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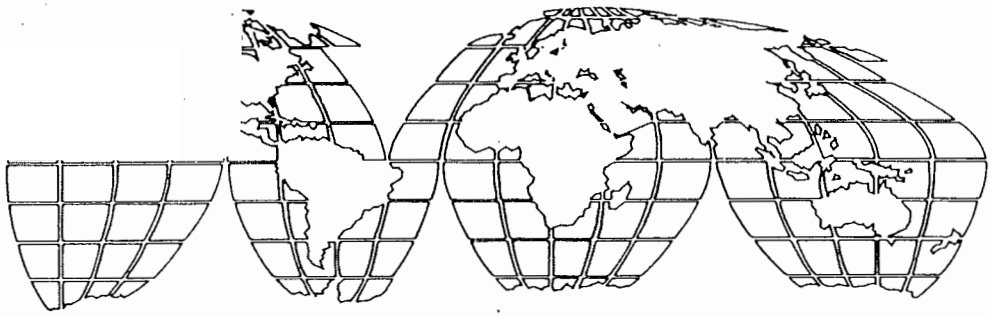
Agriculture and the Environment: Mali Case Study



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Summary

Mali's cropland is largely concentrated in the fertile Upper Niger River Basin, in the southern part of the country. Problems of sustainability began to develop there in the 1970s with a major drought. Rainfall shortages continue, and now deforestation, poor cultivation practices, and population pressures have coalesced into a threat to soil fertility.

To combat the problem, USAID has provided $37.5 million in grants through two bilateral projects, HVN I and its successor, HVN II. ("HVN" stands for "Haute Vallée du Niger.") USAID also supports research in the region through its $19 million Farming Systems Research and Extension project.

The projects seek to spur the adoption of sustainable farming practices in Mali. That objective involves the introduction of technologies that are both environmentally sound and appropriate to local farm conditions. It means improving literacy and financial training so people can participate effectively in local cooperatives and other organizations. It also calls for strengthening linkages between national, regional, and international agencies.

In August 1993 a team of evaluators from USAID's Center for Development Information and Evaluation (CDIE) visited Mali to gauge the impact of the projects as part of a five-country assessment of USAID's programs in sustainable agriculture. (The other countries studied were Gambia, Jamaica, Nepal, and the Philippines.) The evaluators found generally promising results.

The most important advance is the development of strong village-level organizations. Local cooperatives, for example, have largely supplanted the large, autonomous regional development authority, the Opération Haute Vallée du Niger (OHVN), in managing agricultural credit. OHVN used to serve as middleman. Now village cooperatives deal directly with commercial banks.

The change came about as part of a USAID-supported restructuring of OHVN. It became apparent in the 1980s that rural development through the large, powerful parastatal was not working. OHVN lacked the resources to tailor its objectives to local conditions, and farmers had little sense of empowerment. The reorganization reversed OHVN's relationship with farmers. Emphasis now is on upward participation rather than downward direction.

Advances also took place in policy reform. For example, the Agency was instrumental in reducing fertilizer subsidies. That provided an economic incentive for farmers to use organic fertilizers, which are both cheaper and more

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environmentally friendly than chemical alternatives.

In technology transfer, the Agency helped introduce new streak-resistant maize varieties, better fertilizing systems, and measures to prevent soil erosion. These technologies yield quick, observable results that engage farmers' interest. Generally, Malian farmers have become increasingly aware of soil problems—and are willing to change their practices to prevent further damage.

The evaluators found some areas needing improvement. They observed, for example, that OHVN still has only limited capacity to carry out rural development. Extension agents need better training, and technology transfer mechanisms remain weak. The evaluators noted, moreover, that literacy training for members of village associations has produced lasting results in only a few locations.

Overall, the evaluation points to three lessons: (1) Links between research programs and host country development organizations are crucial. (2) Farmers will adopt sound practices if they are tailored to local conditions. And (3) new technologies stand a better chance of acceptance if they have a readily observable short-term payoff.

Background

Although only 2 percent of Mali's land is considered arable, agriculture plays a dominant role in the country's economy. It accounts for more than half of Mali's gross domestic product and employs four fifths of the work force. Cotton alone earns the landlocked nation 40 percent of its foreign exchange.

