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# *Diversification and Successful Settlement in the River Blindness Control Zone of West Africa*

DELLA McMILLAN

For centuries, onchocerciasis or river blindness has been an important factor in the under-population of fertile river basins in the West African savanna. It was therefore anticipated that a massive program to control river blindness in West Africa, which started in 1974, would have a positive impact on economic development. This development potential is generally measured in terms of increased crop production. Yet a ten-year restudy of settlers living in river basins covered by control shows a parallel increase in livestock and off-farm employment. Indeed, local opportunities to develop off-farm employment determined the settlers' long-term investment strategies and their willingness to invest in more labor intensive crop production practices. These research results, in addition to other evidence for high levels of diversification in all the major ecozones of Burkina Faso, has implications for the design of development planning in the control zone, which has heretofore focused almost exclusively on intensifying crop production. The settlers who provide the focus of the study live in three of the 12 planned settlement clusters that the Burkina government created in its river basins covered by the control program. The baseline research was conducted in 1978-1979; a ten-year restudy was conducted in 1989.

**Key words:** disease control, economic diversification, planned settlement, river blindness, Sahel

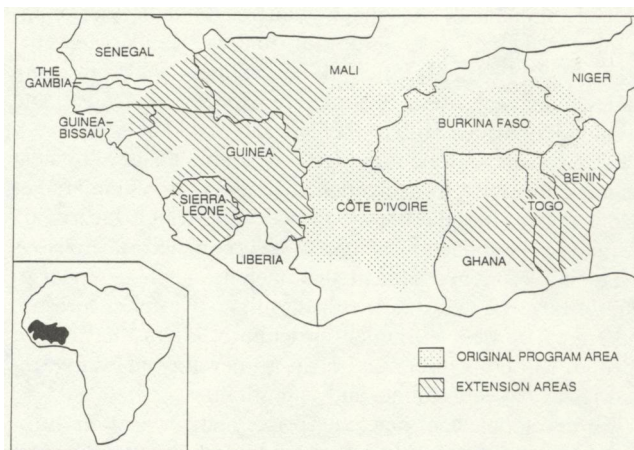
**R**IVER BLINDNESS CONTROL is one of the most successful health programs ever launched in Sub-Saharan Africa (Figure 1).<sup>1</sup> Today, 17 years after control began in 1974, the disease is no longer cited as a public health threat in the original control zone, and many of the river basins are undergoing active resettlement (OCP 1985, 1986; Remme and Zongo 1989; Younger and Zongo 1989).

In the wake of this success, however, there is increasing concern about the environmental sustainability of crop, livestock, and forestry practices in the newly settled areas. A ten-year assessment of settlement trends revealed that most immigration is spontaneous or unassisted, with little or no settler access to

basic infrastructure, economic or social services (Hervouet et al. 1984, OCP 1986). By far the major criticism of spontaneous settlement is that settlers tend to farm the largest area possible, with little attention to sound management of soil, forest, or water resources.<sup>2</sup> If immigration rates are low, extensive cultivation and livestock practices are ecologically and so-

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Source: McMillan, Painter, and Scudder 1990.

FIGURE 1. THE ONCHOCERCIASIS CONTROL PROGRAMME

cially sustainable; population densities are low and reserve lands remain available. Invariably, however, problems arise as population densities increase and it becomes difficult to allow for periods of fallow sufficient to restore soil fertility. Higher densities are also associated with increased competition for potable water, grazing areas, and fuelwood. If new land that can be cleared and farmed remains easy to acquire, and if the economic and social costs of abandoning old land are low, then, as population densities increase, a sizeable portion of the original settlers—or their offspring—may relocate at this point in the settlement cycle.

To develop more intensive crop and livestock production practices, settlers require assistance (McMillan, Painter, and Scudder 1990; Scudder 1981, 1984, 1985, 1991; Scudder and Colson 1981). This assistance includes public and private investment in roads and bridges, along with the provision of crop and livestock research and extension services. One of the key questions that face policy planners today is: what form should this assistance assume?

Planners generally discuss the economic potential of the affected river basins in terms of increased food and cash crop production. This perspective is reflected in the fact that most follow-up assistance has concentrated on the promotion of intensive rainfed agriculture. Far less attention has been focused on the fact that if a crop development program is successful, as it was in the villages described here, it creates a group of farmers with both higher incomes and higher aspirations. If higher yielding sustainable crop technologies or off-farm employment are available, these successful settlers can become a driving force behind new income producing investments. If these opportunities are not available, this same energy will often be turned toward maximum exploitation of the natural resource base and/or “moving on.”

In this article, I argue that it is virtually impossible for planners to anticipate the full range of problems—or opportunities—that settlers moving into the river blindness control zone will encounter. This planning process is complicated by the frequent lack of established cropping systems or research data on which to base extension recommendations and advice. The river basins' sparse population means that they often lack the basic infrastructure (roads, bridges, schools, markets, and administrative centers) that facilitates development. It is also easy to overlook some of the other reasons that an area has remained uninhabited, like other human or animal diseases or unhealthy drinking water (Akwabi-Ameyaw 1990; Hervouet 1977, 1978, 1990; McMillan 1986; Painter 1990). Insecure land tenure poses further problems (McMillan, Nana, and Savadogo 1990; McMillan, Painter, and Scudder 1990).

For all these reasons it is highly desirable for development planning to aspire to a diversified production system, rather than a system like the one described here, which focuses on the intensive production of one or two commercial crops. A diversified economic system that includes income opportunities from irrigated dry season farming, livestock, forestry, and trade, as well as rainfed agriculture, offers the greatest freedom to both settlers and hosts to develop innovative responses to new constraints and opportunities.

The development of new enterprises and services, in turn, feeds back into sustainable farming in important ways. The first has to do with retaining and motivating family labor. Settlers with recurrent sources of income from trade or animal hus-

bandry are better able as well to purchase cash inputs such as fertilizer and insecticide and to pay for supplementary labor during production bottlenecks (McMillan, Painter, and Scudder 1990). These results have implications for the design of government policy at the national and regional levels.

### Background

The settlers who provide the focus of this article are living in three groups of neighboring sponsored settlements: Linoghin (six villages), Mogtedo (six villages), and Mogtedo-Bombore (seven villages) (Figure 2). The agency charged with the coordination of this settlement program is the Volta Valley Authority or AVV (Autorité des Aménagements des Vallées des Volta) of Burkina Faso (formerly known as Upper Volta). Between 1974 and 1984, the AVV installed 12 clusters or *blocs* of six or seven planned settlements each, mostly along the Nakambe and Nazinon (formerly White and Red Volta) Rivers (Figure 2). The research was conducted at various points over a 14-year period between 1977 and 1989.

The official mandate of the AVV when it began in 1974 was to study, promote, coordinate, and control the execution of the operations necessary for the economic and social development of the areas placed under its administration (AVV 1985). Its ultimate goal was the optimal development of the areas' natural resources including soils, forests, pasture, water, and wildlife. This official mandate was declared effective for 20 years.

The early AVV focused on the design and implementation of groups of the model settlements in areas with good agricultural potential. An area was determined suitable for agricultural settlement following a battery of hydraulic, aerial, and soil sur-

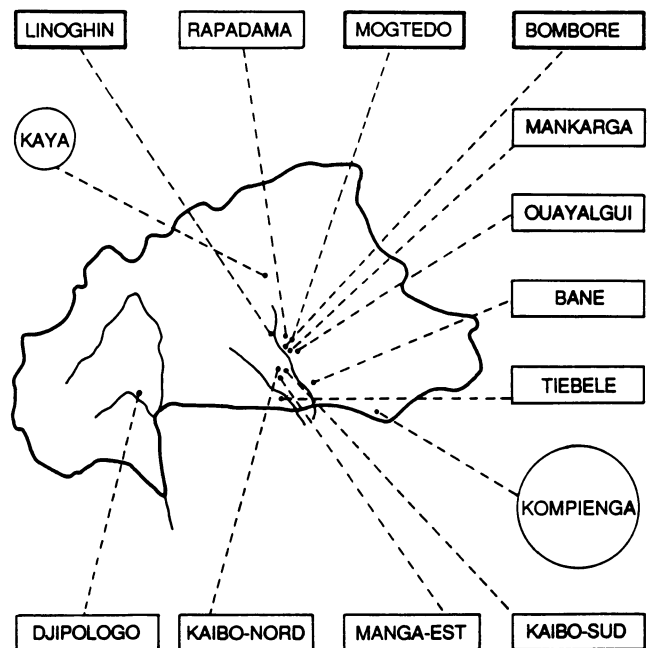


FIGURE 2. LOCATION OF THE 12 AVV PLANNED SETTLEMENTS CREATED BETWEEN 1973 AND 1984, THE CASE STUDY SETTLERS' HOME AREA (KAYA) AND KOMPIENGA

