

Table 4.3 Price Ranges for White Sorghum at the Study Sites, 1988-1989

Location	Economic survey ^a			Retrospective survey ^b			
	Low	Medium	High	August	December	March	August
AVV	44	47	50	83	25	42	66
Solenzo	28	34	40				
Kompienga	50	60	70				

a. Savadogo and Sanders 1989:38; Annex III, Table 2a.

b. Guira, F. 1989; Annex III, Table 2b.

Table 4.4 Estimated Cash Returns to One Hectare of Cotton or Sorghum, 1988/89

	White sorghum					
	Cotton			AVV		Solenzo
	1979	1988 ^a	1988 ^b	1979	1989	1989
NPK Fertilizer (CFA)	5,550	—15,750—		—	—	—
Insecticides (CFA) (12 l/ha)	4,800	—15,120—		—	—	—
Costs/ha (CFA)	10,350	30,870	30,870	—	—	—
Kg/ha	1,000	1,000	800	1,000	1,000	1,000
Gross/ha (CFA)	55,000	95,000	76,000	62,000	47,000	34,000
Price/kg (CFA)	(55)	(95)	(95)	(62 ^c)	(47 ^c)	(34 ^d)
CFA Net (nominal)	44,650	64,130	45,130	62,000	47,000	34,000
CFA Net (real: adjusted for inflation 1988=100)	72,249	64,130	45,130	100,323	47,000	34,000

— Not available.

a. Above average yields for cotton at AVV-UP1, 1988 (1,000 kg/ha).

b. Average yields for cotton at AVV-UP1, 1988 (800 kg/ha).

c. Average price based on a two-year market survey conducted by the Statistical Service, Murphy and Sprey 1980:58.

d. Annex III, Table 2a.

secure stable maize prices for the tractor farmers. At the time of our study, the cotton parastatal SOFITEX had a special arrangement with Burkina's national brewery whereby the latter agreed to purchase the farmers' entire harvest for a guaranteed price of 60 CFA per kilogram. This policy encouraged the tractor farmers to practice the recommended crop rotation while it also helped them reimburse their project credits. In contrast, the price available to the animal traction and manual farmers who had no access to this guaranteed market could fall to as low as 25 to 28 CFA per kilogram, which is 53 to 58 percent below the guaranteed price for tractor farmers.

Local Impact of Policies

On Area Planted in Different Crops

The net income per unit land and labor for different crops at available crop and input prices has had a decisive impact on the settlers' choice of

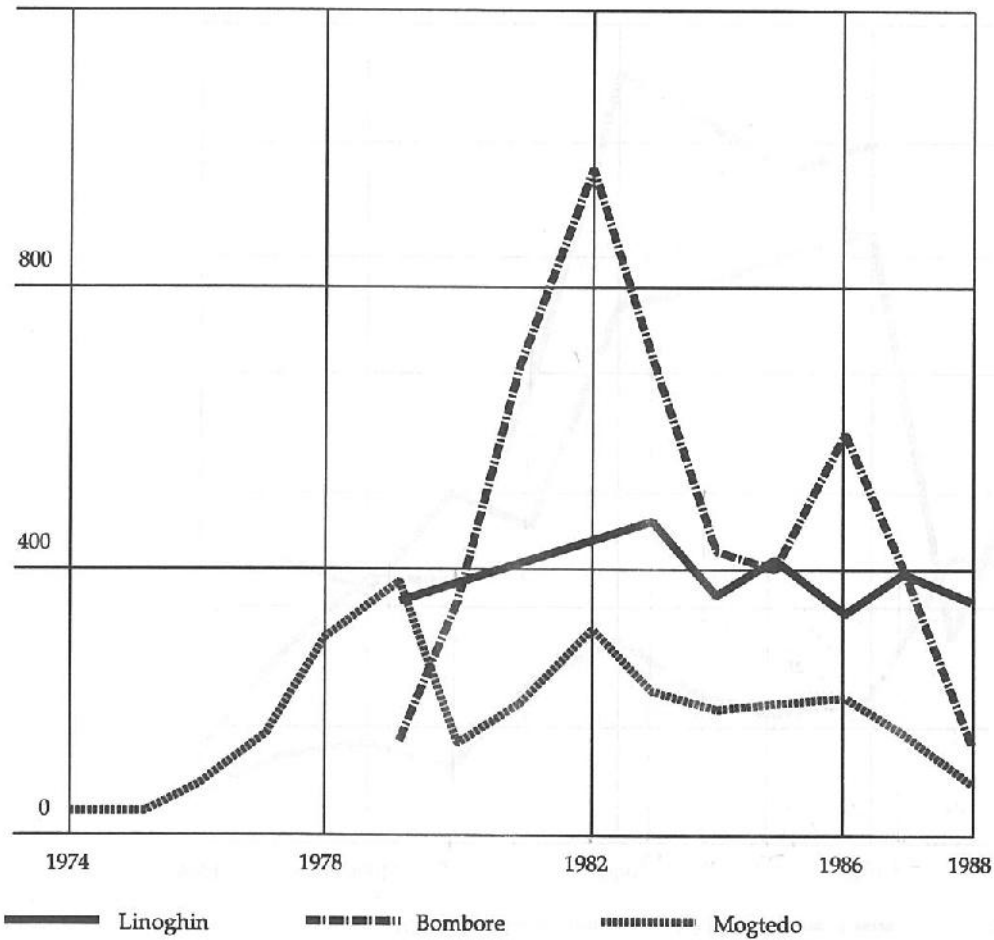
crops and on the use of intensive cultivation methods like prescribed rotations.

Faced with: (1) the huge labor demands for cotton (1,520 adult labor equivalent³ labor hours per hectare as opposed to 394 weighted labor hours per hectare for white sorghum and 507 weighted labor hours per hectare for maize in 1979 [McMillan 1983:397]); (2) rising production costs for cotton; and (3) past experience with uneven, unreliable yields in the northern climatic zone, the AVV farmers have gradually shifted to a more diversified system that includes commercial cereal production, livestock sales and, when possible, trade. These local changes in settler production patterns have resulted in a steady decline in total cotton production and fertilizer use in each of the AVV planned settlements (Figures 4.1 and 4.2).

Cotton production at the AVV was generally highest in the first three to five years of planned settlement, when the settlers were reimbursing their initial medium-term credits to the project. Despite a net decrease in total cotton production

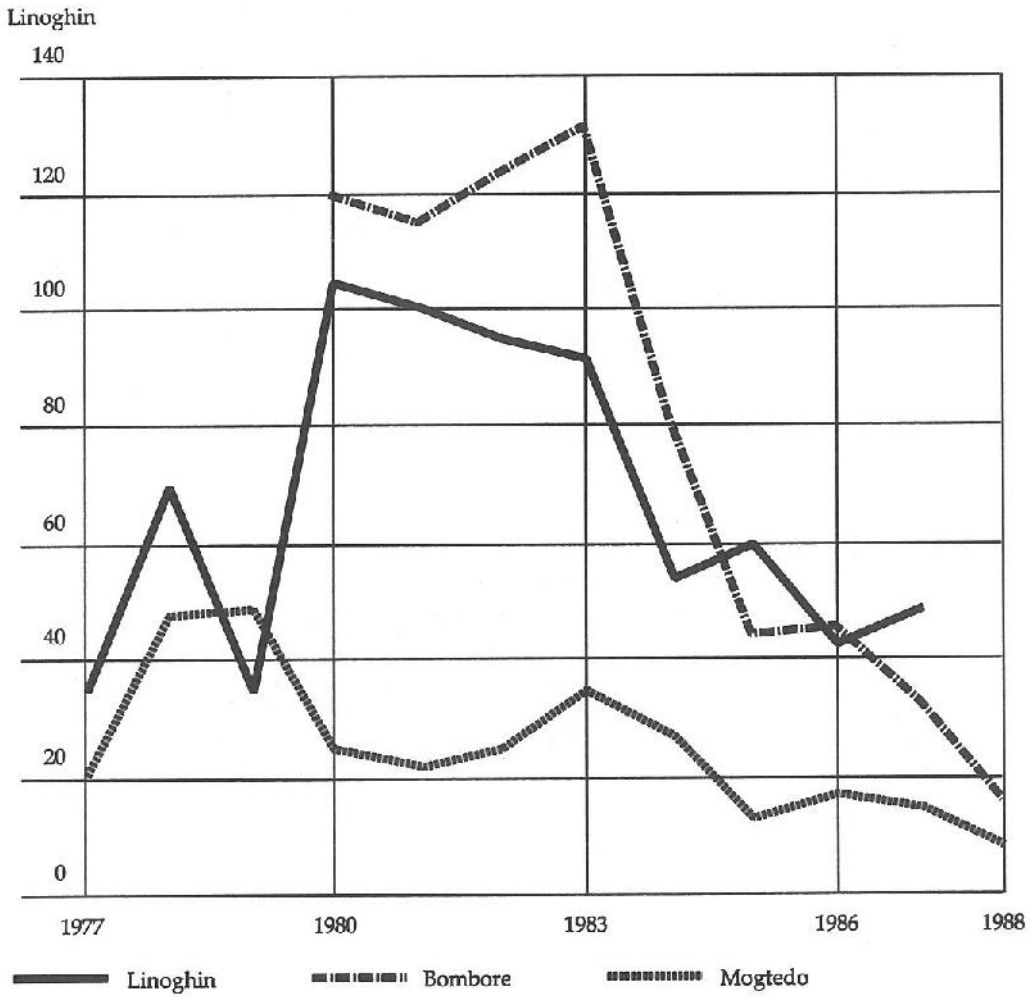
Figure 4.1 Total cotton production in the AVV planned settlements

Kilograms (000s)
1,200



Source: AVV/UD Extension records

Figure 4.2 Total Fertilizer Purchases in the AVV Planned Settlements



Source: AVV/UD Extension records

in each of the planned settlement groups, households with larger labor forces have continued to grow this crop, fearing, from experience, that after a plentiful harvest, the price for sorghum might drop. (Farmers reported that the price had been as low as 25 CFA/kg in December-January 1988, which is a time period when farmers typically need the most cash.) Smaller households, with only two or three active workers, usually grow less cotton. With a smaller labor force, these households are less able to absorb the high levels of risk associated with commercial cotton production in the northern sudano-sahelian river basins. For them, the loss of a key family member (through illness or migration) at an important point in the production cycle (e.g. weeding) can decrease cotton yields. If the crop is lost, farmers still are obliged to reimburse the cost of the inputs, which can amount to as much as 30,870 CFA for one hectare of cotton (Table 4.4).⁴

In contrast to AVV farmers, Solenzo farmers have remained heavily focused on cotton production. Between 1972 and 1988, cotton production in the Solenzo sector has risen from 801 tons to 41,500 tons (Table 4.5). At current prices, the farmers have little incentive to diversify into the commercial production of crops other than cotton. (The one exception to this is maize, because of the arrangement with the national brewery.) High yields and low price and yield risks are the incentives leading farmers to grow cotton (Sanders, Nagy and Ramaswamy 1990;

Nagy, Sanders and Ohm 1988; Deuson and Sanders 1990).

On Input Utilization

It is more difficult to discuss the impact of higher input and output prices on input utilization. In general, purchased inputs such as mineral fertilizer, insecticides, and hired labor, tend to be used only on cotton. At all of the study sites fertilizer use is concentrated on cotton. Our field research confirms the results of the CRPA du Mouhoun farm monitoring survey, which shows high levels of fertilizer use on cotton, and lower levels of application on maize (Table 7.7). Large areas of maize are grown only by the tractor farmers (Table 7.8).

Fertilizer at the AVV is used almost entirely on cotton, and this was reportedly at levels far below those recommended by the project. In addition, a large percentage of the sorghum and maize fields are not grown in rotation with cotton, thus reducing further the benefits of the residual effects of fertilizer use on cotton.

Higher input prices undoubtedly played a role in diminishing the use of inputs, especially for households with smaller labor forces for whom cotton production was especially high risk. Nevertheless, the net decrease in fertilizer consumption at the AVV between 1979 and 1988 is more easily attributed to the lack of an appropriate technology package than to higher fertilizer prices.⁵ In the higher rainfall Solenzo area where the existing cotton production technology is more profitable, research by the CRPA shows only a slight decrease in fertilizer use on cotton between 1982-1983 and 1987-1988 (from 152.5 kg/ha to 140 kg/ha) despite a substantial increase in input prices (CRPA du Mouhoun 1989b:33).

Table 4.5 Average Cotton Yields, Production, and Area Planted in the Solenzo Sector, 1972/73-1988/89

Year	Average yields (kg/ha) ^a	Total production (tons) ^b	Total area (ha) ^b
1972/73	544	801	4,037
1980/81	870	—	—
1981/82	849	—	14,440
1982/83	1,043	—	—
1983/84	1,083	—	—
1985/86	1,076	—	—
1986/87	1,290	—	—
1987/88	1,598	—	—
1988/89	1,050	41,500	38,500

— Not available.
a. CRPA 1989b:29.
b. Nana 1989c.

On Settler Incomes and Patterns of Diversification

Producer and input prices affect settler incomes and the profitability of different cropping strategies. Average prices used to calculate the value of agricultural production in CFA per kilogram at the AVV in 1979 are based on a two year survey of local markets (Annex 3, Table B-7). The prices used for calculating crop income for the 1988-1989 crop year are based on the median prices that farmers received for their products, based on our analysis of crop sales over one calendar year

Sanders and Habash 1988). Thus expensive innovations like roads must be paired with macro and micro policies to diversify the rural economies of both the higher and lower potential river basins.

Sample programs might include:

- (1) research and marketing assistance for grain legumes and dry season irrigated gardening to increase diversifications (crops that might complement commercial cereal production, such as soybean cultivation combined with cereal production in large areas of the southern U.S. and Brazil; see Vieira, Sanders and Habash 1988);
- (2) increase efforts to supply national industries with local products, such as the highly successful program whereby Burkina's national brewery provides the Solenzo tractor farmers with a guaranteed market for their maize;
- (3) a continuation of current policies to promote the processing and sale of locally produced crop and forest products (e.g. karite butter, peanuts, grain and rice) and livestock, especially small ruminants.

Studies throughout developing countries point out that as incomes increase, farmers and urban people alike want a more diversified diet that includes larger quantities of grain legumes, other vegetables, and livestock products. A comparison of the evolving average prices for small livestock at the Linoghin market since 1979 shows the average price for a large goat in 1990 at 188 percent more than it was in 1979; a large sheep was 200 percent more, a pintade (guinea fowl) 100 percent more, and a chicken 200 percent more (Annex 3, Table B-5). Pigs are said to be the most profitable of all, with prices increasing from an average of 4,000 CFA for a hog in 1979 to 16,000 in 1990 (a 300 percent increase).

Need to Link Planning for Settlement Areas with Development of Sending Areas

National planning also must include targeted investment to develop the settlers' home areas and to reduce the inequities between these areas and the river valleys (McMillan, Painter and Scudder 1990). The OCP river basins already include some of the best agricultural lands in Burkina and the other landlocked Sahelian countries. Targeted investment in extension services and infrastructure at Solenzo and the AVV in the mid-1970s only ex-

acerbated these inequities and led to a substantial rapid, uncontrolled, spontaneous immigration from the less well endowed adjacent plateau areas. These high rates of immigration—much of it driven by poverty as well as new opportunity—have already contributed to the saturation of some of the higher potential, more accessible river basins. Parallel programs to develop the home (sending) areas will be needed to reduce the speed at which the valleys will be settled and to give planners more time to develop appropriate extension and infrastructure services.

To date, good farmland with flexible tenure rules is still available in the more southerly river valleys of the Nakambe and Nazinon (ex-White and ex-Red Voltas), as well as in the Kompienga, Lera-ba and Comoe basins. In contrast, the more northerly basins are becoming increasingly saturated. The earliest sign of river basin saturation is the departure of the pastoralists as farmers' fields spread, placing additional pressure on pasture and water resources. If the first 15 years of settlement are any indication, these less populated river basins will soon be occupied as well. It is therefore important that development planning for the basins be incorporated into a national program that uses targeted investment to develop the impoverished home areas—an investment that should pay off by raising income levels and reducing the flood of immigration from these zones.

