Chapter 11

Influences of Programs and Organizations on the Adoption of Sustainable Land Management Technologies in Uganda

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Governments are devolving service and infrastructure provision, regulatory authority, and decisionmaking in many developing countries. Market reforms and structural adjustment policies devolve the provision of services and infrastructure to nongovernmental organizations (NGOs), community-based organizations (CBOs), and the private sector (Farrington and Bebbington 1993; Uphoff 1993; Pender and Scherr 2002). The transition from the provision of extension services, input supply, rural credit delivery, regulation, and other aspects of natural resource management from centralized governments to alternative institutions may have significant implications for the capacity of smallholders to sustainably manage their resources.

Uganda presents an interesting opportunity to analyze the challenges and opportunities for institutional change in the face of government devolution and increasing land degradation. The government of Uganda is presently decentralizing many of its services, including those that are directly related to agriculture and the environment. There is considerable evidence that land degradation in Uganda's rural areas has been increasing and will continue to do so. Average annual soil nutrient losses in Uganda of more than 70 kilograms of nitrogen, phosphorus, and potassium (NPK) are among the highest rates of depletion in Sub-Saharan Africa (Stoorvogel and Smaling 1990). Analysis of community perceptions about changes

in natural resource conditions since 1990 indicates that the availability and quality of cropland, grazing land, forests, and woodland are perceived to be decreasing throughout the country (Pender et al. 2004a). Soil fertility is perceived to have significantly deteriorated, and soil moisture-holding capacity and erosion problems are worsening. Natural water sources and the biodiversity of plants and animals are also perceived to be deteriorating in availability and quality (Pender et al. 2004a).

Land management policy in Uganda is currently being shaped by the Plan for the Modernization of Agriculture (PMA), the Poverty Eradication Action Plan (PEAP), and the Decentralization of Public Service Reform Plan. One of the main goals of the PMA is that all activities related to agricultural production, agricultural processing, trading, the supply of inputs, and the import and export of agricultural produce will eventually be carried out by the private sector (MAAIF 1999). However, given lags in the time it takes for effective private sector intervention, nongovernmental organizations and community-based organizations are being asked to take the lead in providing these services in the medium term, with the goal of privatization of services by 2020.

The primary objective of this chapter is to characterize programs and organizations in Uganda and to determine whether or not community and/or household involvement in programs and organizations is influencing household-level adoption of land management technologies. If community and/or household involvement in programs and organizations have an observable influence on the adoption of sustainable land management technologies, then there is a case for providing incentives to encourage their development and sustainability. In particular, less-favored areas that have traditionally been serviced by few programs and organizations may be key areas for the promotion of organizations.

This chapter is organized as follows. The next section provides a brief historical review of the roles of programs and organizations in Uganda from the mid-1950s to the present. We then describe the study area and survey. Using survey data we characterize programs and organizations that operated in rural Uganda between 1990 and 1999. The next section provides a conceptual framework and econometric analysis of the determinants of programs and organizations and their effect on the adoption of land management technologies. We conclude with a discussion of policy implications emanating from the study.

NGOs and CBOs in Uganda: A Brief History

Organizations, including indigenous NGOs, urban associations, trade unions, and cooperative societies such as the Ugandan African Farmer's Association enjoyed relative independence under the colonial government (Mamdani 1993). However, the

newly independent government of Milton Obote was quick to impose government regulation of cooperatives (Cooperative Societies Act of 1963), and the regulation of trade unions (1970 Trade Union Act), which resulted in the formulation of a single state-run cooperative and a single trade union in the early 1960s (Hyden 1983). Although a 1973 decree restored the autonomy of unions, organizations were unable to function effectively under Idi Amin's regime.

Government programs dealing with agriculture and/or sustainable land management also failed under Obote and Amin. Agricultural research and extension services collapsed in the late 1970s (ISNAR 1988). Smallholder cash crop production was seriously affected. Food crops that could be sold in local or regional markets replaced cotton production, and coffee survived through the smuggling of produce across borders by an evolving network of private traders (Brett 1991).

Throughout the 1970s and 1980s, only a few international NGOs functioned in the country, providing disaster and relief services, and indigenous NGOs had very limited reach (Dicklitch 1998). During this time the most outspoken rural voices were churches, which, in addition to acting as human rights watchdogs, provided assistance to meet basic social needs. Churches also became increasingly involved in the provision of basic health and education services as the economic collapse of state services worsened in the early 1980s (Nabuguzi 1995).

When Musuveni took over leadership of the country in the mid-1980s, rural infrastructure was in serious disrepair (Brett 1991, 1994; Howes 1997). However, economic, social, and political change was rapid under Musuveni's National Resistance Movement. The implementation of structural adjustment programs that emphasized market rather than state delivery of services was the focus of the new government. In addition, donors, self-help organizations, NGOs, and others arrived to assist with rebuilding the country (Dicklitch 1998). Uganda's relative success with structural adjustment led to growth in real agricultural GDP of 4 percent per annum between 1987 and 1997, while real manufacturing GDP averaged 16 percent growth (Belshaw, Lawrence, and Hubbard 1999).[1]

In the late 1980s, during the first structural adjustment phase, the National Agricultural Research Organization (NARO) was formed. In addition to a strong focus on agricultural research, NARO took on the responsibility of organizing and training extension personnel to service the rural areas (ISNAR 1988). Land distribution and tenure rights were also significant issues. Throughout the Amin years the elite appropriated large tracts of land and evicted occupants without recourse, resulting in common lands and forest reserves being invaded by squatters (Brett 1991). The new government assumed responsibility for monitoring and protecting common land and protected areas as foreign NGOs, indigenous NGOs, community organizations, and cooperatives reorganized.

The current framework of decentralization is providing an enabling enviroment for NGO activities. The National Agricultural Advisory Service (NAADS) is an example of one of the five central initiatives of the PMA that is relying on NGOs to provide demand-driven fee-for-service extension services to smallholders until the provision of services can be fully privatized. Proposed requirements to align government policy with NGO mandates will make the transition to fee-for-service extension smoother but may also limit the previously independent scope of NGOs focused on natural resource management.

Community-based organizations (CBOs) are much less formally organized in Uganda and generally grow out of an identified need within the community. CBOs are not registered unless their activities go beyond the needs and services of the immediate community. Because of the absence of a registration system or any formal requirements at the district level to document their presence, information on CBOs is scarce, and their numbers are difficult to estimate. CBOs have the potential to reach policy makers by communicating their message through the established local council (LC) system or by directly lobbying their member of parliament.

Research Method

We investigate the presence and roles of programs and organizations and their influence on the adoption of sustainable land management technologies using data collected from a series of surveys (community, village, and household level), conducted between 1999 and 2001. Community-level characterization of programs and organizations is based on a survey of 107 LC1s (local councils comprised of one or a few villages), and villages from throughout most of Uganda conducted in 1999–2000.[2] A random sample of LC1s was stratified by agricultural potential, market access, and population density.[3]

Agricultural potential classification was based on average length of growing period, average rainfall, maximum annual temperature, and altitude (Ruecker et al. 2003). Six zones were identified: the low- and medium-potential unimodal-rainfall areas at moderate elevations (much of northeastern Uganda and parts of northern and eastern Uganda), the low-potential bimodal-rainfall area at moderate elevations (lower-elevation parts of southwestern Uganda), the medium-potential bimodal-rainfall area at moderate elevation (most of central and parts of western Uganda), the high-potential bimodal-rainfall areas (Lake Victoria crescent), the high-potential bimodal-rainfall areas of the southwest highlands, and the high-potential eastern highlands (see Figure 7.1, in color insert). Market access was classified using the measure of potential market integration estimated by Wood et al. (1999), which is a measure of travel time from any location to the nearest five towns or cities, weighted by the population of the towns or cities. Areas with high market access

include most of the Lake Victoria region, the southwest and eastern highlands, and parts of the north and west that are close to major roads or towns (Sserunkuuma, Pender, and Nkonya 2001) (see Figure 7.2). Population density was classified on the basis of parish-level rural population density in 1991, where more than 100 persons per square kilometer was classified as a high-population-density parish (Sserunkuuma, Pender, and Nkonya 2001). Both highland (elevation greater than 1,500 meters above sea level) and lowland sites are represented in the sample.

