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CASE STUDY
Agriculture and Food Security

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SIKASSO, MALI

This study is of particular relevance to those engaged in agricultural development in drought prone areas.

BACKGROUND

Mali is one of the poorest countries in the world, with approximately 60% of the population living in poverty. Agriculture accounts for a substantial portion of Mali's gross domestic product (GDP) and employs a large portion of the country's workforce. However, the agriculture sector faces severe challenges; the climate is hot and dry, and only 4% of the land is arable. The main farming products are cotton, millet, rice, corn, vegetables, groundnuts, cattle, sheep, and goats. Over 80% of dietary energy consumption is from cereals, and the Food and Agriculture Organization (FAO) of the United Nations has estimated that 28% of Malians are undernourished. Malnutrition and micronutrient deficiencies are common; in 1996 33% of children suffered from stunting and 25% from wasting. The UN has projected that the population of Mali could increase by 49% between 1996 and 2015, which will further strain already deficient resources.

DEVELOPMENT CHALLENGE

To improve the economy and standard of living in Mali by improving agricultural productivity, in spite of major environmental challenges.

CORE PROJECT

Mali was chosen as a study site because of its major food security problems and because its economy, based largely on rain fed agriculture, is particularly climate sensitive. Although USAID is engaged in agricultural development projects in Mali, this was essentially a free-standing pilot study designed to identify climate vulnerabilities and solutions in the agriculture sector.

ADAPTATION OBJECTIVE

To improve both the robustness of the agricultural sector to climatic variability and overall agricultural productivity.

FOLLOWING THE STEPS IN THE USAID ADAPTATION GUIDANCE MANUAL

STEP 1: SCREEN FOR VULNERABILITY

The Malian agricultural sector is currently incapable of adequately providing for local needs. The situation is likely to worsen as the result of global climate change, in particular decreased and temporally altered patterns of precipitation. This adaptation pilot focused on the town of Zignasso in Sikasso, the wettest (~1200 mm precipitation/year) and agriculturally most productive region of Mali. In Zignasso, rice or maize is grown in the wet season and rotated with potato and vegetables in the cooler dry season.

STEP 2: CONVENE STAKEHOLDERS AND DEVELOP A PLAN FORWARD

Local farmers were convened to discuss their perceptions of climate variability and climate change, how they had coped with this variability and change in the past, and how they could continue to adapt to climate change. Farmers stated that it had become hotter and drier, and that there was now more year-to-year variability. Additionally, they could now only grow two (rather than three) crops in a year, the growing season for rice was shorter, there were decreasing yields of other crops, and livestock took longer to start reproducing.

Adaptations to deal with higher temperatures and a shorter rainy season were discussed. Suggestions included: planting crops earlier in the season or planting early-maturing crop varieties, changing where crops are grown, utilizing better soil management practices, installing more rock lines to trap water, installing a water gate in the polder (a water retention area) to allow irrigation, taking advantage of weather forecasts, and decreasing deforestation (by either planting trees, or reducing the amount of firewood used).

STEP 3: ANALYSES

Expected climate change in 2030 and 2060 was previously analyzed by Bruce McCarl & Tanveer Butt (published in: Climatic Change, 2005, 68: 355-378).

Changes in temperature and precipitation were projected for climate scenarios that incorporated different levels of emission reductions and different climate sensitivities, using two different types of models (both had CM3 and CGMC). All analyses projected an increase in temperature (1°C by 2030 and 2-3°C by 2060), while projections for precipitation varied considerably.

Impact of future climate change on crop yields in the Sikasso region was previously analyzed by McCarl & Butt (Climatic Change, 2005), and augmented by them for this pilot study.

Previous work by McCarl & Butt (2005) projected country-wide impacts of climate change on yields of maize, groundnuts, cotton, sorghum, millet, and cowpea. Outputs from the climate analyses were entered in the Erosion Productivity Impact Calculator (EPIC), a sophisticated biophysical model that utilizes historical data and climate projections, as well as information on current farm management practices, to model effects of soil erosion, heat and water stress, and nutrient balance on crop yields. In the absence of adaptation, yields of all crops other than cotton were projected to decrease from 6-17%. Yield reduction was due, in large part, to impacts of climate change on land degradation. Use of heat resistant varieties was projected to lesson yield reduction by 2.5-7%, depending upon the crop. This study also projected that in the absence of adaptation forage, yield would decline 5-36% and livestock animal weights would decrease 14-16%.

The USAID team requested that yield of potato, a major cash crop, also be analyzed. For potato, the adaptation considered was a 20% increase in water application. It was found that if no adaptations were employed, there would be a substantial (~25%) decrease in the yield of potato by 2060. With increased irrigation the negative impact on potato yield could be reduced to 5%, though given the limited water supply available for irrigation, this is unlikely to be a sustainable practice.

