her debt obligation if a higher percent of the obligation is retired by the indemnity payment? Although we expect a smaller debt balance to be more likely to be repaid than a larger debt balance, it is entirely possible that the borrower might reason that a larger indemnity payment offers more than fair compensation to the lender, given that the borrower is suffering from hard times, thereby justifying not having to repay what remains the debt obligation. Will a borrower in Treatment 2 feel he should not be obligated to repay his debt if he suffers losses that he believes should be covered by the insurance, even though indemnity was not triggered because the effects of a drought are not sufficiently broad-based? What impact does the size of the indemnity payment have on lender loan recovery incentives?

Concerns regarding regulatory constraints that might prevent OSU/ACET from conducting its planned field experiments were discussed at length with GAIP and GiZ, who jointly have been working directly with the Ghana National Insurance Commission for several years in the development of index insurance contracts. It is GAIP and GiZ's judgment that current regulations will not stand in the way of our planned work. To the contrary, Ghanaian regulators support development of the index insurance market and welcome innovations and experimentation. Moreover, in each of our experimental treatments, ownership of the insurance contract is legally unambiguous. In Treatment 1, the borrower pays the insurance premium and is entitled to the indemnities; the borrower only acts as an intermediary to the insurance purchase transaction with no ownership interests. In Treatment 2, the lender pays the insurance premium and is entitled to the indemnities; the lender simultaneously offers a loan to a borrower whose terms provide for reduction of the borrower's debt loan on the occurrence of the event that triggers an indemnity. However, the two contracts are legally separate, one is between lender and borrower and one is between lender and insurer.

## ***Methodology***

The first step in our empirical analysis will be to identify a pool of farmers interested in receiving a loan. To do so, we will take advantage of GAIP's radio broadcast outreach program and its well-attended pre-harvest conferences held each year throughout their regions of operation to inform eligible farmers about the experiment and the loan products available to them.

Second, following Gine and Yang (2009), we will then randomly divide our villages into three equal groups. Farmers residing in Group 1 villages will serve as the control category, those residing in Group 2 villages will serve as the Treatment 1 category, and finally farmers in Group 3

villages will serve as the Treatment 2 category. Randomizing treatments and control at the village level rather than at the individual farmer level is preferred in our case in that it serves to mitigate concerns about fairness (and about indirect effects among non-participants from neighbor behavioral changes) which may arise when farmers in the same neighborhood are assigned to different treatments, with one treatment requiring insurance indemnities go to the lender while the other one does not (Gine and Yang, 2009; Barrett and Carter, 2010). Third, once villages are randomly chosen, we will then invite a random sample of farmers within each village to apply for our loan-cum-insurance product, as in Karlan and Zinman (2005).

As discussed above, farmers in our control group will be offered a basic loan with no requirement of purchasing insurance. We recognize, however, that a fraction of such farmers may also purchase crop insurance on their own, potentially muting the effect of Treatment 1. Our empirical analysis will deal with this possibility should it materialize. Farmers in Treatment 1 villages will be required to purchase crop insurance to be eligible for a loan, with the insurance indemnity flowing to the farmer if triggered. Farmers in Treatment 2 villages will be required to purchase crop insurance as a condition for a loan, with the relevant portion of the insurance indemnity transferred to the lender and not the farmer. For both treatments, farmers will have to buy crop insurance at actuarially fair premiums. While the potential of low take-up rates of crop insurance is a valid concern, it is less so in Ghana, where many farmers are familiar with and have purchased crop insurance to mitigate production risk (see discussion above).

In the summer of 2014, we intend to work with the University of Ghana's Institute of Statistical, Social and Economic Research (ISSER) institute to conduct a survey of the randomly selected farmers who have been invited to apply for a loan. The purpose of the survey is to collect relevant covariates every year (before and during the three-year experiment) including investment in and types of agricultural technologies adopted, if any (improved seeds, fertilizers, tractors, etc),

loan amount, application and repayment history, crop insurance indemnity payout history, yields, farm size, education, age and gender of household members, household size and composition, idiosyncratic and systemic shocks, farm and non-farm revenue, risk aversion, consumption and savings, etc.

In the summer of 2015 and 2016, we will conduct more surveys of the same farmers as well as lenders to collect data on adoption of agricultural technologies, loan take-up, default rates, interest rates, average loan amounts and other relevant data. We will also interview farmers who decline to apply for a loan to i) see if they are characteristically different than those who have and ii) understand their reasons for not applying. For example, farmers in treatment villages (where the purchase of crop insurance will be required for a loan) may decline to apply for loans at a higher rate because of ambiguity aversion about insurance (Bryan 2010). Our surveys will be designed to ascertain the causes of non-participation. We will use two-way panel fixed effects (difference-in-differences) estimation (e.g., Galiani, Gertler, and Schargrodsky 2005) to gauge i) if the two treatments (Treatment 1 and Treatment 2) are conducive to the adoption of better production technologies, and if so ii) which of the two treatments is more effective. We will also explore which of the two treatments generates fewer defaults and more loans.

### ***Relevance to USAID Objectives and Activities***

Ghana is at the forefront of Feed the Future, the US Government's global hunger and food security initiative. Drawing upon resources and expertise of agencies across the US Government (led by USAID), this Presidential Initiative is helping countries like Ghana transform their own agricultural sectors to grow enough food sustainably to feed their people. Feed the Future aims to address the root causes of hunger and poverty and forge long-term solutions to chronic food insecurity and under-nutrition.



Our project also complements the USAID-supported Ghana Agricultural Development and Value Chain Enhancement (ADVANCE) program, which seeks to improve the competitiveness of the targeted agricultural commodity value chains: rice, maize and soya. ADVANCE's objectives for Ghana include improving agricultural technology transfer and providing training and capacity building for public, private, and civil society organizations in agriculture and food security. Our proposed project falls right into these objectives. In particular, our proposed project will:

- test risk uses of index insurance that are designed to crowd-in agricultural credit supply and promote adoption of improved agricultural technologies.;
- create the science to cost-effectively scale-up index contracts;
- mitigate the risk confronting small-scale farmers who are reluctant to adopt potentially profitable new technology;
- provide financial mechanisms to allow credit-constrained farmers to adopt improved technology;
- examine the absolute and relative importance of different technology adoption barriers;
- evaluate the impact of interventions designed to simultaneously address multiple constraints in a complementary way;
- identify how best to employ index insurance to address barriers to pro-growth technology investment in agriculture.

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## Anticipated Outputs

The project plans to disseminate its findings through conventional academic outlets, including publications in internationally recognized academic journals and presentations at major international and African regional academic conferences. However, we also plan to implement an aggressive outreach and education program aimed at Ghanaian and African stakeholders and policymakers. The outreach program, to be implemented largely by ACET, will strive to raise public awareness about proper use of index insurance among a wide range of stakeholders, including smallholders, producer groups, implement dealers, input suppliers, cooperatives, exporters, processors, government officials, insurance companies, commercial banks, microfinance institutions, NGOs and donor organizations. Most of this outreach will be rendered through five face-to-face training sessions with the stakeholder groups and numerous other more informal meetings.

As an institution dedicated to promoting economic transformation in Africa, ACET's mission is to promote policy and institutional reforms for sustained growth and transformation in Africa. ACET's senior members and principle investigators on this project have access to senior policymakers in Ghana based on previous engagement with senior policymakers there in discussions of economic and agricultural studies, strategies, and reforms. These links will facilitate ACET's efforts to disseminate and promote the results of the study in ways that enhance the chances that they will translate into policy implementation. ACET will do this by going beyond Ministries of Agriculture and bringing the results to the attention of senior policy makers in charge of overall economic strategy and budget formulation. ACET will also leverage its convening power to also engage farmers, the private sector, civil society, and donors in Ghana to raise their interest

and support for index insurance for prioritizing agriculture in the economic transformation agenda of the country.

To allow higher visibility, the outcomes of this exercise will be disseminated jointly with two ongoing ACET projects in agriculture respectively financed by a DFID/ESRC research grant and a Bill and Melinda Gates research grant. The first seeks to understand the role played by non-market institutions in agriculture in Africa in poverty eradication. The second project seeks to increase smallholder productivity and to improve post-production value (storage, processing, and market access—domestic or foreign) in order to improve the incomes and food security of smallholders. ACET will host forums to launch the reports and to advocate for agricultural transformation using the outcomes of its on-going studies. This arrangement would provide an excellent platform to dovetail the results of the index insurance study proposed here and generate larger impact.

