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WHAT IS TO BE DONE ABOUT LAND REFORM PRODUCTION COOPERATIVES IN NICARAGUA? AN ECONOMETRIC EVALUATION OF INSTITUTIONAL ALTERNATIVES

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WHAT IS TO BE DONE ABOUT LAND REFORM PRODUCTION COOPERATIVES IN NICARAGUA? AN ECONOMETRIC EVALUATION OF INSTITUTIONAL ALTERNATIVES

Since 1981, production cooperatives have been a central part of agrarian reform and agricultural policy in Nicaragua, especially in the agro-export sector. The performance of the production cooperatives (known as Cooperativas Agrarias Sandinistas, or CAS) is an issue of national importance, and has been an object of a national debate which is likely to continue, if not intensify, with the 1990 governmental changes in Nicaragua. How well have the CAS performed to date? More importantly, does the CAS production cooperative model warrant future support and development, or would an alternative organizational model be appropriate in Nicaragua (and elsewhere where questions of agrarian reform farm organization loom large on the agenda)?

Within Nicaragua, there is a loose perception that the CAS have consistently experienced problems of low productivity and high membership turnover rates. Further questions about the adequacy of the CAS model arose in the second half of the 1980's as basic grains displaced export crops on the CAS. At that same time, an apparent trend toward greater individualization on the CAS seemed to signal the failure of the CAS model.

Facts and figures to systematically evaluate the perception of the CAS as economically troubled and institutionally unstable are scarce, and evaluations of institutional alternatives have been few. At the heart of this study is analysis of survey data which was collected from CAS production cooperatives on Nicaragua's Pacific Coast in 1988/89 in an effort to rectify the paucity of systematic information on the microeconomics of the agrarian reform sector.

Section 1 below sketches the evolution of agrarian reform agriculture in Nicaragua over the 1980's. Section 2 evaluates the empirical veracity of the problems and trends perceived to afflict the CAS sector and shows them to be qualitatively accurate, although quantitatively overstated. Moreover, the trends in productivity, cropping patterns and organization alone do not indicate whether or not the CAS production model is intrinsically flawed or poorly implemented. Alternatively, the observed trends may simply reflect the increasingly difficult economic environment in which the CAS have produced.

To move toward a fuller evaluation of the CAS--and toward an answer to the question of "what is to be done about land reform agriculture in Nicaragua--Sections 3 compares the economic efficiency of the CAS with that of the "semi-collective" private plot sector which is not burdened by the sort of labor management problems typically hypothesized to undercut cooperative production. The chief result of this comparison is that there is no evidence of collective property problems on the CAS. Section 4 then considers whether or not the technical and allocative efficiency of CAS production can be improved through appropriate choice of incentive and other internal organizational variables. The results which emerge are ambiguous. Organizational factors matter a lot, but the quantitative estimates identify an offsetting effect such that the net effect of organizational variables on farm productivity are negligible. The Conclusion draws together the implications of the empirical evidence for the question of what role the collective sector can and should play in the coming years.

SECTION 1 A SHORT HISTORY OF THE COOPERATIVE SECTOR WITHIN NICARAGUA'S AGRARIAN REFORM

The current situation of the cooperative sector and the debates that face it are better understood when placed in historical context. Following the triumph of the revolution in 1979, the Nicaraguan state gained control of the 24% of the national agricultural landstock which had been controlled by the Dictator Somoza and his associates. Agrarian policy initially established state farms, not coops on these lands. Existing coops were neglected and in some cases dismantled in favor of the state sector (Kaimowitz 1988a). While there were various reasons for this orientation, the most important were probably the desire to maintain perceived economies of scale on the large, modern farms abandoned by Somocistas who had fled the country, and the calculation that it would make control of the national development process easier if the state retained direct authority over a significant portion of the agricultural sector (Merlet and Naldidier 1987).

An important redirection of policy occurred in 1981 with the formulation of the first Agrarian Reform Law. The law allowed expropriation of properties over a certain size under certain conditions, thus making more land available for distribution. Expropriated land could legally be distributed to state farms, cooperatives, or individuals, but the law expressed a preference for associative forms. With the passage of the Cooperative Law in the same year, "associative forms" came to mean CAS production cooperatives, and credit and service cooperatives (CCS).

The 1981 Agrarian Reform Law was written largely in response to peasant agitation for more land (Kaimowitz 1988a). The law's promotion of cooperatives, rather than state farms or individual holdings, stands as a compromise between various competing agrarian reform goals and constraints.

Cooperatives better responded to peasant demands than did state farms and they relieved the state of further direct managerial responsibility which experience with existing state farms showed the state to be ill-equipped to handle. At the same time, cooperatives gave the state more control over the reform sector than a multiplicity of individual small-holdings would have (MIDINRA 1987). Through its control of credit and other markets, the state expected to induce or otherwise direct the CAS, like the state farms, to channel resources preferentially to export production (Merlet and Maldidier 1987). It was also hoped that their larger scale would allow mechanization, and that the CAS would prove more productive than small private producers (Porras 1987). Under the stimulus of the new law, the area farmed by CAS grew from 1% of the total national agricultural landstock in 1981 to 12% in 1987 (MINDINRA 1989).

During the period 1981-1985, the CAS model was imposed in a rigid and top-down fashion on groups soliciting land. Once formed into cooperatives, these groups were both major recipients of state largess and major objects of state control (Kaimowitz 1988a and Cortes 1987). Agents of MIDINRA (the Ministry of Agriculture and Agrarian Reform), the bank, and to a lesser extent UNAG (the National Union of Farmers and Cattle Producers), had a great deal of say over what was produced and how the CAS organized itself internally. While the number of CAS multiplied enormously in this period, from 499 in 1982 to 1110 in 1985 (Kaimowitz 1988a), the perception of low productivity and membership instability on CAS gave policy-makers pause in their enthusiasm for the production cooperative model (Neira 1988).

The intensification of the contra war in the mid-1980's and the government's realization that it was losing support in the countryside provided the primary impetus for another shift in agricultural policy (Kaimowitz 1988b). Small private producers and intermediate coöp forms, those not officially sanctioned in the 1981 Cooperative Law, were looked upon with more favor and increasingly included in agrarian reform land redistribution. Direct state control of production fell as state farms were dismantled, and although CAS continued to form they did so at a slower rate. The state retreated from direct control of the CAS sector as well, no longer requiring the coops to sell all crops to the government (although it remained the only purchaser of cotton), and agricultural marketing in general was liberalized (see Utting 1988).

Since 1985, the CAS have operated in an atmosphere of increasing autonomy. The result has been a profusion of new forms and adaptations, including increased individualization of CAS resources, as Section 2 discusses below. Whether these changes have been desirable, and what appropriate public policy toward the CAS sector should be at this point in time are the questions which preoccupy the remainder of this paper.

SECTION 2 SOME PROBLEMS OF COOPERATIVE AGRICULTURE IN NICARAGUA: PRODUCTIVITY, PROFITABILITY AND INSTITUTIONAL STABILITY

For this study, 72 CAS from Region II on Nicaragua's relatively highly commercialized Pacific Coast were surveyed in early 1989.[1] The 72 randomly selected CAS constitute one third of the CAS in the region. To buttress the

[1] Region II was the site of the most modern commercial farming in the country before the revolution and it is still the largest producer of cotton, sugar cane, sesame, and banana in the country (DEA 1987). The region's economic importance makes it a crucial arena in which the success or failure of agricultural policy will be played out. Region II also accounts for a large proportion of the CAS in the country--21% in 1986 (Figueroa 1989). Nonetheless, the Region II CAS are not representative of interior areas of the country, and inference from the data should be restricted accordingly.

results of the formal survey, six CAS were chosen for further case study. These six were purposefully selected with the intention of obtaining in-depth, qualitative information on the evolution of organizational forms and other questions, to complement the survey data.

For each CAS in the random sample, data were collected from the CAS leadership and from six randomly selected CAS members. In addition to organizational and management practice data, the survey solicited information on the evolution of production structure and membership over the life of the CAS, and on maize production data for the 1988/89 crop year.[2] In 1989, the average CAS in the sample had 18 members and 482 manzanas[3] of land, or 23.6 manzanas (or 16.5 hectares) per member. The peak year for cooperative formation was 1982, and 60% of the CAS in the sample had formed by that year. Membership turnover has been fairly high (10 to 15% per-year on average over the 1980's). Nevertheless, a full 47% of the members surveyed said they were founding members of their CAS, implying that high turnover only affected a certain group of members--perhaps those not really committed to collective production in the first place. CAS members are almost exclusively former agriculturalists--either landless laborers or semi-proletarians. Familial relations seem to have played a role in group formation as 11 out of 18 members in the average CAS are related to at least one other CAS member.

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[2] While fuller measurement of CAS production activity would have been desirable, a preliminary survey showed maize to be the single most widely grown crop among the CAS in the sample. Additionally, many CAS members individually cultivate maize, and detailed maize production data were gathered from two of the five members interviewed on every CAS. The analysis which follows assumes that maize production efficiency adequately indicates relative CAS efficiency across the range of its activities.