Targeted investment in the valleys to the exclusion of investment in the settlers' home areas creates a magnet that can attract massive amounts of spontaneous settlement. While additional settlement may be necessary for dynamic regional development, rapid, uncontrolled, spontaneous settlement can quickly overload the capacity of existing social, land tenure, extension, and marketing systems.

The rapid spontaneous settlement that occurred in the area around the AVV sponsored settlements contributed to the sponsored settlers' insecurity about their long-term land tenure rights in the area. In contrast to the sponsored settlers, who were recruited by the AVV from the more densely settled plateau, over 90 percent of spontaneous settlers around the AVV planned settlements at Linoghin, Rapadama, Mogtedo, and Mogtedo-Bombore were from more distant, isolated, infrastructure poor and service poor villages in the adjacent provinces. While these settlers were attracted by the opportunities created by AVV wells and roads, they were also res-

ponding to the lack of opportunity in their home villages. A large part of this immigration was short-term seasonal migration, i.e., settlers having little intention of remaining in the area once the productivity of their newly cleared fields began to decline. Nevertheless, these high rates of spontaneous, uncontrolled settlement in the adjacent areas contributed to the atmosphere of insecurity about settlers' long-term tenure rights to land.

To date, however, there is little agreement about how to revitalize the impoverished areas of origin. One example involves promoting new small-scale water conserving technologies like the anti-erosive *diguettes* that have been successfully promoted in the provinces of Yatenga and Sanmatenga. There is a chronic need to develop this and other types of appropriate technology to increase yields and to reduce soil erosion. Another possibility lies in the development of income generating micro-projects. Some of the most successful projects like the "Six S" projects in Yatenga have been launched by non-governmental organizations. This type of project can benefit women as well as men. "Six S," for example, has started a program for on-farm fattening of small ruminants that is providing women with significant revenues.

Notes

1. Since 1981 the International Monetary Fund (IMF) consumer price index seems has been constructed from the *Institut National de la Statistique et de la Démographie* (World Bank 1989). Although the index reflects an urban market basket that includes fuelwood, cereal, and housing expenses not paid for by rural farmers, certain categories of food, clothing, meat, fish, equipment, education, and leisure are purchased by settlers and indigenous farmers with middle and higher incomes. Other expenses, such as transportation, are probably higher than those paid by poor urban dwellers and lower level civil servants.

Our analysis of expenditures by male household heads and other family members shows that the largest portions of the ru-

ral household's incomes were spent on food, transportation, and such manufactured items as bicycles, radios, and mopeds. These goods show substantial price increases—on a scale of 200 to 400 percent—between 1979 and 1988 (Annex 3, Table B-2). Accordingly, we consider that the national consumer price index (Annex 3, Table B-1), which calculates an inflation rate of 62 percent since 1979, seems to be a very conservative means of adjusting the value of net value of production in 1978-1979 for comparisons with 1988-1989 net figure.

2. The results of the survey coincide with information from a joint OFNACER (*Office National des Céréales*)-USAID (United States Agency for International Development) study of national grain markets in 1983-1984 (Sherman, Shapiro and Gilbert 1987). The survey showed that, in 8 of 13 months, the producer prices recorded for maize were 12 to 26 percent greater in Ouagadougou than in the southwestern city of Bobo-Dioulasso. During the same period, the average price of white sorghum was 25 to 70 percent higher at Mogtedo and the neighboring market of Zorgho than at Solenzo. Millet prices during this period were 20 to 90 percent lower at Solenzo. No substantial price differences were recorded for red sorghum in the few cases where ORD recorded figures for it. The higher median prices that were observed for the AVV can be attributed largely to the settlements' easy access to the major grain market in Ouagadougou, the capital.

3. See Table 7.3 and Footnote 2, Chapter 7 for a discussion of the AVV system of labor weights which was used to adjust

4. To reimburse these costs could require the cash value of 700 kilograms of sorghum at the low prices (44 CFA/kg) we recorded immediately after harvests. If such a household were farming the four hectares recommended for that labor force size and had lost one hectare's production due to a failed cotton crop, reimbursing the cost of the inputs would consume about a third of the total cash value of production for the family (Murphy and Sprey 1980:11).

5. Even in 1978-1979 and 1979-1980, when fertilizer prices were being subsidized by 60-70 percent, average fertilizer use for cotton was 90-120 kg/ha for settlers in their third to fifth year at Linoghin and Mogtedo, but only 20-30 kg/ha for white sorghum, and 90-140 kg/ha for cotton for settlers in their third to fifth year at Mogtedo-Bombore (Murphy and Sprey 1980:46). In 1978 and 1979, the AVV recommended 150 kg/ha for both sorghum and cotton. Only 14 of the 43 (32 percent) white sorghum fields cultivated by the settlers studied at Mogtedo received any fertilizer at all in 1975-1980 (McMillan 1983:392).

6. This increased total cereal production. Murphy and Sprey (1980:78) estimated average cereal production in the AVV sponsored settlements to be 200 kg per resident in 1988. In 1988, the settlers in the AVV restudy produced an average of 900-1,100 kilograms of cereals per ALE or 350-400 kilograms per resident at Linoghin, Bombore, and Mogtedo (Table 7.6).

5

Land Tenure

A requisite for successful land settlement is secure tenure to land and water resources as defined by both the settler and host populations (McMillan, Painter and Scudder 1990). Land resources include not only village sites and arable land, but also grazing areas. Water resources include potable supplies for people and their domestic animals as well as fishing rights.

If tenure rights are unclear, both settlers and indigenous inhabitants will be unwilling to invest in the development of more environmentally sustainable land use practices. Even if land tenure rights are spelled out at the national level, settlers may continue to feel insecure if these guaranteed land rights disrupt their long-term collaboration with indigenous inhabitants.

We recommend, therefore, that policymakers focus on land security, rather than on a more legalistic interpretation of land tenure rights. Moreover, we argue that recourse to legal mandates to enforce land tenure rights is likely to create more problems than it resolves. Settlers are aware of the contradiction between state policies that legislate rights and the reality of peaceful social and economic incorporation into a new community. They are therefore likely to favor more traditional mechanisms for acquiring land, especially when the number of migrants has not surpassed the number of indigenous inhabitants in a region. More apt to be successful are government programs like Burkina's new national program for village land management (PNGT) which rein-

forces the capacity of local inhabitants to regulate access to village land and other natural resources.

Le Régime Coutumier—Indigenous Land Tenure Systems

The "new lands" in Burkina's river valleys may have been underpopulated, but they were never unclaimed.

The first category of indigenous land rights, *droit d'appropriation collectif*, refers to the collective rights to land that are vested in various lineage segments (generally defined as those extended from the same father, grandfather, or great-grandfather).

The second category of land tenure refers to the rights of the extended kin group or lineage to a body of land. These rights are much less specific than the *droit d'appropriation collectif*, which refers to specific pieces of land. The lineage's land rights are represented by the *chef de terre* or earth priest, by virtue of his literal and spiritual descent from the first occupants of the land. The earth priest's role includes that of interceding between men and the supernatural powers related to the land.

A third category of tenure includes individual use rights that are accorded either permanently or temporarily to individuals or families who have rights to *droit d'appropriation collectif*. These rights are passed from father to son or, in the matrilineal areas of the southwest, through the mother's line. The rights of other groups—i.e., groups without collective allocation rights such

as immigrants from outside the area—are considered provisional and revocable, or “borrowed.” The outward and visible sign of this symbol of the difference between “borrowed” and “inherited” individual use rights involves certain rules regarding land use. For example, one may be forbidden from planting trees. Enforcement of these edicts is generally through the social ostracism of those who violate the rules. The threat of social ostracism functions as a powerful force since settlers know that their long-term economic success is strongly linked to their ability to integrate themselves into their new social settings.

Once a land loan has been inherited, it is normally considered to pass into the category of individual use right (category one) and is no longer subject to being revoked. The most substantial body of evidence of land loans being reclaimed is in the high density central plateau area, where farmers are reluctant to make land loans for periods of more than a few years (Boutillier 1964; McMillan 1980).

Despite certain differences in application that relate to different patterns of social organization (matrilineal versus patrilineal kinship systems, for example), one encounters the same three basic categories of land tenure rights in all of the river basin populations. The essential characteristic of all three categories is that they do not allow for *appropriation individuelle des terres*, or private land ownership. Instead, all three safeguard the inalienable collective rights of individual lineages or extended kinship groups. This collective system does not exclude migrants, as long as the migrants are willing to respect local customs and traditions.

Le Régime Réglementaire—The Concept of Individual and State Ownership

Parallel to this system of traditional land tenure, the French colonial government introduced the legal concept of private and state ownership (*régime réglementaire*). Individuals or organizations holding such rights have the power to dispose of property in an absolute manner. The legal basis for the *régime réglementaire* dates from a series of government edicts issued between 1906 and 1956. On the basis of these edicts, Burkinabe could claim private ownership of land on which they had built or made improvements.

A further legal distinction was made between public domain and private domain lands. Public

domain lands are considered to be natural resources and certain resources created by man (buildings, infrastructure) that by their nature or social importance should not belong to any private individual. This category included rivers, roads, lakes, river and lake banks, bridges, military bases, and public transport.

Private domain (*le domaine privé*) was considered to be a separate category with a distinction between *domain affecté* (land affected by the statute regarding improved land) and *domain nonaffecté*, for unimproved land not affected by the statute.

The Burkinabe state inherited this system of state and individual private and customary land tenure rights, and modified it by additional edicts. A law enacted in 1960 (No. 77/600/AN, 12 juillet 1960) made the state the final proprietor of all land not already registered by that date. This was followed by a later act (No. 29/63/AN) in 1963 that authorized the government to reserve for the state any land that benefited from state investment in infrastructure development, and to declare as property of the state all underpopulated lands or lands distant from major population centers.

These early laws establishing the *régime réglementaire* provided the legal basis for creating the AVV, as well as Burkina's extensive network of classified forests and protected wildlife areas. In theory, the presidential decree that created the AVV in 1974 gave the agency complete control of all settlement and development planning in the less populated river basins covered by the OCP. This area was legally defined to include almost 30,000 km²—over 10 percent of the total land area of the country. Similarly, the laws creating the classified forests were considered to render null and void any previous land tenure claims.

By 1979, it was clear that the state could do little to control the floods of spontaneous settlers moving into the area surrounding the AVV sponsored settlements. It also became increasingly clear that large areas of the most accessible fertile river basins in the western cotton boom area would be occupied by spontaneous settlers long before the AVV could design sponsored settlements. These spontaneous settlers continued to pass through customary channels to acquire land. Efforts by the government to evict settlers from the AVV project lands and classified forests were complicated by legal ambiguities in the national land tenure laws, which recognized state rights at the

same time that they validated local rights acquired through customary channels.

Agrarian and Land Tenure Reorganization, 1984

On 4 August 1983 Burkina underwent a complete change in government. The new revolutionary government made agrarian and land reform a top priority. An interministerial commission was created in June 1984 to oversee a complete rethinking of the land tenure and agrarian systems in time for the first anniversary of the revolution. Its final document, announced less than two months later, has provided the basic background for rural development planning in Burkina ever since.

Two of the central tenets of the interministerial report and the resulting *Réorganisation agraire et foncière* act involve the nationalization of all land rights and the appropriation of usufructuary rights to whoever clears land. Access to urban or rural land was to be restricted to "those who show a real need, without distinction of sex or matrimonial status" (AVV 1985d:18).

A third theme focuses on the need to invest local residents and village leaders with responsibility for the management of land resources. The local Committees for the Defense of the Revolution (known today as Revolutionary Committees or CRs; see Annex 2) were given the power to allocate village lands. The conditions for receiving land were supposed to be formulated by a village land management committee, under the guidance of the local CR. In project areas, like the AVV or irrigated areas, the organization responsible for development has the right to define the conditions for land occupation in working with farmers through the CR structures for popular democracy (AVV 1985d:11).

A fourth theme deals with regional land use planning. Chapter 2, Article 21, states that rural land management must consider the integration of all the activities of rural life—agriculture, livestock, and forestry—taking into account the natural potential of an area. Thus each area should be subject to a battery of soil and hydraulic surveys as a background to the preparation of a comprehensive land use survey. The need for each development plan to designate land for pastoralism was also emphasized (Chapter 3, Article 24).

National ministries—in collaboration with the new system of popular democratic structures (the CRs)—were supposed to implement these programs. The commission also promoted the idea of

self-help and collective group financing of village development projects (AVV 1985d:10).

Early Impact of the Land Tenure and Agrarian Reform Act

Our field studies show that the majority of spontaneous settlers at the research sites acquired land to farm by making formal requests to customary authorities. This traditional pattern of acquiring land appears to be continuing despite the 1984 land tenure act. In fact, however, even when settlers received authorization from the local Revolutionary Committee, they typically also requested authorization from a traditional authority, on grounds that the land is subject to supernatural forces with which it is necessary to remain in accord. In cases where this authorization was refused, settlers preferred to move elsewhere.

The continuation of these traditional practices despite the limited ability of the indigenous people to expel violators (before land reform), and the ability of the immigrants to bypass local authorities (after land reform), shows the high value that immigrants place on minimizing conflict. The settlers are vividly aware that, land title or not, they have few opportunities for a satisfactory social and economic life in the new area if they overlook local authorities.

Many things happen when a settler borrows land under the traditional land tenure systems. The migrant acquires not only land but also a "friend" to whom he or she is indebted in the new community. In the valley areas, where land is still abundant, the "loan" is usually a straight grant, with little expectation that it will ever be reclaimed. By giving a new settler land and, perhaps, extra food, an indigenous farmer makes a social investment. He creates indebtedness and gains a friend and political ally. Special sacrifices or rituals to ratify a land loan provide additional opportunities to formalize the migrant's incorporation into the new community. In passing through the customary channels to acquire land, the borrower acknowledges the lineage and village leaders' right to control the use of the village land in service to community life.

Settlers moving into the Solenzo villages acquired land through the traditional mechanism of land loans. New settlers would address their request to the indigenous village leaders. Over time, the immigrant group's access to "new" land

that could be cleared and farmed on the edge of the settlement would gradually be increased.

At Kompienga, 43 percent of the 425 farm families in the town purchased their homes and 11 percent rented; most of the other 46 percent acquired their homesites without reference to traditional authorities: through inheritance (1 percent); from the Revolutionary Committees (5 percent); as grants from the construction company (6 percent); or without asking anyone (squatter's rights—16 percent). Only 18 percent went through the traditional authorities. Nevertheless, nearly all the farmers in the farming systems survey acquired their bush fields by requests to the Gourmantche chiefs or another Gourmantche elder in the community. Twenty-four percent of the spontaneous settlers interviewed as part of the assisted spontaneous settlement program at Rapadama and 66 percent of the settlers at Linoghin claim to have passed through the customary authorities for the area occupied by the AVV planned settlements to acquire permission to farm (AVV 1988:21).

In structured interviews with 20 male household heads at Kompienga and 20 heads of households at Solenzo, settlers emphasized their hospitable relations with the indigenous inhabitants. Hence, the social investment obtained through respecting traditional land loan practices proved valuable.

In contrast, our research on the AVV planned settlements showed the high price to be paid for bypassing traditional mechanisms for acquiring land. When the first planned settlements were created—in 1973 at Linoghin and 1974 at Mogtedo—the indigenous inhabitants were not anxious to join. Consequently, the project was implemented with little cooperation from indigenous inhabitants. By virtue of the 1974 presidential decree, all existing land claims were declared void. Thus, the sponsored settlers' claims to their AVV farms were accorded by the project, not by the customary authorities responsible for land allocation.