Through continued collaboration with policy makers, ACET will continue its advocacy work and monitoring of implementation using its advisory services. ACET's advisory services practice has provided experience that could be leveraged to also help move the study's findings towards policy impact. ACET has had discussions at the highest policy levels with the authorities in Ghana. Specifically, ACET has been engaged to review the economic planning process and help make it more effective. Under this assignment, ACET has initiated a process that has brought together the key economic ministries and agencies, the most senior staff in the President's office, representatives of major political parties, the private sector, farmers association, and academics, to discuss identified weaknesses of the existing system and emit proposals for reform. ACET is also engaged in advisory services at the highest policy levels on transformation issues in other countries. These include Liberia (helping to develop an economic transformation strategy, and strengthening implementation capacity by helping re-organize the Ministries of Finance and



Planning); and Guinea, Mozambique, and Zambia (helping develop a strategies for the extractives sector to ensure it contributes effectively to economic transformation in each country).

ACET will incorporate outputs from the proposed research program in its Ghana Agricultural Transformation Report, a sub-report of ACET's flagship biannual African Transformation Report (ATR), and push for policy impact. Activities here will include: (i) launch the report in Ghana in a forum that invites policy makers from the Ministry of Agriculture, Ministry of Finance and Planning, Ministry of Trade and Industry; the Central Bank, farmers associations, the private sector, donors, and other relevant stake holders; (ii) follow-up meetings with the policy makers invited to the launch (some of the meetings could precede the launch) to seek to get them to commit to complementary necessary actions to pursue targeted interventions and to prioritize the agenda proposed by the study in Ghana transformation strategies/plans and budgets; (iii) use ACET publications on economic transformation, particularly the ATR, and the ACET website to advocate to broader audiences for agricultural transformation, (iv) contribute to capacity building in Africa through training sessions for policy makers and academicians to reproduce and extend the analysis carried out in this research program (this activity will not necessarily be funded by BASIS as it may be a response to an invitation by regional stakeholders to ACET to present the results and contribute an on-going capacity building but deliberations from the BASIS project will be presented).

Deliverables listed in the work timeline below include:

- Scientific analytical findings obtained from data generated from a randomized control trial and field surveys, which will help determine the proper uses of index insurance to promote expansion of credit supply among smallholders in the developing world.

- Data generated from a randomized control trial study and field surveys, which will be made publicly available after conclusion of project.
- A minimum of five scholarly articles, ideally to be published in internationally recognized journals such as J. of Development Economics, World Development, J. of Development Studies, Review of Development Economics, J. of African Economies, American J. of Agricultural Economics, Agricultural Economics, J. of Risk & Insurance, and Geneva Papers on Risk and Insurance.
- Six to ten presentations at international scholarly academic conferences discussing results obtained from the empirical work.
- Technical report summarizing the state of Ghanaian agriculture and GAIP index insurance activities.
- Three technical reports summarizing findings of baseline, first follow-up and second follow-up field surveys.
- White paper on policy recommendations to be published in ACET's flagship biannual African Transformation Report.
- Four conferred PhD degrees, two from The Ohio State University and two from the University of Ghana, based on PhD dissertations on topics closely related to project mission.
- Teaching materials for modules incorporated into the University of Ghana PhD program in Applied Agricultural Economics and Policy.
- Educational materials developed for five non-academic outreach and educational events.

## Anticipated Impacts

Anticipated impacts of the OSU/ACET program include:

- Increase adoption of index insurance by financial institutions and other entities involved in agriculture.
- Expansion of the insurance schemes to other stakeholders involved in non-traditional agricultural production.
- Adoption of index insurance in other regions of Ghana and introduction of new financial instruments tied to index insurance.
- Expansion of lending to smallholder farmers due to lower default risk for financial institutions in case of weather-related shocks
- Reduced interest rates for agricultural loans due to lower default risk and increased competition among lenders
- Increased adoption of improved production technologies brought about by the joint effects of better access to agricultural loans and crop insurance

We have already begun the work to increase the likelihood that our findings and recommendations will be translated into practical policy. As mentioned above, we have held several meetings with our GAIP partners in Ghana to ensure their commitment to the implementation of the findings and recommendations of the research team. We have also agreed to help educate GAIP members and clients on the proper uses of index insurance as a risk management instrument. Furthermore, ACET's senior members and principal investigators on this project have access to senior policy makers in the Ghanaian Government. We will use these links to elicit cooperation of the Ghanaian Ministries of Finance and Economic Planning and Food and Agriculture in the implementation and dissemination of our findings.

## **Timeline**

The proposed project will be organized into ten phases that generally follow the structure of the Ohio State University academic calendar, which is divided into an autumn semester, a spring semester, and a summer term. We first provide the timeline in abbreviated outline format, and follow with a more detailed description of planned project activities.

### ***Outline***

#### **Phase 1: Aug 2013 – Dec 2013**

- ACET background desk study
- ACET engagement of GAIP and stakeholders
- ACET prepare plan for outreach activities in next phase
- Selection and initial training of two OSU PhD students for project

#### **Phase 2: Jan 2014 – Apr 2014**

- ACET and Miranda to strike MOU with GAIP members and clients
- Recommendations regarding region, crop, insurers, lenders in study
- Develop survey logistics and work plan with ISSER for baseline survey
- Miranda to identify and engage two UofG students and adviser
- Miranda UofG short-course on index insurance
- Gonzalez-Vega UofG short-course on microfinance
- Two OSU PhD students complete second-year papers

#### **Phase 3: May 2014 – Aug 2014**

- Sam, Toledo, PhD students, and ISSER conduct baseline survey
- Sam or Toledo short-course on impact evaluation

**Phase 4: Sep 2014 – Dec 2014**

Analysis of baseline survey data

ACET continues dialog with GAIP and stakeholders

ACET prepare plan for outreach activities in next phase

Miranda and Sam advise two OSU and two UofG PhD students on dissertations

**Phase 5: Jan 2015 – Apr 2015**

ACET and Miranda outreach activities 1 and 2

Develop survey logistics and work plan with ISSER for first follow-up survey

Miranda and Sam advise two UofG PhD students

Miranda UofG short-course on topic TBA

Gonzalez-Vega UofG short-course on topic TBA

Two OSU PhD students complete dissertation prospectuses

**Phase 6: May 2015 – Aug 2015**

Sam, Toledo, PhD students, and ISSER conduct first follow-up survey

Sam or Toledo short-course on topic TBA

**Phase 7: Sep 2015 – Dec 2015**

Analysis of follow-up survey 1 data

ACET continues dialog with GAIP and stakeholders

ACET prepare plan for outreach activities in next phase

ACET, working with OSU, prepare policy recommendations

Miranda and Sam advise two OSU and two UofG PhD students on dissertations

Preparation of two scholarly manuscripts for publication

**Phase 8: Jan 2016 – Apr 2016**

ACET and Miranda outreach activities 3, 4, and 5

ACET presentation at African regional conference

ACET policy recommendations published in African Transformation Report

Develop survey logistics and work plan with ISSER for second follow-up survey

Miranda and Sam advise two UofG PhD students

Miranda UofG short-course on topic TBA

Gonzalez-Vega UofG short-course on topic TBA

Two OSU PhD students near completion of dissertations

### **Phase 9: May 2016 – Aug 2016**

Sam, Toledo, PhD students, and ISSER conduct second follow-up survey

Sam or Toledo short-course on topic TBA

### **Phase 10: Post Study**

Analysis of follow-up survey 2 data

Secure additional funding to continue field work

Completion of four doctoral dissertations

Preparation of three scholarly manuscripts for publication

## ***Details***

### **Phase 1: Aug 2013 – Dec 2013**

Project principal investigators, collaborators, and PhD students will perform a desk study the state of Ghanaian agriculture and GAIP index insurance activities and to develop recommendations for baseline survey and for the subsequent randomized control trial study. The desk study will a) review risk assessments of Ghanaian agriculture previously conducted by government and non-

governmental agencies; b) gain a deeper understanding of the management of GAIP indemnity pool and the index insurance legal regulatory framework; c) assess GAIP experience with index insurance to date, including, whether there has been significant uptake of contracts and whether index insurance has had any discernible impact on smallholder technology adoption or lender credit policies. The desk study will also make recommendations for the implementation of the baseline survey and randomized control trial, including identifying the index insurance contract to be examined (area yield or rainfall); insurers, lenders, and smallholder groups who will participate in the study; and regions and crops to be included in study. Miranda and Sam will identify two OSU PhD students to conduct research and write dissertations on project related areas and will initiate their training.