veys; the project was then responsible for the selection of village, field, and house sites, as well as for the installation of basic infrastructure (wells, roads, bridges, extension worker housing) and the coordination of economic services. To encourage settlers to move, they were provided transportation to the site, assisted with field clearance, and provided a monthly ration of food until they harvested their first crops. Each household was entitled to one, or in the case of an extremely large labor force, two ten-hectare farms. The project was responsible for the design, testing, extension, and evaluation of a new intensive rainfed cropping package. Planners anticipated that the new package would allow farmers to increase yields while retaining soil fertility. Basic elements of the package included selected seed, high levels of mineral fertilizer, a prescribed system of crop rotations for each field, monocropping, planting in rows, commercial cotton production, controlled clearance and, after the first year, cultivation with an ox-drawn plow. The proposed extension methods were more costly than what the settlers were accustomed to, but it was anticipated that the higher cash costs of production would be offset by higher yields per unit and higher total income. During the first three years, this higher income would derive from the annual addition of a new field. Planners assumed that any additional increase after the third year would be based on increased input use.

The baseline research on which this article is based was funded as part of a four-country project to study Sahelian farming systems.<sup>3</sup> The primary goal of the project's activities in Burkina was to assist the AVV Statistical Service in improving the quality of its farm monitoring program (Murphy and Sprey 1980). The farm monitoring program included 132 randomly chosen households, stratified by year of installation, in 1978 and 313 in 1979 (Murphy and Sprey 1980).

An unusual aspect of this collaborative agreement was the decision to include two intensive case studies to examine specific topics. (See also Saul 1979, 1980, 1983.) The case study presented here describes the impact of the AVV on sponsored settlers from the central Mossi plateau (McMillan 1980, 1983, 1984, 1986, 1987a, 1987b, 1988, 1989a, 1989b, 1992). The settlers who provide the focus of the study immigrated from the same home village to the same project village between 1975 and 1980. The home village, Damesma, is located just outside the regional capital of Kaya (Figure 2); the case study village is Village 3 in the AVV planned settlements at Mogtedo, hereafter referred to as V3 (Figure 3). Short restudies of the case study settlers were conducted in 1983 and 1987.

The most recent restudy in 1989 was part of an 11-country review of settlement and development in the OCP river basins. The project, referred to as the OCP Land Settlement Review, was funded by UNDP (the United Nations Development Program) through the Institute for Development Anthropology; the World Bank was the executing agency (Akwabi-Ameyaw 1990; Buursink and Painter 1990; Koenig 1990; McMillan, Painter, and Scudder 1990; Painter 1990). In Burkina, the Land Settlement Review included research at four sites. One site consisted of the 19 villages at Mogtedo, Mogtedo-Bombore, and Linoghin. The research included a restudy of crop, livestock, and off-farm employment for 60 of the households that had been included in the 1979 baseline farm monitoring program (Murphy and Sprey 1980) (Table 1); 114 of the 148 sample households that were included in the original baseline survey were still living there in 1989. Another 20 households were



FIGURE 3. THE AVV PLANNING UNIT 1 (AVV-UPI) SHOWING THE BLOCS OF LINOGHIN, MOGTEDO AND MOGTEDO-BOMBORE, AND MOGTEDO V3

studied in the case study village, Mogtedo V3 (Table 1). The ten-year restudy was conducted in collaboration with Dr. Kimseyinga Savadogo, then Chair of the Department of Economics, University of Ouagadougou, and Mr. Nana Jean-Baptiste, Sociologist and Research Director of CEARD (Cabinet d'Etudes d'Appuis et de Recherche pour le Développement).<sup>4</sup>

### *Limited Opportunities for Sustainable Crop Income Growth*

Although the settlers' average yields in 1979 were below those projected, they were still two to three times higher than those recorded for the home village farmers during the same cropping season (700–900 kilograms [kg] per hectare [ha] versus 200–350 kg/ha). The settlers' net crop income per unit

TABLE 1 Number of Households included in the Farming Systems Surveys of the AVV Study Villages, 1979–1989

	1979	1983	1987	1989
The AVV statistical service survey				
Mogtedo and Mogtedo-Bombore	97	—	—	40
Linoghin	48	—	—	20
Bane, Kaibo-Sud and Kaibo Nord	168	—	—	—
Total sample	313	—	—	60
Intensive care study				
(a) Mogtedo V3	9	25	20	20
(b) Komienga	—	—	—	25

labor<sup>5</sup> was also two to four times higher than the recorded average in the settlers' home area—even after deducting for the much higher production costs (Table 2). In addition, most settlers in their third to fifth year were left with about 20,000 CFA (\$100) cash after they sold their first pair of traction animals and purchased another (Table 2).

In 1979, average cereal production per unit labor for the Damesma settlers was three times the average produced in the home village (McMillan 1983). This figure represents an average of 515 kilograms per family above the minimum food standards established by the United Nations Food and Agriculture Organization.<sup>6</sup>

The same baseline studies showed, however, that this increased production was due primarily to the expansion of the total area cultivated and the natural fertility of the new soils, not to the successful introduction of the recommended package of technical innovations (Murphy and Sprey 1980). Specifically Murphy and Sprey found that settlers who had been at the project for shorter periods of time tended to follow the extension package more closely than those who had been there longer. Moreover, cotton was the only crop on which the recommended package of intensive cultivation techniques was consistently applied. These procedures included monocropping,

chemical protection, planting in rows, use of recommended quantities of fertilizer, thinning and timely weeding with animal traction. Based on the analysis of these trends, the Statistical Service concluded that it was unlikely that the settlers could continue to increase their crop income on the ten and 20 hectares allocated to each farm (Murphy and Sprey 1980).

The ten-year restudy showed a continuation of the earlier low levels of adoption of the proposed crop production methods (McMillan, Nana, and Savadogo 1990). This trend was especially remarkable for fertilizer use which showed a steady decline after 1983 (McMillan, Nana, and Savadogo 1990). In the beginning, the AVV blamed the settlers' declining cotton yields and soil fertility problems on the fact that settlers were not practicing the prescribed package of intensive crop production methods. The settlers' lack of attention to these methods was in turn attributed to the "bad" example set by the illegal, non-sponsored, and mostly seasonal spontaneous settlers who would clear and farm an area and then abandon it after a few years. The rising cost of fertilizer and insecticides due to reduced government subsidies was also cited.

Later research by ICRISAT (International Crop Research Institute for the Semi-Arid Tropics), INERA (Institut d'Etudes et de Recherches Agricoles), and the AVV demonstrated that rain-

TABLE 2 Net Crop Income per Adult Labor Equivalent (ALE) for 1979 and Net Profit from the Sale of Traction Animals after Repurchasing New Animals (in CFA)

Village groups	<i>n</i>	Net income <sup>a</sup>	Net income <sup>b</sup>	1979 earnings after sale and repurchase of traction animals
AVV				
Mogtedo and Mogtedo-Bombore <sup>c</sup>	97	—	—	—
1 year settlers <sup>d</sup>	—	48,000	—	—
2 year settlers <sup>d</sup>	—	75,400	—	—
2 year settlers	—	66,400	—	—
3–5 year settlers	—	56,600	—	—
6 year settlers	—	65,800	—	—
Mogtedo V3 (3–5 year)				
All	9	86,701	75,566	+13,611
Households selling animals	5	78,566	67,431	+20,777
Kaya home villages				
All	35	—	30,100	—
Without animal traction	22	—	26,916	—
With donkey plow	7	—	29,976	–670
With ox plow	6	—	37,271	–9,397

<sup>a</sup> Estimates "real" costs of animal traction equipment and animals based on potential resale value of the animal, depreciation of the plow, and upkeep of the animals and plow (Murphy and Sprey 1980: 59 and 70).

<sup>b</sup> Calculation based on the recorded case costs of payment and upkeep of equipment and animals (McMillan 1983: 411).

<sup>c</sup> The Statistical Service Survey data is subdivided into five groups of farmers according to the stage of farm development and equipment. First year settlers are newly settled settlers who farm their one hectare home site plus two official bush fields, both plowed by the AVV tractors. Second year settlers are in their second year and have three bush fields to cultivate, one of which is plowed by the AVV. A distinction is made between settlers who have purchased animal traction and the few who did not. Third to fifth year settlers are authorized to farm four bush fields, one of which is plowed by the AVV. It is assumed that by the third year, all households have animal traction. From the sixth year on, settlers are authorized to farm four of their six bush fields (two of the six fields are supposed to lie fallow at any point in time). Having received all six of their official bush fields, these households no longer receive any mechanical plowing.