The indigenous farmers' lack of recognition of the AVV settlers' land rights was a constant source of anxiety. Although the project had bypassed the traditional mechanisms for acquiring land, the new settlers tried to create linkages with indigenous groups for assistance with such practical problems as determining which plants were suitable for medicines, identifying suitable burial grounds, and performing certain rituals. For the most part, these linkages were successfully nego-

tiated only with isolated spontaneous settlers, or with the leaders of small villages whose fields were not immediately adjacent to the sponsored settlement (McMillan 1983).

By 1979, the fifth year of settlement at Mogtedo and Mogtedo-Bombore, relationships between farmers living in the sponsored settlements, indigenous farmers, and spontaneous settlers had become increasingly hostile. The spontaneous settlers quickly learned that although the AVV could threaten to expel them, it could do little to implement such threats because of the legal ambiguity of the settlers' land tenure. Although by presidential decree the project had the authority to declare a given land area property of the state, the state also recognized indigenous land rights.

The result was confusion regarding the issue of whether the AVV had any real power to revoke the spontaneous settlers' rights to remain on project lands. Spontaneous settlers moved into the areas surrounding the sponsored villages, in some cases even onto project fields. Social conflicts between the AVV settlers and the spontaneous settlers emerged over the more accessible areas with better land. The conflicts over land mounted as settlers' plans to expand their private fields ran into direct competition with spontaneous settlers' plans for the same fertile, low lying areas.

In one graphic case, a spontaneous settler who could claim a customary right to an area of the adjacent AVV village used cotton insecticide to poison the chickens of sponsored settlers. The dead chickens were then eaten by the settlers' dogs, who also became sick and died. Although of little economic consequence in itself, the total effect of a series of small incidents such as this was to increase settler anxiety and reduce the settlers' sense of security in the new area.

The more long-term economic impact of the project's bypassing of traditional land tenure rules became significant in 1979, when some of the wealthier AVV sponsored settlers tried to move at least one member of their family into trade. Despite repeated attempts to encourage the development of markets within the project area, only one of these internal markets survived more than a few years. The settlers began to realize that without the participation of the nearby indigenous farmers and spontaneous settlers, they could not create a successful village market. Efforts by the wealthier settlers to launch trading enterprises in the growing regional center of Mogtedo were similarly thwarted. The Mogtedo

townsmen were not going to relinquish their command of new trade opportunities as they had been forced to relinquish what they considered to be their land rights. To this day, not a single boutique or bar in Mogtedo is owned by an actual or former AVV settler. The few AVV settlers that have become prosperous grain or livestock merchants are typically from the same Ganzourgou region as the hosts.

In contrast to the positive to neutral responses of the settlers at Solenzo and Kompienga, almost all of the 40 male household heads interviewed in the AVV sponsored settlements indicated that their relationships with the indigenous inhabitants had been strained. Interviews with 20 study farmers at Linoghin emphasized that although relationships had been very hostile in the past, they were improving. Linoghin farmers cited the participation of spontaneous settlers and indigenous farmers in the market created by the AVV settlers as an important factor bringing them together.

Indirect Consequences of Reform for Settlement-Related Development

Solenzo

Despite the persistence of many of the formal mechanisms of the traditional land tenure system, the large influx of immigrants in some areas like Solenzo, in combination with the change in national land laws, has created a *concours* or competition for land. Once the new land tenure laws were announced, many of the settlers with animal traction and mini-tractors began to clear the largest area possible. The indigenous inhabitants then launched a counterattack in an attempt to lay claim to as much village land as possible—for

themselves and their children—before it could be occupied by the outside immigrants. The resulting race for land is reflected in the high percentage of fields that have been farmed for less than six years (Table 5.1).¹

Under the new land law, certain cultivation hamlets (groups of migrants who had moved away from the central village to be closer to their fields) have requested and received administrative autonomy from the traditional villages that first granted them the authorization to farm. When migrant hamlets break away, the indigenous inhabitants consider the separation a profound act of ingratitude. These “breakaways” have in a few cases provoked physical violence between migrants and indigenous inhabitants. Moreover, there is an increasing tendency for such land disputes to be resolved by the police or another public administrator. The settlers are well aware that these conflicts may jeopardize their future claims to land and other resources in the region.

The AVV Planned Settlements

The early effects of the 1984 reorganization act were quite different in the areas of AVV planned settlement. One result was to strengthen the land tenure rights of the AVV sponsored settlers. The law thus increased the spontaneous settlers’ living near the AVV planned settlements willingness to be incorporated with the sponsored settlers into a single, unified extension and land management program. The assisted settlement program that the AVV started at Rapadama in 1987 was the first attempt to carry out this type of activity; similar programs are now being tried in all of the older AVV planned settlements.

Table 5.1 Years of Cultivation of Collective Fields, Solenzo, 1988/1989

Years	Percent of area of fields			Percent of number of fields		
	Dar/Kie	Daboura	Average	Dar/Kie	Daboura	Average
1 - 3	27	11	21	33.5	33.3	33
4 - 6	24	12	19	27.5	17.5	23
7 - 9	10	34	19	13	28.6	20.5
10+	38	43	40	26	20.6	23.5
	99	100	99	100	100	100
Total (000 m ²)	2,659	1,646	4,305			
Total (Number of fields)				69	63	132

Source: Land Settlement Review.

Policy Implications

Need to Associate Local Populations in Regulating Land Tenure

Government edicts to promote sustainable land use practices by mandating more secure land tenure rights for settlers are not likely to succeed. The original land tenure and agrarian reorganization act was less than fully successful because it has been insufficiently appreciative of the wider social context within which Burkina's local land tenure systems operate. This local context includes the important religious role of the village *chef de terre*, as well as other local customs and the traditional rights of the indigenous people.² More promising will be government initiatives that attempt to reinforce the ability of established local institutions to legislate land tenure rights for immigrants.

Need for Government Intervention to Secure Pasture Rights for Pastoralists

Administrative intervention will generally be necessary to secure pasture rights for pastoralists. The reason is that there was never a category of customary law or a modern *droit réglementaire* that recognized pasture rights prior to the Agrarian and Land Tenure Reorganization. Pasture is considered a natural resource, accessible to all, but rights to pasture are always considered secondary to cultivation rights. For this reason, pastoralists who have traditionally used the valleys as part of their transhumant cycle are being pushed further and further south.

We observed a general trend of pastoralists throughout the valleys becoming increasingly sedentarized, and demanding more land to farm. Such cultivation rights are guaranteed under existing laws, and were generally granted through the same customary channels used by immigrant and indigenous agriculturalists to "borrow" land. The pastoralists' right to pasture, however, has never been guaranteed.

One solution has been to designate certain village areas for pasture. In addition, the state has supported the development of large agropastoral zones reserved exclusively for pastoralists. Past experience, however, shows that these land tenure rights will be difficult to enforce. Boundaries for a large agropastoral zone at Gadeghin were traced in the initial planning for the upper Nakambe in 1974. Local migrants and indigenous lead-

ers were well aware of these limits. Nevertheless, by the time the actual development of infrastructure and social and economic services for the agropastoral zone was started, more than 200 immigrant agriculturalist families had already occupied the zone. To evict these agriculturalists required the intervention of local police and administrators. Similar problems were encountered in the creation of the pastoralist zone at Nouhao.

Projects to protect the grazing rights of pastoralists are unlikely to be successful until the pastoralists themselves are effectively organized and are empowered by the regional administration to enforce respect for their boundaries. Equally important to the success of these efforts will be whether the local agriculturalists—especially large agriculturalist households which have diversified into extensive livestock—believe that they will derive any long-term benefits from the zoning effort.

Need to Promote Joint Settler-Host Natural Resource Management

Burkina's PNGT program for village land management is a promising model for increasing tenure security for both settlers and indigenous inhabitants (Chapter 10). In theory, the PNGT model promises secure tenure for migrants while at the same time protecting the rights of indigenous inhabitants and pastoralists. While this model is considered to be appropriate for the country as a whole, it is especially appropriate for the valleys where low population densities and distance from administrative centers make it virtually impossible to enforce "top down" government land tenure policies that do not have a strong base of local support.

A special set of land tenure problems is presented by projects that necessarily involve sponsored settlement—either because of dam related flooding or the use of sponsored settlements as part of a regional planning effort. Special care must be taken to involve the local population in the design of such projects. For their participation to be voluntary and not forced, the indigenous inhabitants must perceive strong evidence of how such a project will ultimately benefit them. The question of land rights for subsequent waves of spontaneous immigrants who will inevitably be attracted by the new economic opportunities must be dealt with openly, with the indigenous inhabitants taking the lead in deciding how the land rights for

these inhabitants will be handled. Field trips, such as those organized by the AVV to expose Linoghin settlers to the water harvesting technologies being developed by PATECORE (*Projet Aménagement des Terroirs et Conservation des Ressources dans le Plateau Central*) in the Kongoussi region, can be used to prepare local leaders and village land management committees with what to expect.

Notes

1. The recorded "age of field" presented here refers to the period since a particular farm family started farming in a

given area. We know, however, that most farmers typically expanded their initial land grant to encompass a much larger area. Thus, while a three hectare cotton field may be listed as ten years old, only part of the field may have been farmed for this length of time.

2. While the power and influence of the *chef de terre* is reportedly decreasing in many areas of the plateau, this does not discount the central point made here. Efforts to bypass local customs and the rights and roles of traditional authorities can create a socioeconomic backlash and increase, rather than decrease, local insecurity about land.

6

Production at the Household and Community Levels: the Centrality of Diversification

Diversification is a goal as well as a product of successful development in areas of new lands settlement (McMillan, Painter and Scudder 1990). As settlers' incomes rise, their desires for manufactured goods, services, and a wider range of foodstuffs increase. These changes in consumption goals and patterns create demands for new products and services, which lead, in turn, to new opportunities for employment. Employment activities may include cultivation of a more diversified package of rainfed and irrigated crops, as well as expansion into animal husbandry, small manufacturing and trade.

Diversification is also a product of the successful reinstatement of "normal" intrahousehold production and consumption patterns (McMillan, Painter and Scudder 1990). In the absence of some major change in technology patterns in Burkina, settlers know that their long-term security is linked to keeping the largest possible number of people attached to the family farm. Especially important is whether the household can retain one or more sons and their families. A critical determinant of the motivation and welfare of the 51 percent of the population that is female will be the level and type of income they are able to earn in private crop, livestock, and nonagricultural activities. Since a high proportion of this independently produced income is used for condiments and clothing, private female income plays an important role in determining the nutritional well being and living standards of the entire family unit. The development of private

sources of income is thus not just a luxury, but a necessity that is driven by the nature of the household family unit.

For all these reasons, the LSR predicts that the presence or absence of opportunities to invest in more diversified crop, livestock, and nonagricultural production activities will be an important determinant in settler decisions to immigrate to or remain in a given area.

Household Organization of Production at the Study Sites

Most rural households at the study sites are best perceived as overlapping units of production and consumption. Household members collaborate in certain crop and livestock production processes, but also engage in agricultural and nonagricultural activities on their own. Income earned from the latter is usually totally or at least partially under the individual's control. Moreover, there are almost always different expectations for the spending of private as opposed to collectively produced household income. Women, for example, may be responsible for purchasing the condiments and sometimes even the meat used in daily sauces. Women may also be responsible for their own clothing and, in a few cases, the clothing and/or schooling of their children. When we talk about household goals, we are talking about a dynamic balance of these private and collective concerns.

The case study revealed great diversity among the sites in terms of household social organization, land use patterns, patterns of production, goals, and constraints. Within the same site, important differences were apparent among ethnic groups and even among different geographical areas of the same ethnic group. Household organization also varied according to length of residence at a site.

Private crop production, for example, was more important at some sites than at others. An estimated 20 percent of the gross cash value of crop production of AVV settler households was produced on individual private fields. Female Mossi settlers from areas like Kongoussi and Koupela were generally less involved in private crop production than female settlers from areas like Kaya and Ouahigouya.¹

Private crop production was less important among both the indigenous Bobo and the immigrant Mossi at the western Solenzo site. Although 21 percent of total cereal production for animal traction farm families at Dar-es-Salaam/Kie was from private fields, less than 2 percent of the total cereal production was private for animal traction farmers at Daboura (Annex 5, Table D-1). No private crop production was recorded for either males or females in the large tractor farming households.

Even allowing for our having underestimated the phenomenon, it is clear that private crop production is less important as a percentage of total crop production in the cotton boom west than in the AVV. One possible explanation has to do with the much higher labor demands on the collectively worked cotton fields. A similar decrease in private crop production was observed in the early days of AVV (Figure 6.1). Research comparing Mossi settlers who had been living in an AVV sponsored settlement for periods of three to five years with families still living in the settlers' home village showed that, as a whole, the settlers cultivated a much smaller percentage of their total area as private fields (McMillan 1983; Figure 6.1). This was attributed, in part, to the higher labor demands for cotton, which was grown almost exclusively on fields worked cooperatively by the entire family. The same study showed that male settlers typically worked an average of 58 percent more unweighted labor hours, and female settlers 44 percent more, than in the settlers' home village (McMillan 1983:139), in large part because the cotton harvest extended the agricultural sea-

son several months beyond the time when cereal crop activities would normally cease. The average number of weighted labor hours per hectare for cotton were 386 percent as high as for white sorghum, and 300 percent as high as for maize (1,520 weighted hours per hectare for cotton versus 394 hours for white sorghum, and 507 hours for maize [McMillan 1983: 397]). Female farmers were earning a smaller amount of money from livestock and off-farm enterprises than women in the settlers' home village. At least part of the explanation was, once again, the higher demands for women's labor for cultivating cotton; other factors included the greater distances from markets, which made it more difficult for settler women to engage in trade.

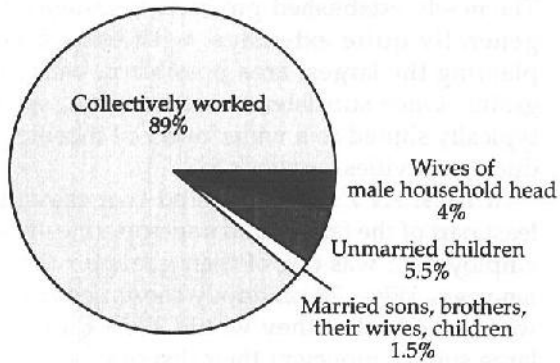
At the AVV, this decline in semi-autonomous sources of income was at least partially offset by the fact that expenses customarily under women's responsibility became the responsibility of their husbands. The male household head, for example, paid all the expenses for family clothing and school fees, as well as purchasing sauce condiments and meat.

It was anticipated that we would see a gradual reinstatement of private crop and livestock activities by women and males who are not recognized as official household heads. The contribution of the settlers' private fields has indeed increased to about 20 percent of net agricultural income. Although greater than ten years ago, when the figure was 11 percent (before subtracting the costs of animal traction), this is still less than in the settlers' home village, where an average of 36 percent of the total CFA value of crop production or gross crop income in 1979 was from private fields (Figure 6.1).