One village was randomly selected from within each LC1. Respondents were groups of approximately 8 to 15 LC1 or village members selected to represent different ages, occupations, and genders. Data on programs and organizations encompassed all programs and organizations present at the LC1 level and below.

Household surveys were conducted during 2000–01 with four or five randomly selected households from within each LC1. The household head as well as other members of the household actively engaged in household decisionmaking were interviewed. Data on household-level involvement with all types of programs and organizations were collected. Information on sustainable land management technologies used by the household was also collected in this survey. We have a sample size of 451 households.

Characterizing Programs and Organizations in Rural Uganda

Types of programs and organizations. Programs are characterized as institutions associated with the government of Uganda. Programs are unique in their ability to evoke the authority of the state to levy taxes and prohibit certain behaviors by implementing and enforcing laws (Uphoff 1993). We divided organizations into two categories. Community-based organizations are those that evolve and are administered, financed, and managed at the local level. Community-based organizations are not registered with the government. Nongovernmental organizations include both international and indigenous organizations established to provide services to communities or districts. They are autonomous and are required to conform to the government's regulatory requirements regarding registration and reporting.

We examined community-level presence of programs and organizations between 1990 and 1999, focusing on the number of each type of program or organization present in each community. We also considered household-level involvement in programs and organizations, where household involvement was defined as any member of the household participating in the program or organization between 1990 and 2000 (Table 11.1). At the community level, NGOs were the most common type of organization, with an average of almost one NGO per LC1. The bimodal high- and low-rainfall zones had the highest average number of NGOs present per LC1. These areas, including the Lake Victoria crescent and the southwest cattle

Table 11.1 Average number of programs and organizations per LC1, 1990–1999, and household involvement in programs and organizations, 1990–2000

		Agricultural potential						Market access		Population density	
Program or organization	Average	Unimodal	Bimodal low	Bimodal medium	Bimodal high	Southwest highlands	Eastern highlands	Low	High	Low	High
Community presence (n =107)											
Number of programs or organizations per community											
Government program	0.64	0.74	0.36	0.39	1.10	0.17	0.30	0.58	0.66	0.60	0.66
	(0.11)	(0.17)	(0.15)	(0.11)	(0.32)	(0.10)	(0.22)	(0.11)	(0.15)	(0.11)	(0.16)
NGO	0.99	1.10	1.41	0.50	1.44	0.79	0.55	0.64	1.13	0.78	1.10
	(0.11)	(0.40)	(0.37)	(0.14)	(0.22)	(0.29)	(0.25)	(0.14)	(0.14)	(0.13)	(0.15)
CBO	0.62	0.07	0.85	0.33	0.52	2.13	0	0.25	0.78	0.48	0.70
	(0.08)	(0.07)	(0.36)	(0.14)	(0.15)	(0.35)		(0.12)	(0.11)	(0.14)	(0.12)
Household involvement (n = 451)											
Percentage of households											
Government program	0.71	0	0	0	1.2	1.7	0	0	1.0	6.9	18.5
	(0.41)				(0.1)	(1.7)			(1.0)	(2.7)	(3.5)
NGO	14.9	20.3	3.4	6.2	21.1	3.1	17.0	8.8	17.0	76.9	84.0
	(2.6)	(9.5)	(3.4)	(2.4)	(4.6)	(1.9)	(9.7)	(2.9)	(3.3)	(3.1)	(2.9)
CBO	81.8	74.2	75.1	76.1	86.2	96.6	2.5	70.7	85.7	6.9	18.5
	(2.2)	(9.6)	(6.7)	(4.0)	(3.1)	(2.4)	(11.0)	(4.2)	(2.6)	(2.7)	(3.5)

Note: Means and errors are corrected for sampling stratification and sampling weights. Values in parentheses represent standard errors.

corridor, have good access to roads and markets, which may influence why NGOs operate in these regions. The lowest average numbers of NGOs per LC1 were found in the medium-potential bimodal-rainfall and eastern highland zones.

The average number of government programs and community-based organizations present in sample communities was approximately equal. The highest average number of government programs was found in the bimodal high-potential areas, which are close to the urban areas of Kampala and Jinja. The unimodal areas in the north and east had the second highest number of government organizations. Conversely, the southwest and eastern highlands had very few government programs. Community-based organizations were most common in the southwestern highlands, in sharp contrast to the eastern highlands and low-potential unimodal areas, where there were no or few CBOs.

We found higher numbers of NGOs in areas with good market access and in areas with high population density. The number of government programs did not vary significantly across low- and high-market-access areas or areas of low and high population density. Like NGOs, community-based organizations were more common in areas with good market access and high population densities. Households reported being primarily involved in NGOs and CBOs. Low reported levels of involvement in government programs might result from the fact that most government programs are infrastructure related. Though these programs may have required labor inputs from households, the households themselves were unlikely to perceive this as "involvement" in the program.

Approximately 15 percent of households reported having at least one member involved in a nongovernment organization at some time between 1990 and 2000. These organizations include both externally organized (for example, CARE, African Highlands Initiative, World Vision) and locally organized groups that were registered as NGOs. The unimodal and bimodal highland areas had the highest levels of household involvement in NGOs with approximately 20 percent of households reporting involvement by at least one household member. The eastern highlands also had a relatively high level of involvement in NGOs, which contrasts with very low levels of involvement in community-based organizations in this region. Over 80 percent of households in our sample were involved in CBOs between 1990 and 2000, with almost all households in the southwestern highlands being involved in a CBO. The proportion of households involved in NGOs and CBOs was higher in more densely populated areas and areas with good market access. These findings are consistent with community-level data on the presence of programs and organizations.

The general picture of organizational presence in the sample communities is that government programs, NGOs, and CBOs were well represented in the bimodal

high-potential areas close to urban centers. Government programs, NGOs, and CBOS were poorly represented in the highland regions with the exception of CBOs in the southwestern highlands. The absence of significant differences in the presence of government programs between high- and low-market-access areas or areas of varying population density indicates that government programs were relatively unbiased with respect to investment in less-favored areas. Higher average numbers of NGOs in areas with good market access and high population densities may result from the lower transactions costs of operating in these areas and contacting potential participants, higher potential economic returns to organizational activities, and the potential for influencing a greater number of people. Our finding that CBOs were more common in areas with good market access may be explained by better access to information about how to organize and the potential benefits of organization, as well as ease of organizing when community members are located closer together.

Main focus of programs and organizations. Programs and organizations in rural Uganda operate in a wide variety of sectors. We consider both the proximate and underlying causes of land degradation to categorize programs and organizations and to identify their potential relationships to sustainable land management. The proximate causes of land degradation include natural factors such as soil type and climate fluctuation and unsustainable farming practices such as decreased fallow periods and the cultivation of fragile lands. We hypothesize that programs and organizations focused on agriculture or environment related topics such as tree planting or the distribution of agricultural inputs are likely to have a direct effect on the adoption of land management technologies (Table 11.2). Programs and organizations also focus on issues such as population pressure, poverty, lack of infrastructure and services, lack of access to credit, and the provision of social services. Though the goal of these types of programs and organizations is not to address the issue of land degradation, they may have an indirect effect on the adoption of land management technologies.