[3] 1 manzana (mz)= 0.7 hectare

As this brief description indicates the Nicaraguan CAS are relatively small and well endowed with land (compared, say, to production cooperatives in Peru--see Carter 1984), and are socially homogenous. Other things equal, this structure suggests that the CAS might be less troubled by cooperative management problems than the larger, more heterogeneous agrarian reform cooperatives in other Latin American countries. The remainder of this section gives a descriptive overview of the sector, assessing the degree to which it confronts problems of productivity, profitability and institutional stability.

2.1 The Evolution of the Structure of Production

Since gaining more autonomy in 1985 (see Section 1 above), the CAS have substantially modified their cropping patterns, as Figure 1 illustrates. Until the mid-eighties cotton was the major crop in the CAS sector, accounting for 54% of the planted agricultural area (excluding pasture) within the CAS in 1985/86. In the span of a few years, crop area allocated to cotton fell to 12%. The proportion of sampled CAS planting cotton fell from over 50% to only 14% in 1988/89 (10 of the 72 CAS in the sample), and the average area planted on those farms fell from 138 mz. to 105 mz.

As cotton production fell, area devoted to basic grains rose. The proportion of agricultural land planted to maize doubled from 1985/86 to 1988/89, to 34%, while sorghum experienced a less dramatic rise from 21% to 28% of cultivated area. Sesame almost tripled in proportion of cultivated area, while other crops as rice, beans, yucca, fruits, and vegetables, together quadrupled their proportion of planted area and now occupy 20% of cultivated area.

Besides this shift in the relative area devoted to different crops, there has been a large rise in pasture area since 1985/86. Only about one third of the CAS had natural grass pasture in 1985/86 and less than one fourth had improved (seeded) pasture. By 1988/89, almost three fourths had natural pasture and more than one half had improved pasture. The average size of the natural pasture for those CAS who had cattle also about doubled in that period, while acreage devoted to planted pasture declined somewhat. Despite the state goal of making the CAS sector one of modern, commercial farms, most CAS follow what is seen in Nicaragua as a "peasant-oriented" dual purpose management strategy, using cattle for both milk and meat, rather than specializing in one or the other.

From the perspective of at least gross export receipts, the shift in the structure of CAS production towards basic grains and cattle production is problematic. One interpretation is that the shift reflects a degenerative collapse into low productivity practices by the intrinsically flawed production cooperative model. Alternatively, the shift might be seen to reflect the reassertion of an irredeemable "peasant-mindedness" by CAS members granted new autonomy by the changes in agrarian policy in the mid-1980's. A third interpretation is that the shift makes good microeconomic (and perhaps macroeconomic) sense given that the wild relative price shifts and input scarcities which have accompanied Nicaragua's macroeconomic imbalance have rendered a purchased input-intensive commercial crop like cotton risky to grow.

Unfortunately, this study is ill-equipped to distinguish between these competing interpretations and must be content with documenting this trend. Nonetheless, the revealed strength of these shifts in production structure is at least consistent with the notion that the CAS model is microeconomically troubled.

2.2 Productivity and Profitability

There has been much discussion of low productivity and disappointing economic performance on the CAS (see Neira 1988 and Cortes 1987). In it least some CAS, poor economic results have been a major cause of internal disarray and member desertion (see Sunderlin 1987), while in others the causality seems to have run the other way (CIERA 1985). If the collective sector is inherently unproductive, then a major justification for its creation--the generation of an appropriable surplus--is removed. But has CAS economic performance been poor in comparison to other property sectors? And to what extent is poor performance a function of internal failures, rather than the result of an inhospitable external environment?[4]

Table 1 contains data compiled from several sources, including the CAS survey information on crop yields in 1985/86. On a national basis, CAS yields do lag behind those of other producers, including small and medium and producers. Yields in the Region II CAS Survey were higher than average national yields for all crops but sorghum in 1985/86 and average yields for small and medium producers in all crops in that year.

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[4] In an evaluation of Tanzanian and Chinese experience with collective production, Putterman (1985) notes the difficulty of separating the effect of hostile external environment from the intrinsic problems of the collective or cooperative production model. Carter and Alvarez (1988) and Melmed-Sanjak and Carter (1989) detail a similar identification problem in their analyses of Peru. As the discussion in the text makes clear, the appearance of such an identification problem is systematic in as much as governments interested in extracting surplus from an agrarian reform sector are likely to choose a larger scale collective production units precisely because such units appear easier to control.

Yields in and of themselves are not good indicators of economic performance because different producers have unequal access to productive inputs, credit and technical assistance. DEA-UNAN (1985) reports that state farms in Region II received almost four times as much credit per agricultural manzana than the CAS, while large producers received almost 2.5 times as much. Small and medium producers received less than half the credit per manzana as the CAS. In an effort to control for input differences, Section 3 below employs a production function methodology to compare collectivized CAS production with production carried out with a control group which produces in the same macroeconomic environment but without the potential collective property problems of the CAS.

Another indicator of intrinsic CAS productivity problems would be a pattern of declining economic performance over time, as happened in Peru (see Carter and Alvarez 1989). Crop yield data provide mixed evidence on this point. National level data indicate no such trend for the cooperative sector as a whole through mid-decade (Spoor et. al. 1987). The CAS sample data do show a decline in yields for the four major CAS crops between 1985/86 and 1988/89. However both weather and credit policy were much less favorable in the latter year. Extending the time series back to 1982 for the 10 CAS for which data are available reveals that yields were lower in that year than in 1985/86, but higher than they were in 1988/89. Clearly there has been no unilinear decline in yields over time. The biggest barrier to inference about CAS productivity is controlling for the shifting and frequently unfavorable macroeconomic environment.

Figure 2 gives a rough indicator of the evolution of the agricultural price environment over the 1980's. Assuming the CAS Sample average yield of

25 quintals per manzana and the production costs estimated by MIDINRA, net profits on each manzana of corn would have been -1000 cordobas in 1980.[5] Figure 2 graphs the evolution of the terms of trade (calculated as output price divided by the price of a fixed input package using data in Spoor et.al. 1989) over the 1980's. The graph also shows the per-manzana profit or loss (in real 1980 cordobas) which would have resulted with those prices. Until 1986, the external economic environment was unfavorably stable. Price and grain marketing liberalization in 1986 created a mini-boom, with gross profits rising to +1000 1980 cordobas per-manzana. The boom was shortlived as the monetary reform of 1988[6] sent relative prices and maize profitability plummeting.

As Figure 2 clearly demonstrates, whatever internal problems the CAS faced, they, and the rest of the agricultural sector, faced a frequently unfavorable and unstable macroeconomic environment. While this environment probably influenced the absolute performance of the CAS and agricultural sectors, there is marginal evidence in the national yield data that relative to other producers, the CAS indeed have internal problems. Subsequent sections will try to more specifically measure the severity of these problems and the degree to which they might be rectified by internal reorganization of the CAS.

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[5] These calculations assume that producers actually paid the market price for all inputs--including all labor. In addition, until recent monetary and financial reforms, loans could be repaid with devalued cordobas. The actual farm level income realized by agricultural production would thus be different than what is indicated by the calculations in the text.

[6] In an effort to curb inflation, Nicaragua instituted a monetary reform in early 1988. This reform attempted to tie domestic input prices to international prices and increased the real rate of interest on agricultural loans. Among other things, the reform had the effect of leading to real relative price changes which were highly unfavorable to agriculture.

2.3 Flexibilización, and the Individualization of CAS Resources

One of the most talked about trends on the Region II CAS in recent years, has been the shift of resources to more individualized production. Like cropping patterns and yields, a wholesale shift away from collectivized production would be a prima facie indicator of problems with the CAS production cooperative model. However, as Figure 3 illustrates, the past few years have not seen a wholesale abandonment of collective farming, but rather a gradual shift away from the completely collectivized CAS model first put forward.[7]

Flexibilización, as the new ppolicy permitting organization changes with the CAS became known, led to the creation of myriad hybrid forms, ranging from completely collective to largely semi-collective farms, with the bulk of the CAS falling at the collective end of the spectrum. Although members of one of the case study CAS were planning to apply to change their status to that of a credit and service cooperative, in the 1988/89 growing season no CAS claimed to have over 50% completely individualized land, and most had far less.

While a few CAS had some individual access to land from the very beginning, the adoption of the policy of flexibilización in 1985 seems to have been the primary impetus behind increasing individualization on the CAS.[8] In 1985/86 the proportion of CAS land worked in any other way but collectively was quite small, about 3% but by 1988/89 non-collective land occupied 15% of

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[7] In theoretical analyses, Putterman and DiGirogio (1985) and Carter (1987) suggest that a mixed collective/individualized system would in general be optimal. The observed changes in Nicaragua could be interpreted as an institutional fine-tuning, rather than a failure of the model.