*Deliverables:* Background report regarding the state of index insurance in Ghana with preliminary recommendations regarding the scope of randomized control trial study and field surveys.

#### **Phase 2: Jan 2014 – Apr 2014**

Miranda, Mulangu, and Depetris Chauvin will meet regularly with GAIP and other stakeholders to forge a formal memorandum of understanding (MOU) that documents terms for collaboration between OSU/ACET and GAIP members. MOU will cover OSU/ACET access to GAIP sales data and GAIP logistical support for randomized control trials, field surveys, and outreach and educational activities. OSU/ACET will seek to become involved in GAIP's index insurance product development, including outreach and educational activities. MOU will finalize the insurers, lenders, and producer groups that will participate in the study as well as the regions and crops covered by the study.

Miranda will teach module on agricultural risk management and index insurance in UofG doctoral program; will work with ISSER to develop logistics for baseline survey in summer of 2014; will identify two UofG PhD students to participate in project and be awarded ACET summer internships;

and will engage their UofG faculty adviser in research. Gonzalez-Vega will also teach module on microfinance in UofG doctoral program. Project principal investigators will continue to advise two OSU and two UofG PhD students conducting research on project related areas. OSU PhD students will write second-year papers on project-related topics.

*Deliverables:* Memorandum of understanding between GAIP and OSU/ACET; service contract with ISSER; two second-year papers by OSU PhD students.

### **Phase 3: May 2014 – Aug 2014**

Sam and Toledo will work with ISSER to develop and pretest baseline survey instrument; will work with ISSER to conduct survey in the field, involving two OSU and two UofG PhD students in activity; and will oversee digital coding of survey data by PhD students working as ACET interns. Sam or Toledo will teach module on impact evaluation in UofG doctoral program.

*Deliverables:* Baseline survey instrument and data collected in digital format.

### **Phase 4: Sep 2014 – Dec 2014**

Project principal investigators, collaborators, and PhD students will work together to analyze data collected during baseline survey; will prepare summary of baseline survey of findings from baseline survey; and will develop recommendations for first follow-up survey. Project principal investigators will continue to advise two OSU and two UofG PhD students conducting research on project related areas. OSU PhD students expected to be developing dissertation prospectuses on project-related areas. ACET will meet regularly with GAIP and other stakeholders to deepen OSU/ACET involvement in GAIP activities and obtain feedback regarding index insurance uptake and evidence of impact on smallholder and lender behavior; and will prepare for two outreach and



teaching activities aimed at GAIP and its clients in Phase 5, including identification of outreach targets and development of activity outline.

*Deliverables:* OSU/ACET report summarizing the findings of the baseline survey with recommendations for design of first follow-up survey; ACET outline for outreach activities during Phase 5.

### **Phase 5: Jan 2015 – Apr 2015**

Miranda, Mulangu, and Depetris Chauvin will meet regularly with GAIP and other stakeholders to further formulate strategies for effective use of index insurance in promoting rural credit and improved technology adoption among smallholders. ACET will host two index insurance outreach and educational events aimed at GAIP and its clients.

Miranda will teach module on project-related topic in UofG doctoral program and will work with ISSER to develop logistics for the first follow-up survey in summer of 2015. Gonzalez-Vega will also teach module on project-related topic in UofG doctoral program. Project principal investigators will continue to advise two OSU and two UofG PhD students conducting research on project related areas. OSU PhD students will write dissertation prospectuses that include project-related topics.

*Deliverables:* ACET aide memoirs of outreach and educational activities 1 and 2; Miranda revised service contract with ISSER; two doctoral dissertation prospectuses by OSU PhD students.

### **Phase 6: May 2015 – Aug 2015**

Sam and Toledo will work with ISSER to develop and pretest first follow-up survey instrument; will work with ISSER to conduct survey in the field, involving two OSU and two UofG PhD students in

activity; and will oversee digital coding of survey data by PhD students working as ACET interns. Sam or Toledo will teach module on topic to be announced

*Deliverables:* First follow-up survey instrument and data collected in digital format.

### **Phase 7: Sep 2015 – Dec 2015**

Project principal investigators, collaborators, and PhD students will work together to analyze data collected during first follow-up survey; will prepare two project-related manuscripts for publication in scholarly journal; and will develop recommendations for second follow-up survey. Project principal investigators will continue to advise two OSU and two UofG PhD students conducting research on project related areas. OSU PhD students expected to be nearing completion of dissertation. ACET will meet regularly with GAIP and other stakeholders to deepen OSU/ACET involvement in GAIP activities and to obtain feedback regarding index insurance uptake and evidence of impact on smallholder and lender behavior; will prepare for three outreach and teaching activities aimed at higher level stakeholders and policymakers in Phase 8, including identification of outreach targets and development of activity outline; and will prepare white paper on policy recommendations to be circulated at outreach activities.

*Deliverables:* OSU/ACET report summarizing the findings of the first follow-up survey with recommendations for design of second follow-up survey; ACET white paper on policy recommendations; ACET outlines for outreach activities during Phase 8; two manuscripts for scholarly journals.

### **Phase 8: Jan 2016 – Apr 2016**

Miranda, Mulangu, and Depetris Chauvin will meet regularly with GAIP and other stakeholders to further formulate strategies for effective use of index insurance in promoting rural credit and

improved technology adoption among smallholders. ACET will host three index insurance outreach and educational events aimed at higher level stakeholders and policymakers; will disseminate findings at African regional conferences; and will develop policy recommendations to be published in ACET's flagship biannual African Transformation Report.

Miranda will teach module on project-related topic in UofG doctoral program and will work with ISSER to develop logistics for the second follow-up survey in summer of 2016. Gonzalez-Vega will also teach module on project-related topic in UofG doctoral program. Project principal investigators will continue to advise two OSU and two UofG PhD students conducting research on project related areas. OSU PhD students to be nearing completion of dissertations that include project-related topics.

*Deliverables:* ACET aide memoirs of outreach and educational activities 3, 4, and 5; Miranda revised service contract with ISSER; two nearly completed doctoral dissertations by OSU PhD students; ACET policy recommendations published in ACET African Transformation Report.

#### **Phase 9: May 2016 – Aug 2016**

Sam and Toledo will work with ISSER to develop and pretest second follow-up survey instrument; will work with ISSER to conduct survey in the field, involving two OSU and two UofG PhD students in activity; and will oversee digital coding of survey data by PhD students working as ACET interns. Sam or Toledo will teach module on topic to be announced

*Deliverables:* Second follow-up survey instrument and data collected in digital format.

#### **Phase 10: Post Funding**

Project principal investigators, collaborators, and PhD students will continue to work together to analyze data collected during second follow-up survey; will prepare three project-related manuscripts for publication in scholarly journal; and will seek funding to continue follow-up field research in future years. Project principal investigators will continue to advise two OSU and two UofG PhD students to the conclusion of their dissertations.

*Deliverables:* OSU/ACET report summarizing the findings of second follow-up survey; three manuscripts for scholarly journals; four doctoral dissertations.

## Budget

OSU/ACET is requesting a total award of \$811,085, divided between an OSU award of \$514,581 and an ACET award of \$296,504. Separate itemized sub-budgets for OSU and ACET, and a summary budget containing the sum of the two sub-budgets are further documented in the pages following this detailed budget narrative:

### *ACET Sub-Budget*

Total Amount: \$296,504

- Salaries: \$121,124
  - \$12,971 - Chief Economist Yaw Ansu; 0%, 0%, and 5% of annual salary in years 1, 2, and 3, respectively; based on annual salary of \$259,412.
  - \$44,370 - Senior Advisor Nicolas Depetris Chauvin; 7.5%, 7.5%, and 7.5% of annual salary in years 1, 2, and 3, respectively; based on annual salary \$197,202.
  - \$48,783 - Agricultural Economist Francis Mulangu; 15%, 15%, and 15% of annual salary in years 1, 2, and 3, respectively; based on annual salary of \$108,406.
  - \$15,000 - External Consultant Patricia Toledo; flat fee paid in annual increments of \$5,000 in years 1, 2, and 3.

