McCubbin, H., C. Joy, A. Cauble, J. Comeau, J. Patterson, and R. Needle
1980 "Family stress and coping: A decade review." Journal of Marriage and the Family 42 (November):855–71.
McCubbin, H. I., R. S. Nevin, A. E. Cauble, A. Larson, J. K. Comeau, and J. M. Patterson
1982 "Families coping with chronic illness: the case of cerebral palsy." Pp. 169–88 in H. I. McCubbin, A. E. Cauble, and J. M. Patterson (eds.), Family Stress, Coping, and Social Support. Springfield, Illinois: Charles C Thomas.
McCubbin, H., and J. Patterson with A. E. Cauble, A. Larsen, J. K. Comeau, and D. A. Skinner
1981 "Systematic assessment of family stress, resources and coping: tools for research, education, and clinical intervention." St. Paul, Minnesota: University of Minnesota, Department of Family Social Science.
Pearlin, L., and C. Schooler
1978 "The structure of coping." Journal of Health and Social Behavior 19 (1): 2–21.
Rosenblatt, P., and R. Anderson
1981 "Interaction in farm families: tension and stress." Pp. 147–65 in R. Coward and W. Smith, Jr. (eds.), The Family in Rural Society. Boulder, Colorado: Westview Press.
Rosenblatt, P. D., and L. O. Keller
1983 "Economic vulnerability and economic stress in farm couples." Family Relations 32 (October):567–73.
Rosenblatt, P., A. Nevaldine, and S. Titus
1978 "Farm families: relation of significant attributes of farming to family interaction." International Journal of Sociology of the Family 8 (January–June): 89–99.
Salamon, S., and K. K. Markan
1984 "Incorporation and the family farm." Journal of Marriage and the Family 46 (February):167–78.
Titus, S., P. Rosenblatt, and R. Anderson
1979 "Family conflict over inheritance of property." The Family Coordinator 2 (July):337–46.
Winer, J. B.
1971 Statistical Principles in Experimental Design. New York: McGraw-Hill.

Rural Sociology 50(3), 1985, pp. 377–396
Copyright © 1985 by the Rural Sociological Society

The Social Ecology of Soil Erosion in a Colombian Farming System[1]

Jacqueline A. Ashby
IFDC/CIAT, Cali, Colombia, South America

ABSTRACT New interest in environmental factors in the sociology of agriculture has stimulated the development of a "social ecology" perspective. This paper applies a socioecological perspective to soil resource degradation and the implementation of soil conservation policy in a Colombian farming system. The analysis illustrates two important themes in social ecology: how interaction between biophysical and social parameters in agriculture structures farmers' use of natural resources and the interpretation of natural resources in terms of how farmers perceive them. Analysis of the political economy of the farming system shows how biophysical and institutional factors create incentives for farmers to use destructive soil management practices, which are reflected in norms and values of land use in the farm community, and farm types or adaptive strategies for coping with this environment. The paper concludes that a socioecological perspective focuses analysis on institutional factors that cause soil erosion.

Introduction

Criticism of the environmental blind-spot in sociological research on agriculture has stimulated interest in the development of a "social ecology" perspective in the sociology of agriculture. Two important themes stand out in recent publications on this issue. First, the importance of treating environmental variables, in particular natural resources, as socioeconomic concepts that are culturally defined. A critical set of environmental indicators for the sociology of agriculture is, therefore, farmers' perceptions and valuations of environmental resources, which emanate from the goals, perceived needs, and expected benefits farmers utilize in their decision making (Bennett, 1978; Coughenour, 1984). A second major theme is the need to utilize a farming systems framework for analysis that incorporates bidirectional causality and interdependence between biophysical features of the environment and social organization for managing and exploiting environmental resources (Ashby, 1982; Dunlap and Martin, 1983; Saint and Coward, 1977). As Coughenour points out (1984:16), a systems perspective on the relationship between farmers and their environment requires attention to the political economic factors, such

[1] Contribution of the International Center for Fertilizer Development (IFDC) and the International Center for Tropical Agriculture (CIAT).

BEST AVAILABLE COPY

as government policies and markets, which structure farmers' perceptions and objectives in exploiting the natural environment for agriculture. In particular, the political economy shapes organizational and environmental "niches" occupied by different types of farms with different adaptive strategies in the use of environmental, social, and technical resources.

A sociological perspective on natural resource use for agricultural production focuses, therefore, on interaction between biophysical and institutional environments and how these parameters structure types of farm organization and corresponding valuations of environmental resources by farmers. A socioecological analysis of soil erosion requires definition of the problem of why farmers overexploit and degrade their soil resources in terms of how the political, institutional, and market forces in their environment create incentives for them to do so.

This paper applies a socioecological perspective to the analysis of soil resource degradation and the implementation of soil conservation policy in a Colombian farming system. The paper discusses how dependency relationships with the market economy at large create incentives for small farmers in the system to pursue cultural practices viewed as a major contributing factor to soil erosion by agencies concerned with local implementation of soil conservation policy. Norms and values associated with land use in the farm community relfect the disincentives structured by the political economy for farmers to adopt soil conservation as a specific objective. The sociopolitical structure of land distribution is then analyzed to show how different types of farms exist, which are associated with farmers' perceptions of soil erosion and adaptive strategies for coping with this problem.

The political economy of soil erosion

A central hypothesis for the explanation of overexploitation of soil resources in the small farm sector of third world countries is that small farmers place a higher value on the short-term benefits they can obtain from mining the land than on the benefits they could obtain in the longer run from soil conservation. These values are often seen as ultimately responsible for the failure of small farmers to adopt soil conservation recommendations and for their persistence in using other seemingly inexplicable, destructive cultural practices. For example, in Tropical America (Mexico, Central America, the Andean countries, and the Caribbean) some 40 million people or 30 percent of agricultural families currently farm on steep slopes, where 20–40 percent of annual cropping takes place, causing serious erosion problems (Posner, 1981). An alternative explanation for this behavior argues that such exploitive values towards soil resources are an adaptive response to particular ecological, technological, and social constraints faced by small farmers in low-income countries.