[8] It is also possible that the information on individual area prior to 1985 was minimized or suppressed by the members we surveyed, since individualization was officially frowned upon in that era.

crop and pasture land (Figure 3). Nevertheless, almost half (35) of the coops are still completely collective, while only one has no collective area at all. And almost three-quarters of the CAS had 90% or more of their total cultivated area in collective production, demonstrating the still largely collective nature of the CAS. Average plot size on those CAS with individual plots is a 1.8 manzanas, and those plots are planted primarily to basic grains, especially maize, sorghum, and beans. Most of the plot production is consumed domestically.

Individual access to land includes the use of pasture land by individuals. In some cases pasture is used primarily to graze collectively owned cattle, with rights of access for cattle owned by individuals. In others, pasture is used and maintained collectively, but all cattle are individually owned. Decollectivization seems to have occurred somewhat earlier in livestock than in crop agriculture. An average 13% of pasture on those CAS with cattle in 1985/86 was used in some non-collective fashion, rising to 19% in 1988/89. In most of these CAS, "non-collective" means collective maintenance of pasture, fences, and other infrastructure, and collective use of grazing land, with individual ownership of animals. Completely individualized pasture areas on CAS land are very uncommon. Only 1% of the CAS members interviewed reported that they had individual pasture on CAS land.

Because of the limited scope of CAS decollectivization which has so far occurred, little can be said about whether the trend toward greater individualization indicates a cautious escape from an intrinsically flawed model, or whether CAS members are simply fine-tuning their institutional arrangements (see note 7 above). The case studies undertaken to supplement the formal surveys do provide information on the reasons for decollectivization.

No single motivation for decollectivization stands out in the case studies as the most important. In some cases, it seems that the state itself, while encouraging cooperative formation, undermined its own goals by its imperious treatment of the coops.[9] Another source of insecurity which encouraged individualization was the transition to large-scale, modern, capitalist management of cattle production. Individualization of cattle production was a reaction to the heavy debt load associated with the formation of a collective herd according to Figueroa's (1989) case study. By selling off the collectively owned cattle to themselves and to outsiders, the coöp members were able to pay back the debt and to insulate themselves from being pressured to borrow heavily again to sustain large-scale production in the future.

For another case study, Cortes (1989) reports that total individualization of both land and cattle that appeared to be a response to internal labor and management problems on the CAS. In this case, the CAS only worked as a collective for one year; by the second year it had already been entirely individualized. Members cite such problems as the inability to incorporate family members into collective production and the feeling that the

[9]In the case of the CAS "GP" (Figueroa 1989), for example, the authorities granted land to the co-op, then failed to respect the very ownership rights it had bestowed, forcing "GP" to make a series of land cessions starting in 1986. Some 350 mz of the original 1844 mz were ceded in that year; additional cessions have stripped the co-op of a total of 1198 mz of the original area as of 1988/89. These land cessions led members to feel insecure in their land tenure. Individualization which had started in the 1985/86 cycle with small parcel of 1.4 mz per member, accelerated rapidly with the land cessions; Figueroa concludes that this acceleration was a direct response to the government actions.

productivity of the most experienced members was being wasted in collective work.

Contrary to this experience, the case study by Siles (1988) identifies individualization as a complement to collective production. In the Siles study, 18% of cultivated area in the 1988/89 cycle was under individual control, and used exclusively for growing basic grains, while cash crops were still collectively cultivated. In this cycle also the CAS began to distribute the entire collective production of milk to members, who generally used it for family consumption, although some sold it. Members gave the rationale for these moves as primarily to guarantee individual family food security.[10]

In summary, a gross characterization of the CAS as a non-viable, low productivity sector collapsing into a decollectivized morass of "peasant" producers would certainly be overstated. Given Nicaragua's macroeconomic imbalance, it is perhaps impossible to unambiguously identify the cause of the radical shift in the structure of CAS production away from cotton and toward domestic food crops. Relative price shifts, input scarcity and risk are at least as likely an explanation as the hypothesis of a collapse of the CAS. CAS yields are comparable to those achieved by other producers, and in Region II at least the vast majority of CAS resources remain collectively cultivated. Even those resources managed on an individual basis utilize the CAS as a service cooperative as Section 3 details. In-depth case studies identify a number of reasons for the increased individualization of production which has

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[10] This point became particularly important in 1988/89 as the bank reduced its level of funding from 100% of the costs of production to 70%. In most cases this meant the curtailment or elimination of advance pay to members.

occurred, and it would be inaccurate to view the observed individualization as an indicator of the non-viability of the production cooperative model.

SECTION 3 ARE THE CAS BURDENED BY INTRINSIC PRODUCTIVITY PROBLEMS? ECONOMETRIC ANALYSIS OF THE CAS VS. SEMI-COLLECTIVE INDIVIDUAL PRODUCTION

The descriptive data reviewed in Section 2 do not show the sort of overwhelming evidence which would signal the intrinsic failure the CAS model. Those data also do not support an unambiguous conclusion that all is well with the CAS. Clearly the CAS are in transition, and more finely tuned analysis is required to evaluate the question of what is to be done about land reform production cooperatives in Nicaragua.

The emerging sector of individual parcels within the CAS provides a control group to evaluate whether collective CAS production is burdened by intrinsic management and productivity problems. In addition, the private parcels are prototypes for an alternative "semi-collective" agrarian reform model. Using data collected on collective and individual plot maize production, this section tries to econometrically answer the following (counterfactual) question: If the CAS and individual producers had access to the same bundle of inputs (fertilizer, machinery, etc.), which would produce more output?

The answer to this question is at the heart of the debate about cooperatives. If labor discipline is impossible to maintain in a collective enterprise--if incentives are inevitably inferior in cooperative as compared to individual production--then a major argument for the establishment of a cooperative sector would be invalidated.

3.1 Property Rights, Incentives and the Efficiency of Agricultural Production

There is a substantial literature which analyzes and documents problems of economically inefficient cooperative production (e.g. see the Putterman 1989 review). At the core of most discussions of cooperative efficiency problems is the "free rider" problem. The free rider problem results from the sharing of the net revenues among coöp members. The member who shirks labor[11] "free rides" on the efforts of others--the cost of reduced revenue is spread across all coöp members, while the shirker privately appropriates all the gains from withdrawing labor effort from co-op. Absent adequate sanctions or other supervisory device, the individual coöp member thus faces marginal incentives to shirk labor. Moreover, the larger the co-op, the more powerful are the incentives to shirk labor (see Carter 1987).

In contrast, when income claims are exclusively held by a single individual who provides all the production labor--as in an ideal type owner-operator system--these incentive and labor management problems dissipate. However, as Carter and Mesbah (1990) discuss, Latin American land reforms have shied away from the creation of individual owner-operator farms because of countervailing constraints thought to limit this tenure form. Among these constraints is limited access to markets (for capital, technical assistance, inputs and outputs) thought to be engendered by the small operational size of land reform owner-operator units.

The individual parcels within the Nicaraguan CAS share some, but not all, of the features of owner-operator farm units. Residual income is the exclusive property of the individual member responsible for the plot. At the

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[11] It should be noted that labor indicates both labor time as well as the qualitative aspects of the labor and managerial processes.

same time the individual parcels here are <u>within</u> the CAS in more than a geographical sense. Survey efforts to identify the degree to which collective control operates over cropping calendar and other management decisions were not successful. The parcels are highly dependent on the CAS for provision of inputs and services. As Table 2 shows, for all inputs (except seed), 70% or more of parcel holders who use a particular input obtained it via the CAS. A full 94% of those who used machine services employed CAS machinery. About half of those CAS which supply seed, fertilizer, and pesticides to members and three-quarters of those that supply machinery do so without charge--that is, the cost is picked up by the collective. Even when members do pay, they benefit from CAS access to low-cost state credit and preferential prices for inputs and machinery.

The comparison between CAS and individual parcels is thus between collective production units and cooperatively linked small holders, rather than between collectives and independent small holders. CAS burdened with the free rider management problems[12] would be expected to ineffectively utilize resources allocated to production and to produce less output from the same bundle of inputs than would a private plot producer. In the language of production economics, the CAS in this circumstance would exhibit lower technical efficiency.

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[12] It should be emphasized that free rider <u>incentives</u> for labor shirking do not necessarily imply that CAS will have efficiency problems. Section 4 below discusses in more detail internal management factors which determine the degree to which free rider incentives burden collective production.

3.2 The Efficiency of Resource Utilization on CAS versus Semi-Collective Individual Parcels

Table 3 presents descriptive information comparing maize production on the collective sector of the CAS versus the individual parcels. Maize yields are some 25% lower on the individual parcels. Yet, as Table 3 also shows, the parcels employ fewer inputs and machinery than do the CAS in collective production. To answer the counterfactual question of which institutional arrangement would produce output with the same inputs, it is necessary to estimate the efficiency of resource use controlling for the levels of inputs actually utilized.