In approximately half of the LC1s in our survey at least one program or organization focused on agriculture- or environment-related issues during the 1990s (Table 11.3). Agriculture and environment programs and organizations were most common in the high-potential bimodal-rainfall areas. Surprisingly, there were very low numbers of these programs and organizations in the highland areas where land degradation is a particularly serious problem, and in the medium-potential bimodal-rainfall areas. Approximately 30 percent of the households in our survey reported involvement in an agriculture- or environment-focused organization. Above-average levels of involvement were found in the unimodal-rainfall areas (42 percent) and in

Table 11.2 Main focus of programs and organizations in relation to the proximate and underlying causes of land degradation

Cause of land degradation	Description of cause	Relationship to land management	Main focus of programs or organizations (activities)
Proximate causes of land degradation			
Natural factors	Soil type and climate variability	Direct	Agriculture and veterinary services/extension (training and sensitization, supply of inputs, stocking and restocking livestock, credit for input purchase, promoting adoption of new technologies, marketing of agroproducts)
Unsustainable farming practices	Decreased fallows and cultivation of fragile lands	Direct	Environment (afforestation, promoting soil and water conservation, energy conservation and research)
Underlying causes of land degradation			
Population pressure	Increased land pressure as a result of decreased fallows and partitioning of farmland, increased food demand	Indirect	Women's empowerment and emancipation (increase household decisionmaking power and community participation) Health (sex education and family planning)
Lack of infrastructure and services	Poor infrastructure can slow price signals and reduce access to agricultural inputs Lack of adequate education, health, water services, and so on can reduce labor productivity	Indirect	Education (construction and maintenance of schools, provision of scholastic materials) Health (construction and maintenance of health facilities, provision of medical supplies and pharmaceuticals) Water and sanitation (improved access to water for drinking and irrigation) General infrastructure (investment in roads)
Lack of credit	Providing credit may affect the use or adoption of inputs and sustainable land management technologies	Indirect	Credit
Poverty	May lead to short-term planning horizons that inhibit households from investing in land management	Indirect	Income generation (job training, entrepreneurial skills) Poverty eradication Social development Social assistance to the disadvantaged
Lack of community services	Generally meet short- to medium-term community needs for assistance	Very indirect	Mutual support Funeral arrangements Youth programs

Table 11.3 Average number of programs and organizations per LC1, 1990–1999, and household involvement in programs and organizations, 1990–2000, by sector

		Agricultural potential						Market access		Population density	
Main focus of program or organization	Average	Unimodal	Bimodal low	Bimodal medium	Bimodal high	Southwest highlands	Eastern highlands	Low	High	Low	High
Community presence (n =107)											
Number of programs or organizations per community											
Agriculture/environment	0.44	0.32	0.57	0.14	0.87	0.13	0.25	0.17	0.55	0.26	0.53
	(0.07)	(0.19)	0.23)	(0.06)	(0.19)	(0.10)	(0.21)	(0.10)	(0.10)	(0.10)	(0.10)
Population	0.09	0.15	0.08	0	0.17	0.09	0.25	0.02	0.13	0.05	0.12
	(0.03)	(0.08)	(0.08)	N/A	(0.08)	(0.09)	(0.21)	(0.02)	(0.05)	(0.03)	(0.05)
Infrastructure and services	0.74	0.74	0.76	0.76	0.58	0.52	0.61	0.77	0.71	0.67	0.75
	(0.10)	(0.10)	(0.33)	(0.25)	(0.17)	(0.22)	(0.29)	(0.18)	(0.11)	(0.16)	(0.12)
Credit	0.08	0.07	0.07	0	0.18	0.09	0	0.03	0.11	0.07	0.09
	(0.04)	(0.07)	(0.07)	N/A	(0.11)	(0.09)	N/A	(0.02)	(0.06)	(0.04)	(0.06)
Poverty	0.76	0.68	0.97	0.49	0.82	1.35	0.09	0.51	0.86	0.74	0.76
	(0.12)	(0.27)	(0.33)	(0.19)	(0.26)	(0.3)	(0.05)	(0.19)	(0.15)	(0.18)	(0.15)
Community service	0.18	0	0.17	0.04	0.12	0.91	0	0.04	0.25	0.08	0.24
	(0.03)	N/A	(0.13)	(0.04)	(0.07)	(0.14)	N/A	(0.03)	(0.05)	(0.04)	(0.05)

Household involvement (n = 451)											
Percentage of households											
Agriculture/environment	29.8	41.5	11.0	23.1	34.2	25.0	27.4	19.7	33.4	26.6	31.3
	(3.4)	(9.6)	(6.5)	(4.8)	(6.2)	(6.3)	(10.7)	(4.5)	(4.3)	(3.6)	(4.7)
Population	0	0	0	0	0	0	0	0	0	0	0
Infrastructure and services	14.9	28.9	8.9	12.1	12.0	23.9	13.6	12.2	15.9	11.3	16.6
	(2.3)	(10.1)	(4.4)	(3.8)	(3.4)	(5.8)	(9.0)	(3.9)	(2.8)	(3.7)	(2.9)
Credit	41.8	32.3	62.3	34.4	37.9	82.1	22.6	35.9	43.9	41.2	42.1
	(3.1)	(5.8)	(8.0)	(4.9)	(5.7)	(5.3)	(11.3)	(5.0)	(3.7)	(4.9)	(3.8)
Poverty	14.0	9.9	13.6	11.6	13.5	23.5	27.6	10.8	15.2	12.5	14.7
	(2.6)	(5.0)	(7.0)	(3.8)	(4.6)	(7.3)	(11.3)	(3.7)	(3.2)	(4.1)	(3.2)
Community service	48.6	27.7	49.1	34.4	56.2	83.4	23.4	42.5	50.8	38.1	53.4
	(2.8)	(9.6)	(9.1)	(5.0)	(4.3)	(6.1)	(9.9)	(5.3)	(3.2)	(4.8)	(3.4)
Labor exchange	12.8	8.2	15.8	14.7	11.2	25.9	1.3	14.4	4.0	17.8	10.5
	(2.1)	(4.8)	(7.1)	(4.5)	(3.4)	(6.8)	(1.3)	(12.2)	(2.4)	(4.3)	(2.3)
Miscellaneous	12.2	11.1	4.7	8.7	16.5	9.6	4.2	9.5	13.2	9.9	13.3
	(2.6)	(9.1)	(4.7)	(3.6)	(4.6)	(3.4)	(3.8)	(3.4)	(3.3)	(3.4)	(3.4)

Note: Means and errors are corrected for sampling stratification and sampling weights. Values in parentheses represent standard errors.

the bimodal high-rainfall areas (34 percent). Given the relatively limited community-level presence of such organizations in the unimodal zone, household participation in the unimodal areas was higher than expected.

Of the programs and organizations focused on topics other than agriculture and the environment, community respondents cited very few with a main focus on credit or reducing population pressure. A high proportion of programs and organizations deal with infrastructure and services (including those focused on education, health, water, and general infrastructure). The highest average number of such programs and organizations was in the southwestern highlands, which may explain general improvements in health and education in this region between 1990 and 1999 (Pender et al. 2004a).