There are, for example, important differences between the planning horizon of the poor, small farmer and that of many recommended soil conservation techniques for the tropics. The short-term for the poor small farmer often means that he can only plan from one harvest to the next, and in extreme cases of poverty, from one operation such as crop establishment to marshalling resources for the next operation, such as weeding. The contrast between this time horizon and that required for implementing available technology for soil conservation in the tropics is best illustrated by an example. Strip contour ploughing is widely recommended in Colombia for soil conservation on steep slopes: it requires the farmer to plough only parallel strips on the contour of a hillside plot, leaving the uncultivated strips as barriers to run-off and soil erosion. Like many soil conservation techniques recommended for the tropics, this example requires the farmer to make an investment of additional capital or labor time in establishment and in maintenance (because the uncultivated strips complicate land preparation and increase weed control problems); it requires the farmer to forgo some income (from the reduction of area under cultivation when no technology for intensifying production on the cultivated strips is available); and benefits from the accumulation of soil, which otherwise would have eroded away, require several cropping seasons to compensate the farmer for his costs and forgone income. Small farmers faced with a choice between maximizing present income in the short-run or making an investment in long-run benefits from using soil conservation techniques will usually opt for maximizing present income, even though this implies potential destruction of their natural resource base in the long-run.

Several theorists argue that this choice is a forced outcome for small farmers in Latin America who are linked into dependency relationships with the world market system that intensify overpopulation and poverty, emphasizing that many of the factors that create pressures to raise present income just to meet survival needs are outside the local control of small farmers (Crouch and de Janvry, 1980; de Janvry, 1975; de Janvry and Garramon, 1977; Margolis, 1977). The complex factors that contribute to a vicious cycle of agricultural exploitation of steep slopes and accelerating soil erosion for poor farmers are summarized schematically in Figure 1, which illustrates the interdependence of biophysical factors, market and political forces, farmers' decisions about use of natural resources, and cultural practices. In this paper the term cultural practices refers to a general set of techniques used by farmers for crop production of which soil management practices (including use of fertilizer for example) are a subset. The term conservation techniques in this paper

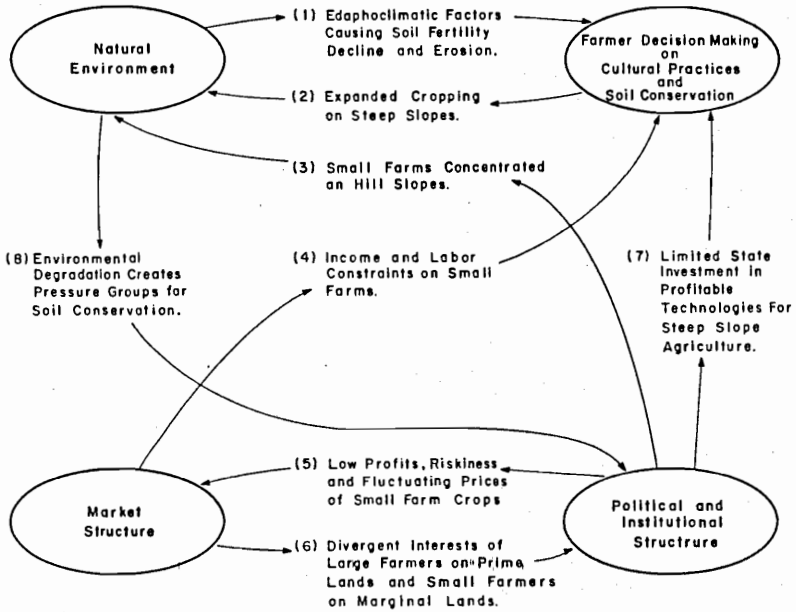

Figure 1. System relationships in the social ecology of soil erosion

refers to a different set of practices, which have soil conservation as a specific objective. Relationships between factors indicated by each of the four major headings in Figure 1 are shown with numbered arrows and a brief statement about each relationship that is of specific interest to this analysis. This section of the paper lays out the general framework of relationships shown in Figure 1, and the remainder of the paper examines these in detail in the case of a Colombian farming system.

The natural ecology of steep-sloping lands in Tropical America is vulnerable to soil erosion once the native vegetation is cleared for agricultural purposes, when edaphoclimatic factors contribute to a process of soil fertility decline under cultivation (see 1, Fig. 1). Traditional cultural practices were adapted to the mountain ecology by rotating cropping with long periods of natural fallow to restore soil fertility. However, recent increases in population pressure on the traditional land base of the small farm sector in Latin America have changed farmers' perceptions of the desirable fallow period to restore soil fertility (Brush, 1983). Farmers have adopted shorter fallow periods and more intensive cultivation of annual crops, and they have expanded cropping into steeper and more marginal slopes (see 2, Fig.

1). This trend reflects their preference for short-term benefits discussed earlier, but why farmers have this preference can only be fully understood by reference to the context of markets and sociopolitical factors illustrated in Figure 1.

The exposure of ecologically fragile lands in Latin America to high risks of soil erosion reflects the political and institutional structure of land distribution (de Janvry and Garramon 1977:211–12). Large-scale capitalist and plantation agriculture monopolizes prime lands, while small farms are limited to the least fertile and most easily destroyed lands (see 3, Fig. 1). This political and institutional structure is dominated by the interests of large-scale enterprises producing export commodities (such as sugar or coffee) or staple foods for urban consumers (such as rice, wheat or beef), which are quite distinct from the interests of small farmers (see 4, Fig. 1). It is important to emphasize that these domestic interests are dependent on the world market system, which represents a set of exogenous factors not shown in Figure 1. Such interests influence policies for farm commodity prices, agricultural input prices, farm wages, and import tariffs, which create a market structure unfavorable to small farm crops, such as cassava, beans, or potatoes (Crouch and de Janvry, 1980; Piñeiro *et al.*, 1979). As a result, such crops face dramatically fluctuating prices, have low profit margins, and are high risk (see 5, Fig. 1).