Assuming that a Cobb-Douglas specification adequately captures maize production technology,[13] the following specification may be used to test for efficiency differences between organizational modes:

$$Q = T[L^{\beta_L} F^{\beta_F} M^{\beta_M} A^{\beta_A}] \quad (1)$$

where "Q" is maize output, "L" is labor input, "F" is fertilizer, "A" is area planted to the crop, the ß are the coefficients to be estimated and "T" is a neutral technical efficiency term which varies across farm types. Higher values of T, corresponding to greater technical efficiency would translate into greater amounts of inputs from any given quantity of inputs. For purposes of estimation, T is specified as

$$T = \exp(T_0 + \tau D).$$

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[13] The choice of this functional form resulted in observations being dropped which used no machinery. While seemingly an undesirable loss of information, this procedure assures the comparison of only those CAS and parcels which utilize approximately the same technology and arguably offers a better test of the technical efficiency hypothesis. More general (and therefore less parsimonious in parameters) functional forms gave similar results on the technical efficiency hypothesis.

where "D" is a binary dummy variable which takes the value one for individual parcels and zero for a CAS. Expressing equation (1) in log-linear form by taking the natural logarithm of both sides gives:

$$Q^* = (T_0 + \tau D) + \beta_L L^* + \beta_F F^* + \beta_M M^* + \beta_A A^* \qquad (2)$$

where the stars (*'s) indicate the natural logs of the variables defined earlier. Table 4 presents results for a ordinary least squares estimates of the parameters in equation (2).[14] Constant returns to scale could not be rejected, and table 4 presents only the results for the regression model with constant returns imposed. The point estimate of the coefficient on the organizational type dummy variable is very close to zero and indicates that parcels would produce only 1.6% more output if they used the same inputs bundles as the CAS. In addition, the hypothesis that there is (on average) no technical efficiency difference between CAS and parcels cannot be rejected statistically.[15]

There is, evidently, no technical efficiency argument for or against the CAS. On average, the CAS utilize their resources as effectively as individual parcel holders who do not face the "free rider" collective property problems of the CAS. Before attempting an evaluation of the two competing agrarian reform modalities, the next section asks whether average CAS performance can be systematically improved by changes in the way the model is implemented.

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[14] The estimated equation also includes two regional dummy variables, which were included to control for systematic soil and climatic differences across observations, and a seasonal dummy variable which controls for the fact that maize yields are lower for the second planting.

[15] Alternative specifications of the production functions which permitted the inclusion of individual plots which did not use machinery tended to show a larger estimated technical efficiency differential favoring small holders. However, the difference remained statistically insignificant.

SECTION 4 ECONOMIC EFFICIENCY DIFFERENCES AMONG THE CAS--LESSONS FOR FORTIFYING THE COOPERATIVE PRODUCTION MODEL

On average, the CAS fare equally well (or badly) as the private parcel sector in terms of technical efficiency. But how heterogenous are the CAS? More importantly, is there evidence of systematic differences in economic performance which identify management or other practices which might fortify the CAS model?

Mean maize yields for collectivized production in the CAS Sample are 26 quintals per-manzana. Among the 62 CAS which cultivated maize in the 1988/89 season, yields varied from a just a few quintals per-manzana up to 65 qq/manzana, with a mean of 25 qq/manzana. Some part of that variation reflects differences in rainfall and climate across the CAS. Another part reflects differences in the quantity and quality of fixed and variable resources brought to the production process. A third component of that variance may reflect differences in internal organization and management practices, some portion of which could perhaps be eradicated by refortifying weak CAS around the model of the more successful CAS.

From a theoretical perspective, heterogeneous performance of production cooperatives might be expected. The free rider incentives for labor shirking (discussed in section 3.1 above) do not necessarily imply that CAS will necessarily have efficiency problems. After all, wage laborers on a private farm have even less incentive than coöp members to work diligently--their (fixed) wage income is completely insulated from revenue-reducing shirking. The specific problem of production cooperatives compared to a conventional labor-hiring farm is the difficulty they have generating the authority to enforce payment rules, or otherwise entice, ample work for the tasks at hand.

While intrinsic to agricultural production cooperatives, the authority problem is not insolvable. Carter (1985b) describes Peruvian production cooperatives where efficient resource utilization was achieved through either effective rule-enforcing authority or bonds of mutual social obligation. But these mechanisms are far from automatic, and many production cooperatives have problems maintaining any pattern of coordination or control of labor (for example, see Carter 1984 analysis of Peruvian agrarian reform cooperatives). This problem is worsened by the "anti-incentivist" tendency (to use Putterman's [1985] expression) of production cooperative models which discourage the use of material incentives to resolve the authority problem and assure an effective labor supply.

4.1 A Statistical Model of Cooperative Management and Economic Efficiency

Management differences could influence the technical efficiency of production--that is, the amount of output obtained from given inputs. Management differences could also affect the CAS's ability to mobilize labor so that fixed resources like land can be fully exploited. Together technical efficiency and labor mobilization (or, more generally, resource allocation) determine the overall economic efficiency of a production units--i.e., the units ability to generate net revenue or economic surplus from a given set of resources and market conditions.

To examine technical efficiency among the CAS, the production function (1) may be rewritten as:

$$Q = T(\underline{m})[L^{\beta}{}_{L}\ F^{\beta}{}_{F}\ M^{\beta}{}_{M}\ A^{\beta}{}_{A}] \tag{3}$$

where the technical efficiency term $T(\cdot)$ is now specified as a function of a vector of variables $\underline{m}$ which measure management, incentive and other organizational indicators. Values of $\underline{m}$ which increase $T(\cdot)$ would multiplicatively enhance the productivity of a given bundle of land, labor, fertilizer and machinery--i.e., boost technical efficiency.

Socially optimal labor mobilization requires that labor be allocated to production until labor's additional contribution to production (its marginal output contribution or marginal product) just equals its social opportunity cost. If too little labor is allocated to production (for example because of labor mobilization problems on the CAS), then labor's marginal output contribution will remain high, exceeding its opportunity cost. For production function (2), optimal labor allocation requires that labor be employed until

$$\beta_L(Q/L) = w \;, \tag{4}$$

where $\beta(Q/L)$ gives labor's marginal output contribution (calculated as the derivative of output with respect labor, dQ/dL) controlling for the level of other inputs (including choice variables like fertilizer and unobserved variables like soil quality). The variable "w" indicates the real opportunity cost of labor. Note that "w" need not be a fixed market wage, but could reflect an internal shadow price of labor.

As Carter (1987) demonstrates in a "worst case" theoretical scenario, a production cooperative afflicted by serious free rider problems will tend to produce with low levels of labor intensity (and yields) such that labor's marginal output contribution exceeds its real opportunity cost, $\beta(Q/L) > w$. The empirical question then is whether there are management practices which enhance CAS labor mobilization such that labor's marginal output contribution is driven down to its social opportunity cost.

To statistically study this question, equation (4) can be expanded to include the impact of management practices on CAS labor mobilization:

$$\beta_L(Q/L) = S(w,\underline{m}) , \tag{5}$$

where the function $S(w,\underline{m})$ depends on the opportunity cost of labor and the internal management practices. Effective management practices would tend, via $S(w,\underline{m})$, to increase labor intensity and move labor's marginal output contribution to lower levels in conformity with its opportunity cost.[16] Before testing for the impact of management on economic efficiency of the CAS, the next section considers the definition and measurement of managerial attributes and effectiveness.

4.2 Factor Analysis of Incentives and Organizational Structure

The CAS surveys asked CAS leadership and CAS members questions about management practices, income payment rules, and sanctions, as well as the degree to which these rules are implemented and enforced. What resulted was a number of indicators of management practice and effectiveness. The first column of Table 5 presents mean values for a subset of these variables which describe internal CAS organization and management. Variable definitions are given in the notes to Table 5. These variables bring out the objective payment rules (use of piece rates, sick leave provision, fines for unexcused absences), CAS members' subjective perceptions of how those rules are enforced and whether the work process is well supervised, and the degree to which the CAS offers land and productive services to its members for their use as individuals.

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[16] A more general approach would be to say that management practices move marginal labor productivity into equality with the real labor cost. Unfortunately in Nicaragua's high inflation environment, the latter is impossible to measure. It will therefore be assumed in the analysis that to the extent that the CAS experience allocative inefficiency, it results from underutilization of labor.

Quick perusal of the mean values for these variables indicates that on average the CAS do have well defined work rules which are at least usually enforced. Implicit health insurance is offered in the form of wage advances paid for absences due to illness, and the average individually assigned plot of 0.27 manzanas is provided some services by the CAS.