<sup>d</sup> Without animal traction.

fall in the northern Nakambe basin where the three groups of planned settlements are located was in fact marginal for cotton (Deuson and Sanders 1990; Jayne, Day, and Dregne 1989; Nagy, Sanders, and Ohm 1987; Ramaswamy and Sanders 1989; Sanders 1989; Sanders, Nagy, and Ramaswamy 1990). Under these conditions, there was little return to fertilizer use unless it was combined with either new or traditional water retention technologies like stone dikes (*diguettes*), tied ridges, or cross plowing.

This new research, plus mounting evidence of soil erosion in the older AVV sponsored settlements, led to a reorientation of extension advice and recommendations after 1986. Most notably the revised program promoted the use of manure pits and stone dikes to improve soil fertility and arrest erosion. The settlers were also given increased autonomy in the administration of village affairs.

Despite these major changes, the 1989 restudy did not show any improvement in settlers' use of either manure or fertilizer on crops other than cotton. In 1979, the Mogtedo V3 settlers used fertilizer on 87% of their cotton fields and on 33% of their sorghum fields in the AVV case study. Ten years later, fertilizer use was confined exclusively to cotton, and at much lower levels than recommended by the project.<sup>7</sup> By 1988, many settlers had virtually abandoned the prescribed five-year rotation of sorghum, cotton, legumes, and two years of fallow. Instead, there was a growing trend toward continuous cultivation of the more accessible fields, with the better fields planted alternatively to cotton and sorghum. Despite the settlers' failure to

practice the prescribed cultivation package, the project records showed no substantial change in yields.<sup>8</sup>

Faced with the huge labor demands per hectare for cotton, rising production costs for cotton (due to decreased subsidies), and past experience with uneven unreliable yields in the zone, the AVV farmers gradually increased the area planted to the less labor intensive cereals—sorghum and millet. Although per worker production of cotton was lower, per worker production of sorghum was higher in 1988 than in 1979 (Table 3). This increased production, however, was not associated with a higher cash value. Indeed, the settlers' average income was 10% less in 1988 than in 1979, using the median price at which crops were sold based on our survey of crop sales<sup>9</sup> (Figure 4). When this nominal net income figure was adjusted for inflation using the IMF (International Monetary Fund) price index,<sup>10</sup> average income per unit labor was 40–50% lower (Figure 4).

The principal reasons for this decrease were (McMillan, Nana, and Savadogo 1990):

- (a) a switch from cotton to cereals which have a lower median price, but also lower labor demands;
- (b) the lower adjusted selling price for cotton because higher input prices were not entirely offset by the parallel increase in the amount paid to farmers;
- (c) the lower median selling price of sorghum (when adjusted for inflation);
- (d) the fact that settlers' main crop activities were restricted

TABLE 3 Crop and Livestock Production and Production Expenses per Adult Labor Equivalent (ALE) in the AVV Planned Settlements, 1988–1989

	Linoghin	Bombore	Mogtedo	Mogtedo V3	All
Mean residents per households	10 (20) <sup>a</sup>	11 (20)	11 (20)	9 (20)	10.25 (80)
Labor force per household <sup>b</sup>	3.8	4.3	4.3	3.5	3.98
Kilograms/ALE					
Cotton					
1979/80 <sup>c</sup>	521	575	575	709	
1988/89	288	100	309	88	
Sorghum, millet, corn					
1978/80 <sup>c</sup>	1,052	391	394	902	
1988/89 <sup>c</sup>	—	1,086	853	1,397	
CFA/ALE					
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	
Annual livestock income (for male household heads/ALE)					
A. high income, low cost/loss scenario	21,897	6,797	14,764	5,415	8,522 <sup>d</sup>
B. low income, low cost/loss scenario	15,570	2,022	7,977	–1,480	6,223

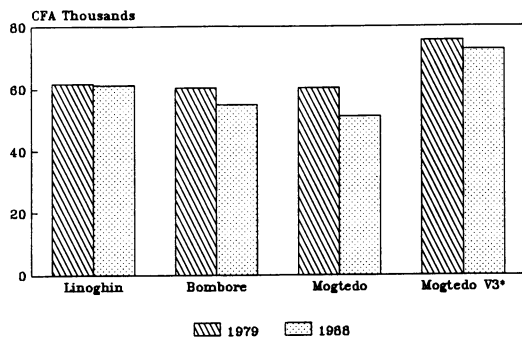
<sup>a</sup> Number in parentheses indicates number of households in each category.

<sup>b</sup> Based on the AVV system of Adult Labor Equivalent (ALE). See Note 3 at end of article.

<sup>c</sup> 1979/80 figures for Linoghin, Mogtedo-Bombore, and Mogtedo are for households in their third to fifth year of settlement at the AVV (Murphy and Sprey 1980:78). See footnote 3, Table 2.

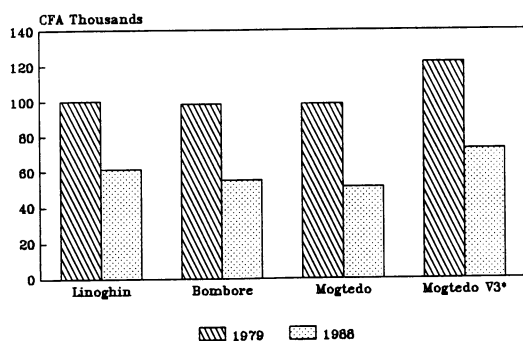
<sup>d</sup> Excludes V3 data.

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



\* Includes both private and family

FIGURE 4a. CROP INCOME, 1978/1979–1988/1989



Source: Annex I

FIGURE 4b. ADJUSTED "REAL" INCOME (1988 = 0)

- to 10–20 hectare project farms which limited the returns to using tractors and restricted the number of "illegal" private fields that they could clear and farm;<sup>11</sup>
- (e) an increase in average family size.

### *Mixed Success in Developing More Diversified Sources of Income*

The fifth year of settlement was an important turning point in the settlement cycle at Mogtedo V3 and the other project villages. During the early years, settlers were preoccupied with the heavy work of clearing new fields. Families were small, and there was little time or money for non-crop activities like livestock and trade. By the fifth year, the settlers had accumulated stores of reserve grain and paid off all or most of their initial debts to the project. This increase in household size on a fixed 10 or 20 hectare farm gave an incentive for settlers to invest in non-crop activities like livestock and trade and to cultivate areas outside the official project fields. The settlers were also motivated by the need to accommodate a second generation of household members. By the fifth year, there were also more opportunities for commercial endeavors and specialized trades such as masonry and mechanics. An additional incentive for diversification was the desire to move away from a singular dependence on agriculture in the face of high levels of uncertainty about the total amount and spacing of annual rainfall.

Finally, the settlers also were motivated by their insecure land tenure. Although the river basins were underpopulated, they were still claimed by the adjacent villages. Transhumant and settled pastoralists relied heavily on the water resources and vegetation of the valleys both for grazing and for transportation from the landlocked cattle producing areas of Mali, Niger, and Burkina to the coast. The 1974 presidential decree that created the AVV declared that the river basins were the property of the state; nevertheless, the legal code still recognized the indigenous hosts' customary land tenure rights. The result was to confuse the issue as to whether the AVV had any real power to revoke the rights of spontaneous settlers and hosts to remain on project lands (McMillan, Nana, and Savadogo 1990).

The first investment to which the settlers turned was livestock. By 1979 several of the most successful households had invested in large livestock holdings. These were generally the same farmers who were the largest cotton producers in the early years. The major cash expense for livestock was usually veterinary care, with some payment for supplementary feeding like salt. If farmers had fewer than five cattle, the cattle were generally kept on-farm. Larger herds were boarded with the local Fulbe herders who received cash and in-kind payments from the cattle owners.

The restudy showed that animal husbandry could be quite risky as well as costly (Savadogo 1989c; McMillan, Nana, and Savadogo 1990). To evaluate risk, farmers were asked to give the number of cattle, goats, and sheep lost through disease and theft for the preceding five years. These figures, divided by stock at interview time, were used to calculate the annual rates of loss per year (Savadogo 1989c). The rate of loss is an important factor in a farmer's investment strategy. The returns to livestock were calculated in two ways (Table 3): a "low" return scenario which considered all feed costs by imputing a value to non-purchased food and full losses due to death and theft; a second "high" return scenario did not consider imputed costs or losses but only cash operating costs (Savadogo 1989c).