Such conditions of economic uncertainty, in particular, price fluctuations, have a major influence on conservation decisions, increasing reluctance of farmers to invest in conservation techniques (see 6, Fig. 1). The tendency for small farmers in Latin America to produce crops that face such unfavorable economic conditions is often an adaptation to labor supply conditions. The market power of the large-farm sector creates peak seasonal demand for wage labor in certain nonmechanized operations of export crops, such as cutting cane or harvesting coffee. Those small farms or *minifundia*, which cannot provide year-round employment for the family, provide seasonal wage labor to the large-farm sector producing export crops. Small farmers who cannot pay wages competitive with those in the large-farm sector must adapt their agricultural production practices to this seasonal outflow of labor, and this can be an important factor determining their choice of crops. The economic viability of small farms in Latin America depends on intensive use of unpaid family labor (de Janvry and Garramon, 1977). Small farms tend to produce labor-intensive crops, for which mechanized technology does not exist and in which capital-intensive mechanized farming cannot compete (Piñeiro *et al.*, 1979). During times of low prices, small farms tend to increase production by substituting family labor for purchased inputs (such as fertilizer), so that the intensified use of the soil leads to its further exhaustion: hence, a cycle of low prices, lower incomes, greater poverty, shorter

time horizons, and increasing soil depletion is created (Ciriacy-Wantrup, 1963:208).

The lack of technology for crops typically grown by small farmers in Latin America reflects a worldwide pattern in agricultural research priorities, which historically has been influenced by domestic and international interests in promoting export crops for trade and has been little concerned with the special technical needs of small-scale, semi-subsistence farming in the tropics (Busch and Sachs, 1981). The lack of profitable technology that helps to control soil erosion and is also adapted to the requirements of small farmers in the tropics is a special instance of this general pattern (see 7, Fig. 1). Once the lack of soil conservation technology appropriate for small farm conditions is explained in this way, it is important to note that the impetus for implementing soil conservation in steep-sloping lands of Latin America often emanates from urban and other interest groups outside small farm communities (Novoa and Posner, 1981). Such groups are affected by the silting-up of waterways, for example, or destruction of recreational facilities by deforestation and run-off, and they influence the political environment for soil conservation policy, which recommends and tries to enforce conservation techniques without necessarily referring to the needs of small farmers who are expected to adopt them (see 8, Fig. 1). The following analysis of the relationships shown in Figure 1 for a Colombian farming system illustrates in detail the linkages between the wider environment of market and socio-political forces and local farmers' decisions about the use of soil resources.

Data collection

A random sample of 102 farmers were interviewed in a farming system covering the area of Pescador and Mondomo, Cauca Department, Colombia, in 1980–1981. Survey interviews concerned crop production practices in the agricultural year prior to interviewing, with emphasis on soil management and fertilizer use, land tenure, family composition, and labor use. Key informant interviews were also conducted with a subsample of 40 farmers on their local soil classification terms and on detailed plot histories, costs of production in major crops, and land tenure arrangements.

The political economy of the farming system

The study area is a watershed in Cauca Department, which is between the central and western ranges of the Andes in South Colombia. Altitude ranges between 1,400–1,600 masl., with average annual temperatures of 17°C to 24°C. Several features of the natural environment make the natural ecology vulnerable to soil erosion (see 1, Fig. 1).

Annual rainfall averages 1,750 mm, characterized by periods of intensive rainfall (maximum 70 mm daily). Experimental data show a cumulative run-off of up to 40 tons/ha of soil over a 10-month period with traditional cultivation practices in the study area (Howeler, 1985). Almost half of the study area has slopes above 50 percent, which are considered suitable only for reforestation by local soil conservation agencies. The pattern of land use in the farming system is an adaption to local soil and climatic conditions, but the crop mix also reflects broad trends in the Colombian national economy. Many of the crops, beans, maize, and *panela* cane (for crude sugar), are typically grown by small farms (Kalmanovitz, 1974). Soils are infertile, and only 17 percent of the farm area is in permanent tree crops, mainly coffee, but soils are marginal for coffee production (FEDECAFE, 1978). Annual cropping takes place on 25 percent of the farm area, and of this, 19 percent is cultivated to cassava, typically grown on the most marginal, infertile soils on steep slopes (see 2, Fig. 1).

The practice of fallowing land to recuperate soil fertility is a key feature of cassava cultivation, and 57 percent of the farm area in the sample is left in secondary brush, scrub pasture, or remnants of woodland for this purpose. The practice of fallow land rotation involves cutting and burning off trees and brush from the plot; land is prepared by ox ploughing, or it is done manually with the pick and spade, and exposed to the rains for two or three months until crop cover is established; two successive crops are normally planted, and the plot is left again with the soil exposed until natural vegetation is re-established.

The settlement of Pescador and Mondomo by a mixed Indian and *mestizo* population of small farmers dates back for the past two centuries to the piecemeal sale of lands from the Indian reserves on the boundary of the farming system in the upper reaches of the western Andes. The small farms on these mountain lands are sandwiched between fertile valleys to the north and south, which have been colonized by extensive cattle ranches and sugar cane plantations (see 3, Fig. 1). Before the Second World War, cattle ranching was an important activity in the study area on communal pastures, but it has since been enclosed as local population increased. With the enclosure of grazing lands, livestock as a major farm enterprise in the area is restricted to a few large farms. Farms in the sample average 9 ha in size, and 41 percent are less than 5 ha (considered the minimum family farm size for Colombia).