How does variation in these management practice variables influence economic efficiency of the CAS? From a purely practical point of view, direct inclusion of the eleven variables in Table 5 in equations (3) and (5) would overwhelm the statistical degrees of freedom available for estimating efficiency effects. Additionally, and not surprisingly, these variables are highly collinear as each is ultimately only an indicator of the underlying--and unobservable--CAS management style. This collinearity would also frustrate any effort to precisely estimate the impact of management variables on efficiency. Rather than try to select some compelling sub-set of indicators for inclusion in the regression estimates of (2) and (4), principal components analysis is used to reduce the dimensionality of the indicators.

Conceptually, there is also a strong case for aggregating the plethora of indicators into a reduced set of management practice indicators. It would seem misleading (even if possible statistically) to estimate the marginal efficiency impact of, say, a 1% increase in the wage advance penalty, holding all other practices equal. What distinguishes CAS are presumably conglomerations of management practices and attitudes. This presumption implies that a few principal components ought to emerge which capture most of the variation in the observed indicators. In the language of factor analysis, each principal component can be taken to represent an underlying latent factor (e.g., supervisory practice, severity of sanctions, etc.).

Table 5 presents the "rotated loadings" matrix for the first three principal components for the observed management practice variables.[17] Each row of the loadings matrix gives standardized regression coefficients which relate the variable to the first three principal components. Together, these three components capture 55% of the total variance in the set of 11 management practice and other structural indicators.

As can be seen, the rotated loadings indicate that each of the three principal components (or factors) is highly related to a particular cluster of variables. Reflecting this clustering, each component has been named to reflect the variables whose variance it largely captures. The first factor is highly correlated with the degree to which production has been individualized. The second principal component, labelled "sanctions," is most strongly related to the severity of fines as well as to the consistency with which those fines are applied. The third component captures common variation in implicit health insurance, supervisory effectiveness, and use of piece rates. Because this component is positively related to the first two variables and negatively related to the third, it is labelled "supervision." For each CAS in the sample, values (or "factor scores") for each of the three synthetic variables was calculated and used in the regression analysis of equations (3) and (5).

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[17] The loadings matrix was rotated using a standard factor analysis procedures which tries to maximize the number of loadings which are close to either zero or one in absolute value. While not changing the total variance explained by the principal components, rotation makes it easier to interpret a particular component as highly related to some variables and not to others.

4.3 Technical and Allocative Efficiency Effects of Internal CAS Structure and Management Practices

Table 6 presents the ordinary least squares estimates of the production function and labor allocation equations. The first column of Table 6 shows estimates for the Cobb-Douglas specification used in the analysis of CAS and parcels above with the addition of a CAS specialization variable (ratio of maize area to total cultivated area). The latter variable, whose value ranges from 1% to 85% in the sample, with a mean of 17%, is included as an indicator of the likely agronomic and crop management attention given the crop. It likely also reflects the appropriateness of CAS land to maize cultivation.[18] The R^2 of 0.48 indicates that up to half of the variation in (log) yields is potentially explicable by managerial differences and other factors excluded from the conventional production function.

The second column of Table 6 presents estimates for the full technical efficiency regression model given in equation (3). Two types of variables hypothesized to affect CAS technical efficiency through the function $T(\underline{m})$ in (3):

> Structural Attributes which at least for already existing CAS are fixed. These are the number of CAS members, CAS age, class origins of CAS members and their degree of familial interrelatedness.

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[18] The estimated coefficients are broadly similar to those reported in Table 4, except for the coefficient on fertilizer. Precise estimates of the impact of fertilizer proved hard to get in the presence of the included regional dummy variables. These dummy variables also impact strongly on the magnitude and significance of the familialness and CAS age variables in the full organizational model. It is not surprising that regional patterns to all three of these variables should induce such multicolinearity problems. While it was tempting to exclude the regional dummies, they have been left in to conform to the authors' classical statistical temprement.

> Management Practices which should in principle be manipulable for already existing CAS. These are measured by the principal components, or factors, representing sanctions, supervision and degree of individualization.

The OLS estimates presented in Table 6 presume that while management practices are manipulable, they are econometrically exogenous. That is, this estimation procedure assumes that causality runs from management practice to efficiency rather than the other way around. This assumption would be true if variability in practice is either random or the result of differences in training programs or government policy when different CAS were established. This assumption would be violated if intrinsically efficient CAS (which perhaps enjoy unique managerial personnel) endogenously choose certain management practices such that efficiency precedes and causes management practice.

As can be seen, the structural variables carry substantial statistical and economic significance. The class origins variable (which increases as the "pesantness" of the CAS membership increases) strongly effects the technical efficiency of maize production. A unit increase in the class variable (which is scaled as a standard normal variable) would imply that the CAS would get 17% more output from the same inputs of labor, fertilizer and machinery. Greater CAS membership, which would be expected to increase free rider problems, is puzzlingly estimated to increase technical efficiency. Mature CAS produce with significantly greater technical efficiency--a result which while reasonable, runs counter to the experience of some countries where production cooperatives experience a degenerative collapse over time (see Carter 1987). Higher degrees of familial interrelatedness is estimated to reduce technical efficiency. It could well be that a greater degree of familialness makes imposition of penalties difficult, as case study work by Carter and Kanel (1985) in the Dominican Republic suggests.

Among the management choice variables, individualization of CAS production resources is estimated to have a major negative impact on technical efficiency. A unit increase in the individualization principal components variable (again scaled to have zero mean and unit variance in the sample) would diminish output roughly 28% from the same resources. The strength of this result is particularly surprising given that the regression controls for the degree of maize specialization. Whatever the merits of decollectivization or other individualization, this result points to a significantly deleterious impact on the efficiency of remaining collective production. It should be noted that the causality could in fact go the other way--i.e., a CAS experiencing efficiency problems may begin to individualize production as a way to escape free rider and other collective management problems.

The supervisory variable is estimated to have a small and statistically insignificant impact on productive efficiency. Most surprisingly, the sanctions variable shows a strong negative impact on technical efficiency. Again, it may be that causality runs opposite that presumed here such that troubled CAS impose severe sanctions in an effort to reestablish productive efficiency. While possible, this seems unlikely as casual observation suggests that it is the <u>in</u>ability to define and enforce work rules which characterizes troubled production cooperatives.

The third and final column of Table 4 displays estimates of the labor mobilization equation (5). Given Nicaragua's hyperinflation over the survey period, there is no reasonable way to directly measure the real wage to include as an explanatory variable. Instead, regional dummy variables are employed to control for local labor market conditions. In addition, total and CAS area and CAS crop area per-member were included as indicators of the internal opportunity cost of member labor.

The total CAS area per-member variable shows a strong negative sign--every additional manzana of land per-member is associated with an increase in labor intensity such that labor's marginal product falls by 2%. One possible interpretation is that land per-member is higher in less productive areas, where most land is devoted to grazing and creates little demand for labor. The area variable might thus be a measure of labor cheapness such that a negative relation with marginal labor productivity would be expected. The cropped area per-member was included to try to control to for this phenomenon, but its expected negative sign was statistically insignificant.

Among the structural and management variables, the estimates of the impacts of class, supervision and individualization are both economically tiny and statistically insignificant. Consistent with the arithmetic of free rider problems, the number of CAS members has a large and significant impact on labor mobilization. With each additional member, it is estimated that labor intensity declines such that the labor's marginal product increases by 5%. Sanctions also are estimated to have a robust impact on CAS labor mobilization.

Figure 4 graphically displays the estimated impacts of CAS membership size and sanction policy on labor mobilization.[19] As can be seen, for an

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[19] To calculate labor hours per-manzana for the figure, estimated or fitted values of the marginal product of labor were calculated using the coefficients reported in Table 6. Using the mathematical expression in equation (5), these fitted values were used to calculate estimates for labor hours per-manzana. In the calculations, mean sample values for all variables except number of members and sanctions. The curve labeled "high sanctions" were calculated with a value of 1.0 to the sanctions variable, moderate sanctions were calculated assuming

average size CAS of about 20 members, it is estimated that a movement from a low to a high sanctions regime will almost double labor mobilized to 200 hours per-manzana. Figure 4 also shows that regardless of sanction regime, increase membership size is estimated to lead to declining ability to mobilize labor. At membership size of 40, estimated labor mobilized is only some 100 hours per-manzana, down from the sample average of 175 hours per-manzana shown in Table 3.

The output effect of the increased labor mobilization resulting from sanctions is calculated in Table 7. For a small, medium and large CAS, Table 7 calculates the estimated labor which would be mobilized under sanction regimes of different severities (see note 18 for calculation method). Using sample mean values for non-labor inputs, yields implied by the labor mobilization estimates were calculated using the production function estimates in column 2 of Table 6. As can be seen in Table 7, the output effects of the increased labor mobilization are substantial, even for larger CAS, as output rises some 30% after a shift from low to high sanctions.

However, these estimates do not take into account the puzzling decrease in technical efficiency which is estimated (column 3, Table 6) to accompany increased sanctions. Taking the technical efficiency decrease into account would more or less erase the output gain estimated to occur from increased labor mobilization, implying in net little impact of sanctions on output. As discussed earlier, the negative impact of sanctions on estimated technical efficiency has no obvious explanation. Nonetheless, it is strongly indicated by the data.