Salaries are assumed to remain constant over the life of the project. ACET operates a web-based timesheet system that monitors time spent on projects and allocates staff costs accordingly. None of the above personnel are employees of the U.S government.

- International Airfares: \$30,017

- \$2,900 - ACET PI travel from Ghana to undetermined African city to present findings at African regional conference; one trip in each of years 2 and 3.
- \$6,936 - ACET PI travel from Ghana to USA to attend BASIS Technical Committee Meeting, Davis, CA; one trip in each of years 1, 2 and 3.
- \$11,140 – External consultant travel from USA to Ghana to conduct field research and teach in Ghana; one trip in year 1, two trips in each of years 2 and 3.
- \$9,041 - OSU Graduate Associate travel from USA to Ghana to conduct field research in Ghana; two trips in each of years 2 and 3.

Airfares priced on 3-19-2013: Accra-Davis, CA, \$2,200, Columbus-Accra, \$2,100, and assuming a 5% annual increase; intra-Africa travel, \$1,400 in year 2 and \$1,500 in year 3.

- International Per Diems: \$45,980
  - \$2,505 - ACET PI travel from Ghana to undetermined African city to present findings at African regional conference; one trip in each of years 2 and 3, four day stays.
  - \$1,904 - ACET PI travel from Ghana to USA to attend BASIS Technical Committee Meeting, Davis, CA; one trip in each of years 1, 2 and 3, four day stays.
  - \$9,284 – External consultant travel from USA to Ghana to conduct field research and teach in Ghana; one trip in year 1, two trips in each of years 2 and 3, seven day stays.
  - \$32,288 - OSU Graduate Associate travel from USA to Ghana to conduct field research in Ghana; two trips in each of years 2 and 3, 2.5 month stays.

Per diems include lodging, meals, and incidental expenses. Per diem rates assumed for year 1 are: \$151 for Davis, CA; \$250 for Accra, Ghana for professional staff; and \$100 for Accra, Ghana for student research associates. Davis, CA per diem rate as published on CONUS website on 3-19-2013. Requested Accra, Ghana rates less than rate (\$331) published on US Dept of State

websites on 3-19-2013 because professionals will stay in U. of Ghana guest house and student research associates will stay in U of Ghana hostels. Assume 5% annual increase.

- Domestic Airfares: \$4,800
  - \$1,200 - ACET PI travel from Accra to undetermined Ghana location to conduct field research; one trip in each of years 1, 2 and 3.
  - \$1,200 - OSU PI travel from Accra to undetermined Ghana location to conduct field research; one trip in each of years 1, 2 and 3.
  - \$2,400 - Two student research associates travel from Accra to undetermined Ghana location to conduct field research; one trip in each of years 1, 2 and 3.

Airfares priced on 3-19-2013: Accra-Tamale \$400, assumed to remain constant over the life of the project.

- Non-Degree Training: \$20,909

Two OSU PhD students hired by ACET as summer interns to conduct project-related research, including administration of surveys, 2.5 months in each of years 2 and 3; assume monthly salary of \$2,060 in year 2 and \$2,122 in year 3, both consistent with current and projected OSU PhD monthly stipends.

- Data Collection: \$29,000

Fee paid to University of Ghana Institute of Statistical, Social, and Economic Research. Fee provides for institutional affiliation, assistance with survey design, pre-test of survey, survey administration, and survey data digital compilation.

- Communications: \$6,000

Workshops with stakeholder groups for education and dissemination of findings; two workshops in year 2 and three workshops in year 3. Assumes each workshop will require a room rental with coffee break, priced at approximately \$60 per person for 20 persons.

- Indirect Cost Recovery: \$38,674

Based on ACET standard overhead rate of 15% on direct expenses, the same as charged by ACET on recent Bill and Melinda Gates Foundation and United Kingdom Department for International Development grants.

### ***OSU Sub-Budget***

Total Amount: \$514,581

- Salaries: \$190,613
  - \$50,737 - Professor Mario Miranda; 1.5 summer months in each of years 2 and 3. Based on current academic year monthly salary of \$16,177.
  - \$36,604 - Associate Professor Abdoul Sam; 1.5 summer months in each of years 2 and 3. Based on current academic year monthly salary of \$11,671.
  - \$47,636 - AEDE PhD Graduate Research Associate assigned to Miranda; 5 months in year 1, 9 months in each of years 2 and 3. Based on current academic year monthly salary of \$2,000. Assume annual increase of 3%.
  - \$55,636 - AEDE PhD Graduate Research Associate assigned to Sam; 9 months in years 1, 2, and 3. Based on current academic year monthly salary of \$2,000. Assume 3% annual increase.



- Benefits: \$23,428

Based on OSU standard benefit rates of 15% for senior personnel and 10% for Graduate Research Associates.

- International Airfares: \$13,241
  - \$6,620 – OSU PI Miranda travel from USA to Ghana to conduct field research and teach in Ghana; one trip in each of years 1, 2, and 3.
  - \$6,620 – OSU PI Sam travel from USA to Ghana to conduct field research and teach in Ghana; one trip in each of years 1, 2, and 3.

Airfares priced on 3-19-2013: Columbus-Accra, \$2,100; assume 5% annual increase.

- International Per Diems: \$23,834
  - \$15,953 – OSU PI Miranda travel from USA to Ghana to conduct field research and teach in Ghana; one trip in each of years 1, 2, and 3; ten day stay in year 1, twenty-five day stay in years 2 and 3.
  - \$7,881 – OSU PI Sam travel from USA to Ghana to conduct field research and teach in Ghana; one trip in each of years 1, 2, and 3; ten day stays in years 1, 2 and 3.

Per diems include lodging, meals, and incidental expenses. Per diem rates assumed for year 1 is \$250 for Accra, Ghana. Requested Accra, Ghana rate less than rate (\$331) published on US Dept of State websites on 3-19-2013 because professionals will stay in U. of Ghana guest house. Assume 5% annual increase.

- Domestic Airfares: \$5,675
  - \$1,892 - Travel of OSU PI Columbus to BASIS Technical Committee Meeting, Davis, CA; 1 trip per year.

- \$3,783 – Travel of OSU researchers Columbus to professional meetings, undetermined USA location; 2 trips per year.

Airfares priced on 3-19-2013: Columbus-Davis, CA flight, \$600. Assume 5% annual increase.

- Domestic Per Diems: \$5,712
  - \$1,904 - Travel of OSU PI Columbus to BASIS Technical Committee Meeting, Davis, CA; 1 trip per year, 4 day stays.
  - \$3,808 – Travel of OSU researchers Columbus to professional meetings, undetermined USA location; 2 trips per year, 4 day stays.

Per diems include lodging, meals, and incidental expenses. Per diem rates assumed for year 1 is \$151 for both Davis, CA and undisclosed USA location. Based on Davis, CA per diem rate as published on CONUS website on 3-19-2013. Assume 5% annual increase.

- Degree Program: \$75,626

OSU Graduate Research Associate tuition and fees for two PhD students hired to conduct project-related research during the September-May academic year. Student assigned to Miranda will be hired for one semester in year 1 and for two semesters in each of years 2 and 3. Student assigned to Sam will be hired for two semesters in each of years 1, 2 and 3.

- Communications: \$3,500

Page charges for 5 peer-reviewed journal articles, 2 in second year, 3 in third year. Assume \$700 per article.

- Computers and Supplies: \$10,500

Purchase of four laptop computers for field research and conventional office supplies for four OSU researchers over three years.

- Indirect Cost Recovery: \$162,451

Based on OSU standard full overhead rate of 53.5% in year 1 and 54% in years 2 and 3.

AMA CRSP  
2013 RFP  
**PROJECT BUDGET--SUMMARY**

Project Title: Promoting Adoption of Improved Production Technologies among Smallholders in Ghana via Coupled Credit and Index Insurance Contracts Country: Ghana

Principal Investigators: Mario J. Miranda, Principal Lead PI; Francis M. Mulangu, Co-Lead-PI.