Although the small farm sector in Colombia produces nearly 60 percent of domestically consumed agricultural products, rates of growth in production of small farm crops, excepting coffee, have been stagnant over the past decade (Crouch and de Janvry, 1980; Kalmanovitz, 1974; Sepúlveda and Conklin, 1979). Local production

BEST AVAILABLE COPY

of sugar cane in the farming system reflects this trend. Competition from sugar factories based on the fertile valley plantations to the north and a slump in world sugar prices drove many small-scale, animal-powered sugar mills in the farming system out of business. Beans and maize, traditionally grown as subsistence crops, could not provide economic alternatives. Technical assistance or credit were not offered in the study area for these crops, which face high risks from susceptibility to disease and from seasonal price fluctuations (see 5, Fig. 1).

Coffee production in the farming system has been affected by the international coffee "bonanza." The Brazilian frosts of 1975 meant that Colombian domestic coffee prices tripled between 1975–1977, and coffee plantations expanded into marginal coffee zones such as the study area. Of the sample farmers, 42 percent reported that they had expanded their coffee area between 1975–1980.

However, the ability of small farmers in the study area to take advantage of the coffee bonanza and to expand their coffee plantations has been limited by a seasonal scarcity of labor for the coffee harvest. Local farmers must compete for the available labor force with large commercial coffee plantations, which bid up wage rates during the coffee harvest. Local labor also migrates seasonally to the prime coffee producing regions to the north for the coffee harvest, where wages are higher than local farmers can afford. Between 1975–1978, wages for coffee labor rose above those paid to urban workers in Colombia (DANE, 1979). As seasonal labor scarcity rose due to these three factors, the profitability of local coffee production declined.

The growing importance of cassava cultivation in the farming system is a response to natural environmental processes of soil fertility decline, consequent on the historical intensification of cropping as population increased in the study area and also to market forces, which made cassava an increasingly attractive alternative to other crops, such as coffee, sugar cane, beans, or maize (see 6, Fig. 1). Slash-and-burn cultivators in this farming system report that they used to leave plots fallow for ten-to-fifteen years and then take two or three successive crops on the plot. Current yields in all crops are lower; there is less fallow land available because of partition of farms among heirs, and most farmers now aim for a three-to-five year fallow between crops on a given plot. As a result, many farmers say that beans or maize will not grow on the poorer soils, which are suitable only for cassava. Traditional sweet cassava varieties also have declined in productivity, but they have been displaced over the past fifteen years by a bitter variety, which yields well on poor soils. Cultivation of cassava tends to exacerbate soil fertility decline because the plant is extremely well adapted to poor soils, i.e., it is efficient at extracting scarce essential nutrients from the soil. Cassava yields improve when

soil is well prepared and with frequent weedings, while the plant is slow to establish a canopy over the soil surface, thus increasing risks of soil erosion when cultivated on steep slopes (CIAT, 1982). The relationship between edaphoclimatic factors, which contribute to soil fertility decline, and the cultivation of cassava in the farming system is an instance of positive feedback relationship (see 1 and 2, Fig. 1), where one factor reinforces the other over time.

This relationship in itself encouraged the expansion of cassava cultivation in the farming system, thus increasing soil erosion. In addition, market factors created a local cassava "bonanza," which made cassava especially attractive to small farmers. Whereas sweet cassava was traditionally a subsistence crop, bitter cassava became a cash crop with a locally expanding market. The availability of ground water of a suitable quality for cassava starch extraction made Pescador and Mondomo into growth centers of rural industrial starch production. Cassava starch is extracted and fermented in rustic *rallanderías* or starch factories, often operated by local cassava farmers, and sold to middlemen who in turn sell to urban factories producing breads, snack foods, and glue. Demand for cassava from local *rallanderías* has grown beyond the extent that local farmers can produce and middlemen import fresh cassava roots for processing in the region from elsewhere. A second feature, which made cassava especially attractive to small farmers unable to compete for costly labor at peak seasons of labor demand during the coffee harvest, is the character of cassava's labor requirements. Cassava production in Colombia has not been mechanized, so it is labor-intensive and unattractive to large-scale enterprises hiring in labor. Although labor intensive, cassava can be planted at any time of year; weeding times are flexible, and the crop can remain in the ground for months awaiting harvest. As a result, unpaid family labor is used extensively for all cassava operations in the farming system. Hence, the cash-income earning potential of cassava due to demand from outside markets and its adaptability to local labor supply conditions encouraged farmers to expand cassava production (see 2 and 4, Fig. 1).

In summary, several features of interdependency between the local farming system and the market economy at large structured a sequence of developments reinforcing the positive feedback relationship between soil erosion and the adaptation of cassava to poor soils. First, the coffee "bonanza" encouraged out-migration of local labor attracted by higher wages outside the region, exacerbating seasonal labor shortages and making cassava a more attractive enterprise than coffee locally. Second, the markets and technology for alternative crops to cassava, such as sugar cane or beans, involved lower profitability and higher risk on poor soils. Third, cassava production was stimulated by the growth of industrial demand for cassava starch from urban markets.

Political and institutional factors in the cropping system

This section of the paper examines relationships between the political and institutional structure, the policy environment for soil conservation in the study area, and the interests of influential groups outside the local community (see 6, 7, and 8 in Fig. 1). Policy for land use and soil conservation in the study area is coordinated and implemented by three agencies: the Federación Nacional de Cafeteros (FEDECAFE), the Cauca Valley Corporation (CVC), and the Instituto Colombo Agropecuario (ICA), which is part of the Ministry of Agriculture. Their joint policy for soil conservation in the study area emphasizes restricting the traditional methods of cultivation used by local farmers to expand cassava cultivation. Instead, cultivation of cassava only on slopes below 20 percent, utilizing strip contour ploughing with live barriers of pasture grass, is recommended. Technical assistance for vegetable crops and fruits is intended to encourage farmers to abandon cultivation of steep slopes in favor of low-lying areas suitable for horticulture.