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the sample average of 0.0 for sanctions, and low sanctions -1.0.

CONCLUSIONS: WHAT IS TO BE DONE?

Production cooperatives have often had economically troubled histories; although, as Putterman (1985), and Carter and Alvarez (1989) argue it is often hard to attribute those failures to the internal, intrinsic problems of the cooperatives as opposed to hostile external environments in which they have often operated. Descriptive data analyzed here show that while the CAS production cooperative sector in Nicaragua is in a state of flux and change, it is clearly not in a state of gross organizational crisis and economic collapse. Individualization of collective property resources is only marginally occurring, and neither the descriptive data nor supporting case studies support the conclusion that this individualization reflects a failure of production cooperative model. Other changes observed to be underway in the sector, such as the large change in cropping patterns, cannot be unambiguously interpreted as a signal of problems with the underlying cooperative model.

In an effort to arrive at a sharper characterization of the economic health of the CAS sector, this paper has made two statistical comparisons. The first has been between the CAS and the emergent individual plot sector. The latter sector is of course not burdened by the collective property problems which are hypothesized to dampen the efficiency of resource use on CAS. However, econometric estimates show that the technical efficiency of the individual plot control group is no greater than that of the CAS. Moreover, because of differences in resource allocation, the individual plot group actually produces lower yields than do the CAS.

The second statistical comparison has been among the CAS themselves. If the CAS on average produce with similar technical efficiency as private producers, is there evidence that well designed CAS (in terms of management practices and structural factors like size) can produce better than the average? The econometric analysis of this question presented a mixed answer. While some factors (notably membership size and sanctions) are estimated to significantly influence both technical efficiency and resource allocation (i.e, labor mobilization), they do so in offsetting ways. It is thus not clear whether CAS can be reshaped to perform better, and thus whether a reshaped CAS sector could unambiguously outperform, say, the individual plot control group.

What then ought to be done, or ought not to be done, regarding the production cooperatives which constitute an important segment of Nicaragua's agrarian reform sector? The CAS appear to be economically viable, or at least as viable as any production organization could be given Nicaragua's troubled macroeconomy. The individual plot sector is emerging as a seemingly viable semi-collective sector--semi-collective in the sense that it relies on the CAS for access to inputs of various sorts. The current evolution of the sector towards some sort of "mixed" model within the structure of collective property may make good sense, as Putterman (1986) and Carter (1986) discuss theoretically.

Less desirable would seem to be a governmental sponsored effort to eliminate CAS. In their collective production, the CAS record as examined here does not indicate the sort of social loss associated with common property efficiency problems which might warrant a major revamping of the reform sector. Moreover, the individual plot sector is tightly linked to the CAS itself. Elimination of the CAS, or delegitimation of its collective attributes, might well undercut the productive potential of a decollectivized private plot sector which would emerge in its place. Summarizing the literature on Peru, Carter (1990) notes that the net productivity effects of a "radical decollectivization" of reform agriculture in that country, appear to have been minimal, despite the fact that the prodcution cooperative sector had been mired in collective property problems. In addition, Peru's decollectivization appears to have resulted in substantial one time losses in indivisible infrastructure, and has left the new small holders facing an ambiguous future of potential differentiation and land reconcentration.

For the moment at least, a policy of benign neglect--if not open-minded support--toward the CAS appears warranted as the CAS move toward their own internal equilibrium.

Fig. 1 Cotton Prod.