Institutions: The Ohio State University and African Center for Economic Transformation

AMA CRSP CORE FUNDS								
Budget Category		UNIT	COST	COUNT	YEAR 1	YEAR 2	YEAR 3	TOTAL
<b>PERSONNEL</b>								
	Salaries				64,051	116,156	131,530	311,737
	Benefits				2,800	10,162	10,467	23,428
	Overseas Living Allowances				0	0	0	0
	<i>subtotal</i>				<b>66,851</b>	<b>126,318</b>	<b>141,997</b>	<b>335,166</b>
<b>TRAVEL</b>								
	International Airfares				8,500	16,940	17,817	43,257
	International Per Diems				7,354	30,447	32,014	69,815
	Domestic Airfares				3,400	3,490	3,585	10,475
	Domestic Per Diems				1,812	1,903	1,998	5,712
	<i>subtotal</i>				<b>21,066</b>	<b>52,779</b>	<b>55,413</b>	<b>129,259</b>
<b>TRAINING</b>								
	Non-Degree				0	10,300	10,609	20,909
	Degree Program				19,334	27,326	28,966	75,626
	<i>subtotal</i>				<b>19,334</b>	<b>37,626</b>	<b>39,575</b>	<b>96,535</b>
<b>OTHER DIRECT COSTS</b>								
	Data Collection				12,000	12,000	5,000	29,000
	Communications				0	3,800	5,700	9,500
	Computer/Supplies				3,500	3,500	3,500	10,500
	<i>subtotal</i>				<b>15,500</b>	<b>19,300</b>	<b>14,200</b>	<b>49,000</b>
<b>SUBTOTAL DIRECT COSTS</b>					<b>122,751</b>	<b>236,023</b>	<b>251,184</b>	<b>609,959</b>
INDIRECT COST RECOVERY					<b>47,026</b>	<b>75,202</b>	<b>78,898</b>	<b>201,126</b>
% for each institution								
<b>TOTAL</b>								<b>811,085</b>

MATCHING CONTRIBUTIONS-NON FEDERAL								
US Institutional Support					49,159	50,798	52,322	152,279
Other institutional support					0	0	0	0
Leveraged funding					0	0	0	0
Private sector support					0	0	0	0
<b>TOTAL CONTRIBUTIONS</b>					<b>49,159</b>	<b>50,798</b>	<b>52,322</b>	<b>152,279</b>

AMA CRSP  
2013 RFP  
**PROJECT BUDGET--DETAIL**

Project Title: Promoting Adoption of Improved Production Technologies among Smallholders in Ghana via Coupled Credit and Index Insurance Contracts Country: Ghana

Principal Investigator: Francis M. Mulangu, Lead-PI; Nicolas Depetris Chauvin, Co-PI.

Institution: African Center for Economic Transformation

AMA CRSP CORE FUNDS								
Budget Category		UNIT	COST	COUNT	YEAR 1	YEAR 2	YEAR 3	TOTAL
<b>PERSONNEL</b>								
	Salaries				36,051	36,051	49,022	121,124
	Benefits				0	0	0	0
	Overseas Living Allowances				0	0	0	0
	<i>subtotal</i>				<i>36,051</i>	<i>36,051</i>	<i>49,022</i>	<i>121,124</i>
<b>TRAVEL</b>								
	International Airfares				4,300	12,530	13,187	30,017
	International Per Diems				2,354	21,259	22,367	45,980
	Domestic Airfares				1,600	1,600	1,600	4,800
	Domestic Per Diems				0	0	0	0
	<i>subtotal</i>				<i>8,254</i>	<i>35,389</i>	<i>37,154</i>	<i>80,797</i>
<b>TRAINING</b>								
	Non-Degree				0	10,300	10,609	20,909
	Degree Program				0	0	0	0
	<i>subtotal</i>				<i>0</i>	<i>10,300</i>	<i>10,609</i>	<i>20,909</i>
<b>OTHER DIRECT COSTS</b>								
	Data Collection				12,000	12,000	5,000	29,000
	Communications				0	2,400	3,600	6,000
	Computer/Supplies				0	0	0	0
	<i>subtotal</i>				<i>12,000</i>	<i>14,400</i>	<i>8,600</i>	<i>35,000</i>
<b>SUBTOTAL DIRECT COSTS</b>					56,305	96,140	105,384	257,830
INDIRECT COST RECOVERY					8,446	14,421	15,808	38,674
% for each institution					15%	15%	15%	
<b>TOTAL</b>								<b>296,504</b>

MATCHING CONTRIBUTIONS-NON FEDERAL								
US Institutional Support					0	0	0	0
Other institutional support					0	0	0	0
Leveraged funding					0	0	0	0
Private sector support					0	0	0	0
<b>TOTAL CONTRIBUTIONS</b>					0	0	0	0

AMA CRSP  
2013 RFP  
**PROJECT BUDGET--DETAIL**

Project Title: Promoting Adoption of Improved Production Technologies among Smallholders in Ghana via Coupled Credit and Index Insurance Contracts Country: Ghana

Principal Investigator: Mario J. Miranda, Lead PI; Abdoul Sam, Co-PI; Claudio Gonzalez-Vega, Co-PI.

Institution: The Ohio State University

AMA CRSP CORE FUNDS								
Budget Category		UNIT	COST	COUNT	YEAR 1	YEAR 2	YEAR 3	TOTAL
<b>PERSONNEL</b>								
	Salaries				28,000	80,105	82,508	190,613
	Benefits				2,800	10,162	10,467	23,428
	Overseas Living Allowances				-	-	-	-
	<i>subtotal</i>				<b>30,800</b>	<b>90,267</b>	<b>92,975</b>	<b>214,042</b>
<b>TRAVEL</b>								
	International Airfares				4,200	4,410	4,631	13,241
	International Per Diems				5,000	9,188	9,647	23,834
	Domestic Airfares				1,800	1,890	1,985	5,675
	Domestic Per Diems				1,812	1,903	1,998	5,712
	<i>subtotal</i>				<b>12,812</b>	<b>17,390</b>	<b>18,260</b>	<b>48,462</b>
<b>TRAINING</b>								
	Non-Degree				0	0	0	0
	Degree Program				19,334	27,326	28,966	75,626
	<i>subtotal</i>				<b>19,334</b>	<b>27,326</b>	<b>28,966</b>	<b>75,626</b>
<b>OTHER DIRECT COSTS</b>								
	Data Collection				0	0	0	0
	Communications				0	1,400	2,100	3,500
	Computer/Supplies				3,500	3,500	3,500	10,500
	<i>subtotal</i>				<b>3,500</b>	<b>4,900</b>	<b>5,600</b>	<b>14,000</b>
<b>SUBTOTAL DIRECT COSTS</b>					<b>66,446</b>	<b>139,883</b>	<b>145,800</b>	<b>352,129</b>
INDIRECT COST RECOVERY					<b>38,580</b>	<b>60,781</b>	<b>63,091</b>	<b>162,451</b>
	% for each institution				53.5%	54.0%	54.0%	-
<b>TOTAL</b>								<b>514,581</b>

MATCHING CONTRIBUTIONS-NON FEDERAL								
US Institutional Support					49,159	50,798	52,322	152,279
Other institutional support					0	0	0	0
Leveraged funding					0	0	0	0
Private sector support					0	0	0	0
<b>TOTAL CONTRIBUTIONS</b>					<b>49,159</b>	<b>50,798</b>	<b>52,322</b>	<b>152,279</b>

## **Investigator Qualifications and Curriculum Vitae**

Principle Investigators Miranda, Sam, Mulangu, and Depetris Chauvin will be responsible for the scientific content and credibility of project. Principal Investigators all hold PhD degrees from internationally-recognized doctoral programs in economics or agricultural economics and collectively possess substantive professional and academic experience in the areas of areas of agricultural economics, micro-finance, and index insurance. Principal Investigators also have field experience performing economic impact assessment in developing countries and/or working with or for international institutions such as the World Bank, the International Food Policy Research Institute, the US Agency for International Development, and the UK Department for International Development.

### **Mario J. Miranda, PhD**

Andersons Professor of Finance and Risk Management, Department of Agricultural, Environmental, and Development Economics, The Ohio State University, Columbus, OH, USA, Project Lead Principal Investigator

Mario Miranda's research has focused on the modeling and analysis of stochastic dynamical systems in agricultural, financial, environmental, and development economics. Areas of application include international economic development, agricultural risk management, agricultural and environmental policy, and industrial organization. His research has produced one book, which has been adopted by seven of the top ten ranked doctoral programs in Economics in the world; over 50 peer-reviewed articles, two of which are among the three most frequently cited articles in the field of "agricultural insurance" and one of which is the most frequently cited article on index insurance; and several computational modeling and risk management software packages. Miranda has won

numerous university research and teaching awards and currently serves as an Associate Editor of the Journal of Economic Dynamics and Control, the Journal of Computational Economics, and the Journal of Risk Analysis and Crisis Response. He has served as a consultant to the Chicago Board of Trade, the World Bank, US Agency for International Development, numerous private corporations, and several branches of the US Department of Agriculture, including the Economic Research Service, Risk Management Agency, Federal Crop Insurance Corporation, and the Office of the Chief Economist. He has acquired extensive international experience, having worked on major research projects or taught graduate-level courses in Bolivia, Colombia, Costa Rica, Ghana, Honduras, Italy, Mexico, Morocco, Nicaragua, and Peru.