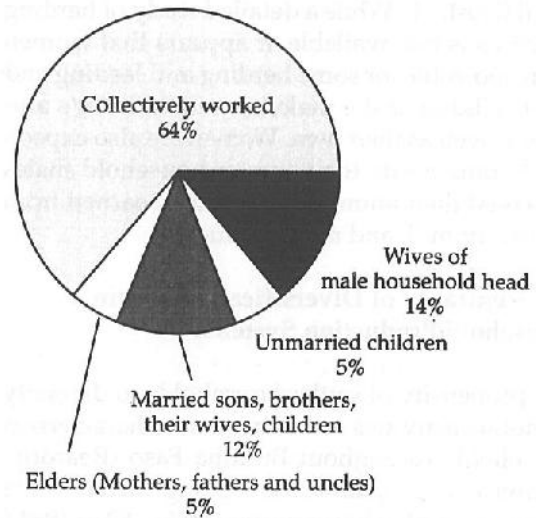
Private crop production was, on average, less important for both Mossi and non-Mossi settlers at Kompienga than at the AVV (Annex 5, Table D-8). The aggregate figures, however, mask significant differences between the different ethnic groups. In general, although Mossi women settlers at Kompienga were less actively involved in private crop production than female settlers at the AVV or at home, they were nevertheless more actively involved than women settlers from the other ethnic groups. The wives of the indigenous Gourmantche, for example, engaged in only limited private cropping and trade. Their participation in collective family farm labor was also much less than that of Mossi women, and generally confined to a narrower range of activities such as

Figure 6.1 Subdivision of net crop value of income per household, the AVV sponsored settlements, 1979-1989

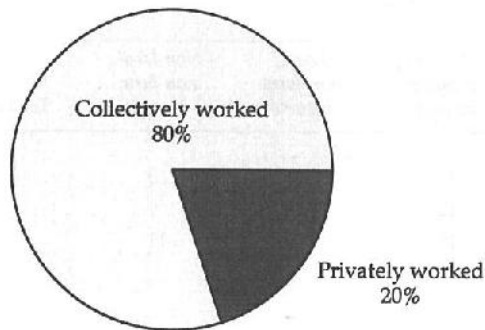
AVV Sponsored settlements, 1979



Settlers' home village in Kaya area, 1979



AVV Sponsored settlers, 1988



Source: McMillan 1983.
Savado, Sanders and McMillan 1990.

planting and harvesting. In contrast, the Mossi women were involved at every stage of crop production except tree cutting and heavy bush clearance. Yana women were also much less involved in private crop production, but were actively involved in local trade.

The wives of FulBe herders do not work in fields. Women participate in the family's livestock herding, however, and have primary responsibility for daily milking, milk processing, and the sale of milk and milk products. In most cases the women pastoralists also "own" or have exclusive rights to a limited number of cattle and small livestock. While a detailed study of herding practices is not available, it appears that women are responsible for some herding and feeding and most milking of the male household head's animals as well as their own. Women are also expected to compensate the younger household males who herd their animals with income earned from the sale of milk and milk products.

The Centrality of Diversification within Household Production Systems

The propensity of settler households to diversify economic activities as incomes rise characterizes households throughout Burkina Faso (Reardon, Matlon and Delgado 1988). Using income data from four rainfed harvest years (1981/82 to 1984/

85), Reardon, Delgado, and Matlon (1992) show the importance of diversification for both poor and rich households in all three of the country's major agroclimatic zones (Table 6.1). Especially important for this study was the observation that local nonfarm activities, including food processing, cottage industry, and commerce, constituted over a third (38 percent) of total income in the higher rainfall, Guinean zone that is most characteristic of the OCP river basins.

Agricultural immigrants at all the sites were initially concerned with reinstating their basic food systems at their former—or higher—levels. The newly established production systems were generally quite extensive, with emphasis on planting the largest area possible in basic food grains. Once subsistence was insured, settlers typically shifted to a wider range of income producing activities.

In 1979, AVV farmers stated that moving at least part of the family into noncrop concentrated employment was one of their goals for the next ten years. When 78 randomly chosen households were asked what they would do if they had a large sum of money at their disposal, 40 percent mentioned investing in livestock and 45 percent wanted to buy merchandise or cereals to trade (Murphy and Sprey 1980:73). In 1989, increasing investments in livestock and commerce was the

Table 6.1 Income Sources by Zone and Income Stratum, 1981-1985 Averages (in percent of total income)

	<i>Crop income</i>	<i>Livestock income</i>	<i>Local, non-farm income</i>	<i>Non-local, non-farm income</i>	<i>Food aid</i>	<i>Other transfers</i>	<i>Total income in CFA/ALE</i>
Sahelian							
Poorest 1/3	66	17	6	5	3	4	22,566
Richest 1/3	36	17	35	9	1	1	70,545
Overall	48	15	34	11	2	1	42,205
N = 45							
Sudanian							
Poorest 1/3	82	5	8	2	0	3	15,660
Richest 1/3	69	6	16	5	0	3	48,616
Overall	74	6	14	3	0	3	29,295
N = 44							
Guinean							
Poorest 1/3	57	18	22	2	0	3	29,886
Richest 1/3	31	19	48	1	0	0	95,629
Overall	43	17	38	1	0	1	55,261
N = 47							

Source: Reardon, Delgado, and Matlon (forthcoming).

most frequently stated five year goal of male household heads at all of the sites.

Livestock Production

In the absence of a fundamental change in the national banking system (like the creation of local *Caisses populaire d'épargne* in certain regions of the country), livestock is likely to remain the principal source of investment for all rural households. Small livestock were especially important for women.

Increased immigration to the Niangoloko region after 1974 was associated with an increase in the number of area cattle. Extension records at the AVV showed a similar increase in the total number of cattle and oxen in each of the groups of planned settlements (Figure 6.2). No doubt this figure underestimates the actual scope of the phenomenon, given the settlers' reluctance to report the exact size of their herds. Almost all of the settlers arrived without large livestock or draft animals. After the first year they were required to purchase two animals on credit from the project. The fifth year of settlement was an important turning point as most settlers completed the final payment on their animal traction equipment. The year usually coincided with the sale of their first set of fattened animal traction animals. The combination of ending their first medium-term credit and selling off the first set of fattened oxen presented farmers with a large block of cash to invest. Many farmers chose to reinvest this in further development of non-draft livestock.

If farmers have fewer than five cattle, the cattle are generally kept on-farm. Under these circumstances, the major cash expense for livestock is veterinary care, with some payment for supplementary feeding like salt. Larger herds were boarded with local FulBe. The actual cash and kind costs of boarding cattle are difficult to estimate since many of the costs are conceived as "gift" exchange between herder and boarder (see Chapter 9). Pastoralists may also have the right to a certain percentage of the calves born while the animals are under their supervision, for example one young cow every two to four years. When taken together (including the price of the calves given to the herder divided over three years), the cash and kind costs of herding livestock can run over 100,000 CFA per year for farmers with large herds (over 40) of cattle and oxen.

Animal husbandry can be risky as well as costly. To evaluate risk, farmers were asked to give the number of cattle, goats, and sheep lost

through disease and theft (Annex 4, Table C-1). These figures, divided by stock at interview time, were used to calculate the annual rates of loss per year (Annex 4, Table C-2). The rate of loss is an important factor in a farmer's investment strategy (Annex 4, Table C-3). Theft became a major problem in the AVV sponsored settlements. Animals are also subject to a variety of livestock diseases. The returns to livestock were calculated in two ways: (a) one, a "low" return scenario, which considered all feed costs by imputing a value to nonpurchased food, and high losses due to death and theft; (b) the second, a "high" return scenario, did not consider imputed costs, but only cash operating costs and low losses (Savadogo 1989c). The low scenario indicates that livestock income came between CFA 8,500 per ALE (AVV) and CFA 18,000 CFA per ALE (Solenzo). When the high scenario was considered, expected livestock income per ALE increased to 14,000 CFA in the AVV and 25,000 CFA at Solenzo. In both cases, the returns in Kompienga were lower.

As livestock densities increase, so does the difficulty of supervising animals so that they do not damage neighboring farmers' fields. These two factors increase the risk and limit the opportunities for additional income growth through animal husbandry. Opportunities are especially constricted for smaller, limited resource families, who lack labor as well as the willingness and ability to gamble on major livestock holdings.

The high labor demands, and in some cases high risks, of large livestock production help to explain why cattle ownership was unevenly distributed across the AVV population. With rare exceptions, all AVV settlers were required to purchase a pair of oxen after their first year in the project. In 1988-1989 the average number of cattle per head of household was 4.2; the average number of goats and sheep, 11.0 (Annex 5, Table D-6). These averages mask the fact, however, that about 25 percent of male household heads (who have been living in the AVV planned settlements for periods of 10-15 years) have no oxen or cattle at all (Annex 5, Table D-7). These are farmers who, for one reason or another, had either lost or sold their animal traction animals, and did not purchase a new pair.

Our study suggests that cattle and oxen ownership is more uneven at Solenzo (Annex 5, Table D-2).² At Solenzo, the households with large herds tend to be those of tractor owners or sedentarized

Figure 6.2 Total number of cattle listed in the AVV extension records



Source: AVV UD Extension records.

FulBe, with a higher concentration of animals in the older settlement at Daboura than in the newer settlement at Dar-es-Salaam/Kie.

The livestock figures at Kompienga are not really representative because settlement in the area is relatively recent (Annex 5, Table D-9). In addition, the high concentration of population in the town makes it difficult to keep livestock on the farm; hostile relations with the FulBe, many of whom were expelled from Ghana in 1988, also have made the local FulBe more reluctant to board settlers' cattle.

Nonfarm Production Activities

Settlers generally perceive off-farm production as a condition for sustainable income growth. Grain merchants operating with working capital (estimated at 500,000-1,000,000 CFA for larger traders) at Mogtedo and Linoghin could easily average monthly net profits of 30,000-50,000 CFA in addition to earnings from crop enterprises. This amount is well above the

monthly take-home pay of lower level civil servants. One successful young merchant, son of an AVV settler at Mogtedo, was earning a monthly net income of between 30,000 and 50,000 CFA from a prosperous, active regional trading enterprise in 1987. We estimated the net income from the store owned by a settler in the study sample at Linoghin to be 300,000 to 350,000 CFA during the 12 month study period in 1988-1989.

Only a small number of the study farmers were engaged in these sorts of lucrative, year round off-farm activities. The majority earned much smaller amounts from the sale of consumer goods and food products, production and marketing of foodstuffs (including beer), and local and nonlocal agricultural and nonagricultural wage labor. For this reason, the analysis distinguishes the first category of settlers as having "secondary occupations" and analyzes their income patterns separately (Table 6.2). Income earned from small scale commercial and wage activities was less important as a source of

Table 6.2 Mean Income from the Sale of Handicrafts and Trade, 1978 and 1988/89

	<i>Male head of household</i>					<i>Entire family</i>
	<i>First year</i>	<i>Second year</i>	<i>Developing farm</i>	<i>Full farm</i>	<i>Average</i>	
1979 Linoghin ^a	—	1,899	6,588	13,834	6,227	—
Mogtedo-Bombore ^a	495	6,627	19,670	13,791	9,715	—
Mogtedo V3 ^b Case Study						
With secondary occupation(2)	—	—	—	—	—	193,792
Without secondary occupation(6)	—	—	—	—	—	17,375
1988/89 Linoghin			—		—	
With secondary occupation (2) ^c				375,000		
Without secondary occupation (18)				9,461		
Bombore						
With secondary occupations (2)				122,500		
Without secondary occupations (18) ^d				1,921		
Mogtedo (20)				19,695		
Mogtedo V3						
With secondary occupations (1)				250,000		
Without secondary occupations (19) ^e				18,118		

— Not available.

() indicates number of households in this category.

a. Source: Statistical Service Survey Research on subsample of 78 farm families in the farm monitoring program (Murphy and Sprey 1980:73).

b. McMillan 1983:417.

c. Includes pension of retired soldier and estimated annual income from one farmer's boutique.

d. Does not include large incomes earned by two butchers.

e. Does not include income from one farmer with secondary occupation.

Table 6.3 Average Non-farm Income from Different Sources for Individuals Reporting Income from the Source, 1988-1989

	<i>Linoghin</i>	<i>Bombore</i>	<i>Mogtedo</i>	<i>Mogtedo V3</i>	<i>Solenzo</i>	<i>Kompienga</i>
<i>Male head of household</i>						
1. Unprocessed agric. products	64,120(1)	—	42,000(1)	—	—	23,167(3)
2. Processed agric. products	—	—	—	—	24,000(1)	8,425(2)
3. Forest and water products	—	—	—	—	—	87,000(1)
4. Meat and animal by-products	28,500(1)	122,500(2)	38,650(3)	25,000	—	107,667(3)
5. Commerce	300,000(1)	—	50,250(2)	14,000(3)	—	81,000(3)
6. Handicrafts	21,300(2)	6,070(6)	1,950(1)	6,950(2)	—	53,167(3)
7. Gold	—	2,000(1)	36,166(3)	27,721(7)	—	—
8. Services	4,000(1)	—	5,000(1)	23,700(2)	41,250(2)	50,000(1)
9. Agriculture Labor	—	—	20,000(1)	—	—	—
10. Nonagriculture Labor	450,000(1)	—	—	250,000	—	—
11. Mill	—	—	—	—	—	550,000(1)
<i>One woman per family</i>						
1. Unprocessed agric. products	9,050(2)	—	—	74,200(2)	—	10,437(10)
2. Processed agric. products	26,043(13)	3,833(5)	3,186(7)	6,642(14)	29,300(6)	6,361(11)
3. Forest and water products	30,050(2)	—	—	—	—	3,000(1)
4. Meat and animal by-products	—	—	37,500(1)	—	—	—
5. Commerce	2,200(1)	6,000(1)	—	—	350(1)	—
6. Handicrafts	7,650(1)	8,150(1)	—	—	—	17,000(1)
7. Gold	—	500(1)	19,691(12)	13,914(16)	—	—
8. Services	—	—	—	3,500(1)	—	—

— Not available.

() indicates how many men and women provided non-zero numbers.

Twenty men and twenty women were interviewed in each of the AVV planned settlements; 36 men and 36 women were interviewed at Solenzo. Means are taken over these numbers.

Source: Savadogo 1989a.

Table 6.4 Percent of Women Indicating Income from Off-farm Employment and Livestock Production and Average Income from these Sources for the Entire Sample, 1988/89 (per woman)

	Off-farm income			Net livestock income ^a	
	N	Percent	CFA	Percent	CFA
<i>Linoghin</i>	(20)	80	21,331	20	201
<i>Bombore</i>	(20)	35	1,690	45	486
<i>Mogtedo</i>	(20)	60	14,805	45	1,887
<i>Mogtedo V3</i>	(20)	95	23,392	55	3,865
<i>Solenzo</i>	(36)	17	6,833	0	0
<i>Kompienga</i>	(25)	64	9,774	8	442

N indicates sample size.

a. Net income on livestock includes deductions for animal losses by death and theft. The low figures reflect both this and the fact that only a few women in each sample had sold livestock at the time this initial analysis (August 1989) was conducted.

Source: Savadogo 1989a,c.

Table 6.5 Average Income by Income Source for Male Heads of Household and Women in the Study Sample, 1988/89 (FCFA)

Site	Net crop production (per ALE)	Net livestock production (per ALE)	Net off-farm (w/o secondary occupations)	Total
<i>Male head of household</i>				
Linoghin	61,315	21,897	9,461	92,673
Bombore	54,988	6,797	1,921	63,706
Mogtedo	51,072	14,764	19,695	85,531
Mogtedo V3	55,101	5,415	18,118	78,634
Solenzo				
manual	30,965	2,445	2,958 ^a	36,368
traction	78,784	8,494	2,958	90,236
tractor	294,422	44,802	2,958	342,182
Kompienga	78,784	8,522	39,495	126,801
<i>One woman per family</i>				
Linoghin	19,336	201	21,331	40,868
Bombore	11,145	486	1,690	13,321
Mogtedo	16,976	1,887	14,805	33,668
Mogtedo V3	17,385	3,865	23,392	44,642
Solenzo	12,687	0	6,833	19,520
Kompienga ^b	12,633	-442	9,774	21,965

Note: Net crop and livestock production are calculated per ALE (adult labor equivalent) for the collectively worked fields and supervised livestock under the responsibility of the male head of household. These herds and fields are generally used for the main food and cash needs of the family unit.

a. The study did not distinguish off-farm income by groups with different technologies.

b. Ethnic groups differed substantially in terms of women's economic activities.

Sources: Savadogo 1989c; Savadogo and Sanders 1989.

cash income or of total income for the male household head than it was for women (Tables 6.3, 6.4, and 6.5),³ married sons and brothers, and unmarried male and female children attached to households.