Household involvement in organizations focused on credit or community service was most common. This finding contradicts community-level data, which show such organizations to be relatively rare in many areas. It is possible that community members did not perceive locally organized credit and savings groups as "organizations" when responding to the community level survey. Alternatively, it could be that the provision of credit is the function that many households identify NGOs and CBOs with, whereas community leaders may not have identified credit as the organization's primary focus. The highest proportion of household-level involvement in community service–focused organizations was in the southwestern highlands. The bimodal high-rainfall and bimodal low-rainfall areas also had above-average household involvement in community service–focused organizations. In general, our findings with respect to household-level involvement in infrastructure and service or poverty reduction–focused organizations were consistent with community-level data on the presence of programs and organizations.[4]

Higher average numbers of agriculture and environment programs were found in LC1s with good market access or high population density. Households in areas with good market access also had higher rates of participation in agriculture- and environment-focused programs and organizations. Both poverty alleviation and community service–focused programs and organizations were more common in high-market-access areas. Household involvement in credit programs and organizations did not differ significantly with market access or population density. Approximately 50 percent of households in areas with good market access and higher population densities were involved in community service–focused organizations.[5]

Consideration of how main focus varies by type of program or organization illustrates the differing agendas of government programs, nongovernmental organizations, and community-based organizations. Table 11.4 summarizes the main focus of the government programs, NGOs, and CBOs found among the LC1s that identified programs or organizations functioning within their communities between

Table 11.4 Main focus of programs and organizations by type

Main focus of program or organization	Total (n = 249)	Program or organization (%)		
		Government	NGO	CBO
Agriculture/environment	18.5	6.7	10.8	1.0
		(1.7)	(2.4)	(0.1)
Population	4.2	0	3.2	1.0
		N/A	(1.0)	(0.1)
Infrastructure and services	31.9	12.3	17.4	2.2
		(2.0)	(3.1)	(1.2)
Credit	3.6	0	2.6	1.0
		N/A	(1.6)	(0.1)
Poverty	33.8	8.9	10.1	14.8
		(2.7)	(2.2)	(2.7)
Community service	8.2	0	0	8.2
		N/A	N/A	(1.4)
Total	~100	27.9	44.1	28.2

Note: Means and errors are corrected for sampling stratification and sampling weights. Values in parentheses represent standard errors.

1990 and 1999. Approximately 19 percent of the total number of programs and organizations are focused on the proximate causes of land degradation. NGOs account for the largest percentage of agriculture- and environment-focused programs and organizations, whereas community-based organizations make up only 1 percent of agriculture- and environment-focused organizations. Programs and organizations focused on infrastructure and poverty alleviation are most common. The highest proportion of infrastructure programs is NGOs, though government programs are also well represented. CBOs are heavily focused on poverty alleviation–related activities, though NGOs and government programs are also well represented in this category. The proportion of total programs and organizations devoted to population (e.g., family planning) and credit is relatively small (4.2 and 3.6 percent, respectively). The majority of organizations that deal with these focus areas are NGOs.

To investigate the effects of programs and organizations on farmers' adoption of land management technologies, we consider household use of inorganic fertilizer, animal manure, incorporating crop residues, mulching, and pesticides (Table 11.5). A higher proportion of households adopted pesticides when there was an agriculture- or environment-focused program or organization in the LC1. Rates of adoption of inorganic fertilizer, animal manure, and applying crop residues were only slightly lower for these communities. Having other types of programs or organizations present in the LC1 appears to have little influence on whether or not

Table 11.5 Household-level adoption of selected land management technologies, all households, households in communities with programs or organizations present, and households with involvement in organizations, 2000

Technology	All households (*n* = 446)	Agricultural/environmental program/organization in LC1 (*n* = 147)	Organization focused on indirect causes of land degradation in LC1 (*n* = 323)	Involved in agriculturally/environmentally focused organization (*n* = 112)	Involved in organization focused on indirect causes of land degradation (*n* = 318)
Applying inorganic fertilizer	10.0	9.1	7.6	17.9	10.9
	(2.0)	(3.7)	(2.2)	(5.5)	(2.6)
Applying animal manure	23.0	22.1	22.6	25.5	24.3
	(2.8)	(4.8)	(3.3)	(6.0)	(3.5)
Applying crop residue	17.6	14.3	19.0	19.4	17.8
	(2.4)	(3.6)	(2.9)	(5.9)	(5.7)
Mulching and applying organic matter	20.4	21.2	20.7	28.1	21.6
	(2.6)	(4.9)	(3.1)	(6.6)	(3.2)
Applying pesticides	23.4	29.9	21.5	25.0	26.3
	(2.9)	(5.9)	(3.4)	(5.8)	(3.6)

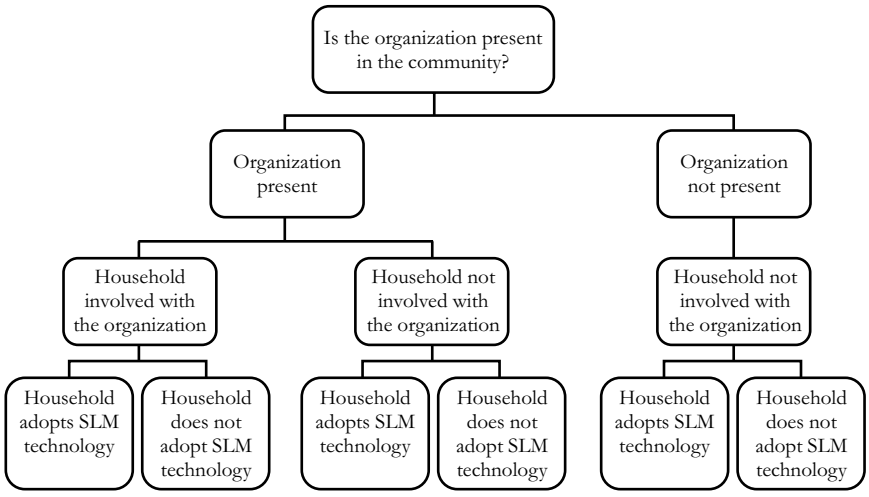
Note: Values are percentages. Means and errors are corrected for sampling stratification and sampling weights. Values in parentheses represent standard errors.

technologies are adopted. Rates of technology adoption were higher in all cases where households were involved in an agriculture- or environment-focused organization, most significantly the adoption of pesticides, mulching, and applying organic matter. Household involvement in other types of programs or organizations (i.e., infrastructure, credit, poverty alleviation, and community service) also had a positive association with the adoption of all land management technologies considered, though to a lesser extent than household involvement in agriculture- and environment-related programs and organizations. However, these associations may be related to other factors, such as differences in agricultural potential or market access, rather than to participation in these programs and organizations. The analysis in the following section further explores the potential effects of organizational presence or household-level involvement in an organization on the adoption of sustainable land management technologies, controlling for other factors.

Conceptual Framework for Econometric Analysis

We propose six possible outcomes related to the effect of a program or organization on the adoption of land management technologies (Figure 11.1). We first consider whether or not the program or organization is present in the community. Our hypothesis is that households located in communities with agriculture- or

Figure 11.1 Organizational presence and the potential for sustainable land management (SLM) technology adoption



environment-focused programs or organizations are more likely to adopt land management technologies, even if not directly involved in such organizations, as a result of knowledge spillover effects. We also expect that communities that have programs or organizations focused on credit provision, poverty reduction, and other areas that generally lead to improved incomes and welfare may be more likely to adopt land management technologies. However, this linkage will be indirect.

The second decision deals with whether or not the household participates in the program or organization. This decision is determined by the organization if they are targeting households that fit specific program criteria, as well as the household. We explore the determinants of household-level involvement in programs and organizations econometrically. As with the presence of a program or organization in a community, we hypothesize that households directly involved with an organization focused on agriculture- or environment-related issues are more likely to adopt land management technologies. We also expect that household-level involvement in organizations focused on poverty reduction, reducing population pressure, and so on may indirectly affect technology adoption. Involvement in these types of programs or organizations may lead to medium to long-run changes in the ability or willingness of smallholders to adopt land management technologies. However, these longer-term effects may be difficult to discern from the limited time period our data consider.

The third decision is whether or not the household will adopt the land management technology. We estimate a two-stage probit model to determine the effect of the presence of a program or organization in a community and household-level involvement in the program or organization on the adoption of land management technologies.