FEDECAFE is an autonomous association of coffee producers, extensively involved in the worldwide marketing of Colombia's coffee and in technical assistance and credit for its members. A key concern of FEDECAFE has been to regulate the supply of coffee to avoid market saturation after the coffee "bonanza" in 1975–1977. Detailed soil and land use studies, undertaken by FEDECAFE to restrict coffee cultivation in marginal areas, found the study area to be unsuitable for high yielding monoculture coffee. Consequently, FEDECAFE instituted a policy of curtailing technical assistance in the area to discourage coffee production (FEDECAFE, 1978).

The CVC has a mandate to manage soil and water resources in the Cauca river basin, which includes the study area and the fertile agricultural valley of large-scale sugar plantations and urban communities downstream. The CVC is a major generator of hydroelectric power; it supplies irrigation water and undertakes flood control projects, which are of main importance to the valley farmers and urban communities. In order to perform these services, the CVC defined a policy of discouraging cassava production in the study area, which was associated with problems of deforestation (to clear new land), erosion, and silting up of waterways downstream. Farmers are required to obtain CVC permits to clear land or to cut down trees in the study area. Fines are levied for burning or clearing of noncultivated land without the CVC permit.

ICA's policy is to make technical assistance and credit available, conditional on the use by farmers of CVC guidelines for soil conservation techniques in cassava cultivation, such as strip contour ploughing. However, cassava is a crop of minor importance in ICA's national research program and scarce resources meant that a comprehensive agronomic and economic evaluation of these guidelines had not been conducted for local cassava production at the time of this study. The technology, credit, and extension assistance for alternative crops to cassava, such as beans, for example, were not included in ICA's program for the local farming system.

The effectiveness of the local ICA office's credit program for farmers owning less than 20 ha was judged in the organization by the number of clients receiving credit and technical assistance via the technical production plan for cassava. The result was a disjunction between policy implementation measures of the different organizations involved in the area as ICA's credit administration became linked to the local boom in cassava production. In practice, it proved impossible for ICA to enforce controls on exploitation of marginal steep slopes by refusing credit because of the lack of improved cassava production technology as an alternative to traditional slash and burn methods.

In summary, it can be seen that soil conservation policy for the study area is molded by interest groups outside the local farming community, which aim to restrict cassava cultivation. FEDECAFE is concerned with protecting all coffee producers from the implications of overproduction. This need gives particular weight in FEDECAFE policy to coffee producers on prime land in other regions, who account for the majority of coffee produced, and to the taxes which finance FEDECAFE's budget (see 6, Fig. 1). CVC aims to control slash and burn cultivation in the study area and prevent silting-up of waterways serving significant urban and agricultural client groups in the valley downstream (see 8, Fig. 1). In ICA, the regional importance of cassava for the study area is not matched in national agricultural research priorities. As a result, the limited resources allocated by ICA to research on locally adapted technology did not identify profitable soil conservation techniques compatible with needs of small farmers (see 7, Fig. 1).

This institutional environment contributed to a situation in which recommended soil conservation techniques failed to provide viable alternatives to traditional soil management practices. The next section of the paper examines farmers' decision making about cultural practices in the farming system to show in detail why farmers continue to use practices that conflict with the adoption of soil conservation objectives.

Norms and the socioeconomic structure of land use in the farming community

Farmers' decisions about management of soils involve subjective perceptions of the value or fertility of different types of soil and of the

ecological processes that affect soil fertility. Field research involved extensive conversations with farmers about their local soil classification terms. Farmers distinguished basically three types of soil: black soils (*tierra negra*), red soils (*tierra colorada*), and "mixed" soils (*tierra mezclada*). Black soils have a surface layer of top soil originating from a deposit of volcanic ash and are high in organic matter. Typically, black soils were equated by farmers with fertile soils that had been left fallow for at least 10–20 years. Red soils are eroded soils from which the black A horizon has disappeared, leaving only the parent matter of red clay of balsatic origin. Farmers subdivided red soils into types differentiated by soil texture, vegetation, and length of fallow. One type was described as the best soil for the newly introduced variety of bitter cassava grown in the area for industrial starch production. The third category of "mixed" red and black soil was associated with run-off (*lavado*) and a vanishing black top soil by farmers, but nonetheless it was seen as suitable for cultivating bitter cassava varieties. The introduction by farmers of a bitter cassava variety adapted to eroded red soils in tandem with the growing demand for this variety from the local starch-processing industry meant that the erosion of black topsoil was not perceived by farmers as a production constraint.

Although clearing fallow land with traditional slash and burn practices for cultivating cassava is defined as antithetical to soil conservation by policy makers, the economic incentives for farmers to continue clearing fallow land are powerful. This is illustrated by the figures in Table 1 for a subsample of 40 cassava plots in the study area. Higher production on fallow land meant higher profits from clearing new land than from continuing to plant on previously cultivated cassava plots. Moreover, with farmers' current fertilization practices, it still remained more profitable to clear new land than to apply fertilizer on the second successive crop of cassava.

Reflecting these differences, 50 percent of cassava plots in the sample had been newly established on fallow land despite efforts of the CVC to restrict this practice. Farmers planting with credit also preferred to cultivate newly cleared plots, since this gives a higher return on variable capital than planting on previously cultivated plots.

Investment in erosion control by farmers implies a stable commitment to cultivation of a plot to capture long-run benefits of improvements. The economic incentives to rotate fallow land, with only one or two successive cassava crops discussed above, mean that farmers typically make at most a two- to three-year commitment to managing a given plot. Land tenure relationships are adapted to the rotation system in such a way that management of a plot can change hands from one cassava crop to the next, a further disincentive for farmers to invest in long-run conservation on a plot.