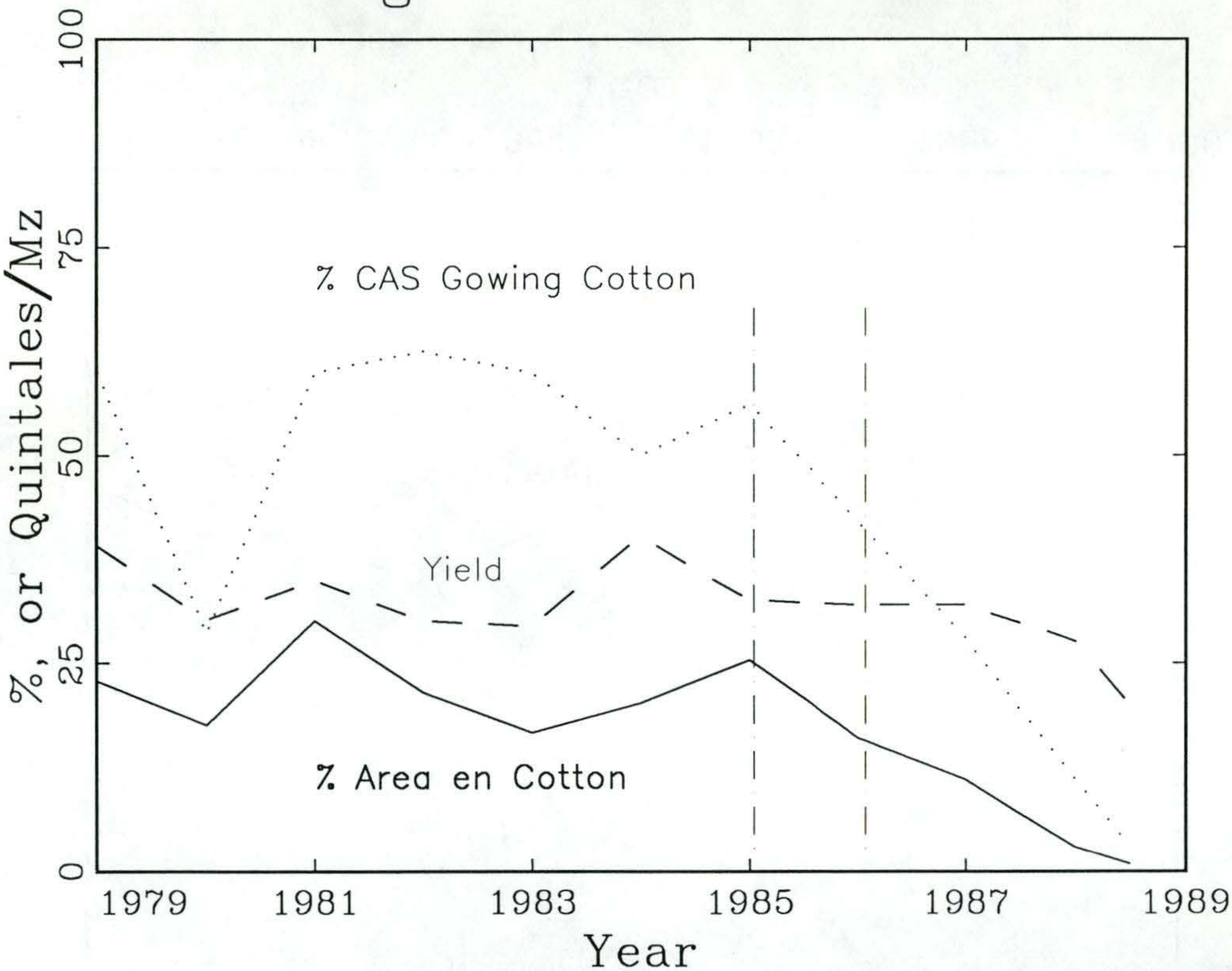

Fig. 2 Maiz Profitability

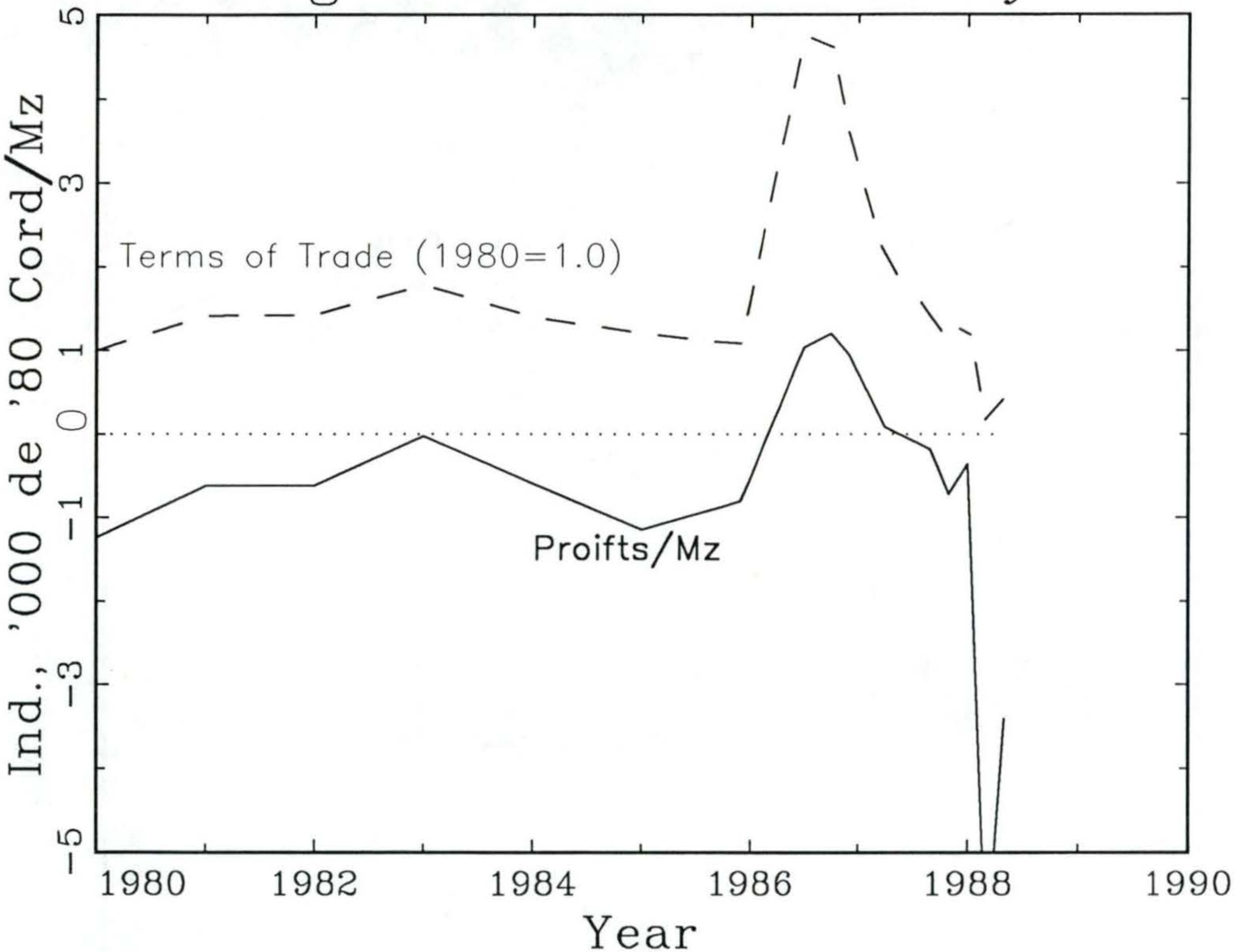

Fig. 3 Evo of Organ. Struct.

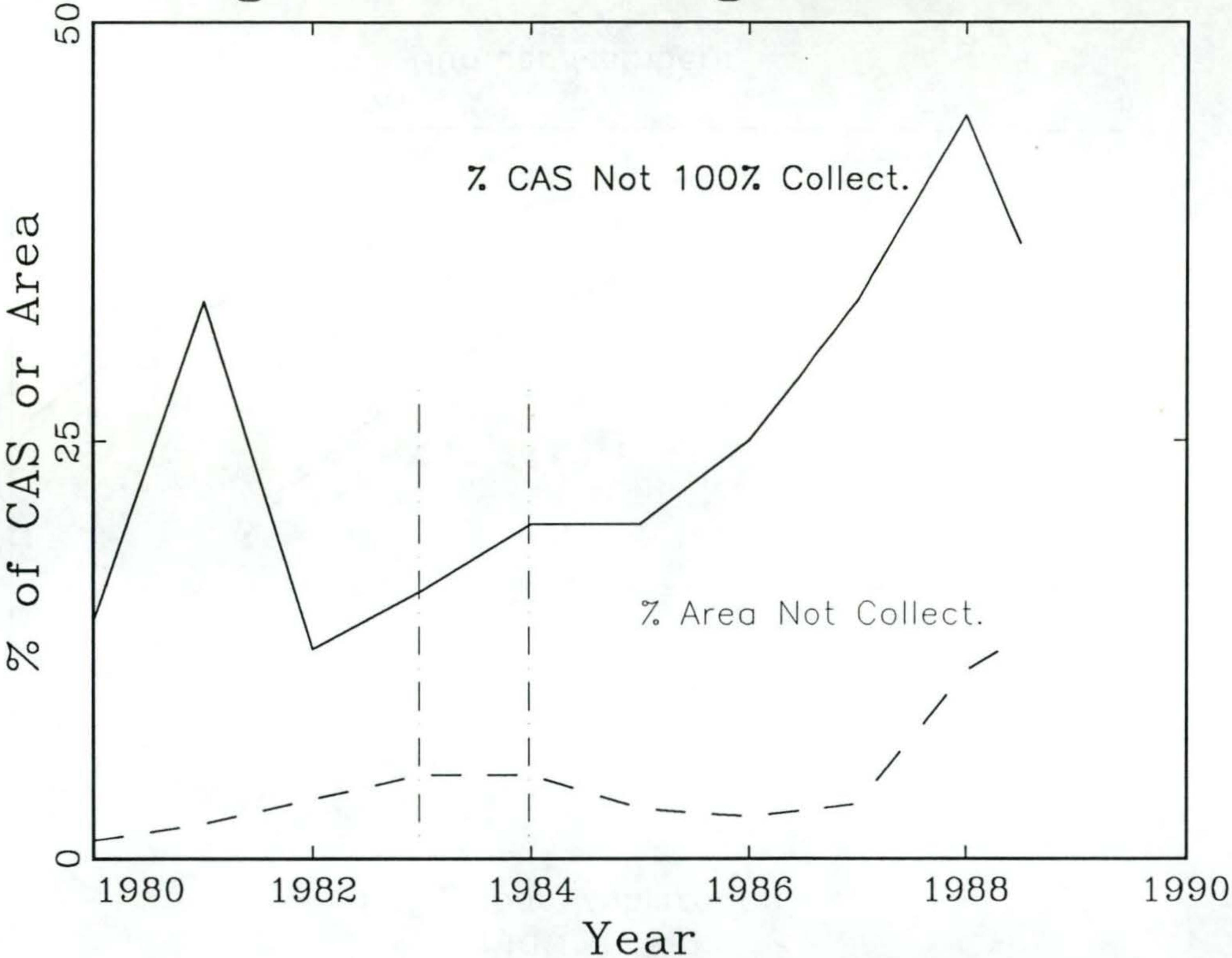

Figure 4
CAS Labor Mobilization

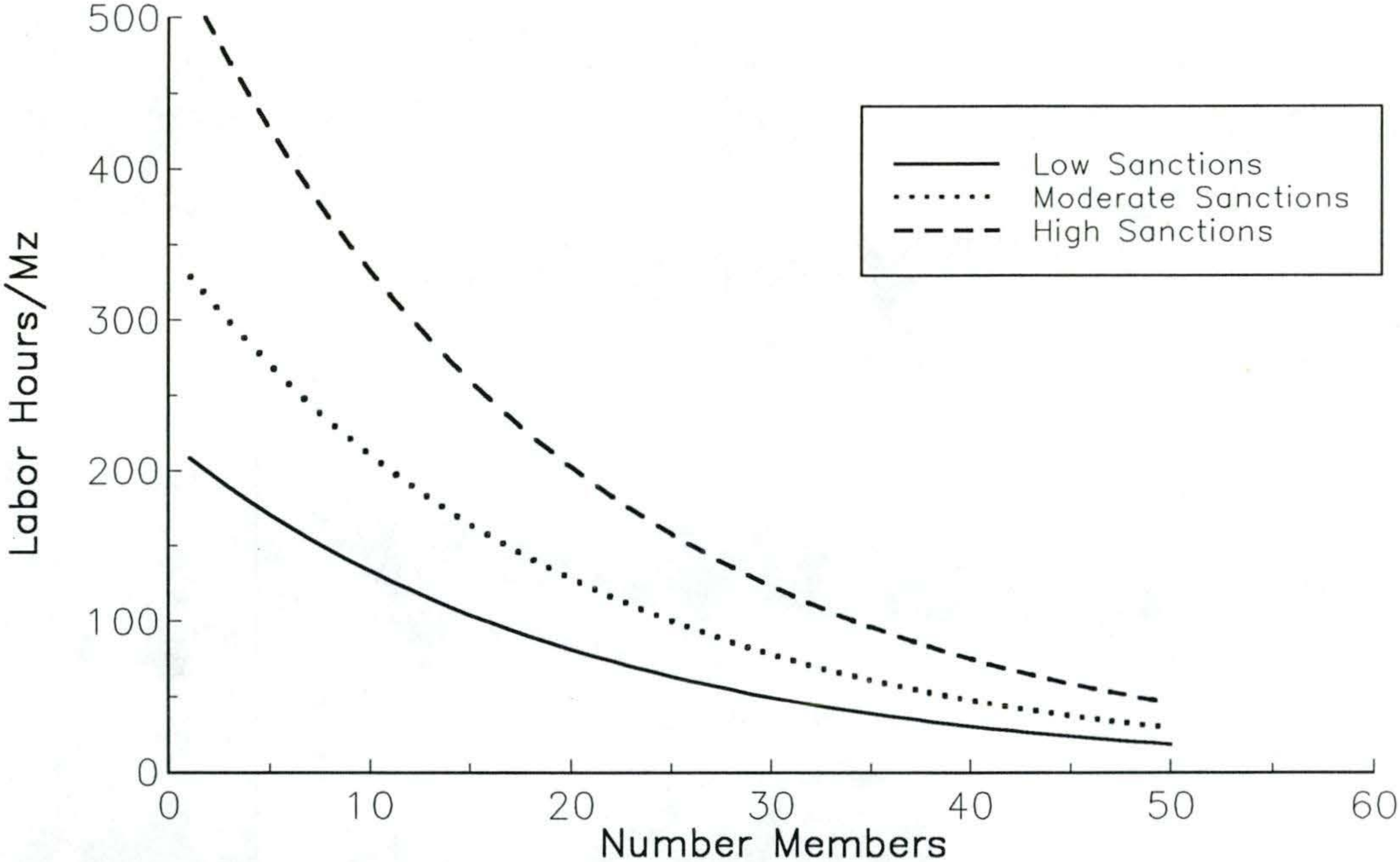

TABLE 1

CROP YIELDS BY PROPERTY SECTOR AND REGION, 1985/86 (QQ/MZ)