When there is no program or organization in the community, there are two possible outcomes in our model: the technology is adopted or not adopted by the household. Technology adoption could depend on interactions with government extension officers, farmer innovations, information diffusion through social networks, and so on. We control for these and other factors in our analysis. The framework we have proposed enables us to investigate the direct effects of programs and organizations on the adoption of land management technologies versus spillover or diffusion effects. Spillover or diffusion effects come into play when a program or organization has the ability to affect adoption even among households not directly working with the program or organization through diffusion of information. This is very important to investigate because the ability of technologies to be widely adopted depends largely on ease of diffusion. Some technologies are more likely to diffuse than others. For example, soil and water conservation measures such as Fanyu

ju terraces that require substantial labor investments and offer limited returns in the short to medium term are less likely to diffuse easily than low-cost, high-return technologies such as improved seeds.

Explanators of Organizational Presence

The dependent variables used in our analysis of community-level program or organizational presence were whether or not there is an agriculture- or environment-focused program or organization functioning in the community and whether or not there is another type of program or organization functioning in the community. Our analysis includes only programs and organizations that started working in communities in 1990 or later.[6] The explanatory variables in our analysis include agroclimatic zone, market access, population density, community-level indicators of welfare and wealth estimated for 1990, estimated community-level indicators of average education, and access to basic infrastructure and services in 1990.[7] By using explanatory variables based on estimates of conditions in 1990, we get a sense of the factors that have motivated programs or organizations to locate or evolve in these communities since then (Table 11.6).[8]

We have only one significant variable in our model to explain the presence of agriculture- and environment-focused programs and organizations. The finding that the coefficient of distance to a tarmac road is negative and significant is consistent with our descriptive analysis and indicates that agricultural and environment programs and organizations are associated with good market access. Because we have few significant variables, our model may be failing to capture some key explanatory variables, or these programs may not be well targeted. The model better explains the presence of programs and organizations that may influence the indirect causes of land degradation, though most of our significant variables are only weakly significant. We find that such programs and organizations are less likely to occur in the bimodal medium-rainfall and eastern highland regions. We find that programs and organizations are more likely in more populous communities and also where housing quality (measured by the proportion of people with a metal roof) is lower. We also find that these programs and organizations are more likely in communities where the proportion of school-aged children enrolled in secondary school is higher, suggesting a linkage between education and organizational development. Finally, we find that programs and organizations are more likely where access to basic infrastructure is poorer (in the case of roads) but where access to resources is better (with respect to access to fuelwood). Such programs and organizations appear to focus on less-market-connected and more-resource-abundant communities.

Table 11.6 Determinants of program or organization presence by main focus between 1990 and 1999, probit estimation

Variable	Program or organization focused on agriculture and/or the environment present in LC1	Program or organization focused on other issues present in LC1
Agricultural potential (cf. unimodal)		
Bimodal low	0.1102	0.0422
Bimodal medium	–0.2148	–0.3234*
Bimodal high	0.3085	0.2269
Southwestern highlands	0.0223	0.1655
Eastern highlands	0.1903	–0.5319*
Market access (0/1 dummy where high = 1)	0.1941	0.1937
Population density (0/1 dummy where high = 1)	0.0313	–0.1767
(ln) Households in LC1 in 1990 (number)	0.0561	0.1290*
Households without adequate food in 1990 (proportion)	–0.0023	0.0346
Households with metal roof in 1990 (proportion)	–0.0041	–0.5448*
Households where adult can read and write, 1990 (proportion)	–0.0018	–0.5253
Households with children of secondary school age in school, 1990 (proportion)	–0.0041	0.5497*
(sqrt) Distance to tarmac road in 1990 (miles)	–0.0724**	0.0593*
(sqrt) Distance to primary school in 1990 (miles)	0.0612	–0.0153
(sqrt) Distance to nearest fuelwood source in 1990 (miles)	–0.0708	–0.1588**
(sqrt) Distance to drinking water source (dry season) in 1990 (miles)	–0.0296	0.0244
(sqrt) Distance to drinking water source (rainy season) in 1990 (miles)	0.0735	0.0152
Number of observations	98	98
Mean of dependent variable	31.6	73.8
Mean predicted probability of program or organization	23.9	80.0
Pseudo-R^2	0.2863	0.2773

Note: Reported coefficients represent the effect of a unit change in explanatory variable on probability of a program or organization being present at the mean of the data. Coefficients are adjusted for sampling weights and stratification and are robust to heteroskedasticity. Intercept is not reported.

*** and ** mean coefficient statistically significant at 10 percent and 5 percent levels, respectively.**

Explanators of Household Involvement in Organizations

Household-level characteristics determine whether or not households will be involved in organizations. The dependent variables for our probit regressions include whether or not any member of the household was involved in any type of organization, any agriculture- or environment-focused organization, or any organization with a focus on topics that might influence the indirect effects of land degradation, between 1990 and 2000 (Table 11.7). Our explanatory variables include the human, social, and physical capital of the household. Indicators of human capital include the education level of the household head, whether or not the household head is female, the number of male and female members in the household, and the age of the household head. We consider religion and ethnicity of the household head as well as whether or not the household head and spouse were born in the village they currently reside in, as indicators of social capital.[9] We use estimated acres of land owned or operated by the household in 1990,[10] the number of bulls and cows or heifers owned by the household in 1990, and whether or not the household owned a radio or bicycle in 1990 as our proxies for physical capital.

We also consider whether or not the primary or secondary source of income of the household is dependent on farming or some other natural resource–based enterprise (for example, fuelwood-intensive enterprises such as brickmaking and beer brewing). We expect households with a high degree of resource dependence (i.e., those households where both the primary and secondary sources of household income are related to agriculture or natural resources) to be more involved in agriculture- or environment-focused organizations than households less dependent on natural resources for income.[11,12]

In general, social capital is an important determinant in household involvement in organizations. Households where the head is from a dominant ethnic group (e.g., Banyankore and other southwestern highland peoples), or where the head's spouse was born in the village, are more likely to be involved in programs and organizations. Human capital and gender are also an important determinant in our regressions. Female-headed households and households with higher proportions of women are more likely to be involved in programs and organizations. We also find that higher levels of education of the household head are positively and strongly associated with involvement in agriculture- or environment-related organizations. Note also that all households with education beyond "O" level participated in some kind of organization. This is a significant result, although the variable had to be dropped since it predicts participation perfectly. We find that resource dependence is positively correlated with household-level involvement in programs and organizations. However, surprisingly, this is not the case for household involvement in programs focused on agriculture and the environment.

Table 11.7 Determinants of household involvement in programs and organizations between 1990 and 2000, all households, probit estimation

Variable	Household involved in any organization	Household involved in agriculturally/environmentally focused organization	Household involved in other organization
Education level of household head (cf. none)			
Some primary or completed primary	–0.0139	0.1204	0.0168
More than primary up to O-levels	0.0019	0.3571**	0.0058
Beyond O-levels	Variable dropped[a]	0.7286***	0.1397
Female household head	0.0856	0.1280	0.1378*
(sqrt) Number of men in household	–0.0573	–0.0515	0.0026
(sqrt) Number of women in household	0.0652*	0.0916	0.0099
(ln) Age of household head	0.0408	0.0925	–0.0236
Non-Christian household head	0.1068	0.0005	0.0950
Baganda	0.1100*	0.0136	0.1180
Banyankore and southwestern highland peoples	0.1388***	–0.0231	0.1895***
Northern people (e.g., Acholi, Langi)	0.1538**	0.4183	0.1037
Iteso and Kumam	0.0676*	0.0208	0.0565
Eastern peoples (e.g., Basoga, Bagisu)	0.1636*	–0.0061	0.1474
Eastern highland peoples	0.0307	–0.1550	0.0136