There are several types of land tenure arrangements and about

Table 1. Profitability of cassava on newly cleared land and farmers' previously cultivated plots, Pescador and Mondomo, 1981–1982

	Type of cassava plot		
	Newly cleared	Previously cultivated	
	Unfertilized	Unfertilized	Fertilized
Gross revenue			
Yield (kg/ha)	10,031	6,715	8,430
Price (US$/100 kg)	9.62	9.62	9.62
Value of output (U.S.$/ha)	965	646	811
Expenditure (U.S.$/ha)			
Cleaning land	113	49	49
Ploughing	116	76	76
Planting and fertilizing	91	91	127
Weeding	247	160	191
Harvesting, packing, transport	158	141	147
Fertilizers	0	0	79
Total costs	725	517	669
Net profit (U.S.$/ha)	240	129	142

half the farmers in the sample had entered into such an arrangement. A rental arrangement, which leaves all costs of operations to the tenant, is paid for in cash or kind to the value of one-third of the harvest. Sharecropping or *compañía* entails 50 percent of the crop to the landowner, who provides harvest labor for his share and may provide laborers' meals and land preparation. More informal land sharing arrangements are also formed by families or neighbors, some of whom provide cash inputs, while others provide labor and management.

Histories of the management of cassava plots show that the small farm adapts to the need to maintain a minimum viable fallow area by sharing responsibility for cultivating plots among family members. Not only does cropping shift from plot to plot in the land rotation system, but so may the responsibility for managing the plot shift from person to person within a family. There are several advantages to this intra-family land sharing. The opportunity cost of leaving some land fallow can be shared when plots brought into cultivation are also worked collectively. Some adults work off farm, leaving management of their shares in the holding to family members at home, while they contribute cash for purchased inputs. In other cases, fathers or other senior relatives "loan" plots for one cropping season to young men or women who use a proportion of the crop value to pay for their schooling or other household expenses in return. This is an important means of binding young men to the farm economy who might otherwise migrate permanently to the city.

Table 2. Profitability of sharecropping cassava on newly cleared and previously cultivated plots, Pescador and Mondomo, 1982

	Type of cassava plot	
	Newly cleared plot	Previously cultivated
Sharecroppers' share of	U.S.$/ha	U.S.$/ha
Expenditure		
Clearing land	56.50	24.50
Ploughing	0	0
Planting	45.50	45.50
Weeding	123.50	80.00
Harvesting	79.00	70.50
Total costs	304.50	220.50
Gross revenue	482.50	323.50
Net profit	178.00	102.50

There are different types of landowners renting out land. One group not included in the sample are absentee landowners: a number are elderly couples or widows who have migrated elsewhere to join their children but have not yet sold their land; some are "weekend farmers," city dwellers with small farms for recreation; a few own cattle ranches and rent out degraded pastures for clearing and planting by tenants. Most of the land rented by farmers in the sample is in the form of sharecropping or the family agreements described above.

One advantage of sharecropping land out for small farmers is that the landowner's cash investment in the crop is minimal and short-term since it occurs mainly at harvest time. The *compañía* relationship can serve as a means of paying off a debt or making a "loan" without requiring a cash outlay from the landowner.

Renting and sharecropping are generally perceived by local farmers as a strategy for obtaining access to well-tested fallow land: 76 percent of the tenants or sharecroppers in the sample owned land that they left fallow while they cultivated someone else's land. Apart from the wish to leave land that they own in fallow to recuperate its fertility, the profitability of planting newly cleared plots provides farmers with an incentive to rent or sharecrop fallow land rather than in planting successive crops on their own land. This is illustrated by the difference between the $129/ha profit the farmer obtains from a second successive cassava planting on own land and the profit of $178/ha obtained from sharecropping fallow land, shown in Table 2. Sharecropping previously cultivated land gives a profit of only $102.50/ha, so sharecropping only appears worthwhile on newly cleared land. Sharecropping arrangements enable small farmers to spread cash investments and risk of harvest losses through time and across different locations by sharecropping a number of different plots. The expenditure per hectare carried by the sharecropper, if the landowner provides land preparation and meals for labor, may be considerably lower than that incurred in cultivating his own land alone.

In order to examine the socioeconomic structure of land use in the farming system and to determine how this relates to the norms and practices for cassava cultivation described above, types of farm enterprise were identified within the sample utilizing factor analysis. Four factors were identified, which account for 73.4 percent of the variance in nine variables selected to represent the main characteristics of land allocation to different uses and types of labor use in the sample. The factors shown in Table 3 describe four types of farm enterprise in the sample, characterized by the factor loading ≥.40 shown in parentheses in Table 3.

Factor 1: The agricultural-laboring type of farm is a *minifundia* type, characterized by a high man-land ratio and high scores on an index of agricultural employment off-farm; it is associated with low use of hired labor for on-farm operations.

Factor 2: The land-extensive type of farm is characterized primarily by a high proportion of area in pastures and a livestock component; it has a low man-land ratio and a relatively low proportion of area to cassava.

Factor 3: Family cassava farms are associated with a specialization in cassava production, with a low proportion of area in coffee, and a high factor loading on the index of family labor for on-farm operations.

Factor 4: Intensive cassava farms are so termed for a high proportion of land in cassava, coupled with a high negative factor loading on the proportion of land in fallow.

Factor scores were utilized to classify each farm in the sample into one of four types, and the average farm size, man-land ratios, and proportion of land in different uses were computed for each type. These characteristics show (Table 4) how the different types of farms are adaptations to the natural environment, the market opportunities and constraints, and the institutional environment for credit and technical assistance described earlier. Agricultural-laboring farms are extremely small farms or *minifundia* with a high concentration of population on the holding; much of the land is left in fallow as a result of previous cassava cultivation, which has exhausted the soil, and little cultivable land is left. Household members are mainly engaged in providing off-farm labor year-round to other farms in the locality, because their landholding is so diminutive and unproductive that their labor or other resources cannot be better employed on-farm. Land-extensive farms give little importance to crop production, either coffee or cassava, but concentrate land in pasture. These farms