Factors that Affect the Development of Off-farm Employment at the Study Sites

We found substantial differences among the AVV planned settlements in both the total level and the sources of off-farm income. These activities were affected by settlers' proximity and "social access" to area markets, as well as by the presence of alternative opportunities in commercial agriculture. Gold mining was an important factor affecting off-farm employment at one of the study sites.

The AVV Planned Settlements at Mogtedo and Mogtedo-Bombore

EARLY INCREASE IN AND THEN DEMISE OF PROFITABLE SOURCES OF NONFARM INCOME. Within five

years after the first planned settlement was created at Mogtedo in 1974, a considerable number of settlers (five in just one of the six villages we studied) had profitable secondary occupations. This trend did not last, however, and today the bloc of Mogtedo, and the adjacent bloc of Mogtedo-Bombore have no permanent stores and only a few settlers can be classified as having secondary occupations. Several factors explain the early rise and fall of profitable secondary occupations. These include the termination of construction of planned settlements at Mogtedo-Bombore in 1981; gradual depletion of the surrounding wood resources and an associated drop in income from commercial woodcutting; the substantial decrease in cotton production and conversion to commercial cereal production that is sold in the larger regional markets away from the villages; and a gradual decrease in the number of salaried extension workers who provided farmers with a steady market for their services and products.

As early as 1979, the most prosperous AVV settlers at Mogtedo and Bombore were planning to

invest in trade and special services for the larger Mogtedo market that was 20 to 30 kilometers from their villages and located on the paved highway linking the area to Ouagadougou. These early efforts to diversify into area trade were actively blocked by the indigenous inhabitants, however. Although they were from the same Mossi ethnic group as most settlers, the indigenous inhabitants resented the AVV land tenure policies. In the six AVV villages at Mogtedo, only two AVV settlers' children and one male household head who had immigrated from outside the region, had official places in the Mogtedo market in 1989, and only one of the original settlers' sons had ever developed a successful regional trading enterprise. The successful merchant has since left the Mogtedo area to develop trade in another, more hospitable area. The one exception—a prosperous grain merchant now living in the Mogtedo sponsored settlements—is a native of the surrounding region, and only came to the project in 1988.

DISCOVERY OF GOLD. Gold was discovered near the AVV planned settlements at Mogtedo in late 1987. Since then, panning for gold has become an important revenue source in certain villages. In addition to the direct benefits of the gold, the flood of gold miners created a market for meat, water, and raw and cooked food. The largest gold mine and gold market is at Nobsin, near villages V3 and V4 in the AVV sponsored settlements at Mogtedo; a second smaller gold site and gold market is located near village V3. Lesser sites are being prospected throughout the region.

Twenty-eight of the 40 women that we interviewed at Mogtedo earned income from gold-mining. The range of recorded income was large—from a few thousand to over 50,000 CFA (Table 6.3). The gold mines also created new opportunities to sell food products and water. The net result, which is certainly underestimated in our figures, was a substantial increase in the income of women farmers in the Mogtedo villages nearest the sites. Some of the indirect effects of this higher income could be seen in the improved quality of women's clothing on Muslim and Christian holidays, in the volume of new metal dinnerware, and in women's purchases of locks and other improvements for their houses. No similar increase was observed in women's income from nonfarm employment in the more isolated Bombore planned settlements except in V2 and V5, villages that had functioning markets.

The AVV Planned Settlements at Linoghin

A different scenario was recorded in the AVV sponsored settlements at Linoghin largely because the settlers developed a dynamic market on the paved road to Ouagadougou. The importance of these activities is not reflected in the interviews with official heads of households. Instead, it is more accurately reflected in the higher income levels of men who were not household heads (married sons, brothers, and unmarried children) and of women. Even the 300,000 CFA in annual income recorded by one household head (Table 6.3) was actually earned by a married son. The father simply put up the money for the initial investment.

Eighty percent of the 20 women interviewed in the farming systems survey at Linoghin recorded income from off-farm employment, none of it from gold (Table 6.4). Most of this income derived from selling cooked food, homemade beer, and gathered forest products. The average off-farm income for all the women interviewed at Linoghin was at about the same level as income recorded at Mogtedo V3—the village where women gained the most from the direct and indirect benefits of the 1988-1989 gold rush (Tables 6.3 and 6.5). Linoghin is also the village where extension programs to promote women's weaving have been most successful. Although it was a dismal failure for most of the first ten years that it was promoted, a combination of increased demand for handwoven cloth, proximity to Ouagadougou, and increased free time has made hand weaving very popular.⁴ In 1989, 21 female sponsored settlers, 8 female spontaneous migrants, and 2 female hosts belonged to the Linoghin women's weaving cooperative (personal communication, F. Guira, DEPC, AVV, April 1990).

Solenzo

Only three household heads in the Solenzo village reported earning off-farm income (Table 6.3). Among the women, the most noticeable source of off-farm income was from sales of homemade beer, from which six women earned an average of 29,300 CFA (\$98) (Table 6.3).

We suspect that these figures underestimate the importance of off-farm income in the village economy. A high proportion of the income is probably earned by the married and unmarried brothers and sons we did not interview. The exist-

ence of several privately owned grain mills, well stocked, sturdily built boutiques, and thriving village markets at Dar-es-Salaam, Kie, and Daboura suggests that at least part of the high income from crop production is being reinvested into the development of commercial enterprises.

Some of the large income disparities we observed between farm families with manual technology and those with animal traction and tractors may be offset by off-farm employment. Four of the six manual male farmers with low crop and livestock incomes at Kie/Dar-es-Salaam have secondary occupations (masonry, carpentry, trade), and one engages in dry season irrigated gardening. Only two of the six are recent migrants (one in 1982 and one in 1985). None of the seven male farmers who farmed without animal traction or tractors at Daboura indicated secondary occupations, however, except for two FulBe households who (not surprisingly) indicated herding.

Kompienga

Greater opportunities for dry season irrigated gardening and trade were the principal reasons cited for moving by the male and female settlers who immigrated from the AVV to Kompienga. To date, the state has not yet begun to develop the irrigated perimeter that is planned for the lake bank. Nevertheless, both male and female settlers benefitted from high levels of off-farm employment in trade and services (Table 6.3). In 1988-1989, these revenues were still being fueled by a large contingent of wage laborers involved in tree clearance. As these wage earning opportunities decreased, so did the profitability of commercial enterprises. It is doubtful that the earlier high levels of off-farm employment can be regained unless other changes, like the development of irrigation, occur.

Household Level Factors That Affect the Development of Off-farm Employment

In addition to village level factors, a variety of household level factors affect the distribution of off-farm employment within a given village. Some of these are cultural and include local attitudes toward women's participation in trade and handicrafts. The size of the family labor force is also important. Settlers repeatedly emphasized that in order for someone to engage in a profitable

year round secondary occupation, at least one other adult male must be available to help with heavy farm labor. Two successful merchants—one a kola merchant and the other a mechanic—were forced to abandon their trade when they lost key family members (a married brother in one case, an older unmarried son in the other) through out-migration.

Linkages among Diversification, Agricultural Intensification, and Sustainability

The AVV Planned Settlements

DIVERSIFICATION AND NEW TECHNOLOGY. Diversification need not necessarily be at the expense of additional investment in intensive farming or higher levels of crop productivity. In 1988/89 the net CFA value of crop production per ALE was 12 percent higher for the study farmers at Linoghin than at Bombore, and 20 percent higher than for the Mogtedo households. Ten years ago there was no visible difference between the blocs in terms of net productivity per ALE (Murphy and Sprey 1980:69).

Linoghin, the planned settlement group with the greatest actual and future potential for diversification into activities other than mining, had average per household cash and kind expenses for production that were 24 percent higher than at Mogtedo, and over 200 percent higher than at Mogtedo-Bombore and Mogtedo V3 (Savado, Sanders and McMillan 1989:43). Seventy-nine percent of the study farmers used some compound fertilizer on their fields at Linoghin, 85 percent at Mogtedo, but only 45 percent at Mogtedo-Bombore (Savado, Sanders and McMillan 1989:34).

Linoghin also is the planned settlement where there was the greatest interest in the development of soil conservation measures like *diguettes* (small dikes), manure pits, and straw.⁵ To assist farmer *groupements* with the initial development of *diguettes*, the AVV-UP1 provided trucks. Even after the AVV program ended, some farmers continued to rent trucks on their own in order to expand their *diguette* networks. One family invested 37,500 CFA (the equivalent of the mean expenditure per household on fertilizer, insecticide, seed, and wage labor at Linoghin for 1988/89) on installing stone *diguettes* (personal communication, F. Guira, DEPC, AVV, 19 April 1990). The highest level of interest in stone *diguettes* was in

the most isolated Linoghin village, V6, which is 20 to 25 kilometers from the Linoghin market. Although too distant from the market for many family members to engage in trade easily, the V6 settlers are close enough to Ouagadougou to develop profitable off-season crops—in this case, fresh corn. In 1989 the V6 farmer who sold the greatest amount sold 20 carts of fresh corn; the lowest amount was 4 carts.

The dynamism of the Linoghin settlers and their commitment to diversification is reflected in other areas as well. Average household expenditures on education—especially secondary education—were much higher at Linoghin than in the other settlements. The percent of debt repayment on short-term credits has generally been the highest of all the settlement groups studied (Figure 6.3). In comparison with the other blocs, Linoghin also has had one of the most successful records for the development of *groupement* managed enterprises, the income from which has been used to maintain basic infrastructure like roads and wells. Especially remarkable was the Linoghin *groupement's* development of the first kindergarten in the region. Settler turnover has been very low at Linoghin. Although a number of wealthier settlers have moved into full time commerce based in Ouagadougou, they have in almost every case left some member of their family responsible for the farm.

In contrast to Linoghin, the more isolated, less diversified neighboring blocs of Mogtedo and Mogtedo-Bombore have experienced high turnover. Of the 255 households who acquired AVV farms at Mogtedo, only 58 percent (148) are still living there. Eighty-one percent of the 345 households that have had official rights to an AVV farm at Mogtedo-Bombore were still living there in 1989. Other factors, like the settlers' lack of understanding about the project when it first started, undoubtedly contributed to the higher rates of settler turnover in the six Mogtedo villages which were created five years before Mogtedo-Bombore. Nevertheless, settlers' perception of the lack of local opportunities for developing nonagricultural sources of income contributed to the high rates of settler turnover in the more isolated AVV blocs of Mogtedo, Mogtedo-Bombore, Kaibo South, and Kaibo North, and to lower rates of turnover in less isolated blocs like Linoghin and Bane, which offer greater opportunities to earn income from trade and services (see also Annex 1, Table A-3).

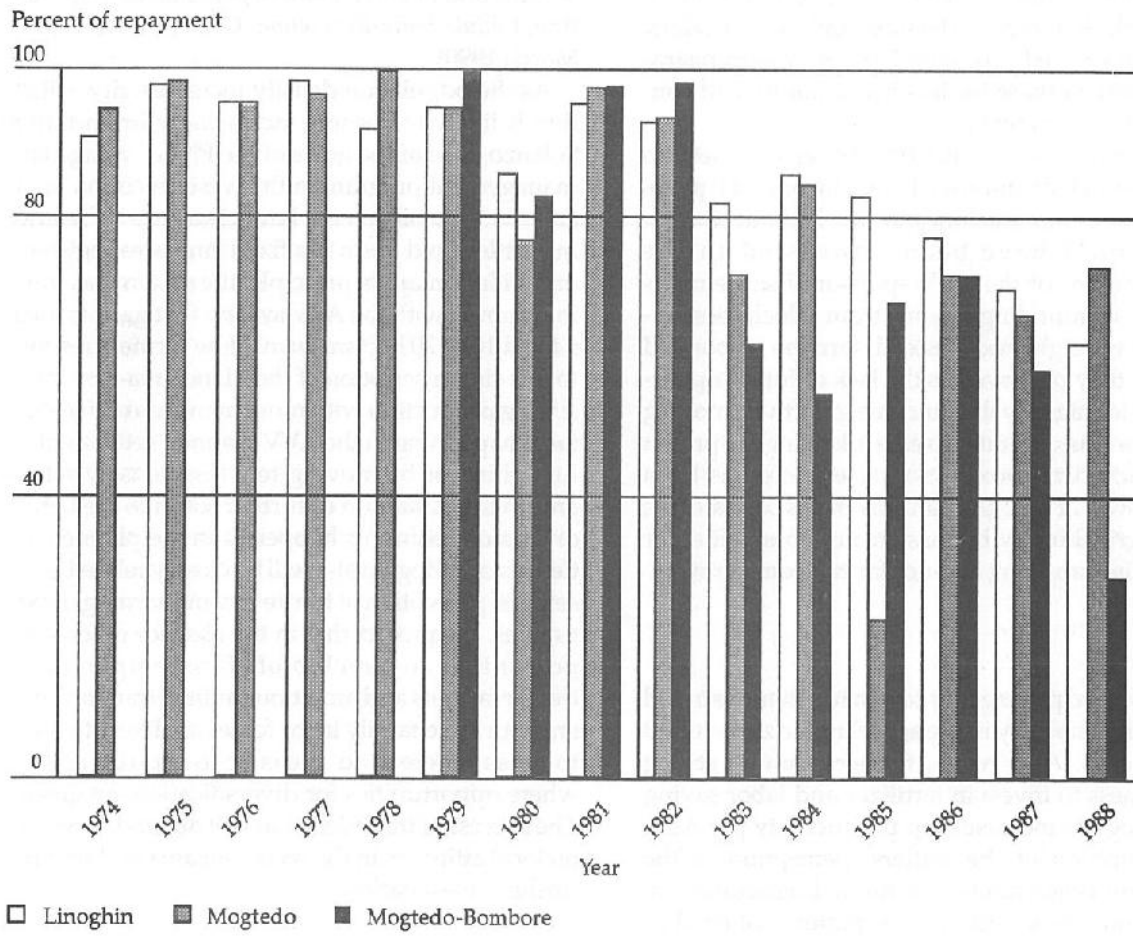
Settler "Step" Migration from the AVV to Kompienga

The importance of diversification in the lower rainfall, northern river basins was brought to light by the immigration of some of the most successful AVV settlers to Kompienga. The Kompienga census identified 55 male heads of household who were former AVV settlers in the planned settlements at Mogtedo, Mogtedo-Bombore, Rapadama, and Mankaraga. More than 30 families left the bloc of Mogtedo, cutting all ties with the AVV. Overnight, the number of children attending the AVV Mogtedo primary school dropped by a third. The actual number of families that left was even larger, but some did not appear in the official figures since their moves were classified as "dissociations," with only part of the family leaving.

Two of the households who left V3 at Mogtedo were very wealthy, with large cattle herds (one with 25 animals and another with over 50) as well as sizable incomes from off-farm employment. The male heads of these wealthy households had lobbied intensively to get the planned settlement group to support development of a central market on the road linking the planned settlements to the town of Mogtedo. One of the men had even offered to subsidize the price of grain sold at the market in order to attract outside merchants. Another settler had been recognized as the province's leading "progressive farmer" at the 1987 agricultural fair and had received over \$1,000 worth of prizes. The six other families who left V3 were all better off than average in terms of the size of their livestock herds and past crop production levels. The settlers' main motivation for leaving was to move to an area with greater opportunities for dry season irrigated farming and regional trade.⁶

"Step" agricultural migration, like that of the AVV farmers to Kompienga, is not new. The deterioration of opportunities in an area of in-migration has always encouraged agriculturalists to move. This sort of serial migration has been an integral feature of agricultural migration on the Mossi Plateau for centuries. Thus, it is of little surprise that many of the settlers from the Sanmatenga (Kaya) region who left the AVV for Kompienga had lived in other areas before coming to the AVV. As many as 50 percent of the Mossi living in Kompienga today had lived for periods ranging from two to ten years in other areas of the OCP valleys or plateau before migrating to the town.

Figure 6.3 Rate of Credit Reimbursement, AVV Planned Settlements



Source: AVV, Crédit Agricole, March 1990.