Household head born in village	–0.0019	–0.0967	0.0428
Spouse born in village	0.0342*	0.0792	0.0453
Estimated acreage in 1990	–0.0007	–0.0060	0.0002
(sqrt) Number of bulls in 1990	0.0188	0.0296	–0.0224
(sqrt) Number of cows/heifers in 1990	0.0057	0.0296	0.0027
Owned radio in 1990	0.0913	0.1040	0.0549
Owned bicycle in 1990	–0.0299	0.0062	–0.0013
Only secondary source of income resource dependent, 1990 (cf. income not resource dependent)	0.1184	–0.0599	0.1867*
Only primary source of income resource dependent, 1990	0.1246**	–0.0383	0.1390***
Both primary and secondary source of income resource dependent, 1990	0.2268***	0.0103	0.2474***
Number of observations	425	445	445
Mean of dependent variable	83.0	29.9	78.8
Mean predicted probability of program or organization	85.8	27.4	80.9
Pseudo-R^2	0.1211	0.1847	0.0916

Note: Reported coefficients represent the effect of a unit change in explanatory variable on probability of a program or organization being present at the mean of the data. Coefficients are adjusted for sampling weights and stratification and are robust to heteroskedasticity. Intercept is not reported.

[a]Variable dropped: predicts success perfectly.

***, **, *** mean coefficient statistically significant at 10 percent, 5 percent, and 1 percent levels, respectively.**

Explanators of Household Adoption of Sustainable Land Management Technologies: Do Programs and Organizations Matter?

Whether or not the presence of an organization in a community and/or a household's level of involvement in an organization contributes at least in part to the adoption of new technologies has important implications for the future role that organizations will have in providing an enabling environment for sustainable land management in Uganda. In our final set of regressions, we use the adoption of selected land management technologies in 2000 as our dependent variables. We focus on five technologies that have been adopted by at least 10 percent of the households in our sample: use of inorganic fertilizer, use of animal manure as fertilizer, incorporation of crop residues, mulching, and pesticides.

Our explanatory variables include those factors that we hypothesize will directly affect the adoption of land management technologies. We use the agro-ecological potential of the LC1s in which the households are located as well as market access and population density as described in the community-level regressions. We hypothesize that the costs and returns associated with technology adoption will be a function of agroclimatic factors as well as access to markets and population density (Pender, Scherr, and Durón 2001; Chapter 2). We also consider the population growth rate in the community, hypothesizing that high rates of population growth may prompt the adoption of land management technologies to compensate for land use pressure. To provide information about household-level access to infrastructure, we include average distance from all parcels of land the household owned or operated to the nearest all-weather road and nearest market. We also consider the average distance from the household to each parcel owned or operated by the household. Travel time to plots as well as the distance bulky inputs such as animal manure need to be carried will influence whether households adopt different technologies.

We include several household-level variables to describe human, social, and physical capital. We include whether or not the household is female headed, the age of the household head, the education level of the household head, and whether or not the household head was born in the village as indicators of household-level human and social capital. We are uncertain of the effect of gender of household head on technology adoption. Female-headed households are likely to have significant constraints on their time, possibly making them unlikely to undertake labor-intensive technologies such as manure collection. We also include information on the household labor force. We hypothesize that larger households will be more likely to adopt labor-intensive land management technologies. Asset access is indicated by the estimated total area of land the household owned or operated in 2000 as well as the number of bulls and cattle the household owned in 2000 and

whether or not the household owned at least one radio or one bicycle. Households with greater wealth may be more likely to undertake land management technologies that offer medium- to long-run returns because of lower discount rates and less binding cash constraints (Pender 1996; Holden, Shiferaw, and Wik 1998; Pender and Kerr 1998). We expect households with low asset levels to undertake technologies, such as using animal manure as fertilizer, that are labor-intensive and may offer short-run returns.

Access to both informal and formal credit may be important indictors of whether or not households can obtain access to external inputs such as inorganic fertilizer, improved seed, and pesticides. We hypothesize that access to credit will have a positive effect on the adoption of technologies purchased with cash. Where access to credit is poor, the adoption of technologies that do not require the purchase of external inputs, such as use of manure or mulch, may be greater. We also consider the effect of contact with an extension worker in 2000. We hypothesize that contact with extension will be positively correlated with adoption of the various land management technologies we consider. With respect to land tenure, we expect that adoption of technologies such as tree planting that yield benefits over the medium to long term will be associated with more secure forms of land tenure such as freehold (Feder and Onchan 1987). Tenure security also may increase the value of land as collateral for credit, thus potentially increasing the adoption of technologies requiring cash inputs (Feder and Onchan 1987). As with the last set of regressions, we consider the level of dependence of the household on natural resource–related primary and secondary income sources. We hypothesize that households are more likely to undertake various sustainable land management technologies when their livelihoods are more dependent on natural resources.

Finally, we include the presence of agriculture- or environment-related programs in the community, and the presence of a program or organization focused on the indirect causes of land degradation in the LC1 as potential determinants of the adoption of various technologies.[13] We hypothesize that the presence of an agriculture- or environment-related program increases the likelihood of the household adopting various land management technologies. We also include household involvement in agriculture- or environment-focused organizations and group together those that are focused on the indirect causes of land degradation in our regressions. Similarly we expect that households involved in agriculture- or environment-related organizations are more likely to adopt sustainable land management technologies. However, household-level involvement in other types of organizations may also affect technology adoption.

Note that we do not include variables related to community-level infrastructure and poverty in 1990 from our first set of regressions. We also omit variables

pertaining to ethnicity and religion that were used in our second set of regressions. The variables that have been excluded from our two-stage probit model but that were included in our earlier models are instrumental variables used to help identify the effects of programs and organizations using predicted values to control for endogeneity of program placement and participation. Consider, for example, ethnicity: we expect that stature in the community is likely to be directly related to household-level involvement in programs and organizations. As we have already pointed out, organizations may seek out community leaders to work with, or leaders themselves may organize groups within the community. However, we do not expect social capital to directly cause the adoption of land management technologies, controlling for household participation in programs and organizations. Regression results are presented in Table 11.8.[14]

Our findings with respect to the presence of agriculture- or environment-focused programs and organizations in a community provide limited evidence that they are directly affecting household adoption of land management technologies.[15] We found a strong positive association between the adoption of pesticides and the presence of an agriculture- or environment-focused program or organization in a community. One possible explanation for this is that the knowledge spillover effects of programs and organizations may be greater for purchased inputs, yielding higher short-term benefits than for labor-intensive on-farm organic alternatives such as mulching and manuring. When we consider the effects of direct household involvement in programs and organizations, we find significant results for two of the five technologies we consider. Household involvement in agriculture–environment organizations is associated with a higher likelihood of adopting inorganic fertilizer (a purchased input) and manuring (a labor-intensive organic technology). Thus, more direct involvement in programs and organizations may be required to promote the adoption of organic land management practices.[16]

We find a positive association between household involvement in other types of organizations and the adoption of pesticides and crop residues. Household adoption of pesticide use may be facilitated by involvement in credit and community service–oriented programs and organizations. Such organizations enable poorer households to purchase inputs such as pesticides.