In the past two decades, Mali has found that existing farming practices are inadequate to deal with increased pressure on available cropland. This is especially true in the Upper Niger River Basin region, where nonsustainable agricultural practices (notably with cotton), deforestation, changes in rainfall patterns, and population pressures threaten soil fertility.

The Government of Mali traditionally approached rural development through large autonomous regional authorities, or *opérations,* to carry out its programs. In the Upper Niger River Basin, agricultural extension service is performed by the OHVN. OHVN management gives priority to developing commercial crops, now primarily cotton. (Much more than food crops, commercial crops produce revenue and jobs, both on- and off-farm.)

Research had suggested that if farmers changed from hand tools to animal traction, the average area under cultivation would double to 10 hectares per household. That might increase food production significantly. Once farmers actually did adopt animal traction, however, they used it only incidentally for food crops. Farmers chose instead to raise more profitable commercial crops, chiefly cotton, with its intensive cultivation techniques.

By the mid-1980s intensive cotton cultivation and food-crop production had left much of Mali's southern HVN-zone soils exhausted. Soil erosion and declining use of organic fertilizers have led to predictions that, if conventional cotton production practices continue unmodified, soil productivity in Mali's cotton-growing areas will collapse in 30 years. As one farmer in the zone remarked, *"Pas de coton, pas de paysan."*

OHVN, with its central control and top-to-bottom approach, afforded little local participation in planning or introducing technologies and practices. Farmers had little sense of empowerment. Furthermore, OHVN had insufficient financial and human resources to tailor its objectives to specific localities. As a result, Mali's efforts at installing systems of sustainable agriculture were not succeeding.

USAID's Assistance Approach

During the late 1970s USAID's strategic objectives supported the Malian Government's goal of increasing productivity of food grains after years of drought. In 1978 USAID launched the HVN I project to increase agricultural productivity, production, and marketing. HVN I and its successor, HVN II, took the form of an integrated rural development program with components in agriculture, health, literacy, and transportation (see box 1). Both projects have been carried out under OHVN (see box 2).

The Agency's goals in agriculture have evolved substantially since 1978. The original approach aimed at increasing basic food-crop

Box 1. Projects

Opération Haute Vallée (HVN I). This $20 million integrated rural development project started in 1978 and ended in 1988. Although it concentrated on food-crop production, it financed research, road construction, animal traction training, credit for farmers, administrative support, rice polder rehabilitation, health services, and functional literacy. Credit for oxen and equipment (plows, seeders, harrows) was deemed sufficient to increase productivity of staple cereals (sorghum, millet, maize) and enable farmers to cultivate twice the land that they could using hand tools. Malian parastatals provided other credit needs.

Development of Haute Vallée (HVN II). To confront chronic weaknesses of national agricultural institutions in delivering agricultural inputs and services in the HVN zone, USAID and the Government of Mali in 1988 signed a new $17.5 million project. HVN II undertakes local community development and restructuring of the OHVN parastatal and provides further support to earlier OHVN rural roads and functional literacy programs. The project includes assistance from the National Cooperative Business Association to strengthen the cooperatives' capacities to absorb many of the parastatal's functions. HVN II was being amended at the time of the CDIE evaluation to extend it to 1998.

Farming Systems Research and Extension (FSRE). To address problems of stagnating crop production, USAID in 1985 authorized a 10-year, $19 million FSRE project. FSRE seeks to develop and introduce more sustainable production systems. It provides support for on-farm development and testing of new sustainable agricultural practices and for extending these practices to farmers through better communications. A second-phase project to strengthen agricultural research institutions and sustainable agriculture programs was authorized in fiscal year 1992.

Box 2. Institutions

Opération Haute Vallée du Niger (OHVN) is the parastatal charged with rural development of the upper valley of the Niger River. It covers the valley to the north and south of Bamako, extending to the Guinea border. OHVN was established in 1972 to provide services for tobacco production. Later cotton became the main cash crop. When large integrated rural development projects were in fashion, OHVN was a powerful multisectoral agency and took on many of the functions of the state within its territory. USAID assistance started in 1978 with HVN I and continued with HVN II.