No value was attached to the high social costs of keeping large livestock on-farm. As livestock densities increased, so did the difficulty of supervising animals so that they did not damage neighboring farmers' fields. These factors increased the risk and limited the opportunities for additional income growth through animal husbandry. Opportunities were especially constricted for smaller, limited resource families who lacked labor as well as the capacity to gamble on major livestock holdings.

The high labor demands, and high risks, of large livestock production help explain why cattle ownership became increasingly uneven. By 1989, 30% (24) of the male household heads (who had been living in the AVV settlements for periods of 10–15 years) had no large livestock at all,<sup>12</sup> in spite of the AVV project policies, which required settlers to purchase a pair of oxen after their first year.

Settlers' generally perceived non-farm employment as holding greater long-term potential for sustainable income growth than animal husbandry. By 1989, grain merchants at Mogtedo, operating with working capital (estimated at between 800,000–1,000,000 CFA [\$2540–3175 US] for larger traders), could easily earn monthly net profits of 30,000–50,000 CFA (\$95–159) in addition to earnings from crop enterprises. This amount is well above the monthly take home pay of lower-level civil ser-

vants. One successful young merchant, son of an AVV settler in Mogtedo, was earning a monthly net income of between 30,000 and 50,000 (\$95–159) from a regional trading enterprise in 1987. We estimated that the average net income from the store owned by one settler in the study sample at Linoghin to be 300,000–350,000 CFA (\$952–1111 US) per year (Tables 5 and 6).

Only a small number of the study farmers were engaged in the more lucrative year round off-farm activities. For this reason the case study distinguished the second category of farmers as having “secondary occupations” and analyzed their income apart (Table 5). The majority earned much smaller amounts of income from the sale of consumer goods and food products, production and marketing of food stuffs (including beer), local and non-local wage labor. Income earned from small-scale commercial enterprises continued to be less important as a source of cash income or of total income for the male household head than it was for women (Table 6), married and unmarried males attached to households.

In 1979, the Statistical Service Survey did not show dramatic differences between the three groups of settlements in terms of the reported income from non-farm employment (6,227 CFA vs. 9,715 for Linoghin, Mogtedo, and Mogtedo-Bombore respectively) (Table 5). By 1989, however, there were substantial differences. These differences were affected by the settlers’ physical proximity and social access to area markets as well as new, unforeseen opportunities like gold mining.

**MOGTEDO AND MOGTEDO-BOMBORE.** Within five years

after the first planned settlement was created at Mogtedo in 1974, a considerable number of settlers were earning large amounts of income from profitable secondary occupations as merchants and tradesmen. In 1979, there were five outstanding examples of settlers with secondary occupations at V3: a storekeeper, a merchant who resold beer and bread, a mechanic, and a *marabout* (Muslim religious man with healing powers). Two of the five were included in the study sample.

This trend did not continue, however. 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 this pattern, including: 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; decreased cotton production, which had generated a large single amount of cash in the village; conversion to the commercial production of cereals that were sold in the larger regional markets away from project settlements; and a drop in the number of project extension workers who had once provided farmers with a steady market for their services and products.

As early as 1979, the most prosperous AVV settlers at Mogtedo and Mogtedo-Bombore were planning to invest in trade and special services for the larger Mogtedo market located on the paved highway that linked the area to Ouagadougou, 20 to 30 kilometers from the village (McMillan 1983) (Figure 3). These early efforts to diversify were blocked by the indigenous inhabitants, however. Although they were from the same Mossi

TABLE 4 Comparison of Net Agricultural Income in the Older AVV Planned Settlements, 1977–1988/9 (in nominal and real CFA<sup>a</sup>) per Unit Labor (ALE)

	Linoghin	Bombore	Mogtedo	Mogtedo V3
<b>Nominal CFA</b>				
Cooperatively worked fields only <sup>b</sup>				
1977	55,700	---62,200---		—
1978	51,700	---50,550---		—
1979	{57,300 to 66,300}	{56,600 to 65,000}		—
1988	61,315 (\$204)	54,988 (\$183)	51,072 (\$170)	55,101 (\$184)
Privately and cooperatively worked fields				
1979				75,566
1988	76,766	64,329	65,742	72,588
<b>Real CFA, 1988 = 100</b>				
Cooperatively worked fields only				
1979	{92,718 to 107,282}	{91,586 to 105,178}		—
1988	61,315	54,988	51,072	55,101
Private and cooperatively worked fields				
1979	—	—	—	122,275
1988	76,766	64,329	65,742	72,588

<sup>a</sup> Adjusted for inflation using IMF consumer price index for Burkina Faso (1988 = 100). Both 1979 and 1988 were good rainfall years.

<sup>b</sup> Figures for 1977, 1978, and 1979 are for AVV settlers in their third to fifth years of living at the project, by which time they were presumably farming the full area that they were authorized to farm under the AVV system. For 1979, the first figure refers to farmers in their third year, and the second to farmers in their fourth or higher year. Net income figures for farmers in their first or second years were calculated separately in the Murphy and Sprey report (1980:69) but are not listed here.

Sources: Savadogo 1989a; Murphy and Sprey 1980:69; McMillan 1983; McMillan, Nand, and Savadogo 1990.



TABLE 5 Mean Income from the Sale of Handicrafts and Trade, 1978–1988/9

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

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

<sup>b</sup> McMillan 1983:417.

<sup>c</sup> Number in parentheses indicates number of households in this category.

<sup>d</sup> Includes pension of retired soldier and estimated annual income from one farmer's boutique.

<sup>e</sup> Does not include large incomes earned by two butchers.

<sup>f</sup> Does not include income from one farmer with secondary occupation.

Sources: McMillan 1983; McMillan, Nana, and Savadogo 1990; Murphy and Sprey 1980.

ethnic group, the indigenous inhabitants resented the AVV settlers taking land that they felt was rightfully theirs. By 1989, only two AVV settlers' children and one male household head from the six settlements at Mogtedo had official places in the Mogtedo market in 1989. Only one of the AVV settlers' children ever developed a successful regional trading enterprise, and even he ultimately left. The one male household head—a prosperous grain merchant—is a native of the Mogtedo region and only came to the project in 1988.

Gold was discovered near the AVV planned settlements at Mogtedo in late 1987. The associated "gold rush" increased immigration and market activity throughout the surrounding region. By 1989, four sites were being exploited near the AVV planned settlements at Mogtedo. Since then, panning gold has become an important revenue source in the Mogtedo villages. In addition, the flood of gold miners created new markets for meat, water, raw and cooked food.

The net result was a substantial increase in the income and welfare of women and men farmers in the Mogtedo sponsored settlements located nearest to the mining sites (Tables 4 and 5). The highest reported incomes were in Mogtedo V3, which is closest to the gold sites. The average income earned from off-farm employment was substantially lower at Mogtedo-Bombore which was not within easy walking distance to the sites.

Despite an associated increase in living standards, the settlers were not optimistic that gold revenues would be reinvested in ways that would improve non-farm employment in the

long-run. This suspicion was supported by our research, which showed that the settlers' gold revenues were spent largely on consumer goods (bicycles, dishes, clothing, sleeping mats, higher valued foods, and radios) (McMillan, Nana, and Savadogo 1990:127–128). Moreover, the same forces that excluded the AVV settlers from the most profitable commercial activities at Mogtedo seemed to be operating at the mines. Not one of the entrepreneurs who provided the most lucrative businesses that catered to the miners was either a current or a former AVV settler.

Frustrated by the lack of long-term prospects for reversing these downward trends, 21 registered households and ten individuals from households who continued to occupy one of the AVV farms left the bloc of Mogtedo in early 1988. Another eight families and one individual left Mogtedo-Bombore just as suddenly. All relocated to Kompienga, the site of Burkina's first hydroelectric dam, located in the extreme southeast of the country (Figure 2).

The settlers who immigrated to Kompienga were the project success stories. They included some of the most ambitious leaders who had worked closest with the AVV administration. Many of these people had accumulated considerable investments which they used to rent trucks to transport their families and possessions and to purchase and improve housing at the new site.<sup>13</sup> Our 1989 census of Kompienga showed that 55 (13%) of the 425 non-civil servant households living in the town were headed by former AVV settlers from the blocs of Mogtedo, Mogtedo-Bombore, Mankaraga, and Rapadama.