In general, with the exception of organizations focused on agriculture and environment, we do not have strong results linking involvement in programs and organizations to the adoption of land management technologies. However, community survey respondents perceived strong positive effects of several types of organizations on crop production, land quality, and livestock production. Additional research is needed to consider the effect of involvement in programs and organizations on crop productivity, livestock productivity, and other livelihood strategies.[17]

Table 11.8 Determinants of investment in selected land management practices, probit estimation, 2000

	Inorganic fertilizer	Pesticides	Crop residues	Mulching	Animal manure
Presence of agriculturally/environmentally focused program or organization in LC1	0.0013^{---}	0.1942***	–0.0042	–0.0186	–0.0633
Presence of program or organization focused on indirect causes of land degradation in LC1	–0.0056^{+++}	–0.0282^{++}	0.0954**	–0.0335	–0.0181
Household involvement in agriculturally/environmentally focused organization	0.0326**	0.0908^{+++}	0.0273	0.0862	–0.0982**$^{+++}$
Household involvement in organization focused on indirect causes of land degradation	0.0029	0.1314***	0.0695*	0.0742	0.0175
Agricultural potential (cf. unimodal)					
Bimodal low	–0.0144	–0.1848***$^{--}$	–0.1160**$^{--}$	0.3478**$^{++}$	0.0347
Bimodal medium	–0.0051	–0.0055	–0.1152***$^{---}$	–0.1334**$^{---}$	–0.2011***$^{---}$
Bimodal high	–0.0593***$^{--}$	–0.1693*$^{--}$	–0.2918***$^{---}$	0.0952	–0.1311*$^{--}$
Southwestern highlands	–0.0203***$^{---}$	–0.0973	–0.1264***$^{---}$	0.2027	–0.0631
Eastern highlands	0.1093^{+++}	0.1680	–0.1132**$^{---}$	0.0149	0.3269*$^{+}$
Market access (low/high)	–0.0011	–0.0749	–0.2256***$^{---}$	–0.1566**$^{---}$	0.0856
Population density (low/high)	0.0161^{+++}	0.0945*$^{+++}$	0.0703*	0.0603	0.0814
Altitude (meters above sea level)	0.0001**$^{+++}$	0.0001	0.0001	0.0001	–0.0001
Population growth rate (percent)	–0.0008	0.0035	–0.0013	–0.0033	–0.0092^{-}
(sqrt) Average distance from all parcels to all-weather road (kilometers)	–0.0050	–0.0329	0.0065	–0.0108	–0.0206
(sqrt) Average distance from all parcels to market (kilometers)	0.0079	0.0656**$^{++}$	0.0272*$^{+}$	–0.0136	0.0247
(sqrt) Average distance from all parcels to residence (kilometers)	0.0056	–0.0277	0.0198	0.0029	0.0253
Education level of household head (cf. none)					
Some primary or completed primary	0.0042	–0.3003***$^{---}$	0.0266	–0.0347	–0.2702***$^{---}$
More than primary up to O-levels	0.0414	–0.1617**$^{---}$	0.0694	–0.0058	–0.0943
Beyond O-levels	0.0915	–0.1422^{---}	0.3168**$^{++}$	0.0819	–0.0374
Female household head	0.1686***$^{++}$	–0.0806	–0.0391	–0.0881	0.0878
(ln) Age of household head	–0.0169	–0.1498^{--}	0.0378	0.0604	–0.2690***$^{--}$
Household head born in village	0.0000	0.1071**$^{++}$	0.0120	–0.0541	–0.0997**$^{--}$

(*continued*)

Table 11.8 (continued)

	Inorganic fertilizer	Pesticides	Crop residues	Mulching	Animal manure
(sqrt) Number of men in household	0.0132^{+}	0.0431	0.1336^{***+++}	–0.0027	0.1259^{***+++}
(sqrt) Number of women in household	0.0188^{**+++}	–0.0247	–0.0742^{**--}	–0.0486	0.0351
Estimated acreage in 2000	–0.0018^{**-}	0.0025	0.0007	0.0009**	–0.0059**
(sqrt) Number of bulls in 2000	0.0139^{*++}	0.0179	–0.0126	0.0898	–0.0179
(sqrt) Number of cows/heifers in 2000	–0.0022	–0.0351	0.0083	–0.0266^{++}	0.0343^{+}
Owned radio in 2000	0.0083	0.0169	–0.0062	0.0529	0.0764*
Owned bicycle in 2000	–0.0100	0.0272	–0.0178	0.0920^{**++}	–0.0337
Formal credit available in village in 2000	–0.0027	0.1738	–0.0872	–0.1522	–0.2258^{**--}
Informal credit available in village in 2000	–0.0137	0.1362	–0.0115	–0.1049	–0.2848^{***---}
Contact with extension in 2000	0.0692^{***+++}	0.1373^{**+++}	–0.0493	0.0884^{**+++}	0.1263^{**++}
Tenure status of primary parcel (cf. freehold)					
Leasehold	–0.0142^{-}	–0.1574	0.0721	0.1734	–0.0079
Mailo	–0.0007	0.0946	0.1992^{***++}	0.2037^{**++}	0.1058^{+}
Customary	–0.0324^{**--}	0.0006	0.0514	–0.0041	–0.0313
Only secondary source of income resource dependent, 1990 (cf. income not resource dependent)	–0.0138	–0.1245^{-}	0.0724	0.0499	0.0288
Only primary source of income resource dependent, 1990	–0.0065	–0.0707	0.0722	0.0994^{+}	0.0486
Both primary and secondary source of income resource dependent, 1990	–0.0314^{***--}	–0.1265*	–0.0332	0.0622	0.0162
Number of observations	445	445	445	445	445
Mean of dependent variable	10.0	23.8	17.6	20.4	23.0
Mean predicted probability of adoption	1.3	17.5	11.5	11.4	14.2
Pseudo-R^2	0.4434	0.2357	0.2492	0.3009	0.2975

Note: Reported coefficients represent the effect of a unit change in explanatory variable on probability of a program or organization being present at the mean of the data. Coefficients are adjusted for sampling weights and stratification and are robust to heteroskedasticity. Intercept is not reported.

***, **, *** mean coefficient statistically significant at 10 percent, 5 percent, and 1 percent levels, respectively; $^{+}$,$^{++}$,$^{+++}$ and $^{-}$, $^{--}$, $^{---}$ denote level of positive or negative significance when predicted probabilities of programs and organizations are used in regressions.**

With respect to the other determinants of adoption of various land management technologies, we had somewhat mixed results among our five regressions. In general, we found that households with higher numbers of male members were more likely to adopt organic technologies such as manuring and crop residues. Female-headed households and households with more women were more likely to adopt inorganic fertilizer. Households with more cattle, bulls, and bicycles were more likely to adopt some technologies (inorganic fertilizer, manuring, and mulching), which supports our hypothesis that wealthier households will be more likely to invest in land management technologies characterized by medium- to long-term returns, such as manuring and mulching. We also find that households with extension contact are more likely to adopt inorganic fertilizer, manuring, mulching, and pesticides. Education of household head and age of household head have varying effects on technology adoption. Households with older heads were less likely to use animal manure. Access to both formal and informal credit was negatively associated with adoption of animal manure in 2000. Households with resource-dependent primary and secondary income sources were less likely to use inorganic fertilizer and pesticides.

Better market access is associated with less use of some organic practices such as incorporating crop residues and mulching, possibly because of higher labor opportunity costs or higher demand for such organic materials in places of better access. Higher population density is associated with greater likelihood of using crop residues and pesticides, and smaller land area owned is also associated with more fertilizer and manure use. These findings support the Boserupian hypothesis of population-induced intensification (Boserup 1965).[18]

Conclusions and Policy Implications

Government devolution of infrastructure and services is taking place in Uganda. Of particular relevance to the Plan for the Modernization of Agriculture is the role that NGOs and CBOs will play in fulfilling roles traditionally filled by government programs. Our analysis of programs and organizations functioning at the community level indicates that during the 1990s government programs were better distributed throughout Uganda than NGOs and CBOs and that, in general, government programs focused on poorer communities. As devolution takes place, it is worth considering how these roles will be fulfilled by NGOs and CBOs. Providing incentives for NGOs and CBOs to locate in less-favored areas may ensure that these communities do not experience negative effects as a result of devolution. This is particularly important to the delivery of land management technologies to smallholders as the Government of Uganda moves toward demand-driven fee-for-service

extension. The ability of communities or individual households to identify extension needs and request services will be influenced by access to information on technologies and options available to smallholders.

