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Climate Change and Agriculture in Africa

Climate change will have a significant impact on African agriculture. How farmers adapt will matter

African farmers and agricultural systems are at the forefront of vulnerability to climate change. Yet until recently there has been little or no comprehensive understanding of vulnerability to climate change across Africa—critical to guide concerted and focused policy and investment interventions needed to protect agriculture, which is central to many African economies.

A recent study, synthesized in *Climate Change and Agriculture in Africa*, undertook a comprehensive quantitative analysis and assessment of potential economic impacts of future climate change on agriculture—and the value of measures to adapt to climate change—for different zones, regions, countries, and farm types in Africa. Four papers address different aspects of the climate change–agriculture nexus, using a survey of nearly 10,000 farmers sampled across West Africa (Burkina Faso, Cameroon, Ghana, Niger, Senegal), southern Africa (South Africa, Zambia, Zimbabwe), East Africa (Ethiopia, Kenya), and North Africa (Arab Republic of Egypt). The analytical framework is based on the presumption that there is a relationship between the value of land (if available), or the net revenue from growing crops, and climate, while controlling for water availability (runoff), soil quality, and socioeconomic variables.

Kurukulasuriya and Mendelsohn, in a Ricardian analysis of the impact of climate change, find that net revenues fall as precipitation falls or as temperatures rise across all surveyed farms. Examining rainfed and irrigated farms separately, they also find that rainfed farms are especially climate sensitive. Irrigated farms, located in relatively cooler parts of Africa, have an immediate positive response to warming. Using a climate sensitivity

response function, the authors simulate climate change scenarios, both uniform across Africa and location specific. The results suggest that not all countries are equally vulnerable to climate change—with predicted vulnerability depending on temperature and precipitation changes, whether a country is already hot and dry, and the extent to which farms are irrigated.

Maddison, Manley, and Kurukulasuriya conduct a similar analysis, except that they use farmers' own perceptions of the value of their land (as in a land sale). The results reinforce the findings of the analysis based on climate variables. Using additional variables, this second analysis finds that distance to markets is an important factor in farmers' ability to adapt to climate change. Country differences stemming from institutions and regulations also affect adaptability.

Two approaches are used to measure adaptation. In the first, based on observed household behavior, Kurukulasuriya and Mendelsohn examine whether the choice of crops is affected by climate in Africa. Not surprisingly, crop choice appears to be very climate sensitive. The crop mixes selected by farmers differ, depending on whether the region is cooler, moderately warm, or hot—and whether conditions are dry, medium wet, or wet.

The findings in this paper suggest that as temperatures warm, farmers will shift toward more heat-tolerant crops. And as precipitation increases or decreases, they will shift toward water-loving or drought-tolerant crops. Moreover, while the analysis examines choices only among current crops, farmers may well have more choices where new varieties, more suited to higher temperatures and lower or higher rainfall, are developed.

Is the observed behavior of farmers in adapting to the present climate across Africa optimal? Maddison raises doubts about whether farmers know immediately what constitutes the best response to climate change when the agricultural practices it requires are outside their range of experience. Nor can they be expected to immedi-

ately recognize that the climate has changed.

Using responses to open-ended survey questions, Maddison determines how well farmers in Africa are able to detect climate change and how they have adapted to whatever climate change they believe has occurred. While significant numbers of farmers believe that temperatures have already increased and that precipitation has declined, those with the greatest experience in farming are more likely to notice climate change.

Among adaptations made in response to climate change, planting different varieties of the same crop and changing planting dates are important everywhere. But stratifying the data by the precise perception of climate change provides greater insights. Where temperature changes are perceived, farmers plant different varieties, shift from farming to nonfarming activities, increase water conservation, and use shading and sheltering techniques. Where changes in precipitation (especially in the timing of the rains) are perceived, varying the planting date appears to be

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Teacher Compensation and Decentralization in India

● Lant Pritchett and Rinku Murgai

The system of teacher compensation, combining high pay and zero accountability, is at the heart of problems in India's public education

Publicly produced elementary education in India faces enormous problems. Although enrollments have increased, a recent survey of rural areas in all districts found shockingly low levels of learning achievement, confirming the accumulating piece-meal evidence. There are many other indicators of distress: high levels of dissatisfaction with teachers among parents and students, a massive and ongoing shift into private schooling, and the unhappiness of the public sector teachers themselves. In a new paper Pritchett and Murgai argue that the system of teacher compensation in the public sector is at the heart of many of these problems.