TABLE 6 Average Non-farm Income from Different Sources for Individuals Reporting Income from the Source, 1988–1989

	Linoghin	Bombore	Mogtedo	Mogtedo V3	Kompienga
<b>A. Male household head</b>					
1. Unprocessed agricultural products	64,120 (1) <sup>a</sup>	—	42,000 (1)	—	23,167 (3)
2. Processed agricultural products	—	—	—	—	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)	50,000 (1)
9. Agricultural labor	—	—	20,000 (1)	—	—
10. Nonagricultural labor	450,000 (1)	—	—	250,000 (1)	—
11. Mill	—	—	—	—	550,000 (1)
<b>B. One woman per family</b>					
1. Unprocessed agricultural products	9,050 (2)	—	—	74,200 (2)	10,437 (10)
2. Processed agricultural products	26,043 (13)	3,833 (5)	3,186 (7)	6,642 (14)	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)	—	—	—
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)	—

<sup>a</sup> Number in parentheses indicates how many men and women provided non-zero numbers.

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

Sources: Savadogo 1989a; McMillan, Nana, and Savadogo 1990.

The settlers' main motivation for leaving was to locate in an area with greater opportunities for dry-season irrigated farming and regional trade. Kompienga was also an area to which few Mossi had immigrated prior to construction of the dam. As such, they were less likely to encounter conflicts in developing trade. The female family heads were especially attracted by the income opportunities related to living near a market. It is indicative that even in the first years of establishing the new farm, many of the AVV settlers' wives were earning an income from trade that was substantially higher than what the average woman was earning at Mogtedo-Bombore (Table 5) (McMillan, Nana, and Savadogo 1990; Savadogo, Sanders, and McMillan 1989). The women's income patterns at Mogtedo-Bombore today are our best proxy for actual income levels of women at Mogtedo prior to discovering gold.

**LINOUGHIN.** A very different scenario was recorded in the AVV planned settlements at Linoghin, which are about 60 kilometers from Mogtedo. Here the settlers developed a dynamic market on the paved highway linking Ouagadougou to eastern Burkina, Togo, Niger, Benin, and Ghana (Figure 3). The economic importance of this market was not reflected in the reported off-farm income for male household heads (Table 5). Instead, it is more accurately reflected in the higher income levels of the women household heads (Table 5), married and unmarried sons and brothers. Eighty percent of the women interviewed at Linoghin recorded income from off-farm employment, none of it from gold. Most of this income was from cooked food, homemade beer, and gathered forest products.

The average off-farm income for all of 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 1987–1988 gold rush.

Several factors contributed to the much greater development of non-farm employment at Linoghin than in the other two blocs. The Linoghin market, in contrast to Mogtedo, was created by the AVV settlers themselves. As a result, the Mossi AVV settlers could not be accused of stealing trade opportunities from the indigenous Mossi hosts. Linoghin's location along the main paved highway was ideal (Figure 3). The market attracted male settlers from all six of the Linoghin planned settlements as well as female settlers from the nearby settlements at Rapadama V1 and V2. The settlers' ready acceptance of indigenous farmers in their market was appreciated. The fact that a large majority of the AVV settlers at Linoghin were recruited from the same Oubritenga province as the hosts, and "illegal" self-settled migrants made it easier for the three groups to collaborate.

One reflection of the greater degree of social integration between the Linoghin settlers and the surrounding host population was a jointly built mosque. Another strong indicator was the growing trend toward intermarriage. By 1989 we counted five daughters of self-settled immigrants and four daughters of indigenous inhabitants who were married to settlers living in the AVV sponsored settlements at V1, V2, and V5 Linoghin. We also found six daughters of AVV sponsored settlers who were married to spontaneous migrants. This pattern of intermarriage, cooperation and increasing social integration con-

trasts sharply with the AVV-sponsored settlements at Mogtedo and Mogtedo-Bombore.

The dynamism of the Linoghin settlers was expressed in other ways as well. In 1988/89 the net CFA value of crop production per unit of labor was 12% higher for the study farmers at Linoghin than at Bombore, and 20% higher than for the Mogtedo households (Table 3). Ten years ago there was no visible difference between the blocs in terms of net productivity per worker (Murphy and Sprey 1980:69). The Linoghin settlers had average per household cash and kind expenses for production that were 24% higher than at Mogtedo, and over 200% greater than at Mogtedo-Bombore and Mogtedo V3 (Table 3) (Savadogo, Sanders, and McMillan 1989:43). Seventy-nine percent of the study farmers used some compound fertilizer on their fields at Linoghin, 85% at Mogtedo, but only 45% at Mogtedo-Bombore (Savadogo, Sanders, and McMillan 1989:34).

The Linoghin settlers also showed the greatest interest in investing in the more labor intensive soil conservation measures like *diguettes* (small dikes) and manure pits. This long-term labor investment indicated a greater interest in remaining at the site. To assist farmer groups with the initial development of dikes, the AVV provided project trucks. Even after the AVV support for *diguette* building ended, individual farmers continued to expand the number of stone dikes on their fields. The highest level of interest in stone dikes was in the most isolated Linoghin village, V6, which is 20–25 kilometers from the Linoghin market. Although too distant from the market for many family members to engage in trade easily, the V6 settlers were close enough to Ouagadougou to develop profitable counter-season crops—in this case fresh corn.

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 was higher than in the other two blocs. Linoghin also had the most successful record for the development of group-managed enterprises, the income from which has been used to maintain basic infrastructure like roads and wells. Especially remarkable was the Linoghin group's development of the first kindergarten in the region.

On the whole settler turnover has been very low at Linoghin. A number of the wealthier settlers have moved into full-time commerce based in Ouagadougou, but they did not abandon the project farm. Indeed, there was a great deal of competition to inherit the Linoghin project farms.

In contrast, the more isolated, less diversified neighboring blocs of Mogtedo and Mogtedo-Bombore experienced high rates of settler drop-out. Of the 255 households who acquired AVV farms at Mogtedo between 1974 and 1978, only 58% (148) were still living there in 1989. Out-migration was lower, but still substantial (19%), at Mogtedo-Bombore.

### *Summary and Policy Implications*

**SUMMARY.** Although the AVV did not succeed in introducing intensive agriculture, the project did provide a substantial increase in settlers' income. Moreover, various elements of the project—access to new land, supplementary food aid, extension services—did combine to raise settler income and to create new economic options. With new successful economic

ventures came a sense of personal empowerment within the wider economy of Burkina and a desire to expand even further.

At Mogtedo and Mogtedo-Bombore, these commercial ventures were thwarted by the settlers' physical and social isolation from important markets. One group of commercial farmers, including some of the most successful farmers in the region, chose to leave the project for an area where they felt there were better opportunities. Another group adapted to the increasingly isolated social and economic conditions that were resulting from the project's winding down by reintroducing and expanding their traditional patterns of extensive rainfed agriculture.

In contrast, the greater opportunity to develop trade at Linoghin was a factor that encouraged the more successful settlers to remain living there, despite given the constraints that they faced. These constraints included inappropriate extension recommendations, unfavorable price policies and insecure land tenure rights. None of these were factors that either the project planners or the settlers themselves could control.

Increased diversification was not at the expense of additional investment in intensive farming or higher levels of crop productivity (McMillan, Painter, and Scudder 1990; Salem-Murdock 1989; Scudder 1981, 1985; Scudder and Wimaladharma 1985, 1990). Indeed, the Linoghin settlers also had the highest level of investment in variable inputs (e.g., fertilizer, insecticide, and labor) as well as new soil conservation technologies.

Based on the case study research and comparative research in Burkina, in the OCP river basins, and worldwide,<sup>14</sup> we can predict then that local opportunities to develop off-farm employment, as well as land quality, will influence settler choice of immigration sites. In the same way, we can predict that the long-term profitability of these off-farm enterprises will affect the willingness and capacity of the local inhabitants to invest in environmentally sustainable natural resource management. High rates of settler turnover in Africa and Latin America are associated with a lack of opportunity to develop either crop or non-crop employment as well as with insecure tenure rights and unfavorable price policies which deflate the returns to sustainable cropping (Cernea 1988; Chambers 1969; Christodoulou 1965; McMillan, Painter, and Scudder 1990:75; Scudder 1981, 1984, 1985, 1991; Van Raay and Hilhorst 1981; Weitz, Pelley, and Applebaum 1978).

**POLICY IMPLICATIONS.** The research results have implications for policy both at the national (macro) and the local (micro) levels. Policy makers are attracted to planned settlements as one way of providing the kind of coordinated assistance needed in areas of new lands settlement. They are also attracted to the more isolated sites as a means of reducing or eliminating altogether land tenure disputes.