STEP 4: SELECT COURSE OF ACTION

Stakeholders, including farmers, village chiefs, the head women, and representatives from regional agricultural services, extension services, nongovernmental organizations (NGOs), the Direction National de la Conservation de la Nature, the Direction Nationale de la Meteorologie, Stratus Consulting, the USAID/Mali Mission, and the USAID Global Climate Change (GCC) Team, were assembled to discuss adaptations. Prior to this, the Institut d'Economie Rurale du Mali (IER) had evaluated the previously-identified adaptations for their likely effectiveness, cost, feasibility, adequacy in the current climate, and degree of assistance needed to implement. A small subset of adaptations, such as crop residue incorporation, crop diversification, and seed priming were simultaneously inexpensive, easy to implement, and highly effective. However, many adaptations expected to be among the most effective, such as agrometeorology, or using access to capital to finance a water gate or purchase fertilizer, had high cost and assistance requirements.

Farmers and regional technical services differed greatly in the types of adaptations they favored. Farmers were most interested in improved physical infrastructure, such as a water gate that would allow furrow irrigation to be used for potatoes, equipment (such as better plows, carts, and oxen), and increased support for a warrantee scheme that allowed rice to be stored until market prices were more favorable. In contrast, technical experts more strongly favored strategies related to improved crop management practices, such as crop diversification, germplasm improvement, soil management, and access to and appropriate use of fertilizer.

STEP 5: IMPLEMENT ADAPTATIONS

The USAID Mission is currently evaluating its funding priorities.

STEP 6: EVALUATE ADAPTATIONS

Not yet applicable.

OUTCOMES

Identification of ways in which USAID can help Sikasso improve its agricultural productivity:

a) Promoting water harvesting techniques;

b) Promoting crop diversification and germplasm improvement;

c) Improving soil management through integrated natural resource management;

d) Providing farmers with access to credit for fertilizer, equipment and storage;

e) Improving accuracy of and availability of weather forecasts; and

f) Training farmers on no-cost or low-cost adaptations that can be readily implemented.

LESSONS LEARNED

1. **Stakeholder involvement is critical.** Stakeholders had experienced declining crop yields and were highly motivated and engaged. Stakeholders may provide key insights – the suggestion to analyze potato came from local farmers. Although cash crops are often ignored in studies related to food security, the projected large impact on the economically important potato crop was one of the major outcomes of this study.

2. **Managing stakeholder expectations is important.** For a pilot study such as this, it is important be clear that the outcome will be a series of recommendations. In some cases, implementing adaptation recommendations will require identifying additional donors.

3. **A range of adaptive solutions, from easily implemented low cost approaches to high cost infrastructure projects, should be identified.** In this study, farmers were particularly interested in the building of a water gate similar to one other donors had recently installed in a neighboring village. However, in the near term lower cost approaches such as installation of rock lines are more feasible and realistic.

QUESTIONS TO CONSIDER AS YOU THINK ABOUT ADAPTING SIMILAR PROJECTS

Current Obstacles to Development

1. To what extent are demand for food and water currently being met? How is demand likely to change in the coming decades?

2. How do farmers balance short term and long term needs? Do what extent do they maintain soil quality and avoid problems of land degradation?

3. How does the government manage and regulate use of water resources? How do community members comply with these regulations? Under current approaches, are sources of fresh water becoming depleted or contaminated?

4. Are there cultural or social barriers to the adoption of farming practices (or crops) that would result in higher yields, increased income, or better nutrition?

Observation of Change in Climate

5. Has the frequency, magnitude, or timing of precipitation changed in the last several decades?

Impacts of Climate Change

6. How have crop yields changed in recent decades? Is there reason to think this is due to the observed changes in climate versus other factors?

7. Are impacts of climate change being exacerbated by what crops are being grown? For instance, have farmers switched to growing value added crops that require high levels of water, or are possibly unsuited in other ways to current and likely future climate?

Sources of Advice, Support, and Training

8. Where do farmers currently go for advice and support on agricultural practices? How could information be better disseminated, and how could training opportunities be expanded or improved?

9. Where do farmers get weather information relevant to planting and harvesting? How heavily do they rely on information from meteorological services, from other villagers, and from government? How could information about weather be distributed more effectively?

Current Coping Strategies

10. What practices do farmers employ to improve crop yields? What methods, tools, and technologies do they have access to?

11. To what extent do farmers respond to recent climate when deciding what to plant (or how to manage crops), versus simply continuing traditional practices?

For more information on Mali, visit: http://mali.usaid.gov

For a copy of the USAID Adaptation Manual, visit:
http://www.usaid.gov/our_work/environment/climate/docs/reports/cc_vamanual.pdf