**Abdoul G. Sam, PhD**

Associate Professor, Department of Agricultural, Environmental, and Development Economics, The Ohio State University, Columbus, OH, USA, Project Co-Principal Investigator

Abdoul Sam's scholarly interests range from nonparametric econometrics, financial economics, environmental economics, to development economics. His research in econometrics focuses on regression function estimation and hypothesis testing in data-rich environments with applications to micro-econometrics and continuous-time finance. Research in environmental economics investigates the determinants, effects, and effectiveness of voluntary corporate environmental programs. Sam's current research in development economics explores the empirical determinants of the adoption of improved agricultural production technologies with a focus on the role of nonfarm income in environments where households are credit-constrained. Sam, a native of Senegal, has published in top economic field journals such as the *Journal of Law and Economics*, the *Journal of Financial and Quantitative Analysis*, *World Development*, and the *American Journal of Agricultural Economics*.



**Francis M. Mulangu, PhD**

Agricultural Economist, African Center for Economic Transformation, Accra, Ghana, Project Co-Principal Investigator

Dr. Mulangu is an agricultural economist whose current responsibilities at the African Center for Economic Transformation (ACET) includes leading the Center's policy and research agenda in the areas of agriculture and agro-processing as they relate to economic transformation. Dr. Mulangu joined ACET in 2011 and has published multiple academic and policy papers, book chapters, and high profile reports including a background paper for the First African Human Development Report published by the United Nations Development Program. Dr. Mulangu is experienced in oversight and implementation and design of data analysis and country reports on food production and consumption, agricultural value added opportunities, commodity trade, and prospects for agricultural transformation and agro-processing. Prior to joining ACET, Dr. Mulangu worked as a consultant for the Center for Farmland Policy Innovation at The Ohio State University, where he managed multiple projects that provided direct policy advise to the Governor of the State of Ohio. Dr. Mulangu was born in the Democratic Republic of Congo. He holds a Ph.D. Agricultural, Environmental, and Development Economics and an MA in Economics from The Ohio State University and a BS in Economics from the University of North Texas. Dr. Mulangu is a member of the American Economic Association, the African Finance and Economic Association, and the African Growth and Development Policy Modeling Consortium. Dr. Mulangu will participate in research, develop policy recommendations, disseminate findings in Africa, manage host country fieldwork and workshop logistics, contribute to academic publications, and perform other miscellaneous project activities.

## **Nicolas Depetris Chauvin, PhD**

Senior Advisor, African Center for Economic Transformation, Accra, Ghana, Project Co-Principal Investigator

Nicolas Depetris Chauvin is a Senior Advisor at the African Center for Economic Transformation and Associate Professor of International Economics at Universidad de Buenos Aires. He is also a Fellow at the Oxford Centre for the Analysis of Resource Rich Economies in the Department of Economics at the University of Oxford. Dr. Depetris Chauvin previously worked as a Policy Specialist in the Office of Development Studies at the United Nations Development Programme and as a Consultant at the World Bank, the Inter-American Development Bank and the Ministry of Economics of Argentina, among others. He has held academic positions at the University of Oxford, the Dubai School of Government, Sciences Po, and INSEAD. His areas of research are international trade, development and agriculture economics. His latest work focuses on food and cash crops in Sub Saharan Africa. Dr. Depetris Chauvin recently published a book on Agriculture Supply Chains with the CEPR, a book chapter on South-South Cooperation in Africa, a background paper on Food security for the First African Human Development Report and several articles in academic journals. Dr. Depetris Chauvin holds a PhD in Economics from Princeton University. Dr. Depetris Chauvin will participate in research, develop policy recommendations, disseminate findings in Africa, and contribute to academic publications.

## **Collaborators**

The OSU/ACET project will benefit greatly from collaboration with scholars not listed as principal investigators, including

- Claudio Gonzalez-Vega, PhD, Professor Emeritus, Department of Agricultural, Environmental, and Development Economics, The Ohio State University, Columbus, OH, USA, Project Collaborator.
- Patricia Toledo, PhD, Assistant Professor, Department of Economics, Ohio University, Athens, OH, USA, Project Collaborator.
- Yaw Ansu, PhD, Chief Economist, African Center for Economic Transformation, Accra, Ghana, Project Collaborator.
- Ramatu Mahama, PhD, Associate Professor, Department of Agricultural Economics and Agribusiness, University of Ghana, Legon Campus, Accra, Ghana, Project Collaborator
- Irene Egyir, PhD, Senior Lecturer, Department of Agricultural Economics and Agribusiness, University of Ghana, Legon Campus, Accra, Ghana, Project Collaborator
- John K. M. Kuwornu, PhD, Senior Lecturer, Department of Agricultural Economics and Agribusiness, University of Ghana, Legon Campus, Accra, Ghana, Project Collaborator

## **Mario J. Miranda**

Andersons Professor of Finance and Risk Management  
Dept. of Agricultural, Environmental & Development Economics  
The Ohio State University  
2120 Fyffe Road  
Columbus, OH 43210-1067  
Office: (614) 292-6280  
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E-mail: miranda.4@osu.edu

### **Personal**

- Born: 23 September 1954, Havana, Cuba
- Citizenship: United States of America

### **Education**

- Ph.D. Economics and Operations Research, University of Wisconsin-Madison, 1985
- M.S. Economics, University of Wisconsin - Madison, 1984
- B.A. Mathematics, College of Wooster, 1976

### **Employment**

- Andersons Professor of Finance and Risk Management, Department of Agricultural, Environmental, & Development Economics, The Ohio State University, 1998-Present.
- Visiting Research Scholar, Development Research Group, The World Bank, 2012.
- Assistant/Associate Professor, Department of Agricultural, Environmental, & Development Economics, The Ohio State University, 1988-1998.
- Assistant Professor, School of Business Administration, University of Connecticut, 1986-88.

### **Editorial Service**

- Associate Editor, Journal of Economic Dynamics and Control, 2000-present.
- Associate Editor, Computational Economics, 1998-present.
- Associate Editor, Journal of Risk Analysis and Crisis Response, 2010-present.
- Associate Editor, American Journal of Agricultural Economics, 1996-2001.

### **Honors**

- Outstanding Teaching Award. College of Food, Agricultural, and Environmental Sciences, The Ohio State University, 2001.
- Outstanding Research Award. Ohio Agricultural Research and Development Center, 1999.
- Rodney F. Plimpton Outstanding Teacher Award. College of Food, Agricultural, and Environmental Sciences, The Ohio State University, 1998.
- Gamma Sigma Delta Research Award of Merit, The Ohio State University, 1997.

### **Book**

- Miranda, Mario J. and Paul L. Fackler. 2002. *Applied Computational Economics and Finance*. Cambridge, MA: MIT Press.

### Articles in Peer Reviewed Journals (selected)

- Lowry, Mark N., Joseph W. Glauber, Mario J. Miranda, and Peter G. Helmberger. 1987. "Pricing and Storage of Field Crops: A Quarterly Model with Application to Soybeans." *American Journal of Agricultural Economics* 69(4):740-749.
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- Rui, Xiongwen and Mario J. Miranda. 1996. "Solving Nonlinear Dynamic Games via Orthogonal Collocation: An Application International Commodity Markets." *Annals of Operations Research* 68(1-4):89-108.
- Makki, Shiva S., Luther G. Tweeten, and Mario J. Miranda. 1996. "Wheat Storage and Trade in an Efficient Global Market." *American Journal of Agricultural Economics* 78(4):879-90.
- Miranda, Mario J. and Joseph W. Glauber. 1997. "Systemic Risk, Reinsurance, and the Failure of Crop Insurance Markets." *American Journal of Agricultural Economics* 79(1):206-215.
- Miranda, Mario J. and Xiongwen Rui. 1997. "Maximum Likelihood Estimation of the Nonlinear Rational Expectations Asset Pricing Models." *Journal of Economic Dynamics and Control* 21(8-9):1493-1510.
- Miranda, Mario J. 1998. "Numerical Strategies for Solving the Nonlinear Rational Expectations Commodity Market Model." *Computational Economics* 11(1/2):71-87.
- Makki, Shiva S., Luther G. Tweeten, and Mario J. Miranda. 2001. "Storage-Trade Interactions

under Uncertainty: Implications for Food Security.” *Journal of Policy Modeling* 23(2):127–140.