The concept of a group of isolated planned settlements looks good on paper and may even raise settler living standards, but the long-term prospects for sustainable development are highly suspect. Due to their locations far from major markets, the most isolated settlements will be unlikely to create the variety of employment opportunities that settlers will demand as they become more prosperous. In the absence of profitable opportunities to develop cash cropping, such as we see in the cotton "boom" area of Burkina's southwest, we can predict that the most commercially oriented farmers will end up leaving the project.

In view of the importance that settlers attach to developing diversified sources of income, policy makers should concen-

trate, at least initially, on developing infrastructure and crop and livestock extension services in less isolated areas like Linoghin, where opportunities for diversification are greater. The principal exception to this pattern would be isolated areas that are determined to have unusual natural resource potential such as land around dams (McMillan, Painter, and Scudder 1990).

Land tenure and zoning policies should strive for a balance to promote the economic interests of all of the groups to be effected including hosts and immigrants, pastoralists and agriculturalists. This planning guideline, which is often seen in terms of social equity, has a number of pragmatic economic consequences. Most notably, high levels of social conflict can restrict successful diversification and the settlers' willingness to reinvest in a region. High levels of conflict also effect the agriculturalists' chances of negotiating herding and manure contracts. Local pastoralists, in turn, can be penalized with high fines for the destruction of farmers' crops by animals, although determining whose animals are at fault is complicated by the large number of temporary residents moving in and out of the settlement areas.

Special administrative intervention may be necessary to secure pasture rights for pastoralists to accommodate the fact that there is seldom a category of either customary or modern legal codes that recognizes pasture rights. Pasture is frequently considered a natural resource, accessible to all, but rights to pasture have historically been considered secondary to cultivation rights (McMillan, Nana, and Savadogo 1990:67; McMillan, Painter, and Scudder 1990).

A final recommendation addresses the need to phase development investments over a longer period of time. If the first generation of development planning is successful, it is likely to attract additional new lands settlement. Doing so normally results in the creation of new markets and the expansion of activities in markets that were established before settlement began. The AVV's many futile attempts to develop project markets show that it is not always easy to predict where new market centers will develop. Nevertheless, government investment in roads and infrastructure that facilitate the development of these centers increases the profitability of local agricultural and non-farm enterprises. Donors might, therefore, include a second generation set of funding plans to support the development of market and administrative centers that emerge during the first phase of an intervention, and are critical to the attainment of more long-term project goals for successful, sustainable development.

The significance of this study and the impact of the AVV must be viewed in a wider context. Disease-control programs like the OCP can and do have a profound impact on settlement patterns. Moreover, there is every reason to expect that scientists will one day have inexpensive but effective technologies to control other diseases like malaria and animal sleeping sickness. These diseases have been key factors in determining the ecological balance among natural resources, humans and animals in West Africa for millennia.

Disease-control projects are attractive to donors because, for a small dollar amount, they can affect large numbers of people. Donors are typically far less interested in becoming involved in or funding development interventions for the areas once the disease has been successfully controlled. One reason has to do with the gross difference in direct cost-benefits. The annual

costs per beneficiary for river blindness control in 1986 were only one US dollar. In contrast, the one time costs per beneficiary family of installing even the most basic roads, bridges and year round water points in the new communities being established can range from several hundred to several thousand dollars.

For all of these reasons, foreign donors are far more likely to be attracted to biological control than to follow-up development planning. Nevertheless, the AVV reminds us that a biological innovation like river blindness control is only a partial development vision. Other types of assistance are required if this type of biological control is destined to result in stable, long-term development. Neither the settlers moving into a disease control area nor their national governments can adequately address this issue on their own. There is, therefore, a critical need for foreign donors who support disease control to develop more cost-effective models for follow-up development planning and projects. This follow-up planning should at least parallel—if not precede—the planning for control.

The conditions of balanced, diversified development are not likely to be found in an area with limited economic opportunities, and certainly not in areas that depend on the cultivation of a single cash crop like cotton. Instead, these conditions are most likely to be found in locations where, over time, abundant opportunities exist. These opportunities give both settlers and hosts the maximum opportunity to respond creatively to the changes set in motion by disease control.

#### NOTES

<sup>1</sup> Onchocerciasis is caused by the threadlike worm *Onchocerca volvulus*. The adult worms have an estimated life of 14 years in the human body where they inhabit the subcutaneous tissues of the skin causing raised nodules. Each female worm produces millions of microscopic microfilaria, which live for about two years. This microfilaria migrate in the epidermis, causing itching, skin depigmentation and, eventually, eye lesions that can result in blindness. The disease is carried between humans by the bites of a female black fly of the *Simulium* genus. The flies can breed only in fast flowing streams or rivers. As a result, the highest incidence of onchocerciasis occurs among people who live in river valleys—hence the name, river blindness.

<sup>2</sup> These issues are discussed in greater detail in the following: Angel 1985; Becker 1985; Bharin 1981; Couty et al. 1979; Dollfus 1981; Hunting Technical Services 1988a, 1988b, 1988c, 1988d; McMillan, Painter, and Scudder 1990; Nicolai and Laserre 1981; OCP 1986; Raison 1979, 1981, 1985; Remy 1968, 1973, 1975, 1981; Van Raay and Hilhorst 1981; Weitz, Pelley, and Applebaum 1978).

<sup>3</sup> The project was funded by the United States Agency for International Development (USAID) through the Department of Agricultural Economics at Purdue University.

<sup>4</sup> Savadogo was responsible for analyzing the economic survey that we designed to study the farming systems at three of our four study sites in Burkina Faso. One site was the three groups of adjacent AVV sponsored settlements (Linoghin, Mogtedo, and Mogtedo-Bombore). He was assisted in his analysis by Dr. John Sanders at Purdue University (Savadogo 1989a, 1989b, 1989c, 1989d; Savadogo, Sanders, and McMillan 1989). Nana's research focused on our two non-AVV sites in Burkina's southwest (Solenzo and Niangoloko) and a new AVV assisted settlement scheme at Rapadama (Nana 1989a, 1989b, 1989c). The author served as team leader and focused her research on the AVV sponsored settlements and the fourth site, Komienga.

<sup>5</sup> The AVV uses a system of labor equivalents to determine the amount of land a household receives and a similar system to determine

the distribution of supplementary food aid during the first year. This potential for labor is measured by a labor index that assigns weights to persons according to sex and age. Since an adult male is considered to have the work capacity most readily transferred to a variety of tasks, this is the standard unit and is assigned a value of one. Women and children are assigned lesser values (0.75 for adult women, 0.50 for teenage boys, 0.25 for a female over 55, etc.). The use of labor and consumption equivalents to standardize the units of comparative analysis (so that one does not calculate the "average" household income based on units that may range from three to 35 residents and one to 12 workers in size) is a standard and hotly debated topic in farm management research. For purposes of comparisons with the projected income and production figures of the AVV, I have used the AVV system.

<sup>6</sup> Figures are based on the 1975 Project Identification Report of the Dutch Government for the AVV, which estimated a minimum daily food requirement of 2,230 calories per person per year including losses during storage (Murphy and Sprey 1980:22). Figures represent the difference between the recorded grain per resident and the recommended 240 kilogram minimum of cereals.

<sup>7</sup> As we did not measure all of the fields, we were unable to determine the levels of input use per unit land for the entire area. Interviews with extension agents and settlers, however, suggest that average fertilizer use on cotton fields was substantially below the recommended 150 kg/ha.

<sup>8</sup> 800 kg/ha in 1988 versus 1000 kg/ha in 1979 for cotton, and 1000 kg/ha in 1988 versus 800 kg/ha in 1979 for sorghum.

<sup>9</sup> Average prices used to calculate the value of agricultural production in the Statistical Service Survey research in 1979 were based on a two-year study of local markets. The prices used for the 1988-1989 restudy were based on the median prices that farmers received for their products based on reported crop sales over one calendar year. Both 1979 and 1988 were considered good agricultural years.

<sup>10</sup> The figures used to adjust income were developed by Burkina's national statistical service based on the purchases of a typical, non-wage earning urban household. We also attempted to develop our own inflation indicators by comparing prices on key products purchased in 1979 and 1989. Based on the latter, we determined that the service's figures were reasonable and indeed quite conservative.

<sup>11</sup> Only 21% of the 678 fields in the 1988 AVV sample (which included private fields for the male household head and one woman in 80 sample households) were classified as "illegal" or outside the project boundaries.