The cost of this step migration from one OCP area to another is not only economic, but institutional and environmental as well. Out-migration of wealthier farmers, as we have seen at Mogtedo and certain villages at Rapadama, means the loss of cash resources earned during the early period when crop production at a settlement site is usually most productive. These cash resources could have been reinvested in the development of more intensive, sustainable environmental management like the *diguettes*. Another incalculable cost is the loss of a first generation of settler leadership. The commercial farmers who left Mogtedo for Kompenga included some of the most ambitious leaders, who had worked closest with the AVV administration. Many of these leaders had accumulated considerable investments.

The cash resources that the former AVV settlers used to purchase improved housing or rental properties and to rent tractors and hire labor at Kompenga could have been reinvested in the development of the AVV sponsored settlements and the surrounding regions from which these resources were gleaned. Instead, farmers responded to what they perceived as the lack of future opportunities for high levels of income growth by moving on. In contrast, the rate of settlers leaving the project for agricultural production elsewhere has been much lower at Linoghin, an area that is basically the same agriculturally, but has greater possibilities for diversified cropping and nonfarm income growth.

Solenzo

The technical package for cotton has demonstrated its steady reliability in the agroclimatic zone suited to this crop. As a result, farmers show a strong willingness to invest in fertilizer and labor saving technology to increase crop productivity per ALE. One reflection of the settlers' perception of the long-term opportunities in rainfed agriculture in the region can be seen in their patterns of rural financing for crop production technology. National research shows that the Solenzo zone has one of the highest rates of cash purchases of agricultural material (personal communication, *Cellule Suivi-Evaluation*, CRPA du Mouhoun, March 1990). Although local credit has tended to stagnate, the area has experienced an increase in animal traction equipment, such as plows and carts. This agrees with the results of our economic survey, which showed that a high percentage of the plows, and almost all of the carts, owned by the settlers stud-

ied were purchased with cash rather than credit, as is almost always the case in the AVV sponsored settlements.

Although intersectoral linkages between agriculture and the service sector in Solenzo may be considered weak in comparison with the AVV, the settlers have shown a strong tendency to reinvest in social infrastructure. The Solenzo area, which is one of the top cotton producing areas in the country, also boasts one of the highest rates of agriculturalist investment of *ristournes* (returns) from farmer managed cotton markets into village schools and health facilities (personal communication, *Cellule Suivi-Evaluation*, CRPA du Mouhoun, March 1990).

As the population density increases, diversification is likely to become increasingly important at Solenzo. One of the goals of the PNGT village land management program in the western cotton boom areas is to stabilize new land clearance by restricting settlers and hosts to a fixed land area registered on a village map. In principle, the system has much in common with the AVV system that gave farmers a fixed 10 or 20 hectare farm. How farmers respond to this circumscription of their land area—by intensifying production with more manure and fertilizer (as is happening in the AVV planned settlements at Linoghin), or by moving to a less densely settled area in the Mouhoun or further south to the Leraba or Comoe Basins (as happened in the planned settlements at Mogtedo)—will be closely related to the settlers' perception of future income earning opportunities. We predict that in the absence of local opportunities to develop off-farm employment, tractor farmers and ambitious animal traction farmers with large family labor forces are likely to move to areas where land is easier to acquire and/or where opportunities for diversification are greater. The success of this migration will depend, however, on local attitudes in the receiving area and requires further investigation.

Policy Implications

The important role of economic diversification has a number of implications for policy at both the national and local levels.

National Level Planning Issues

Any long-term policy to encourage the dynamic development of Burkina's rural sector will necessarily be linked to the creation of a certain

synergism between agricultural and nonagricultural activities. The establishment of small enterprises to transform agricultural products, for example, could encourage the development of transportation infrastructure, facilitating the movement of agricultural products between villages and regions.

As food processing tends to be a female activity, this activity is especially important for programs aimed at raising women's incomes. A national program to encourage the development of food processing for major and secondary urban markets could thus be a means of redistributing revenues to women and encouraging women's participation.

The next question, then, is how best can national, regional, and local governments facilitate the development of such activities? A policy environment that is conducive to investment is essential. Tax concessions and temporary subsidies might be considered to encourage private businesses to relocate to some of the high potential valley areas. Agricultural fairs and "development weeks" can be used to educate farmers and local administrators about the potential of such programs. The products produced must also be moved between regions and villages. It is here that national and regional policies are likely to have their greatest impact—by either encouraging or discouraging local food processing and trade between regions. A national program to improve infrastructure in the west, as was discussed in Chapter 4, would encourage greater regional specialization of production. Under these circumstances, certain areas like the higher rainfall river basins in the west would tend to become specialized in commercial cereal and crop production as well as cotton. Other areas like the lower rainfall northern river basins that currently produce large amounts of cereal for urban consumption are likely to specialize in intensive livestock raising, nonfarm handicraft production, and vegetable gardening for the cities. This sort of regional specialization demands an overarching policy for augmenting basic transportation.

Local Level Planning Issues

- **SITE SELECTION.** In view of the importance that settlers attach to developing diversified sources of income, policymakers should concentrate on less isolated areas, where the opportunities for diversification are greater.

- **EARLY EMPHASIS ON FACILITATING REGIONAL ECONOMIC AND SOCIAL INTEGRATION.** Early planning is needed to incorporate the needs and concerns of indigenous inhabitants into a project in order to minimize host-settler conflict and the negative impact that conflict can have on diversification.

- **UPGRADE EXISTING MARKET AND ADMINISTRATIVE CENTERS AND CREATE NEW CENTERS.** In view of the costs of creating new administrative centers, attention should be given to upgrading existing regional centers when they exist. As more and more immigrants arrive, however, new centers will emerge. The experience of the AVV shows that it is not always easy to predict where centers will grow as new lands settlement increases. For this reason, we recommend that outside aid to develop basic roads and infrastructure should be phased in over a 10-15 year period, thereby increasing the chances that these roads can be used to reinforce the development of dynamic, stable centers.

Notes

1. Both male and female settlers from the Kongoussi region said that this was changing, however, and that their women had tended to increase the amount of land they were farming privately with longer periods of living in the valleys.
2. A comparison of our results with the results of the economic survey conducted by the CRPA suggested that we might have underestimated the incidence of non-traction livestock. In view of the importance of livestock in future plans for diversification in the area, this is a topic that needs additional research.
3. One should note that the woman chosen for the interview in each household was usually the most "economically active" woman in the family. Computing statistics based on these women tends to inflate data. The data can be interpreted, therefore, as expected maximum productivity per woman.
4. This increased demand was partially due to the revolutionary government's requirement that officials wear clothing made from locally produced cotton for work and official ceremonies. The progressive relaxation of this measure is expected to lead to a decreased demand.
5. We do not feel that the high levels of interest of farmers in the new technology are fully reflected in the official project records. The extension records list only the number of hectares covered with *diguettes* that were constructed as part of the UP1 program; our observations consider the *diguettes* created under project auspices as well as those created through personal initiative.
6. Although economic factors appeared to have primary importance, the final decision by individual families to go or stay was also influenced by such factors as intravillage social conflict and strong social ties with other settlers who were leaving.

Farming Systems

The term "farming system" encompasses the different management techniques, crop rotations, technologies, labor systems, land tenure norms, and macroeconomic policies that affect local crop and livestock systems. The farming system is a subsystem of the broader household production systems discussed in Chapter 6. A specialized study of household farming systems is justified by the fact that production of crops and livestock is likely to remain the principal source of cash revenue and food for rural households living in the river basins (McMillan, Painter and Scudder 1990).

The case studies illustrate the potential of new lands settlement in the valleys to increase total production and, in so doing, to raise total agricultural income levels and settler welfare. This increased production is engendering wider regional effects of increased on- and off-farm employment, livestock production, and cereal production.

The present chapter provides a brief overview of farming systems at the study sites. Detailed examination of the study results is presented in Annex 5, in K. Savadogo (1989a, b, c, d) and Savadogo, Sanders and McMillan (1990). This overview is followed by a discussion of key factors that contributed to or detracted from the development of sustainable crop production methods, and some of the implications that this has for future policies.

Farming Systems in Areas of Unassisted Spontaneous Settlement: Niangoloko and Kompienga

The first two study sites—Niangoloko and Kompienga—are examples of how unassisted settlement tends to reproduce extensive cultivation systems with little attention to sustainability and high potential for social conflict at higher population densities.

Niangoloko

Crop production in the Niangoloko region focuses on the extensive production of cereals. While cotton production has undergone a tenfold increase since 1985, it is largely confined to a small number of villages in the Leraba Basin. Moreover, the chief stimulus behind the sudden increase in cotton production (from 50 tons in 1985-86 to 500 tons in 1987-88) has been the recent return migration of Burkinabe from Côte d'Ivoire rather than any new initiative on the part of the Burkina government.

Despite this recent growth in cotton production, the area's extension services have remained limited; four agents, including the area director, cover 15 villages. Extensive livestock production and trade continue to be the major sources of settler income growth.

Farmers in the region traditionally farmed a field for only five years before leaving it fallow for an average of 20-25 years (Nana 1989a). An abundance of reserve fields made this lengthy

fallow period possible. Traditional cultivation techniques included a system of mounding that follows the water flow from torrential downpours—a technique that reduces the effects of soil erosion. While two of the study villages showed visible erosion, no special technique to offset its effects had been developed, as farmers tend to respond by abandoning their fields at the first sign of erosion.

If immigration continues at present rates, clearing new fields (i.e., expansion of extensive farming) will no longer be an option in some villages, especially those near Niangoloko, the major administrative and market center, where immigration rates have been the highest. At that point, farmers will undoubtedly want to spread the villages' field areas into adjacent classified forests. The most immediate threat to the forests, however, is from pastoralists. Cattle, in the area of the Classified Forest of Toumousseni, for example, are estimated at 10,000 head. One solution to the problem is to introduce experimental programs like the Classified Forest Project at Toumousseni, which helps local pastoralists and agriculturalists to develop sustainable sources of revenue from forest products. Projects like this can create a group of local people with a vested economic interest in forest preservation. Over the long run, however, this sort of multiple use forest project must be combined with the development of other sectors, including crop and livestock production.

Kompienga

Kompienga is another example of extensive agricultural systems that develop in areas of unassisted spontaneous settlement. Prior to 1982, when construction started on the road linking Fada to the proposed dam site, immigration to the Kompienga valley was very much like immigration to Niangoloko. As in Niangoloko, the Kompienga

Basin region had not benefitted from any special donor funding for crop and livestock development. Crop production continues to be heavily focused on subsistence food production. Rates of adoption of animal traction and fertilizer were among the lowest in Gourma province. The sample failed to reveal any use of fertilizer (Table 7.1).

The Burkina government was correct in assuming that rapid spontaneous settlement would accompany construction of the dam. For this reason, it was adamant about preparing a comprehensive regional development plan to reinforce the area's weak infrastructure and extension services. To date, however, no special extension services have been developed except for the relocation of four villages from the flood basin and for another nine villages on the basin's edge that are losing all or part of their fields because of flooding. The relocation program, administered by the AVV and DGMOK (*Direction Générale de la Maîtrise d'Ouvrage de la Kompienga*), includes a variety of extension programs whose administration was supposed to revert to the regional offices of the relevant national ministries after 22 months.¹ The town of Kompienga is slated to benefit from a series of special development programs that includes irrigated gardening and flood recession agriculture on the lake banks, as well as special infrastructure and extension programs to promote intensive farming (Agrotechnik 1989). In the meantime, there are no special programs for settlers living in the town, and very limited services for villages other than those in the AVV program.

Despite significant differences in the household organization of production, and in the relative importance of agricultural (crop and livestock) versus nonagricultural (trade) sources of income among the three principal ethnic groups (the indigenous Gourmantche, and immigrant Mossi

Table 7.1 Mean Input Costs for the Male Head of Household for Different Ethnic Groups, Kompienga, 1988/89 (CFA)

	Ex-AVV	Non-AVV	Yana	Gourmantche	All
Number	7	6	6	6	25
Fertilizer, urea, phosphate, manure	—	—	—	—	—
Insecticides	—	—	—	—	—
Hired labor (cash and kind)	22,171	9,255	38,875	3,250	18,539
Hired equipment (cash and kind)	2,344	1,000	3,125	5,475	2,344

— Not available.

Source: Savadogo, Sanders, and McMillan 1989.

and Yana), the crop production systems of all three groups are uniformly extensive.

What distinguishes the Komienga farmers from spontaneous settlers at the other study sites is their high use of purchased labor (Table 7.1). They spent an average of nearly 20,000 CFA (including cash and kind expenditures) on labor as opposed to 5,000-10,000 CFA in the AVV and less than 1,000 CFA at Solenzo. This high level reflects the substantial cash resources enjoyed by the average Komienga settler. These settlers are not typical low resource farmers. Attracted by the long-term possibilities of the area for irrigated farming and trade, former AVV settlers were willing to pay from 100,000-150,000 CFA for truck transportation to bring their families to Komienga. At the site, 52 of the 55 former AVV settlers purchased their house sites from departing dam workers at an average cost of 100,000 CFA. None of this cash reserve was being spent on fertilizer. The only study farmer who used any fertilizer during the 1988/89 crop year had won the fertilizer as a prize in a "progressive farmer" contest at the AVV.

In 1988, the total production in kilograms and net CFA value of production per worker was highest for the indigenous Gourmantche and for the Yana farmers who had been living at the site for several years (131,313 CFA/ALE and 125,841 CFA/ALE, respectively for net value). Net crop income and production were lower for the Mossi settlers, both former AVV and non-AVV (64,366 CFA/ALE and 72,145 CFA/ALE, respectively), most of whom had been living at the site for only one to two years (Table 7.2). The immediate prospects for sustainable income growth in livestock and crop production look dim however.

The majority of settlers now farming in Komienga moved there in 1987 and 1988. Some of their fields had been farmed earlier by dam

workers. In any case, a large percentage of the surrounding area is rapidly approaching the fifth year of continuous cultivation—a time when the indigenous Gourmantche farmers would begin letting the land lie fallow under the system of crop rotations they have followed for many generations. This type of lengthy fallow will not be an option for the new migrants, who have occupied almost all the good rainfed land for a ten kilometer radius around the settlement.

Efforts to Promote Higher Yielding, Sustainable Farming Systems

The Solenzo and AVV sites are good examples of the two most important models of government assistance to agriculture in the river basins.

The Solenzo Assisted vs. AVV Sponsored Crop Extension Models

The crop extension services offered to settlers in the Solenzo area make up one model for assisted spontaneous settlement. The program that is promoted at Solenzo was developed over several decades—first by the French colonial government, and later by the semiautonomous Burkinabe cotton agency, SOFITEX. Although the basic package focuses on commercial cotton production, it includes a balanced mixture of crop rotations, fertilizer, and cultivation techniques that, used together, was expected to reduce the long-term deleterious impact of cotton production on area soils. In recent years the program has also promoted the use of high levels of manure to offset a decline in soil organic matter.

When the AVV was created in 1974, the program advocated many of the same agronomic themes that the cotton programs in Burkina's southwest were promoting. Farmers in both re-

Table 7.2 Crop and Livestock Production per Adult Labor Equivalent (ALE), Komienga, 1988/1989

	<i>Mossi</i>		<i>Yana</i>	<i>Gourmantche</i>	<i>All</i>
	<i>Ex-AVV</i>	<i>Non-AVV</i>			
Average family size (no. residents)	13 (7)	15.5 (6)	7.3 (6)	6.7 (6)	12.9 (25)
Average family labor force (ALE)	5.9	6.5	4.8	3.8	5.2
Cereal production (kg.): sorghum-maize per ALE	988	1,129	1,666	1,911	1,357
Net crop income (CFA per ALE)	64,366	72,145	125,841	131,313	91,616
Net livestock income (CFA/ALE high scenario)	19,116	102 ^a	12,155	2,578	8,522

() indicates number of households

a. verified 3/26/92

Source: Savadogo, Sanders, and McMillan 1989, and unpublished analyses of field data.