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- Makaudze, Ephias M. and Mario J. Miranda. 2010. “Catastrophic Drought Insurance Based on Remotely Sensed Normalized Difference Vegetation Index for Smallholder Farmers in Zimbabwe.” *Agrekon* 49(1):418–432.
- Nadolnyak, Denis, Mario J. Miranda, and Ian M. Sheldon. 2011. “Genetically Modified Crops as Real Options: Identifying Regional and Country-Specific Differences.” *International Journal of Industrial Organization* 29(4):455–663.
- Miranda, Mario J. and Claudio Gonzalez-Vega. 2011. “Systemic Risk, Index Insurance, and Optimal Management of Agricultural Loan Portfolios in Developing Countries.” *American Journal of Agricultural Economics* 93(2):399–406.
- Miranda, Mario J. and Katie Farrin. 2012. “Index Insurance for Developing Countries.” *Applied Economic Perspectives and Policy* 34(3):391–427.

### **Major Consulting Assignments - Domestic**

- Chicago Board of Trade, “Analysis of the Iowa Corn Reinsurance Options Contract”, 1994.
- Risk Management Agency and NAU Insurance, “Actuarial Certification of Group Risk Income Protection Harvest Revenue Option”, 2003.
- Risk Management Agency and Great American Insurance Co., “Actuarial Rating of Area Yield Indemnity Contract”, 2003.
- US Department of Agriculture Risk Management Agency and Iowa Farm Bureau, “Actuarial Certification of Ethanol Insurance Contract,” 2004.

- US Department of Agriculture Risk Management Agency and AgForce, Inc., Actuarial Certification of Pasture, Rangeland, and Forage Vegetation Seasonal-Constrained Rainfall Index Contract, 2005.
- US Department of Agriculture Risk Management Agency and AgForce, Inc., Actuarial Certification of Pasture, Rangeland, and Forage Vegetation Temperature-Constrained NDVI Index Contract, 2005.
- US Department of Agriculture Risk Management Agency and FarmRisk, Inc., Actuarial Certification of Livestock Gross Margin for Cattle Contract, 2005.
- US Department of Agriculture Risk Management Agency and FarmRisk, Inc., Actuarial Certification of Livestock Gross Margin for Dairy Cattle Contract, 2006.
- US Department of Agriculture Risk Management Agency and FarmRisk, Inc., Actuarial Certification of Livestock Gross Margin for Swine Contract, 2006.
- Hudson Insurance, “Actuarial Assessment of Area Revenue Combo Insurance”, 2011.

#### **Major Consulting Assignments - International**

- The World Bank and Agricultural Risk Management Consulting, Inc., “Rainfall Insurance Contracts for Nicaragua”, 1998-2001.
- The World Bank and Agricultural Risk Management Consulting, Inc., “Weather-Based Index Insurance: A Feasibility Study for Drought Insurance for Morocco”, 2000.
- US Agency for International Development and GlobalAgRisk, Inc., “Hedging Weather-Driven Portfolio Risk for Microfinance Institutions in Peru: The El Nino–Southern Oscillation Index Insurance Contract”, 2004-7
- US Agency for International Development, PREMIER Project, “Economic and Actuarial Analysis of Catastrophic Drought Insurance for Bolivian Agriculture”, 2005-7.
- The World Bank Agricultural Rural Development Department. “Ghana Agricultural Sector Risk Assessment”, 2011.
- The World Bank Agricultural Rural Development Department. “Honduras Agricultural Sector Risk Assessment”, 2011.
- The World Bank Agricultural Rural Development Department. “Review of Agricultural and Rural Development Department Research and Development Activities in Weather Risk Management, 2004-2010”, 2012.

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### **Education**

- Ph.D., Economics, University of Arizona, August 2005
- M.S., Agricultural and Resource Economics, University of Arizona, May 2002
- B.S., Management, Université Gaston Berger, Saint-Louis, Senegal, October 1998

### **Current Appointment**

- Associate Professor, Department of Agricultural, Environmental, and Development Economics, The Ohio State University

### **Grants**

- Workshops on Voluntary Pollution Control Initiatives, 2011-2012, funded by the Environmental Protection Agency, \$74,728.
- An Empirical Study of the Effects of Pollution Prevention Practices on Innovation in Environmental Technologies, funded by the Ohio Agricultural Research and Development Center Competitive Grant Program, 2007-2010, \$43,530.
- Development of a West African e-Education Agro-ecology Program for Sustainable Food Production, funded by the Africa-US Higher Education Initiative, 2009-2010, \$50,000.

### **Courses**

- AEDE 801, Applied Econometrics, core PhD course, 2011-present
- AEDE 803, Applied Demand Analysis, core PhD course, 2006-2010
- AEDE 403: Principles of Agribusiness Finance, Undergraduate course, 2006-present
- AEDE 601: Strategic management: Undergraduate capstone course, 2006-present

### **Publications (selected)**

- Hernandez E., Abdoul G. Sam, Claudio Gonzalez, and Joyce Chen (2012). "Does the Insurance Effect of Public and Private Transfers Favor Financial Deepening? Evidence from Rural Nicaragua," *Review of Development Finance* 2: 9-21.
- Reece Christopher and Abdoul G. Sam (2012). "Impact of Pension Privatization on Foreign Direct Investment in Latin America," *World Development* 40(2): 291-302
- Sam Abdoul G. and Yi Zheng (2010). "Semiparametric Estimation of Consumer Demand Systems with Micro Data," *American Journal of Agricultural Economics* 92(1):246-57
- Sam Abdoul G. (2010). "Impact of Government-Sponsored Pollution Prevention Practices on Environmental Compliance and Enforcement," *J. of Regulatory Economics* 37(3): 266-86
- Sam Abdoul G. and George J. Jiang (2009). "Nonparametric Estimation of the Short Rate Diffusion Process from a Panel of Yields," *Journal of Financial and Quantitative Analysis* 44(5):1197-1230



- Sam Abdoul G., Madhu Khanna and Robert Innes (2009). "Voluntary Pollution Reduction Programs, Environmental management, and Environmental Performance: An Empirical Study," *Land Economics* 85(4): 692-711
- Innes, Robert and Abdoul G. Sam (2008). Voluntary Pollution Reductions and the Enforcement of Environmental Law: an Empirical Study of the 33/50 Program," *Journal of Law and Economics* 51(2):271-296 (senior authorship equally shared)
- Sam Abdoul G. and Alan P. Ker (2006). "Nonparametric Regression under Alternative Data Environments," *Statistics and Probability Letters* 76(10):1037-1046

#### **Professional Presentations (selected)**

- Wrenn Douglas, and Abdoul G. Sam. 2011. Not All Policies are Equal: A Nonparametric Examination of the Heterogeneous Effects of Land Use Policy. Presented at Annual North American Meetings of the Regional Science Association International. Miami, Florida.
- Reece Christopher and Abdoul G. Sam. 2010. Impact of Pension Privatization on Foreign Direct Investments: a Study of the Latin American Experiment. Presented at the Department of Food, Agricultural, and Resource Economics, University of Guelph, Guelph, ON, Canada.
- Sam Abdoul G. 2009. Impact of Government-Sponsored Pollution Prevention Practices on Environmental Compliance and Enforcement: Evidence from a Sample of US Manufacturing Facilities. Accepted for presentation at Annual Meeting of the American Agricultural Economics Association. Milwaukee, Wisconsin, USA.
- Sam Abdoul G. and Stanley R. Thompson. 2009. Impact of Country of Origin Advertising on US Import Wine Demand: A Panel Data Analysis. Presented at Annual Conference of the American Association of Wine Economists. Reims, France.
- Hernandez Emilio, Abdoul G. Sam, Claudio Gonzalez, and Joyce Chen. 2008. Conditional Cash Transfer Programs and Remittances on Credit Market Outcomes in Rural Nicaragua. Presented at Boulder-Bergamo Forum on Access to Financial Services. Bergamo, Italy.
- Sam Abdoul G. and Yi Zeng. 2007. Semiparametric Estimation of Consumer Demand Systems with Micro-Data. Presented at Annual Meetings of the American Agricultural Economics Association. Portland, Oregon, USA.
- Sam Abdoul G. and George J. Jiang. 2007. Nonparametric Estimation of the Short Rate Diffusion Process from a Panel of Yields. Presented at the CIREQ Conference on Financial Econometrics. Montreal, Quebec, Canada.
- Sam Abdoul G. and George J. Jiang. 2005. Nonparametric Estimation of the Short Rate Diffusion Process from a Panel of Yields. Presented at the World Congress of the Econometric Society. London, England.