<sup>12</sup> These were farmers who, for one reason or another had either lost or sold their animal traction animals, and did not purchase a new pair. Forty-six percent [37] had two to four; 19% owned five or more large livestock; 5% of the largest farm families had herds that ranged in size from 20 to 50 head.

<sup>13</sup> Immigration to Komienga was not cheap. The 100,000-150,000 CFA cost of renting a truck to transport the settlers' household goods from Mogtedo to Komienga represents the cash equivalent of the total crop income produced in 1988 by the poorer AVV settler households. Fifty-two of the 55 former AVV settlers purchased their homes from departing construction workers for an average of 100,000 CFA. Two of the three former AVV settlers who were included in the expenditure revenue survey spent 255,000 CFA (\$850) and 418,000 (\$1,395) on housing and housing improvements in the first year and a half alone. The same two former AVV settlers purchased rental properties as well.

<sup>14</sup> This research is detailed in the following: Gabre-Madhin and Reardon 1989; McMillan, Nana, and Savadogo 1990; McMillan, Painter, and Scudder 1990; Reardon and Delgado 1989, 1990; Reardon and Islam 1989; Reardon and Matlon 1989; Reardon, Delgado, and Matlon, 1992; Reardon, Matlon, and Delgado 1988; Scudder 1981, 1985.

#### REFERENCES CITED

Akwabi-Ameyaw, K.

1990 Land Settlement Review Case Study: Ghana. Binghamton,

NY: Committee of Sponsoring Agencies of the Onchocerciasis Control Program and the Institute for Development Anthropology.

Angel, S.

1985 Spontaneous Land Settlement on Rural Frontiers: An Agenda for a Global Approach. Paper presented at the International Seminar on Planning for Settlements in Rural Regions: The Case of Spontaneous Settlements. Nairobi, Kenya.

Autorité des Aménagements des Vallées des Volta (AVV)

1985 L'impact socio-économique du programme de lutte contre l'onchocercose au Burkina (1974-1984). Ouagadougou: AVV.

Becker, B. K.

1985 Spontaneous/Induced Rural Settlements in Brazilian Amazonia. Paper presented at the International Seminar on Planning for Settlements in Rural Regions: The Case of Spontaneous Settlements. Nairobi, Kenya.

Bharin, T. S.

1981 Review and Evaluation of Attempts to Direct Migrants to Frontier Areas through Land Colonization Schemes. *In* Population Distribution Policies in Development Planning. UNFPA, ed. Pp. 131-143. New York: United Nations, Department of International Economic and Social Affairs.

Buursink, J. and T. Painter

1990 Land Settlement Review, A Review of Settlement Experiences in: Benin, Côte d'Ivoire, Guinea, Guinea-Bissau, Niger, Senegal and Sierra Leone (7 Country Review). Binghamton, NY: Institute for Development Anthropology.

Cernea, M.

1988 Involuntary Resettlement in Development Projects: Policy Guidelines in World Bank Financed Projects. Washington, DC: The World Bank Technical Papers (No. 80).

Chambers, R.

1969 Settlement Schemes in Tropical Africa: A Study of Organizations and Development. New York: Praeger.

Christodoulou, D.

1965 Land Settlement. Some Oft-neglected Issues. *Monthly Bulletin of Agricultural Economics and Statistics* 14:1-6.

Couty, P., J. Y. Marchal, P. Péliissier, M. Poussi, G. Savonnet, and A. Schwartz, eds.

1979 Maîtrise de l'espace agricole et Développement en Afrique Tropicale: Logique Paysanne et Rationalité Technique. Paris: Office de la Recherche Scientifique et Technique Outre-Mer.

Deuson, R. and J. H. Sanders

1990 Cereal Technology Development in the Sahel: Burkina Faso and Niger. *Land Use Policy* 7:195-197.

Dollfus, O.

1981 Phénomènes pionniers et problèmes de frontières: Quelques remarques en guise de conclusion. *Travaux et Mémoires de l'Institut des Hautes Etudes de l'Amérique Latine* 32:445-448.

Gabre-Madhin, E. and T. Reardon

1989 The Importance and Determinants of Women's Non-Agricultural Income Strategies in Rural Burkina Faso. Paper presented at the 1989 American Agricultural Economics Association Annual Meetings, Baton Rouge, LA.

Hervouet, J. P.

1977 Peuplement et mouvements de population dans les vallées des Volta blanche et rouge. Ouagadougou: ORSTOM.

1978 La mise en valeur des vallées des Volta blanche et rouge: Un Accident historique. *Cahiers ORSTOM: Série sciences humaines* 15:81-87.

1990 Le mythe des vallées dépeuplée par l'onchocercose. Montpellier: Cahiers GEOS (Atelier de géographie de la santé, Université Paul Valéry).

Hervouet, J. P., J. C. Clanet, F. Paris, and H. Some

1984 Settlement of the Valleys Protected from Onchocerciasis after Ten Years of Vector Control in Burkina. Ouagadougou: OCP.

Hunting Technical Services, Ltd.