Institut de l'Economie Rurale (IER) is the consolidation of several institutes conducting research on agriculture, livestock, forestry, and fisheries. Its Division de Recherche sur les Systèmes de Production carries out farming systems research. USAID's FSRE and successor projects provide support to a research station in the Sikasso region (just to the east of the OHVN zone), conducts some field work in the northern part of the OHVN zone, and has recently started work out of the Mopti research station 640 kilometers northeast of Bamako.

production through supplying inputs to support technologies. It gradually became clear, however, that the multisector rural development approach using parastatals was not working. USAID continued to support food-crop production, but its strategy moved toward (1) sustainable cropping systems and (2) policy reforms reducing the role of the public sector and increasing liberalization of markets.

USAID authorized a Farming Systems Research and Extension (FSRE) project in 1985 to develop more sustainable production systems and extend these technologies and practices to farmers through better communications. To confront chronic delivery and service weaknesses in the HVN zone, USAID and the Malian

Government in 1988 signed a new Development of Haute Vallée project, HVN II.

Technologies for sustainable agriculture have been available in the Sahel for years, but widespread adoption was rare. Adoption required several policy changes, including removal of market and price controls. In addition, cost-sharing mechanisms were needed for interventions with high potential for social payoffs but less obvious returns to private investors. USAID and other donors helped the Government of Mali to move away from state intervention and toward market-driven production. Fertilizer subsidies were reduced, partly to encourage farmers to use organic rather than chemical fertilizers.

Evaluation Findings

Mali's physical and institutional landscape has changed since the HVN I project began a decade and a half ago. Mali's donors, government, and people have added to the inventory of know-how, infrastructure, and organizations in the HVN region. USAID has had a significant causal role in several changes.

Program Outcomes

With USAID support, OHVN has reoriented its activities to include community development, but it still has only limited capacity to carry out this type of work. A major objective of HVN II was to help OHVN concentrate primarily on extension and to transfer management responsibility for agricultural credit and marketing to village cooperative associations, private enterprises, and banking institutions. To do so, HVN II planned the following actions:

- Clarify extension messages through systematic production and distribution of technical sheets
- Reinforce monitoring capacity to ensure that extension messages get out and farmer feedback percolates up through the OHVN hierarchy
- Transfer a number of extension responsibilities to village farmer–agents
- Shift extension communication methods from individuals to groups, using farmer field days, farmer-to-farmer visits, pilot farmers, and village extension groups
- Reduce OHVN staff by half

OHVN has tried to implement all measures, except for staff reduction. Although extension personnel have become more professional, there remains room for improvement. For example, extension staff are trained in a variety of extension messages by agroecological zone and socioeconomic group, but they have made little progress in building these variations into information sheets for easier targeting of recipients. Furthermore, mechanisms to solicit feedback from farmers on extension messages are not well developed. Even where strong village institutions exist, the public sector lacks adequate technology transfer mechanisms to help farmers adopt sustainable practices.

Reforms in food grain marketing have had important economic and psychological effects on farmers in the HVN zone. The cereal marketing reform program, for which USAID was the lead donor during the mid-1980s, increased farmers' confidence, helping them boost production. Because farmers and traders received official blessing to market maize, sorghum, and millet without state interference, they became more willing to make other decisions on agricultural production. Moreover, market liberalization reduced the power of government agents; partial liberalization of input delivery systems allowed procurement of credit and inputs from any source in the project zone.

Local village associations now play an active role in OHVN program development and implementation. HVN II emphasizes the creation of village and other local-level cooperatives as engines of rural development. This emphasis includes greater concentration on developing local-level capacities to acquire credit and production inputs without recourse to state-run agencies. As of June 1993, OHVN was assisting 178 village-level associations and 59 local groups. That compares with 11 HVN I pilot organizations in 1984 and 47 in 1988.

A notable transition occurred from OHVN-managed credit to a system in which village associations deal directly with banks for short- and medium-term agricultural credit. USAID was instrumental in shifting responsibility from OHVN to the associations for determining

credit needs, soliciting and negotiating bank loans, and using group solidarity as collateral.