Table 3. Typology of farms from varimax rotated factor analysis

Variables	Variable description	Factor 1 Agricultural-laboring farm	2 Land-extensive livestock farm	3 Family cassava farm	4 Intensive cassava farm
Cassava	Percent of total area in cassava	−0.089	(−0.456)	(0.405)	(0.634)
Coffee	Percent of total area in coffee	0.128	−0.217	(−0.830)	0.222
Fallow	Percent of total area fallow	−0.120	−0.211	0.344	(−0.875)
Pastures	Percent of total area in natural or seeded pastures	0.015	(0.910)	0.116	0.082
Cattle	Number of cattle	−0.204	(0.726)	0.055	−0.043
Man-land ratio	Ratio of adult family members to total farm area	(0.736)	−0.347	0.057	0.226
Family labor off-farm	Index of labor operations for activities performed on other farms as hired laborers by family members	(0.813)	0.009	0.233	0.110
Hired labor on-farm	Index of labor operations for activities performed on the farm by hired labor	(−0.746)	0.001	0.190	0.376
Family labor on-farm	Index of labor operations for activities performed on the farm by family members	0.240	−0.013	(0.646)	0.068

Table 4. Characteristics of farm types

Farm type	Size of holding (ha)	Man-land ratio	Percent of area: Coffee	Cassava	Pasture	Fallow	Minor crops
Agricultural-laboring farms	2.8	2.20	33	13	1	47	6
Land-extensive farms	14.8	0.48	12	7	46	29	6
Family cassava farms	11.4	0.56	12	23	8	52	5
Intensive cassava farms	6.6	0.85	31	40	9	14	6

have a scarce supply of family labor on-farm, so cassava is not an attractive enterprise given its labor intensity.

Cassava is the most important crop enterprise for family cassava farms and intensive cassava farms. Family cassava farmers maintain a substantial reserve of fallow land in contrast to intensive cassava farmers, who as Table 5 shows, are the group most commonly engaged in renting and sharecropping land for cassava. Access to credit, also shown in Table 5, suggests that cassava farmers are an entrepreneurial group with small farms utilizing credit to cash in on the local cassava boom.

The relationship between the socioeconomic structure described by the farm typology and the incidence of soil erosion on cassava plots is shown in Table 6. All cassava plots of sample farms were classified individually by the farmer with the interviewer for the presence of landslides, gully erosion, and the three soil color categories used locally. A composite erosion score for each plot was created using these indicators of erosion, and plot scores were summed and averaged on a per plot basis for each farm type. The erosion score shown in Table 6 is a purely qualitative measure of the state of soil degradation on an average plot planted to cassava, so tests of statistical significance are not reported. Moreover, the score does not reflect differences in the area planted to cassava among farm types. However,

Table 5. Renting or sharecropping and access to credit among different farm types

Farm type	Renting or sharecropping: Percent of farmers	Percent of area	Access to credit for cassava: Percent of farmers
Agricultural-laboring farms	30.4	23.1	26.0
Land-extensive farms	4.2	7.2	12.5
Family cassava farms	28.5	16.0	46.4
Intensive cassava farms	40.7	47.9	48.1

Table 6. Incidence of erosion symptoms on cassava plots by type of farm

Farm type	Farm size	Erosion score	Percent of cassava area: Eroded top-soil	Percent of cassava area: Black top-soil
Land-extensive farms	14.8 ha	0.94	42.2	57.8
Family cassava farms	11.4 ha	1.47	74.7	25.3
Intensive cassava farms	6.6 ha	1.37	74.9	25.1
Agricultural-laboring farms	2.8 ha	2.42	74.0	26.0

Notes: Erosion score: completely eroded red clay weighted 4; land slide 3; gully erosion 2; partially eroded (*tierra mezclada*) 1; noneroded black top-soil −1.

the proportion of cassava area on black and eroded soils was also computed for each farm type. Land-extensive farms have the lowest erosion score. Operators can rotate the small proportion of their land that they plant to cassava with well-rested fallow land, which has suffered less erosion. Hence, most of the area they plant to cassava has black top-soil. Agricultural-laboring farms have cassava plots with the highest erosion score. This represents the extreme end of the cycle of planting cassava on eroded soils, which contributes to further erosion until much of the farm land is uncultivable. The degraded state of the cassava plots reflects the vicious circle of poverty mining the land and intensifying soil depletion on the *minifundia* referred to earlier in the paper. Intensive and family cassava farmers represent the intermediate stage of this trend. They are planting more eroded cassava plots than are larger farmers, but their cassava plots are less eroded than those of agricultural-laboring farmers because they either have enough land to rotate less-degraded fallow with cassava or because they are able to access better quality land through rentals or sharecropping.

Conclusions

This paper has examined the social ecology of soil erosion in a Colombian farming system. Several features of the local agrarian structure are characteristic of the small farm sector in low-income countries. Small farms located on steep-sloped land highly susceptible to soil erosion adapt to environmental processes of soil fertility decline with cultural practices that provide them with income in the short-run but which exacerbate the long-run process of soil erosion. In this case, small farmers have responded to a market structure and a political and institutional environment, which create incentives for them to expand cassava production, a crop which can be grown on eroded soils and which farmers cultivate with practices that exacerbate soil erosion, while alternative crops or soil conservation techniques are

not adapted to local conditions. Nonetheless, influential interest groups external to the local economy shape soil conservation policy that attempts to restrict cassava cultivation. Four types of farms were identified that differentiate the local class structure into land-extensive farms, agricultural-laboring farms or *minifundias*, and small commercial and family farms. Agricultural-laboring farms represent the extreme outcome of the short-run adaptive strategy, which depletes soils to the point where a significant proportion of the small farm is not worth cultivating but is left fallow, while the family works off-farm. Other types of small farms grow cassava on eroded soils because owners still have sufficient land to recuperate it under fallow rotations. They have access to land tenure and credit relations, which in themselves reinforce their preferences for short-run gains from growing cassava rather than for investing in long-run conservation objectives.