1988a Final Report: Socioeconomic Development Studies in the

- Onchocerciasis Control Programme Area. Volume 1: Main Report. London: Hunting Technical Services, Ltd.
- 1988b Socioeconomic Development Studies in the Onchocerciasis Control Programme Area. Volume 2: National Oncho Zone Development Studies and Development Proposals. London: Hunting Technical Services, Ltd.
- 1988c Socioeconomic Development Studies in the Onchocerciasis Control Programme Area. Volume 3: National Oncho Zone Development Studies and Development Proposals. London: Hunting Technical Services, Ltd.
- 1988d Socioeconomic Development Studies in the Onchocerciasis Control Programme Area. Volume 4: Bibliography. London: Hunting Technical Services, Ltd.
- Jayne, T., J. C. Day, and H. E. Dregne  
1989 Technology and Agricultural Productivity in the Sahel. Washington, DC: USDA.
- Koenig, D.  
1990 Onchocerciasis Control Programme. Land Settlement Review Case Study: Mali. Binghamton, NY: Committee of Sponsoring Agencies of the Onchocerciasis Control Programme and the Institute for Development Anthropology.
- McMillan, D.  
1980 Land Rights and Resettlement. West Lafayette, IN: Department of Agricultural Economics, Purdue University.  
1983 A Resettlement Project in Upper Volta. PhD dissertation, Northwestern University.  
1984 Changing Patterns of Grain Production in a Resettlement Scheme in Upper Volta. Washington, DC: Center for Women in Development, South-East Consortium for International Development.  
1986 Distribution of Resources and Products in Mossi Households. *In Food in Sub-Saharan Africa*. A. Hansen and Della E. McMillan, eds. Pp. 260–273. Boulder, CO.  
1987a Monitoring the Evolution of Household Economic Systems over Time in Farming Systems Research. *Development and Change* 18:295–314.  
1987b The Social Impacts of Planned Settlements in Burkina Faso. *In Drought and Hunger in Africa: Denying Famine a Future*. M. Glantz, ed. Pp. 297–322. Cambridge: Cambridge University Press.  
1988 Is a Turnaround in African Agriculture Possible Without Helping Women Farmers? *Economic Development and Cultural Change* 37:345–369.  
1989a Draft Country Case Study: Burkina Faso. (Analysis of Material from Site Reports and Other Research at AVV-UPI, Komienga, Solenzo, and Niangoloko.) Binghamton, NY: Institute for Development Anthropology.  
1989b Seasonality, Planned Settlement and River Blindness Control. *MASCA Research Papers in Science and Archaeology* 5: 96–120.  
1992 Rapid Assessment Procedures (RAP): Qualitative Methodologies for Planning and Evaluation of Health Related Programmes. *In Rapid Assessment Procedures*. N. S. Scrimshaw and G. R. Gleason, eds. Pp. 10–25. Boston: International Nutrition Foundation for Developing Countries.
- McMillan, D., J.-B. Nana, and K. Savadogo  
1990 Onchocerciasis Control Programme. Land Settlement Review Case Study: Burkina Faso. Binghamton, NY: Committee of Sponsoring Agencies of the Onchocerciasis Control Programme and the Institute for Development Anthropology.
- McMillan, D., T. Painter, and T. Scudder  
1992 Onchocerciasis Control Programme, Final Report of the Land Settlement Review: The Experience with Land Settlement in the OCP River Basins and Strategies for Their Development. Binghamton, NY: Committee of Sponsoring Agencies of the Onchocerciasis Control Programme and the Institute for Development Anthropology.
- Murphy, J. and L. Sprey  
1980 The Volta Valley Authority: Socio-economic Evaluation of a Resettlement Project in Upper Volta. West Lafayette, IN: Department of Agricultural Economics, Purdue University.
- Nagy, J., J. Sanders, and O. Ohm  
1987 Cereal Technology Development—West African Semi-Arid Tropics: A Farming System Perspective. West Lafayette, IN: International Programs in Agriculture.
- Nana, J. B.  
1989a Rapport sur le site de la zone de sous-secteur de Niangoloko et de la forêt classée de Toumousseni. (English version: 1989 Report on the Niangoloko Site and the Toumousseni Forest Reserve.) Binghamton, NY: Institute for Development Anthropology.  
1989b Rapport sur le site. Programme PNGTV Rapadama. (English version: 1989 Site Report PNGTV Rapadama.) Binghamton, NY: Institute for Development Anthropology.  
1989c Rapport sur le site de sous-secteur de Solenzo. (English version: 1989 Solenzo Sub-sector Site Report.) Binghamton, NY: Institute for Development Anthropology.
- Nicolai, H. and G. Laserre  
1981 Les systèmes de cultures traditionnels et les phénomènes pionniers en Afrique tropicale. *Travaux et mémoires de l'Institut des Hautes Etudes de l'Amérique Latine* 32:95–115.
- Onchocerciasis Control Programme (OCP)  
1985 Ten Years of Onchocerciasis Control. Geneva: World Health Organization.  
1986 Report on the Evaluation of the Socioeconomic Impact of the Onchocerciasis Control Programme.
- Painter, T.  
1990 Onchocerciasis Control Programme. Land Settlement Review Case Study: Togo. Binghamton, NY: Committee of Sponsoring Agencies of the Onchocerciasis Control Programme and the Institute for Development Anthropology.
- Raison, J.-P.  
1979 Les Modèles d'intervention et leurs objectifs. *In Maîtrise de l'espace agricole et Développement en Afrique Tropicale: Logique Paysanne et Rationalité Technique*. P. Couty, J. Y. Marchal, P. Péliissier, M. Poussi, G. Savonnet, and A. Schwartz, eds. Pp. 281–286. Paris: ORSTROM.  
1981 La colonisation des terres neuves en Afrique Tropicale: réflexions sur quelques travaux récents. *Travaux et mémoires de l'Institut des Hautes Etudes de l'Amérique Latine* 32:59–76.  
1985 Les mouvements spontanés de migration en milieu rural dans les pays africains francophones: evaluation et propositions. Paper presented at the International Seminar on Planning for Settlements in Rural Areas: The Case of Spontaneous Settlements. Nairobi, Kenya.
- Reardon, T. and C. Delgado  
1989 Income Diversification of Rural Households in Burkina Faso. Washington, DC: World Bank/Environment Department/ Human Resources Development Division.  
1990 Income Diversification of Rural Households in Burkina Faso. *In Professional Development Workshop on Dryland Management*. J. Trollidalen, ed. Pp. 71–78. Washington, DC: World Bank, Environmental Department.
- Reardon, T. and N. Islam  
1989 Issues of Sustainability in Agricultural Research in Africa. *In Proceedings of the Symposium on the Sustainability of Production Systems in Sub-Saharan Africa*. S. W. Bie, ed. Pp. 43–68. As, Norway: NORAGRIC.
- Reardon, T. and P. Matlon  
1989 Seasonal Food Insecurity and Vulnerability in Drought-Affected Regions of Burkina Faso. *In Seasonal Variability in Third World Agriculture: The Consequences for Food Security*. D. Sahn, ed. Pp. 118–136. Johns Hopkins University Press.
- Reardon, T., C. Delgado, and P. Matlon  
1992 Determinants and Effects of Income Diversification Amongst Farm Households in Burkina Faso. *Journal of Development Studies* 28:264–296.

- Reardon, T., P. Matlon, and C. Delgado  
1988 Coping with Household-level Food Insecurity in Drought-affected Areas of Burkina Faso. *World Development* 16:1065-1074.
- Remme, J. and J. B. Zongo  
1989 Demographic Aspects of the Epidemiology and Control of Onchocerciasis in West Africa. *In* *Demography and Vector Borne Diseases*. M. Service, ed. Pp. 367-386. Boca Raton, FL: CRC Press.
- Remy, G.  
1968 Les mouvements de population sur la rive gauche de la Volta Rouge region de Nobere (region de Nobere). *Cahiers ORSTOM* 5:45-66.  
1973 Les migrations de travail et les mouvements de colonisation Mossi. Paris: ORSTOM.  
1975 Les migrations vers les "Terres Neuves." Un nouveau courant migratoire. *In* *Enquete sur les mouvements de population à partir du pays mossi*. Ouagadougou: ORSTOM.  
1981 Les Mossi a la rencontre de la grande brousse (région de Dédougou, Haute-Volta). *Travaux et Mémoires de l'Institut des Hautes Etudes de l'Amérique Latine* 32:117-131.
- Salem-Murdock, M.  
1989 Arabs and Nubians in New Halfa: A Study of Settlement and Irrigation. Salt Lake City: University of Utah Press.
- Sanders, J.  
1989 Agricultural Research and Cereal Technology Introduction in Burkina Faso and Niger. *Agricultural Systems* 30:139-154.
- Sanders, J., J. Nagy, and S. Ramaswamy  
1990 Developing New Agricultural Technologies for the Sahelian Countries: The Burkina Faso Case. *Economic Development and Cultural Change* 30:1-22.
- Saul, M.  
1979 Notes on the History and Demography of Bentenga. West Lafayette, IN: Department of Agricultural Economics, Purdue University.  
1980 Beer, Sorghum and Women: Production for the Market in Rural Upper Volta. *Africa* 51:746-764.  
1983 Work Parties, Wages and Accumulation in a Voltaic Village. *American Ethnologist* 10:77-96.
- Savadogo, K.  
1989a Analysis of Off-Farm Income: Land Settlement Review Draft Site Report. Binghamton, NY: Institute for Development Anthropology.  
1989b Land Tenure Systems: Land Settlement Review Draft Site Report. Binghamton, NY: Institute for Development Anthropology.  
1989c Livestock in the Farming System: Land Settlement Review Draft Site Report. Binghamton, NY: Institute for Development Anthropology.  
1989d Factors Explaining Household Food Production Systems: Land Settlement Review Draft Site Report. Binghamton, NY: Institute for Development Anthropology.
- Savadogo, K., J. Sanders, and D. McMillan  
1989 Farm and Female Incomes and Productivities in the River Blindness Settlement Programs of Burkina Faso: Land Settlement Review Draft Site Report. Binghamton, NY: Institute for Development Anthropology.
- Scudder, T.  
1981 The Development Potential of New Lands Settlement in the Tropics and Subtropics: A Global State-of-the-Art Evaluation with Specific Emphasis on Policy Implications. Binghamton, NY: Institute for Development Anthropology.  
1984 The Development Potential of New Lands Settlement in the Tropics and Subtropics: A Global State of the Art Evaluation with Specific Emphasis on Policy Implications. Washington, DC: USAID.  
1985 The Experience of the World Bank with Government-Sponsored Land Settlement. Washington, DC: The World Bank.  
1991 A Sociological Framework for the Analysis of New Lands Settlements. *In* *Putting People First: Sociological Variables in Rural Development*. M. Cernea, ed. Pp. 148-187. New York: Oxford University Press.
- Scudder, T. and E. Colson  
1981 From Welfare to Development: A Conceptual Framework for the Analysis of Dislocated People. *In* *Involuntary Migration and Resettlement*. A. Hansen and A. Oliver-Smith, eds. Pp. 267-288. Boulder: Westview Press.
- Scudder, T. and K. P. Wimaladharna  
1985 The Accelerated Mahaweli (Sri Lanka) Programme and Dry Zone Development, Report No. 6. Binghamton, NY: Institute for Development Anthropology.  
1990 The Accelerated Mahaweli (Sri Lanka) Programme and Dry Zone Development, Report No. 7. Binghamton, NY: Institute for Development Anthropology.
- Van Raay, G. T. and J. Hilhorst  
1981 Land Settlement and Regional Development in the Tropics: Results, Prospects and Options. The Hague: Institute for Social Studies Advisory Board.
- Weitz, R., D. Pelley, and L. Applebaum  
1978 Employment and Income Generation in New Settlement Projects. Geneva: International Labour Office.
- Younger, S. and J-B. Zongo  
1989 West Africa: The Onchocerciasis Control Programme. *In* *Economic Development Institute In Successful Development in Africa: Case Studies of Projects, Programs and Policies*. R. Bheennick, ed. Pp. 27-56. Washington, DC: World Bank.