The amount of agricultural credit the banks granted in the zone nearly doubled from 1989 through 1992. In the same period, group credit grew from 68 percent to 83 percent of the total. Village associations have banded together to negotiate bulk prices and delivery terms with private sector suppliers (more than 200 did so for the 1993 season). Previously they had to order through a state-owned supply agency.

Several factors contributed to the achievements of the village associations. They include stronger functional literacy and numeracy (where programs were carried out effectively), market liberalization, greater public commitment to local-level empowerment, and better training in financial management and organizational skills. Commercial banks are rarely interested in extending credit to individual small farmers, but they have been willing to lend to small-farmer *groups.*

Accomplishments in functional literacy are mixed after 15 years of on-again off-again support. HVN II project managers believe adequate levels of literacy and numeracy are essential for developing effective cooperatives and local institutions. These groups are key links in transferring sustainable agriculture technologies to farmers. The Direction National de l'Alphabébetisation Fonctionale et de la Linguistique Appliquée (DNAFLA) is the agency charged with functional literacy. DNAFLA is trying to transfer costs and responsibilities to local entities. Village literacy classes, for example, will be transferred gradually to local groups as village treasuries increase through expanded economic activities and as program graduates become instructors.

By late 1992 more than 500 literacy centers operated in the zone. Sixty-five percent were for men and 20 percent were for women, with the remainder for mixed-sex groups. It is unclear how many centers still function regularly, and some seem to have gone out of business.

Results appear minimal if measured by actual numbers of people literate and numerate. Women are said to constitute more than 20 percent of neoliterates and more than 10 percent of village literacy teachers. However, evidence suggests these figures are inflated. Even in the southern project zone there is reportedly an average of only two literate females per village association. On balance, literacy training was well intentioned but not well implemented.

Still, the cooperatives could not have carried out credit and input procurement programs without a sufficient number of literate and numerate members. This is particularly true for the growth of women's cooperative groups (at least 25 in early 1993).

Program Impact

Sustainable agriculture technologies promoted by USAID since the early 1980s include widely accepted animal traction and improved food-crop varieties. Beginning with the 1989 growing season, the HVN II project promoted soil conservation practices and natural resource management. There is little evidence that these have been adopted beyond farmer demonstrators. They may find wider adoption with time, as benefits become more evident.

Unreliable data—the result of an overreliance on simple counting and a lack of qualitative analysis (see box 3)—make it difficult to gauge the impact of USAID interventions. Still, the CDIE team examined what farmers in the OHVN are doing differently as a result of the project and whether changed practices are sustainable. Farmers most enthusiastically embraced three technologies:

(1) They adopted improved rock-line technologies to reduce soil erosion. OHVN records show construction of 1,711 meters of rock bands and 19,740 meters of dikes from 1989 through 1992. OHVN extends a rock-line technology developed by a Dutch–Malian team in the adjoining Sikasso region. It refines a traditional practice, so farmers are already aware of the concept. Farmers are interested in the improved version because the rock lines constructed along the contour line of slopes are less prone to wash out during heavy rains. After a few downpours on lightly sloped, somewhat degraded land, farmers can quickly gauge the difference.

Because damage from flash floods and heavy rains is rarely limited to a single farmer's fields, strong village institutions are essential for establishing soil conservation systems. The rush of water begins at the top of an incline and winds down through other fields, washing away topsoil and seedlings and leaving sand deposits

Box 3. Tallying Technologies Adopted

Although farmer adoption rates for new technologies appear impressive, several observers have noted problems with OHVN's measurement methods. Here's what they found:

(1) Continued use of traditional practices is often attributed to OHVN extension. It is not clear what criteria are used to distinguish between traditional live fences and those with a project-extended innovation. Application of organic fertilizer, use of animal traction, and various cultural practices for cotton predate OHVN. The marginal contribution of USAID support to OHVN could not be determined.

(2) OHVN counts research trials and equipment donated by voluntary organizations as "adoption" of OHVN practices. In such instances, it is too early to tell whether farmers will incorporate technologies into their production systems.