With respect to household-level involvement in programs and organizations, we found relatively high levels of involvement in credit and community service–oriented NGOs and CBOs. Fewer households were involved in organizations focused on agriculture and the environment. We found that female-headed households and households with high numbers of women were more likely to be involved in organizations. Strong female involvement in organizations is encouraging news, and this may have implications for the adoption of land management technologies. If women are able to influence household-level decisionmaking regarding the adoption of land management technologies, then higher proportions of women involved in organizations may have positive implications for technology adoption. Recall that female-headed households and households with higher numbers of women were more likely to use inorganic fertilizer. However, it may be the case that women prioritize education, health, and/or basic needs ahead of land management. Our data indicate that high proportions of women are involved in community service–focused organizations that generally do not deal with land management issues. Further investigation into household-level decisionmaking regarding technology adoption is required.

With respect to social capital and household involvement in organizations, we found that households where the head belonged to a dominant ethnic group were in some cases more likely to be involved in organizations (for example, Acholi and Langi in the north and Banyankore and other dominant groups in the southwestern highlands). Also, having the spouse born in the village increased the likelihood of involvement in organizations focusing on the indirect cause of land degradation. These findings indicate the importance of social capital in organizational involvement and suggest that households with weak social capital may be excluded from participation. With respect to assets, we found that households with smaller landholdings were more likely to be involved in infrastructure- or credit-focused programs and organizations and more likely to use inorganic fertilizer and manure, indicating that they are farming more intensively. Households facing tighter land constraints may be participating in organizations as a way of learning about or becoming involved in both farm and off-farm opportunities.

The results of our econometric analysis of the determinants of adoption of land management technologies indicate that the presence of an agriculture- or environment-focused program or organization at the community level had a negative effect on the adoption of animal manuring and a positive affect on the adoption

of pesticides. This suggests that spillover effects of programs and organizations may be greater for technologies that have short-term benefits and that require some degree of coordination to be most effective. For example, technologies such as pest management are most effective when a group of households with contiguous cropping fields use them (Knox, Meinzen-Dick, and Hazell 2002). Household-level involvement in an agriculture- or environment-focused organization had a positive effect on the adoption of inorganic fertilizer and manuring. Adoption of labor-intensive land management technologies such as manuring that yield longer-term benefits apparently do not spill over to nonparticipants in local programs and organizations. Thus, direct involvement of households in programs and organizations that promote such technologies may be necessary to ensure technology diffusion throughout communities.

This information may be taken as an indicator of the effectiveness or influence of agriculture- and environment-focused organizations in Uganda and should be considered in the broader context of the government devolution of services to NGOs and CBOs. Further analysis of additional technologies is required to determine whether or not agriculture- and environment-related programs are positively affecting land management in Uganda. One possible explanation for our weak results regarding the effect of these programs and organizations on the adoption of land management technologies is that smallholders may be receiving training on land management but not actually adopting the technologies. If this is the case, there is a need to evaluate the role and effectiveness of these organizations. There is evidence of limited profitability of many land management technologies in Uganda. Analysis of the productivity effects of land management technologies including the use of inorganic fertilizer, manuring, improved fallows, and others indicates limited benefits to adopting these technologies in the short run (Nkonya et al. 2004). This emphasizes the importance of identifying profitable technologies or applying technologies to more profitable crops.

Notes

1. Growth rates can be compared with real average annual rates of growth of 4 percent for agriculture and 8 percent for manufacturing in the late 1960s and early 1970s (Belshaw, Lawrence, and Hubbard 1999).

2. The original sampling frame excluded most of northern Uganda. Community-, village-, household-, and plot-level surveys have since been conducted in this region.

3. Because of security threats in the western part of the country during the time of the survey, some LC1s drawn in the random sample were dropped.

4. As with the community data, we encountered some households that reportedly had no involvement in organizations (20 percent).

5. In our sample of 107 LC1s, approximately 21 percent of communities did not report having any programs or organizations between 1990 and 1999. This finding might be a result of miscommunication during the administration of the questionnaire.

6. We use indicators of general welfare, access to infrastructure and services, and so on in 1990 as a benchmark. By examining the programs and organizations present in communities between 1990 and 1999, we are able to determine how factors in 1990 have contributed to the presence of programs and organizations.

7. We have estimated the proportion of households in the community with each of the welfare, wealth, and education indicators by adding or subtracting 10 percent for minor increases or decreases since 1990, and 25 percent for major increases or decreases since 1990 from 1999 proportions.

8. Regressions were checked for multicollinearity using variance inflation factor (VIF). The maximum VIF of any of our explanatory variables was 3.63, indicating that multicollinearity is not a serious problem in our models (Mukherjee, White, and Wuyts 1998). We take the natural log or square root of our explanatory variables when the variable is more normally distributed in this alternative functional form. Doing so generally improved the specification of our model (Mukherjee, White, and Wuyts 1998).

9. Social capital refers to features of social organization such as networks, norms, and social trust that facilitate coordination and cooperation for mutual benefit (Putnam 1995). In our model, religion and ethnicity of the household head are proxy indicators of social capital, whereas our indicators of physical and human capital are direct indicators.

10. Land owned or operated by the household in 1990 was estimated by calculating the total area of land acquired before 1990.

11. Our regressions were based on all households in our survey (not only those in communities reporting the presence of programs and organizations) because we found that households reported involvement in a wider range of organizations at the household level than was indicated in the community survey. We ran a second set of regressions including only those households with a program or organization present in their LC1 (in keeping with our conceptual framework as presented in Figure 11.1) and found similar results.

12. These regressions were also checked for multicollinearity using variance inflation factor (VIF). The maximum VIF of any of our explanatory variables was 8.83, indicating that multicollinearity is not a major problem in our models (Mukherjee, White, and Wuyts 1998).

13. To control for endogenous program and organization presence and participation, regressions were run with both actual and predicted probabilities of program or organization presence/involvement. The robustness of the results to use of predicted probabilities is reported in the results.

14. Regressions using actual and predicted values were checked for multicollinearity using variance inflation factor (VIF). The maximum VIF of any of our explanatory variables was 8.05, indicating that multicollinearity is not a major problem in our models.

15. We also considered a model that examined type of program or organization (i.e., government program, NGO, or CBO) rather than main focus of program. Of the five technologies considered, only NGO presence at the community level was found to positively influence the adoption of using animal manure on fields and was only weakly significant ($P < 0.10$).

16. We considered an alternate model specification that excluded variables indicating household involvement in various types of programs and organizations. The specification yielded similar results to those presented in Table 11.8, although the presence of an agriculture or environment program or organization at the community level was no longer significant for the regression examining explanators of household-level animal manure technology adoption. Because of the additional

information gained from including household level involvement in various types of organizations and the significance of these variables in several of our models, we have included both community presence of and household involvement in programs and organizations of various types.

17. Nkonya et al. investigate some of these impacts in Chapter 7 in this volume.

18. We considered the differential impact of programs and organizations by running a series of probit models for the lowland and highland subsamples. The presence of an agriculture- or environment-focused program or organization in the community was more likely to affect the adoption of pesticide use in lowland areas. In highland areas, the use of inorganic fertilizers and pesticides was negatively associated with the presence of other types of programs and organizations in the community. Household involvement in agriculture- or environment-focused programs and organizations was associated with adoption of pesticides in lowland areas and animal manuring in highland areas. Household involvement in other types of programs and organizations was positively associated with the adoption of pesticides and crop residues in lowland areas.