Table 7.3 The AVV Index of Adult Labor Equivalents (ALE) by Sex and Age

Age	Male	Female
0-12	—	—
12-15	0.5	0.25
15-55	1.0	0.75
55-65	0.5	0.25

gions were supposed to cultivate a proposed rotation of cotton, cereals, and legumes that would, in combination with the recommended levels of mineral fertilizer, allow them to attain higher, sustainable yields. Both programs focused heavily on commercial cotton production, which provided the means for reimbursing short-term credit for inputs, and longer-term credit for animal traction equipment, such as plows and carts.

An important difference between the two sites was that the AVV restricted the amount of land that settlers could farm. A system of weights that assigned a labor value to each registered family member (Table 7.3) was used to determine the amount of land that a family was officially allowed to clear and farm.² Total farm size was restricted to either one or, in the case of a very large labor force, two ten hectare farms. Each project farm consisted of a one hectare home site and six bush fields measuring 1.5 hectares each. Under the prescribed system of crop rotations (Table 7.4), each of the six bush fields was supposed to lie fallow for two years as part of a six year rotation that included sorghum, cotton, and legumes. The AVV also specified the type and level of fertilizer, seed, and insecticide to be used on each crop. There was no such restriction at Solenzo.

A second important difference between the AVV and Solenzo programs was that participation in the proposed package of intensive cultivation methods was not voluntary for the AVV sponsored settlers. When settlers joined the

Table 7.4 Recommended AVV Rotation

Year	Crop
1	Sorghum
2	Cotton
3	Cotton-peanuts-cowpeas
4	Red sorghum-millet
5	Fallow
6	Fallow

project, they signed an agreement pledging to follow the recommended program for intensive farming. Their participation was closely monitored. During the first five years, each planned settlement included one male extension agent for every 25 settler households and one female agent for every 50. Although the project administration only rarely exercised its right to expel farmers for not adhering to the proposed technology and land use techniques, the threat of expulsion, or of being refused access to short-term credit, carried some weight. In contrast, the adoption of the new cotton technology package was voluntary and conformed with the individual household's financial situation and goals in Solenzo.

Climate and soils mark a third difference between the two programs. The AVV planned settlements are located on the northernmost fringe of the area deemed suitable for cotton. Lower average, less evenly spaced, rainfall made cotton production a fairly high risk activity even in an average year. The Solenzo area benefitted from a better set of natural conditions.

Early Response to the AVV Sponsored and Solenzo Assisted Crop Extension Models

AVV. Although the 1979 farm monitoring survey conducted by the AVV showed that average yields for sorghum were below the expectations of the project planners, yields were still two to three times as high as the figures recorded for the McMillan (1983) case study of home villages in the Sanmatenga (Kaya) region. The survey also showed, however, that the increase in settlers' incomes was primarily a result of the expansion of the total area cultivated and the natural fertility of the new soils rather than the successful introduction of the recommended package of intensive technical innovations (Murphy and Sprey 1980). In particular: (1) cotton was the only crop for which settlers were following the recommended package of intensive cultivation techniques; and (2) even for cotton, settlers tended to diminish their use of the intensive package with longer periods of residence in the project. Based on this evidence, Murphy and Sprey concluded that it was unlikely that the settlers could continue to maintain the same high levels of agricultural income growth on a fixed 10 or 20 hectare AVV farm.

What we saw then, after the fifth year, were two different patterns of coping with perceived

limitations on future income growth in crop production.

The first pattern, adopted by the wealthier AVV farmers and larger households, involved re-investing their new earnings from cotton crops into the development of non-crop enterprises. This usually included: efforts to launch at least one family member into a high earning secondary occupation in trade or services; development of a cattle herd that was boarded with neighboring FulBe;³ and cultivation of the largest area possible within the allocated cultivation zone, sometimes via the use of rented tractors.

A second pattern observed in less successful households, which were often smaller, involved a shift toward limited practice of the prescribed cultivation methods plus limited diversification into livestock.

The 1989 restudy of a subsample of farmers that were included in the 1979 AVV farm monitoring survey sample indicated a continuation of these earlier trends. Field measurements (of the collectively worked household fields) show that settlers are farming an area per unit labor slightly larger (1.31 ha) than that recorded in 1979 (1.15) (Table 7.5). The 1988 figure, however, is still within the range of what was recommended by the project (1.04-1.71), which suggests that the settlers' patterns of production are only slightly more extensive than they were in 1979.

While the area planted in cotton has decreased as a percent of total area planted (from 42 percent in 1979 to 20 percent in 1988) (Table 7.5), the percent of total area planted in cereals increased from 56 percent in 1979 to 71 percent in 1988 (Table 7.5). During the same time period the average kilogram production per unit labor decreased from 500-700 kg/ALE to 100-300 for cotton but increased to over 1000 kg/ALE for sorghum, millet and maize (Table 7.6).

An analysis of fertilizer trends for the three AVV blocs shows a steady decline in purchased fertilizer since 1979 (see Figure 4.2). In most cases, the first dip coincides with the fifth year of settlement. Mineral fertilizer was used on 87 percent of cotton fields and 33 percent of white sorghum fields at Mogteto V3 during the 1979/80 cropping year. In 1988 fertilizer use was almost exclusively on cotton.

SOLENZO. In contrast, the cotton package at Solenzo has allowed migrant farmers to enjoy a sustained rate of income growth from commercial farming since the late 1960s through a steady increase in yields and a steady expansion of the total area farmed. The average yields per hectare for cotton increased from 544 kg/ha in 1972/73 to 870 kg/ha in 1980/81, and to 1,076 kg/ha in 1985/86 (See Chapter 4; Table 4.5). During the same time period, total cotton production increased fiftyfold (from 801 tons to 41,500 tons).

Table 7.5 A Comparison of the AVV's Recommended Crop Area with the Actual Area Planted in 1979 and 1988 (with and without compound fields^a)

	Hectares per unit labor		Percent of area planted in different crops					
	with comp.	w/o comp.	Sorghum/ millet	Corn	Cotton	Cowpeas peanuts beans	Rice	Other
<i>Recommended:</i>	—	1.04-1.71	33-48	—	38-42	16-31	—	—
<i>Observed:</i>								
1979 AVV Mogteto/Bombore (household)	—	1.15	54	2	42	2	—	—
AVV Linoghin (household)	—	—	40	5	30	9	—	16
Mogteto V3 ^a (private and household)	1.95	—	50	12	29	7	1	2
Mogteto V3 (household)	1.74	—	—	—	—	—	—	—
<i>Observed:</i>								
1988/89 AVV all (household) Linoghin, Mogteto, Mogteto-Bombore, and Mogteto V3	1.31	—	60	11.3	19.9	9.2	—	—

— Not available.

a. 1979 AVV Statistical Service Survey did not count the 1-hectare homesite (compound field) in the measure of field area. *as per work field*

Sources: Murphy and Sprey 1980; Savadogo 1989b. *Not d*

Table 7.6 Crop and Livestock Production and Production Expenses per Adult Labor Equivalent (ALE) in AVV Planned Settlements, 1988/1989

	<i>Linoghin</i>	<i>Bombore</i>	<i>Mogtedo</i>	<i>Mogtedo V3</i>	<i>All</i>
Mean residents per households	10 (20)	11 (20)	11 (20)	9 (20)	10.25 (80)
Mean labor force per household (ALE)	3.8	4.3	4.3	3.5	3.98
<i>Kilograms/ALE</i>					
<i>Cotton</i>					
1979/80	521	575	575	709	
1988/89	288	100	309	88	
<i>Sorghum, millet, corn</i>					
1979/80	—	391 ^a	391 ^a	902	
1988/89	1,052	1,086	853	1,397	
<i>CFA/ALE</i>					
Crop inputs (fertilizer, insecticide)	31,417	11,327	32,876	15,211	
Hired labor (cash and kind)	5,999	2,385	5,625	0	
Rented equipment (cash and kind)	10,564	1,675	277	555	
Net crop income	61,314	54,988	51,071	55,899	
<i>Annual livestock income (for male heads of household/ALE)</i>					
A. high income, low cost/loss scenario	21,897	6,797	14,764	5,415	8,522 ^b
B. low income, low cost/loss scenario.	15,570	2,022	7,977	-1,480	6,223

() indicates number of households

a. Murphy and Sprey 1980:78. Figure includes households in 1st - 5th year installation and only household fields.

b. Excludes V3 data.

Sources: Savadogo, Sanders and McMillan 1989:30; Murphy and Sprey 1980.

Fertilizer use in the Solenzo area is among the highest in the country. The most concentrated applications tend to be on cotton and, to a lesser extent, on corn, which is grown as a cash crop by the tractor farmers. The CRPA estimated fertilizer use in 1987/88 to be 143 kg/ha NPK for cotton, and 80-90 kg/ha NPK, with about 95 percent of the area planted in cotton and 80 percent of the area planted in corn receiving some fertilizer (CRPA 1989b:32-33). Our data show a similar pattern for 1988/89 (Table 7.7): 80 percent of the cot-

ton fields received NPK fertilizer at 100 kg/ha or more, close to or above the recommended levels of 150 kg/ha for NPK and 50 kg/ha for urea; 57 percent of the maize fields received lower amounts of NPK fertilizer. Only 23 percent of the red sorghum, and 21 percent of the white sorghum fields received any fertilizer. In general, the tractor farmers used the largest amounts of fertilizer per hectare. Only the tractor farmers, who receive a guaranteed price for their production from the cotton parastatal that finances their

Table 7.7 Number of Fields that Received Different Doses of NPK Fertilizer at Solenzo

<i>Fertilizer (kg/ha)</i>	<i>Cotton</i>	<i>Red sorghum</i>	<i>Maize</i>	<i>White sorghum</i>	<i>Millet</i>	<i>Soy beans</i>
0	2	20	10	11	21	0
1-49	2	0	2	1	0	0
50-99	1	1	5	1	0	0
100-149	13	2	4	1	0	1
150-199	8	2	1	0	0	0
200+	3	0	6	0	0	0
Urea only	0	0	2	0	0	0
Manure only	1	1	0	0	0	0
Total	30	26	30	14	21	1
Manure and NPK fertilizer			(2)			

Source: Land Settlement Review.

tractors, normally grow corn in large quantities (an average of 2,864 kilograms per ALE versus 124 kilograms/ALE for animal traction farmers and 88 kilograms/ALE for manual farmers).

The lower use of fertilizer on cereals can be attributed to several factors. When farmers fertilize, they tend to think in terms of fertilizing a rotation, with the residual effects of the fertilizer passing on to the corn and sorghum crops to be planted in the same field the next year. The CRPA observed, however, that only 26 percent of the sorghum and 55 percent of the corn fields included in its farm monitoring program in 1987/88 were planted on former cotton fields; 48 percent of the sorghum and 28 percent of the maize fields were preceded by other maize or sorghum fields.

High levels of fertilizer use on cotton, in combination with the high quality area soils and timely insecticide spraying, have allowed the Solenzo area farmers to sustain high yields. While there is increasing concern about the loss of soil organic matter in the soil, this is not yet alarming.

The study showed substantial differences between net crop revenues for farmers at different levels of technology (Figure 7.1). Animal traction in Solenzo was associated with crop income levels that were 2.5 times as high as manual traction (Table 7.8). There was another big jump in

productivity per ALE between animal traction and motorized tractor farmers (Figure 7.1). Even deducting the substantial costs of mechanized cultivation (estimated at 650,000 CFA per family per year) and the high costs of fertilizer (Annex 5, Table D-2), net crop income for the tractor farmers was three times as great as that for animal traction (Table 7.8).

SOFITEX (1989) research shows that the yields obtained by farmers with tractor technology tend to be slightly higher than those recorded for animal traction farmers (CRPA 1989b) after an initial learning period. It is difficult to ascertain, however, what portion of the high yields per hectare enjoyed by the tractor farmers is attributable to their much greater capacity to clear and farm "new" land. At Solenzo, 51 percent of the collectively worked fields at Kie/Dar-es-Salaam (the newer settlement) and 23 percent of the fields at Daboura (the older settlement) had been farmed for six years or less, in contrast to the AVV, where all of the collective project fields had been farmed for ten years or more.

Increasing population densities will probably constrain the more ambitious farmers in their attempts to exploit the larger areas. Our best evidence for this is the recorded differences in net crop income per ALE for the tractor farmers at

Table 7.8 Crop and Livestock Production per Adult Labor Equivalent (ALE Solenzo 1988/89)

	<i>Dar/Kie</i>			<i>Daboura</i>			<i>All</i>		
	<i>Manual</i>	<i>Animal traction</i>	<i>Tractor</i>	<i>Manual</i>	<i>Animal traction</i>	<i>Tractor</i>	<i>Manual</i>	<i>Animal traction</i>	<i>Tractor</i>
Average family size (no. residents)	8.0 (6)	13.5 (8)	29.5 (5)	8.0 (7)	7.5 (6)	37.0 (4)	—	—	—
Average family labor force (ALE ^a)	2.8	5.3	10.9	2.6	2.5	13.8	2.7 (13)	4.1 (14)	12.2 (9)
Collective field area (per farm ^b)	4.4 (6)	7.0 (9)	37.7 (5)	2.7 (7)	5.8 (6)	29.9 (4)	3.5 (13)	6.5 (14)	34.5 (9)
Collective field area (ALE)	1.4	1.6	3.4	1.5	1.9	2.2	1.4	1.7	2.8
Cotton (kg. per ALE)	148	548	2,789	133	513	869	138	537	1,824
Sorghum-millet (kg. per ALE)	422	694	808	411	1,252	737	410	838	771
Maize (kg. per ALE)	42	135	4,292	132	94	1,448	88	124	2,864
Net crop income all fields (CFA per ALE)	24,416	79,821	521,167	39,134	104,988	182,850	31,978	86,398	297,331
Annual Livestock Income (CFA per ALE) for male heads of household	1,000	11,200	71,907	3,737	-4,911	10,921			

— Not available.

() indicates number of households.

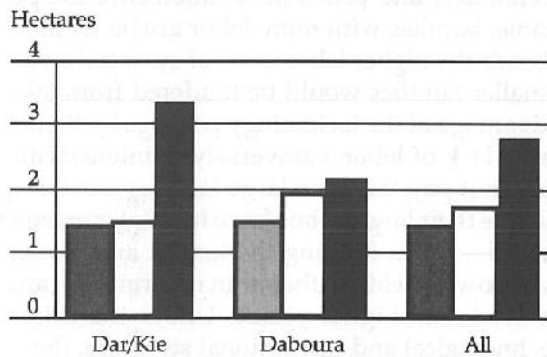
a. See Table 7.3 for weights used to derive ALE.

b. Measurements for the fields of the household head and one wife were estimated by crude calculations of length and width. A subsample of fields was subjected to more rigorous field measurements in order to verify the accuracy of our estimates.

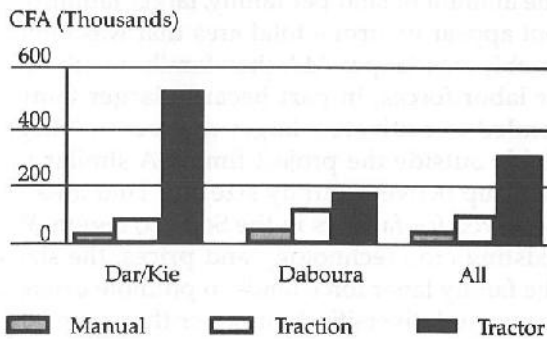
Sources: Savadogo, Sanders, and McMillan 1989 and McMillan calculations.