(3) OHVN employees count technologies extended in packages in a misleading way. Often farmers select components within a package. According to one informant, if a given package has four components, and the farmer adopts only one practice, OHVN records the farmer as having accepted "25 percent" of the package. When aggregated this way, adoption statistics become meaningless. The numbers hide potentially valuable information about which parts of a technology package are adopted and which are discarded. Adoption of "half" the package by two farmers becomes indistinguishable from a single farmer adopting the full package.

(4) Reporting is strictly by numbers: number of farmers, meters of infrastructure created, and units created. There is little in the way of qualitative analyses of farmer attitudes or critiques of practices. Nor are there economic analyses of farm-level profitability of individual technologies. OHVN adoption studies also do not record spillover effects in nearby villages.

or bare bedrock. The velocity and volume of runoff render conservation measures useless on any single field. Therefore, all families whose fields are threatened must build rock-line systems.

Building is arduous and time-consuming. Rocks are transported in borrowed carts or headloads. OHVN helped alleviate the difficulty by paying 75 percent of truck rental costs for transporting rock. Villagers supplied everything else in cash or in kind. Less labor-intensive adaptations of the rock-line technology are also possible (see box 4).

(2) They used combined crop–livestock systems that improve soil nutrition. Increased soil acidity from excessive application of chemical fertilizers and reductions on fertilizer subsidies gave farmers powerful reasons to "go organic." Organic solutions promoted by OHVN and by FSRE projects include systems that combine stabling of animals, composting, manure pits, and improved corrals. USAID helped develop these systems from methods already in use. In addition, USAID promoted cultivation of a leguminous nitrogen-fixing forage, *Dolichos lablab*. These technologies build on local practices. Being familiar with the concepts makes it easier for farmers to adopt the technologies.

Attempts to extend these technologies run into problems. The current array of extension information on organic fertilizer use is confusing to extension agents and farmers alike. Information sheets are vague, incomplete, or even conflicting. Practices are not tailored to local agronomic conditions or socioeconomic status of recipients. Costs and benefits have not been analyzed. No adequate examination has been done on the differences between traditional practices and the new combination with regard to returns on labor, fertilizer quality and quantity, and impact on crop yield.

(3) They planted improved maize varieties. The new varieties provide more reliable yields while requiring lower fertilizer and pesticide applications. USAID has supported introduction of streak-resistant early maize varieties with lower fertilizer requirements than previous high-yielding varieties. Pesticides are not needed to control insects that transmit the streak virus.

Lack of improved seed multiplication and distribution systems currently constrains further adoption of improved maize varieties in the OHVN zone. Adoption is further hampered by the weakness of extension services. The extension function is necessary to transfer knowledge of the new technologies and practices from researchers to enough local institutions and individuals to launch farmer-to-farmer spread. People in the OHVN zone know that new varieties exist, but not enough seed is available to meet demand. From an institutional perspective, OHVN has little incentive to promote food crops. Public funding is not ensured, and the agency's only profit-making operations are cotton and (to a lesser extent) tobacco.

Program Performance

Incentives to adopt sustainable technologies are stronger now than before, because OHVN-zone farmers are increasingly aware of erosion and losses in soil productivity. They also have economic incentives to change their practices. Higher prices for chemical fertilizers and removal of fixed floor prices for coarse grains have pushed farmers to search for cheaper ways to maintain soil fertility—such as with organic fertilizers.

Furthermore, adoption of cotton-based cropping systems introduces complex dynamics. Cotton production is strongly correlated with increased use of animal traction equipment, chemical fertilizers, and land. This combination leads to substantial short-run yield and production gains. Without ameliorative actions, however, it speeds reduction of soil fertility. Eventually, obvious depletion will motivate farmers to adopt prescribed technologies, assuming they are appropriate for local conditions and are disseminated effectively.

Reducing erosion and restoring soil quality appear profitable, but profitability varies with the means employed. Rock lines are a good example. Calculations of internal rates of return are high if rocks are trucked or carted but decline with more rudimentary modes of transport. For example, it took twice as much labor to construct rock lines using carts for transport as it did for trucks (21 labor days versus 10 to complete 100 meters) and four times as much labor for headloads as for trucking (nearly 40 days).