	Cotton	Maize	Sorghum	Sesame
Sector				
National Average[1]	8.9	21.9	31.5	5.8
State	8.5	42.4	37.1	---
Co-op Average	7.5	16.2	27.6	5.9
CAS-CT[2]	6.6	22.3	23.5	6.9
Lg. Producers	10.0	39.0	40.0	12.0
Sm. & Med. Producers	12.0	23.2	21.5	5.0
Region II CAS Average[3]	21.6	18.9	20.9[4]	7.3
CAS Survey Average	32.6	26.3	25.6	8.8
1988/89 CAS Survey Average[5]	27.8	23.7	22.4	3.7

1 Source: Neira 1988.
2 Source: MIDINRA, cited in DEA-UNAN 1987.
3 Source: DEA-UNAN 1987.
4 Average of <u>sorgo millon</u> and <u>sorgo industrial</u>.
5 For primera only.

TABLE 2

PROPORTION OF INPUTS OBTAINED VIA CAS USED IN PARCEL PRODUCTION OF MAIZE

Input	Average % via CAS[1]
Seed	22%
Fertilizer	71%
Herbicide	73%
Insecticide	86%
Machine Hours	94%
Labor Hours[2]	84%

1 Those individual plots on which a given input was not used are not included in the calculation of averages.

2 Includes labor of the member and the member's family, considered potentially available for CAS use; does not include mano vuelta, that is, labor done on a mutual exchange basis by other members. Obviously it would be more accurate to include the latter, but unfortunately, it is categorized in the data as a part of paid labor, and it cannot be separated out.

TABLE 3

DESCRIPTIVE STATISTICS ON MAIZE INPUT USE AND YIELDS,
CAS VERSUS INDIVIDUAL PLOT PRODUCTION

	CAS	Individual Plots
Maize Area Sown (mzs.)*	34.0	1.3
Per-Manzana Values		
Yields (QQ)*	25.0	18.2
Labor Hours	168.8	198.0
Machine Hours*	13.6	2.5
Fertlizer (QQ)*	4.0	2.7
Total Chemical* ('000 C$)[1]	42.3	26.7

* The differnce in means between CAS and individual plots is statistically signifcant at the 5% level.

1. Total cost of chemical inputs was calculated using standard prices for Septermber, 1988.

TABLE 4

OLS ESTIMATES OF CAS VERSUS INDIVIDUAL PARCEL TECHNCIAL EFFICIENCY

Explanaatory Variables	PRODUCTION FUNCTION (Output/Mz)[1]
Std. Inputs/Mz	
Labor Hours[1]	0.160
	(0.13)
Fert.[1]	0.392
	(0.21)
Machine Hours[1]	0.183*
	(0.82)
Constant	1.66*
	(0.66)
Controls	
Region2	-0.97*
	(0.26)
Region6	-0.43
	(0.21)
Season	-0.60*
	(0.20)
Property Regime	
Individ Parcel	0.016
	(0.192)
No. Obs.	86
R^2	0.40

Notes

Figures in parentheses are estimated standard errors.

* Estimated coefficient is statistically different from zero at the 5% level.

1. Variable was entered in log form.

TABLE 5

PRINCIPAL COMPONENTS/FACTOR ANALYSIS OF MANAGEMENT VARIABLES

Variable	Principal Components or Factors		
	Individualization	Sanctions	Supervision
Private Plot	0.81	-0.18	-0.11
Individ Inputs-S	0.90	-0.07	-0.12
Individ Inputs-C	0.82	0.12	0.06
Salary Fine	0.00	0.78	-0.21
Profit Fine	-0.01	0.68	0.06
Apply Fines	-0.23	0.63	0.05
Profits if Sick	0.34	0.54	0.35
Supervise	-0.16	0.09	0.53
Piece Rates	-0.37	0.24	-0.61
Salary if Sick	-0.01	0.16	0.69
Other Fines	0.24	0.26	-0.42

Variable Definitions

Private Plot: Size of plot allocated for individual use. Sample mean: 0.27 manzanas.

Individual Inputs-S/C: Two alternative measures of the degree and extent of collectivley provided services provided to members on their plots. Mean scores are 2.1 and 4.0 on a scale ranging from 0 to 9.

Salary/Profit Fine: The number of days of salary (subsistence or advance payment) and of profit shares taken away per-day of unexcused absence. Sample means: 0.86 and 1.12 days, respectively.

Apply Fines: Categorical variable ranging from 0 (almost never apply fines) to 3 (almost always apply fines). Sample mean: 1.2.

Profits if Sick: Share of profits given for excused absences--Sample mean: 63%.

Superivse: Categorical variable ranging from 1 (poor supervision) to 3 (high supervsion). Sample mean: 2.3.

Piece Rate: Binary variable which equals 1 if piece rates used, 0 otherwise. Sample mean: 0.73.

Salary if Sick: Share of salalry or advance payment given for excused absences. Sample mean: 80%.

Other Fines: Additional cash fines levied for unexcused absences. Sample mean: 33 cordobas.

TABLE 6

TECHNICAL AND ALLOCATIVE EFFICIENCY EFFECTS OF MANAGEMENT VARIABLES

Explanatory Variables	Production Function (Output/Mz)[1]		Labor Mobilization (MP Labor)[1]
<u>Std. Inputs/Mz</u>			
Labor Hours[1]	0.26*	0.29*	--
	(0.13)	(0.13)	
Fert.[1]	0.02	-0.03	--
	(0.30)	(0.25)	
Machine Hours[1]	0.21	0.30*	--
	(0.11)	(0.10)	
Constant	2.12*	-0.50	-4.29*
	(0.76)	(1.12)	(0.69)
<u>Opp. Cost Labor</u>			
Area/Member	--	--	-0.02*
			(0.01)
Ag Area/Member	--	--	0.02
			(0.04)
<u>Controls</u>			
Region2	-1.06*	-0.89*	-0.63
	(0.32)	(0.30)	(0.36)
Region6	-0.13	-0.76	-0.59
	(0.26)	(0.26)	(0.37)
Season	-0.46	-0.62*	--
	(0.25)	(0.25)	
Crop Spec.[1]	0.24*	0.27*	--
	(0.14)	(0.09)	
<u>CAS Structure</u>			
Members[1]	--	0.55*	0.05*
		(0.21)	(0.13)
CAS Age	--	0.10*	0.20*
		(0.05)	(0.07)
Familianess[1]	--	-0.47*	-1.04*
		(0.15)	(0.42)
Class Origins	--	0.22*	-0.24*
		(0.08)	(0.11)
<u>Mgt Practice</u>			
Sanctions	--	-0.22*	-0.44*
		(0.10)	(0.13)
Supervision	--	-0.04	0.15
		(0.08)	(0.12)
Individualization	--	-0.28*	-0.09
		(0.08)	(0.12)
R^2	0.48	0.75	0.59
nobs	54	50	53

<u>Notes</u>

Figures in parentheses are estimated standard errors.

* Estimated coefficient is statistically different from zero at the 5% level.

1. Variable was entered in log form for the production function regressions.

TABLE 7
ESTIMATED IMPACT OF SANCTIONS ON LABOR MOBILIZATION AND YIELDS*

Coöp Size	Level of Sanctions		
	Low	Moderate	High
Small Coöp--10 socios			
Labor Mobilization (hours/mz)	133	210	331
Output (QQ/mz)	16.0	18.2	20.8
Medium Coöp--20 socios			
Labor Mobilization (hours/mz)	81	128	202
Output (QQ/mz)	20.2	23.1	26.4
Large Coöp--40 Socios			
Labor Mobilization (hours/mz)	30	47	75
Output (QQ/mz)	22.2	25.3	28.9

*Calculated base on the regression estimates in Table 6.

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