#### **Service (selected)**

- Panelist, Ohio Agricultural Research and Development Center Seed Grants Committee, 2012-present
- Elected member of AEDE Faculty Council, 2007-2008, 2009-2011, 2012-2014
- Topic Leader for "Demand and Price Analysis" for the 2008 annual meeting of the American Agricultural Economics Association
- Moderator of "Prices and Price Relationships among Commodities and along the Marketing Channel", Annual Meeting of the American Agricultural Economics Association, Milwaukee, Wisconsin, 2009
- Moderator of "Term Structure Estimation (FIN)," World Congress of the Econometric Society, London, United Kingdom, 2005

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### **Professional History**

- Economist, African Center for Economic Transformation, Ghana, 2011-present
- Project Manager, Center for Farmland Policy Innovation, USA, 2009–2011

### **Education**

- 2011 The Ohio State University, PhD Agricultural Economics
- 2009 The Ohio State University, MA Economics
- 2006 University of North Texas, BS Economics, Top Student

### **Research Interests**

- Agricultural and Poverty
- Rural Development
- Applied Development Microeconomics

### **Teaching Experience**

- Lecturer. Columbus State Community College, Columbus, OH, USA, “Principles of Microeconomics.” 2010-2011.
- Teaching Assistant. The Ohio State University, Columbus, OH, USA, “Quantitative Methods in Economics.” 2010.
- Teaching Assistant. The Ohio State University, Columbus, OH, USA, Agribusiness Management.” 2010–2011.

### **Publications and Working Papers**

- *Climate Change and the Future of Mountain Farming on Mt. Kilimanjaro.* in The Future of Mountain Agriculture, Ed. Stefan Mann. Springer. Forthcoming 2013
- *Food Production and Consumption Trends in Sub-Saharan Africa: Prospects for the Transformation of the Agricultural Sector,* with Nicolas Depetris Chauvin and Guido Porto, 2012. Background paper for the First African Human Development Report, United Nations Development Program (UNDP), Regional Bureau for Africa, New York.
- *Identifying and Measuring Food Deserts in Rural Ohio,* with Jill Clark, 2012. Journal of Extension [On-line], Vol. 50(3) 3FEA6.
- *Optimal Rainfall Insurance Contracts for Maize Producers in Northern Ghana: A Mathematical Programming Approach,* with John Ulimwengu, 2010. IFPRI Discussion Paper 1016 August 2010,
- *Selling at the Farm-Gate or Traveling to the Market: A Conditional Farm Level Model,* 2011 Journal of Developing Areas, Vol. 44 (2) 2011, 95-107
- *The Potential and Cost Of Carbon Sequestration in Mt. Kilimanjaro: A Dynamic Model,* with David Kraybill. Under review at African Development Review.
- *Preferential Trade Agreements, Employment, and Productivity: Evaluating The Impacts of AGOA on African Firms.* Under review at World Economy

### **Languages**

- English, French (mother tongue), Lingala, Swahili

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### **Education**

- 2009 Princeton University, Ph D in Economics
- 2005 Princeton University, M.A. in Economics
- 2000 Universidad Torcuato Di Tella, M.A. in Economics
- 1998 Universidad de Buenos Aires, B.A. in Economics (Suma cum laude)

### **Fields of Interests**

- International Trade and Finance, Applied Economics, Development, and Agriculture and Resource Economics.

### **Current Affiliations**

- Senior Advisor, African Center for Economic Transformation, Accra, Ghana
- Fellow, Oxford Centre for the Analysis of Resource Rich Economies, Department of Economics, University of Oxford, United Kingdom

### **Past Work and Academic Experience**

- Dubai School of Government, United Arab Emirates, Jan 2009–Jun 2011, Assistant Professor.
- World Bank, Research Department, United States, Nov 2008–Jul 2010, Jan–April 2011, Co-Investigator, Agriculture Value Chain Project
- Sciences Po, France, Sep 2010–Jan 2011, Visiting Professor Kuwait Program
- INSEAD, France, Jan-May 2009, Visiting Researcher
- CEPPII, France, Jan-May 2009, Visiting Researcher
- New College, University of Oxford, United Kingdom, Oct 2007–Mar 2009), Lecturer
- United Nations Development Programme, Office of Development Studies, United States, Oct 2006-Sep 2007, Policy Specialist/Senior Economist
- Inter-American Development Bank, Office of Oversight and Evaluation, United States, Aug 2005-Jul 2006, Evaluation Officer
- Princeton University, United States, Sep 2003-May 2005, Instructor of Macroeconomics
- INSEAD, France, Jun-Aug 2004, Visiting Researcher, Instructor of Global Macroeconomics
- CREST-INSEE, France, May-Nov 2004, Visiting Researcher
- Universidad Argentina de la Empresa, Argentina, Mar-Jul 2001, Assistant Professor of Economics
- Universidad Torcuato Di Tella, Argentina, Jul 2000–Jul 2001, Researcher and Instructor of Trade
- Universidad de Buenos Aires, Argentina, Mar 1996-Jul 2001, Instructor of International Trade and Finance

## **Research Grants**

- Bill & Melinda Gates Foundation, 2013-2014: “Sustainable Rural Development in Africa”.
- DFID-ESRC Growth Programme, 2012-2015: “Agricultural Supply Chains, Growth and Poverty in Sub-Saharan Africa: Market Structure, Farm Constraints and Grass-root Institutions”.
- BNPP Research Grant, 2007-2010: Co-Investigator
- Mellon Foundation Grant, 2004: Dissertation Grant
- Princeton University International Economics Section Grant, 2004: Dissertation Grant

## **Fellowships**

- Princeton University Graduate School Summer Fellowship, 2002-2005
- Princeton University Graduate School Fellowship, 2001-2005
- Social Science Research Council Program in Applied Economics, 2003
- Argentinean National Science Foundation (CONICET) Graduate Fellowship, 2000-2003
- PROPAL UBA Fellowship, 1997-1998

## **Peer Reviewed Publications**

- 2012 “South-south cooperation and the experiences of Sub-Saharan Africa and the Maghreb region: Missed opportunities and the Way Forward” (with Mhamed Biygautane), Chapter 10 in “The Rise of the Global South: Philosophical, Geopolitical and Economic Trends of the 21st Century” Edited by Justin Dargin, World Scientific Publishing Company
- 2011 “Supply Chains in Export Agriculture, Competition, and Poverty in Sub-Saharan Africa” Book published by CEPR (with Guido Porto and Marcelo Olarreaga)
- 2010 “The rise of the Gulf: Saudi Arabia as a Global Player” Journal of Konrad-Adenauer-Stiftung.
- 2007 “Who Gets Debt Relief?” (with Aart Kraay). Journal of the European Economic Association, Vol. 5, No. 2-3.

## **Policy Papers, Reports for International Organizations and Other Work**

- 2012 “The Quest for Economic Transformation in Africa” SKOLKOVO Business School-Ernst & Young Institute for Emerging Market Studies. Monthly Report Series.
- 2012 “FDI flows in the MENA region: Features and Impacts” SIEMS-SKOLKOVO Business School Monthly Report Series.
- 2012 “Food Production and Consumption Trends in Sub-Saharan Africa: Prospects for the Transformation of the Agricultural Sector”. Background paper for the First African Human Development Report, UNDP (with Francis Mulangu and Guido Porto)
- 2011 “African Lions in the Making”. SIEMS-SKOLKOVO Business School Issue Report Series.
- 2011 “Food Prices: Drivers and Welfare Impacts in Emerging Market Economies”. SIEMS-SKOLKOVO Business School Monthly Report Series.
- 2011 “The New Geography of Capital Flows”. SIEMS-SKOLKOVO Business School Issue Report Series.