Analysis of the social ecology of soil erosion in this farming system shows that effective implementation of soil conservation depends vitally on changes in the institutional environment. Agricultural research, technical assistance, and credit administration need to be reoriented towards the development and extension of technologies adapted to small farm conditions, which create incentives in the short-run for farmers to adopt soil conservation techniques. Market development and national price policy need to consider the promotion of viable markets for small farm crops suited to steep-slope agriculture. Access to land with security of tenure would then be required for small farmers to make a long-term commitment to the future of their soils.

References

Ashby, J. A.
1982 "Technology and ecology: implications for innovation research in peasant agriculture." Rural Sociology 47 (Summer):234–50.

Bennett, J. W.
1978 "A rational-choice model of agricultural resource utilization conservation." In N. L. Gonzales (ed.), Social and Technological Management in Dry Lands. Boulder, Colorado: Westview Press.

Brush, S.
1983 "Traditional hillside farming systems." Culture and Agriculture 18:9–16.

Busch, Lawrence, and Carolyn Sachs
1981 "The agricultural sciences in the modern world system." Pp. 131–56 in Lawrence Busch (ed.), Science and Agricultural Development. Totowa, New Jersey: Allanheld Osmun.

Centro Internacional de Agricultura Tropical (CIAT)
1982 Annual Report. Palmira, Colombia: CIAT.

Ciriacy-Wantrup, C. V.
1963 Resource Conservation, Economics and Policies. Berkeley: University of California Press.

Coughenour, C. M.
1984 "Social ecology and agriculture." Rural Sociology 49 (1):1–22.
Crouch, L., and A. de Janvry
1980 "The class basis of agricultural growth." Food Policy (February):3–13.
de Janvry, A.
1975 "The political economy of rural development in Latin America: an interpretation." American Journal of Agricultural Economics 57:490–99.
de Janvry, A., and C. Garramon
1977 "The dynamics of rural poverty in Latin America." Journal of Peasant Studies 4:206–16.
Departamento Administrativo Nacional de Estadisticas (DANE)
1979 Boletín Mensual de Estadística 338 (Septiembre). Bogotá: DANE.
Dunlap, R. E., and K. E. Martin
1983 "Bringing environment into the study of agriculture: observations and suggestions regarding the sociology of agriculture." Rural Sociology 48 (2): 201–18.
Federación Nacional de Cafeteros (FEDECAFE)
1978 Estudio de Zonificación del Suelo en la Zona Cafetera del Departamento del Cauca. Bogotá: Federación Nacional de Cafeteros de Colombia.
Howeler, R.
1985 Personal communication, soil scientist. Cali, Colombia: Cassava Program, CIAT.
Kalmanovitz, S.
1974 "La agricultura en Colombia 1950–1972." Bogotá: DANE, Boletín Mensual de Estadística.
Margolis, M.
1977 "Historical perspectives on frontier agriculture as an adaptive strategy." American Ethnologist 4 (1):42–64.
Novoa, A. R., and J. L. Posner (eds.)
1981 Agricultura de Ladera en América Tropical. Turrialba, Costa Rica: CATIE.
Piñeiro, M., E. Trigo, and R. Fiorentino
1979 "Technical change in Latin American agriculture." Food Policy 4 (1): 169–77.
Posner, J. L.
1981 The Densely Populated Steep Slopes of Tropical America: Profile of a Fragile Environment. New York: Rockefeller Foundation.
Saint, W. S., and E. W. Coward, Jr.
1977 "Agriculture and behavioral science: emerging orientations." Science 197: 733–37.
Sepúlveda, S., and H. E. Conklin
1979 "The effects of modern technology on labor needed for producing crops on small farms in two integrataed rural development districts in Colombia." Ithaca, New York: Cornell International Agriculture Bulletin No. 68.

Rural Sociology 50(3), 1985, pp. 397–408
Copyright © 1985 by the Rural Sociological Society

RESEARCH NOTE

Rurality and the Residualist Social Welfare Response

Michael J. Camasso and Dan E. Moore
School of Social Work, Rutgers University, New Brunswick, New Jersey 08903
Department of Agricultural Economics and Rural Sociology,
The Pennsylvania State University, University Park, Pennsylvania 16802

ABSTRACT The paper examines the role played by values in conditioning a residualist or minimalist social welfare response in rural areas. Such values suggest that welfare services should remain subordinate to major production units of society, i.e., the family and the market, and should be used mainly as temporary or provisional measures. Previous research on the subject has been limited by a narrow definition of public welfare (e.g., public assistance, job training) and by a failure to rule out the effects of rival hypotheses. In this study, the responses of over 9,000 Pennsylvanians to a statewide needs assessment questionnaire are examined using logit analysis. An independent effect of place of residence was found to operate across the entire spectrum of social welfare institutions. Implications of the findings for ongoing theoretical development and future research agenda are discussed.

Introduction

The rural landscape has often been viewed as a juxtaposition of broad social welfare needs and scarce human service initiatives.[1] The characterization becomes especially well drawn when the social welfare needs and service resources of urban and rural areas are contrasted. While approximately 32 percent of Americans live in nonmetropolitan settings, 41 percent of our nation's poor reside there (Vinson and Jesberg, 1979). Nearly 60 percent of all substandard housing units in the United States are located in rural areas (Webster and Campbell, 1977). And while unemployment tends to be equally high in both our cities and the countryside, underemployment is a more serious problem in rural America (Margolis, 1979).

Comparisons of health needs consistently demonstrate greater unmet needs and fewer resources in nonmetropolitan places. Rural peo-

[1] Our definition of social welfare follows that of Wilensky and Lebeaux (1965:17): "Social Welfare refers to those formally organized and socially sponsored institutions, agencies, and programs, exclusive of the family and private enterprise, which function to maintain or improve economic conditions, health, or interpersonal competence of some parts or all of a population." We use the term human service in the same sense that Hasenfeld and English do (1974:1); i.e., formal organizations where the "input of raw material are human beings with specific attributes," where the "production output are persons processed or changed in a predetermined manner," and where the "mandate is that of service, that is, to maintain and improve the general well being and functioning of people."