A system of compensation for any performance-oriented organization should attract, retain, and motivate workers who, on a day-to-day basis, pursue the goals of the organization. All four elements of a system of compensation—durability of the employment relationship, structure of pay across states of the world, assignment of workers to tasks, and cash relative to benefits—should work together toward this goal.

While there are many variations across states in India, it is not unfair to describe the system of teacher compensation as combining high pay and zero accountability. The paper documents four facts about the system of teacher compensation:

- There is little or no ability to separate teachers from service—for any cause.
- The average pay in public sector teaching is very high relative to the pay in alternative employment (both private teaching and other private sector jobs).
- The degree of overpayment is higher for public sector teachers at the early stages of a career.

- The pay of public sector teachers has very little variance even potentially related to performance—much less so than the pay of either private sector teachers or other private sector salaried workers.

Each of these elements of the system of compensation reinforces the lack of accountability. There is nothing in the system to attract people well matched to teaching, to retain the best and most committed teachers, or to motivate good teachers (or, for that matter, to prevent good teachers from becoming disillusioned, cynical, and embittered and yet stay until they reach the age of 60). Moreover, the institutional context of basic schooling—all the other relationships of accountability—is also weak.

This system of compensation plays a large part in producing today's "perfect storm" in public schooling: the learning achievement of students is low, the absenteeism of teachers is high, the treatment of students by teachers is often abysmal, recourse to private instruction is rampant, parents and students are dissatisfied with government schools, and people are voting with their feet and their pocketbooks for the private sector. Perhaps worst of all, the potentially good teachers in the public system are disenchanting and overburdened and feel disrespected by parents and management. Any reform of teacher compensation needs to be *pro-teacher* because the present system is dramatically *anti-teacher*.

Most observers agree that there is no possibility of significant reform of teacher compensation in the existing system. But the devolution of education to the local governing bodies known as Panchayati Raj institutions (PRIs) provides an opportunity to sail out of this perfect storm—to completely restructure the system of compensation to be consistent with an accountable, performance-oriented public sector. Decentralization to PRIs is certainly no panacea—but it may well be the last best hope.

But simply shifting the existing system—with its lack of performance orientation, lack of external accountability, and strictures on compensation—to the PRIs is unlikely to lead to improvements. That said, decentralization to PRIs, if done well, has the potential to break the political impetus behind business as usual by combining a reallocation of functions across tiers of government (states and PRIs) with the freedom for PRIs to develop systems of compensation aligned with the realities of public employment and the particularities of the practice of teaching.

With the development of a new cadre of teachers under district control, newly hired teachers can be launched into a new system and sail out of today's perfect storm—and publicly produced schooling will be able to compete with private alternatives.

Lant Pritchett and Rinku Murgai. Forthcoming. "Teacher Compensation: Can Decentralization to Local Bodies Take India from the Perfect Storm through Troubled Waters to Clear Sailing?" India Policy Forum. Washington, D.C.: Brookings Institution. Also available at http://lpritchett.org/research_education.htm.

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an important response. There is also evidence that adaptation measures are linked to baseline climate and that adaptation occurs mainly on sites that are already marginal (hot and dry).

The propensity of farmers to adapt differs across locations, and understanding the underlying factors would require further analysis. Yet only those who perceive climate change undertake adaptation—and the perception of climate change appears to hinge on farmers' experience and the availability of affordable technologies, management practices, and extension advice related to climate change. While the policy options for promoting greater awareness of climate change may be limited, the perception of climate change is already widespread.