Figure 7.1 Average household field area farmed collectively, net crop income per adult labor equivalent (ALE) for the major technology groups at Solenzo, and comparison of net crop income for the AVV and Solenzo

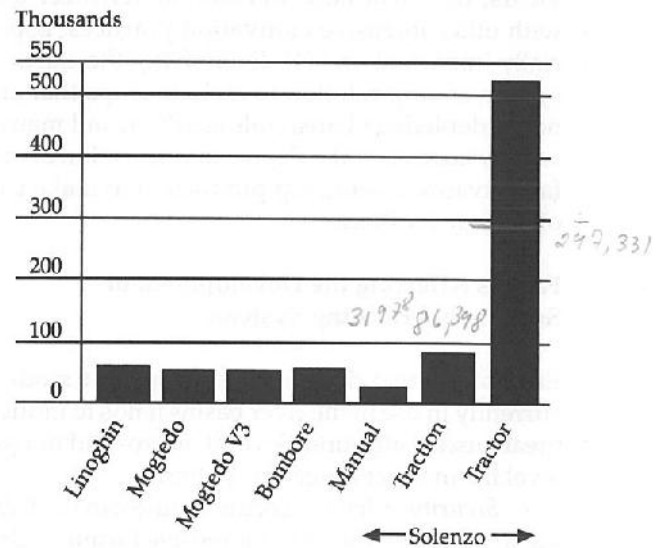
A. Average household field area farmed collectively (Solenzo)



B. Net crop income from both privately and collectively worked fields (Solenzo)



C. Comparison of net crop income for the AVV and Solenzo



Source: Tables 7.5 and 7.7.

Daboura and Dar-es-Salaam/Kie. Net productivity per ALE for the tractor farmers at Dar-es-Salaam/Kie was more than two and a half times that recorded for Daboura (Table 7.8; Figure 7.1). Daboura, located along the main highway linking Dedougou and Solenzo (Figure 7.2), was one of the first villages to experience extensive immigration—much of it before 1974. Dar-es-Salaam did not begin to develop as a cultivation hamlet of Kie until after 1974. Dar-es-Salaam possesses a vast uninhabited bush between the core village and the Mouhoun (ex-Black Volta) River. Because of this large area of uncleared land, the Dar-es-Salaam settlers and hosts can still expand toward the river.

For farmers to maintain their high levels of yields, they will need to combine fertilizer use with other intensive cultivation practices. Especially important are: (1) diversifying the existing system of crop rotation to include crops that are not as depleting of area soils as cotton and maize, and (2) increasing the degree of integration of on-farm livestock with crop production to make use of organic fertilizer.

Factors Affecting the Development of Sustainable Farming Systems

Each of the two dominant development models currently in use in the river basins tends to induce greater extensification. Several macro- and micro-level factors encourage this pattern.

- *Security of Tenure.* Secure tenure can contribute to the development of intensive farming. Unfortunately, recent efforts to provide settlers with greater security by allocating "land (rights) to those who work" seems to have encouraged both migrants and indigenous farmers in the Solenzo area to expand the total area that they farm.

- *Opportunities for Diversification.* The existence (or lack) of alternative opportunities for diversification can have a positive (or negative) effect on intensification. One example of this is Linoghin, where farmers are reinvesting cash returns from crop and noncrop enterprises into rainfed agriculture at a higher rate than in the other two planned settlement groups.

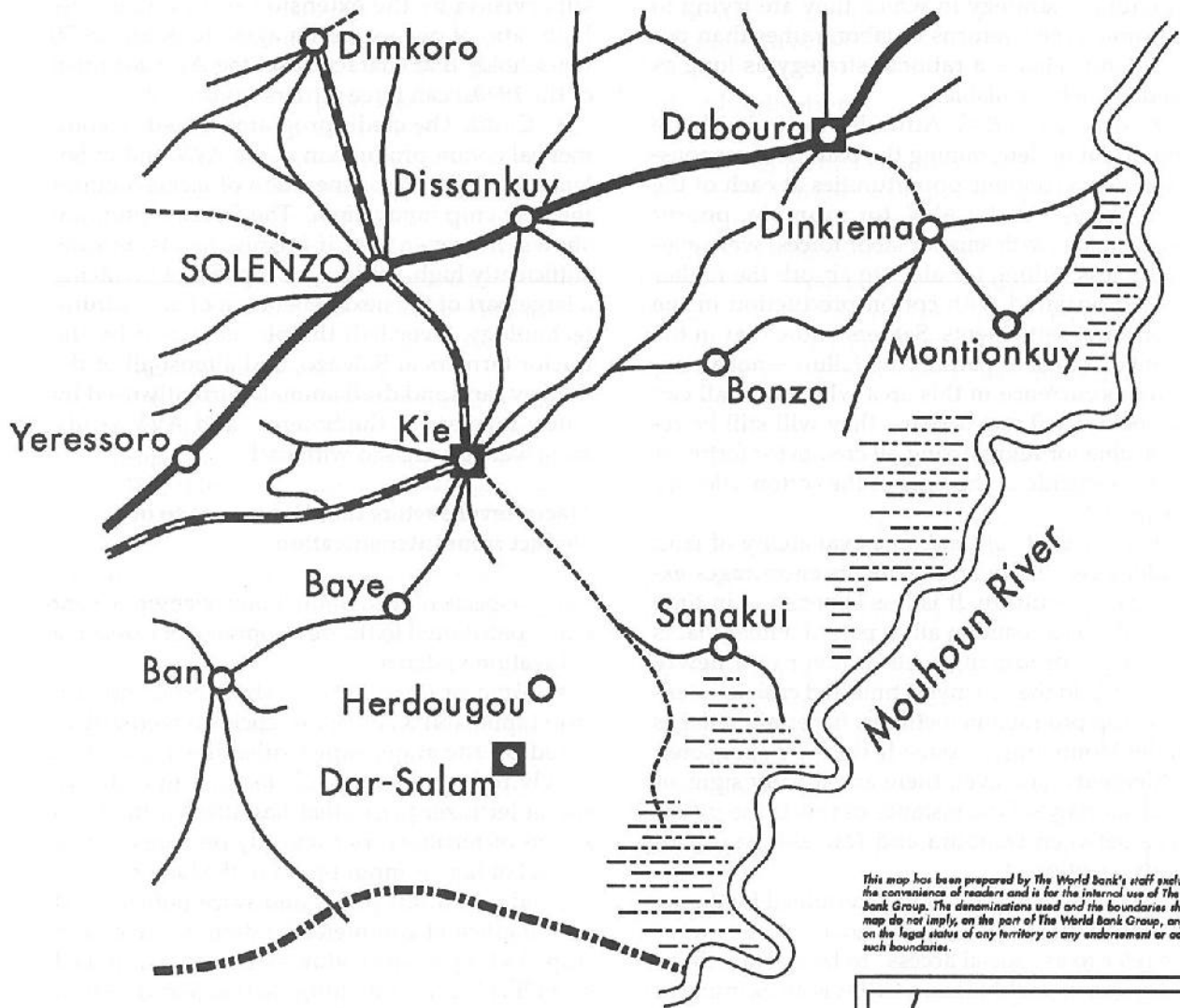
- *Attitudes toward Experimentation.* Immigrants can be a force contributing to agricultural innovation just as they can contribute to greater extensification. In Solenzo, for example, the Mossi immigrants were the first to adopt animal traction and cotton production in the 1960s. They were

later joined by the indigenous Bobo. Similarly, the indigenous Mossi in the Ganzourgou region were not interested, at first, in the intensive crop production program promoted by the AVV, nor were they particularly interested in living in large numbers near the rivers. The early success of the AVV settlers, however, attracted large numbers of spontaneous settlers from the region's indigenous villages who moved into areas adjacent to the sponsored settlements. From these examples, one could argue that new settlers are often more open to innovation than are their hosts, but that, over time, differences in receptivity to change often taper off.







- *Family Size.* Family size can work both for and against intensification. If crop production technology and prices make intensification profitable, families with more labor are better able to absorb the higher labor costs of such technology. Smaller families would be hindered from taking advantage of the technology package by their relative lack of labor. Conversely, if intensification does not pay, the same large families are likely to devote their larger labor force to greater extensification—i.e., in farming the largest area possible with lower yields, rather than in farming a smaller area with higher yields. Under the existing technological and institutional structure, the size of the family labor force tends to be positively correlated with the size of the total area farmed. Even at the AVV, which has official restrictions on the amount of land per family, larger families did not appear to farm a total area that was demonstrably smaller per ALE than families with smaller labor forces, in part because larger families tended to cultivate a larger number of "illegal" fields outside the project limits. A similar relationship between family size and land area was observed for farmers in the Solenzo region. With existing crop technology and prices, the size of the family labor force tends to promote extensification and diversification rather than crop intensification.

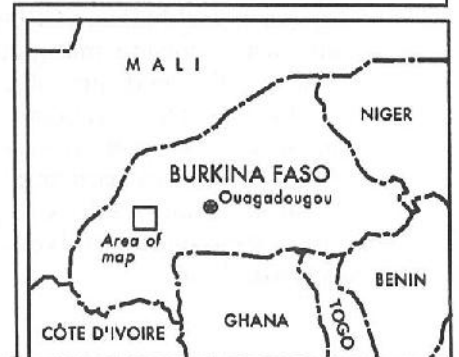
- *New Technologies.* Mechanization is another factor that can contribute to, as well as detract from, intensification. New technology, such as animal traction and tractors tends to be used extensively, even though these technologies were originally intended to help farmers overcome the labor bottlenecks associated with more labor intensive cultivation techniques. Our data showed that in 1988, the average land area per ALE farmed by the animal traction farmers at Solenzo

BURKINA FASO
 LOCATION OF THE STUDY VILLAGES IN THE
 SOLENZO SUBSECTOR: DABOURA, KIE, AND
 DAR-ES-SALAAM (A CULTIVATION HAMLET OF KIE)
 LOCALISATION DES VILLAGES D'ETUDES DANS LE
 SOUS-SECTEUR DE SOLENZO: DABOURA, KIE ET
 DAR-ES-SALAAM (HAMEAU DE CULTURE DE KIE)



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-  STUDY VILLAGES
VILLAGES D'ETUDES
-  MARSH
MARAIS
-  ALL WEATHER IMPROVED UNPAVED HIGHWAY
ROUTE PRINCIPALE NON-GOUDRONNEE DE TOUTE SAISON
-  ALL WEATHER UNIMPROVED SECONDARY ROAD
ROUTE SECONDAIRE NON-AMELIOREE DE TOUTE SAISON
-  UNIMPROVED SECONDARY ROAD
PISTE SECONDAIRE NON-AMELIOREE
-  UNIMPROVED SECONDARY ROAD / PATH
SENTIER NON-AMELIOREE



within any local context there are likely to be important differences in cash and labor resources, needs and concerns, experience, and entrepreneurial capacity of farmers. No single, monolithic extension program is likely to be sufficiently sensitive to these variations within a population.

Extension programs must work with evolving patterns of diversity within a population. The AVV extension model, for example, focused on a single set of crop recommendations. It was anticipated that differences would exist or develop between larger and smaller households, but primarily in terms of the total area farmed, rather than in terms of the types of crop and noncrop enterprises developed. A longitudinal analysis over fifteen years, however, reveals increasing diversification in terms of types of technology used, crops grown, and the relative importance of animal husbandry and off-farm employment.

Similarly, substantial differences exist among the activities, resources, and incomes of the manual, animal-traction, and tractor farmers at Solenzo. Earlier extension models focused on the idea of moving settlers progressively from lower to higher technology levels. One of the important results of recent research by the Mouhoun CRPA Monitoring Unit was to show great variation within technology levels and movement between technology levels over a five year period. Within the category of manual farmers, for example, were farmers who preferred to rent animal traction or tractor plowing equipment, rather than to own and look after their own oxen. This same category, however, could include young farmers without the resources to rent, who were aspiring to animal traction. The question was then raised, given high rates of variation within categories, how meaningful is "technology type" as the key variable with which to identify groups of farmers for a particular extension effort?

If local development programs are successful at a first stage, they create a group of farmers with higher expectations and resources in a second stage. If "captured" by profitable crop and livestock technology and local opportunities for diversified investment, the first generation of successful settlers can become a driving force for income producing investments and activities. If not captured, this same energy will be turned toward cultivating the largest possible area.

Successful development is also likely to attract large amounts of additional immigration. These later migrants are not likely to have the cash, la-

bor, or land resources of those who arrived earlier. These newer, "poorer" settlers are either unwilling or unable to gamble on the high risk, high potential, income producing strategies that attract wealthier settlers.

Reinforce Appropriate Crop Research Programs

Our study identified two research areas critical to both the short-term and the long-term development of the valleys. The first area involves reinforcing current efforts to promote water harvesting technology for agroclimatic zones with less than 800 mm average rainfall (McMillan, Painter and Scudder 1990). Large sections of the Nakambe and Nazinon fall within this agroclimatic zone. Although the river basins are generally considered to be of higher potential and to have fewer soil problems than adjacent plateau zones, they share many of the same soil characteristics and experience the same low, irregularly spaced rainfall.

A second priority area involves research to help increase the diversification of local crop and livestock systems in the southwest. The present crop extension program focuses almost exclusively on cotton, with lower levels of support for maize. Both crops are hard on area soils. In addition, cotton demands almost twice the amount of labor per hectare as other crops. Research can contribute to the development of more diversified crop production systems by exploring opportunities for developing rainfed grain legumes, on-farm livestock, and dry-season irrigated gardening. New technology for these crops will be important. Equally, if not more important at the present stage, however, is research to identify some of the key processing, storage, marketing, and socio-economic constraints that restrict the dissemination of crop and livestock production technology that has already been developed by INERA (*Institut d'Etudes et des Recherches Agricoles*), SOFITEX, ICRISAT (International Crop Research Institute for the Semi-Arid Tropics), and other national and international research institutes.

In both instances, researchers are likely to promote more realistic programs and policy supports if there is a conscious attempt to link the results of their studies to past and projected market trends, and to the socio-economic characteristics of farmers.

Reinforce Local Projects with Sound National Policies to Support Regional Marketing Systems

Total cereal production in Burkina experienced an upward trend over the last decade. Although production dropped during the 1983-1984 drought years, the dip was considered less severe than those associated with earlier successive drought years. One reason is the substantial increase in the total area farmed in cereals. If the present course continues, the valleys will continue to be cleared and Burkina will continue to increase its annual production of cereals and cotton until the new land resource is exhausted. Many of the northern river basins are already becoming saturated, with migration shifting south.

One can hypothesize that increased cereal production is a response to increased family consumption and cash needs. However, one of the unintended results of successfully increasing total cereal production has been to hold down local market prices. A ten year analysis of local market prices at Linoghin shows that the median per kilogram price of white sorghum at the AVV is 25 percent less than the price recorded in the AVV market surveys in 1979 (Murphy and Sprey 1980:58, 143; Annex 3, Tables B-3 and B-7). Adjusted for inflation, the real price of sorghum is 54 percent less. Better farm prices encourage farmers to invest more in intensive

technologies, rather than to choose the less risky route of extensification.

We are not advocating strengthening government marketing boards. Our research on the dynamic food distribution systems that have developed along the paved highway to the AVV sponsored settlements suggests that a more practical route will be for government to enact policies that reinforce the private sector's ability to carry out this role. The case studies provide additional evidence to support national programs that deal with food surpluses through improved storage, better roads, and the development of on-farm livestock feeding programs.

Notes

1. The Kompienga Relocation Project (*Projet Transfert des Populations de la Kompienga*) was created 13 June 1988. Special funding for the project was slated to end in March 1990 (AVV 1990).
2. This potential for labor was measured by a system that assigned labor values to persons in the family according to age and sex (see Table 7.3). Since an adult male was considered to have the work capacity most readily transferred to a variety of tasks, this was the standard unit and was assigned a value of 1.0. Women, children, and older workers were assigned lesser values. On the basis of its total index (the sum of all the labor values for family members), a household can be classified by farm "type." Type Ia, for example, with the smallest labor force, included families with a labor index of 1.75-2.25, which could consist of a man and wife (1.75), a man, wife, and a teenage boy (2.25), or other combinations with sums in that range.
3. See Annex 5, Table D-5.