The most serious constraints on profitability are organizational and psychological. For example, a network of stone lines often runs several kilometers across land worked by several households. Building such a network requires organized support from all those affected. Sometimes the task cannot be completed in one dry season, and that can create tensions in households. The sequencing of benefits favors group members who have fields at the top of the slope over those at the bottom. Construction begins at the top. If networks are only partially completed when the rains come, those at the lower end of the network still suffer from flooding.

The development of strong village-level organizations and institutions has greatly enhanced chances for sustainable agricultural development in the OHVN region. The greatest and potentially most sustainable effect of USAID support to OHVN-zone farmers has been in developing village-level organizations and institutions. They can provide the critical interface between farmers and the research and

Box 4. Prevention of Soil Erosion in Fallan

Daouda Traoré, a farmer in the OHVN village of Fallan, built three *fascines* on his 1 hectare sorghum field 2 years ago. These lines of vegetative debris are held in place with wooden stakes. Adjacent to his field is a series of rock lines stretching nearly a kilometer over his neighbors' fields. Although the land slopes gently, flash flooding threatened to destroy several fields in Fallan until villagers constructed the rock lines with the assistance of OHVN extension staff.

Traoré estimates that 2 years ago his sorghum yields fell to 15 sacks of 70 kilograms each. Since installing the fascines, however, he thinks that he will be able to harvest 25 sacks of sorghum when rains are good. Because the power of the flood decreases before it reaches his field, he installed fascines that are somewhat weaker than rock lines but much less labor-intensive.

extension agencies in delivering technology just as they now do with credit and other inputs. Several factors contribute to sustainability. Among them:

- A history of functional literacy training, grassroots cooperative development, and local-level empowerment
- Access to private input and output markets and bank credits
- Existence of cash crops such as cotton and, increasingly, maize
- Capacity in financial management, planning, and implementation of income-generating activities
- Roads providing farmers with access to markets and services such as extension

The evaluation found that farmers take the initiative in making decisions and will not easily return decision-making powers to government agents. In this sense, the phenomenon of empowerment can potentially contribute to institutional sustainability after donors have pulled out. These achievements are fragile, however, because of

- Problems in meeting recurrent program costs for generation of new sustainable agriculture technologies and continued dissemination of existing ones
- Overwork and poor pay of village-level extension agents
- Dependence on a single cash crop—cotton—as the motor for rural development

Lessons Learned

Linkages between international research programs and regional development organizations increase chances that appropriate sustainable agricultural technologies will be developed. Using research products obtained through regional and international networks can increase cost-effectiveness of national-level research efforts. For example, rapid introduction of streak-resistant maize varieties that resolved local problems would not have occurred without sustained support of research at regional and international institutions.

Farmers will adopt environmentally sound and sustainable cropland technologies insofar as these are tailored to fit local agronomic conditions and socioeconomic circumstances, and to the extent they are correctly communicated. Farmers are more likely to adopt cultivars, technologies, and land-use practices that complement local practices than they are alien ones. Hence the relative success of such interventions as a new variety of a common crop (maize), improvements in soil and water conservation using rock lines, and intensification of organic fertilizer recycling.

The most widely adopted sustainable agriculture technologies are those that have a readily observable short-term payoff. Rock lines and other simple soil conservation structures visibly retain water and reduce soil runoff. Organic fertilizers and disease- or pest-resistant cultivars clearly save on expenditures for agrochemicals. Cultivated forages are cheaper than purchased agroindustrial by-products such as cottonseed cake. And they require less ready cash.

This Evaluation Highlights *was prepared by Phillip Church of the Center for Development Information and Evaluation. It summarizes the findings from the CDIE Working Paper "Sustainable Agriculture and the Environment: Mali Case Study," by Abbe Fessenden, David Kingsbury, and Constance McCorkle. Readers can order copies of CDIE reports from the DISC, 1500 Wilson Blvd., Suite 1010, Arlington, VA 22209–2404, telephone (703) 351–4006; fax (703) 351–4039; Internet docorder@disc.mhs.compuserve.com. Editorial and production services provided by Conwal Inc.*