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ABBREVIATED ECONOMIC ANALYSIS OF THE SMALL FARMER DEVELOPMENT PROJECT (520-T-0233)

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May 1983

USAID/GUATEMALA

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EXECUTIVE SUMMARY

Because the original plan to conduct a four-week evaluation of Project 520-0233 with a four-man team was reduced to a three-week study by a one-man "team", the author had to make some drastic compromises with methodology. These included rapid visits to three or four sites for each type of activity (access roads, soil conservation, small-scale irrigation) and quick, informal interviews with participating farmers and other rural inhabitants to get their impressions of changes in agricultural yields and sales, family earnings, and other activities. Although the data were not always detailed and exact, at least they indicated orders of magnitude. If the information obtained from more than one source was consistent, it was accepted; if inconsistencies appeared, the alternative least favorable to the activities in question were chosen in order to reduce excessive bias in favor of the Project. In brief, the findings were as follows:

1. Rural Access Roads

- Road sub-projects in Region V tended to favor non-farmers. Commercial activities depending upon roads -- restaurants, stores, transportation firms -- and upon outside sales (including tourism) did well in the sites visited. Farmers producing only for family consumption before roads were built did little better afterwards, since transport costs had not been their main production constraint. However, instances were noted where, had the road been accompanied by other infrastructural improvements and technical assistance for the farmers (e.g., soil conservation and small-scale irrigation), the favorable impact of roads would have been much greater.

- Roads built under the Project have held up very well structurally, and they have been reasonably well maintained, although some local residents complained of problems during the rainy season on steep stretches.

- In parts of Region V and most of Region I, roads have contributed to increased agricultural activity. Savings in time previously needed to travel to markets over poor trails (about one person-day per week per family) and in transport costs resulted in up to 30% more produce getting to market in Region I.

- An unintended negative impact appears to be accelerated deforestation in some Region V sites as increased sales of charcoal and firewood — usually to truckers using the new roads -- have begun to deplete local forest resources.

2. Soil Conservation

- Where traditional crops continue to be raised on terraced land, output has risen by approximately 100%. The principal effect has been to reduce the amount participating families previously had been obliged to buy of staples such as corn, beans and squash, with little resulting change in dietary patterns or sales.

- Where non-traditional crops (mainly vegetables and some fruits) had been grown prior to terracing, yields have risen an average of 50% with terracing. Increases in cash earnings have been roughly proportional.

- Beneficiaries seem to be enthusiastic about terracing, taking pride in their work and frequently extending terracing without social payment.

3. Small-scale Irrigation

- In Region I all irrigation sites obtained water by gravity flow from springs via plastic piping to sprinkers. Where farmers have used irrigation to plant new vegetable and fruit crops, they have been able to get up to three harvests per year. Their earnings per unit

of land rose by as much as ten times the first year, ultimately stabilizing at levels approximating 600% of the pre-Project earnings from sales of traditional crops. Where farmers continued to plant traditional corn and beans, total output increases were reported to be about 150% due to the harvesting of a second, dry-season crop and a small (up to 20%) increase in overall yields due to a more regulated water supply. In some instances, it appeared that such farmers could benefit from assistance in diversifying their crops.

- Half of the sub-projects in Region V are serviced by electric pumps lifting water from nearby rivers. In such instances, electricity costs become an important cost of production, and there seems to be a problem with reliability of some pumps. Judging from experience in Rincon Grande and Santa Maria Cauque, the larger the sub-project, the better it is able to handle large electricity bills. In these two sites costs, while high, were offset by high returns from such non-traditional crops as strawberries, snow peas and chrysanthemums.

- In some instances (e.g., Lo de Silva in El Progreso Department) the favorable impact of gravity-flow irrigation is offset by poor access, excessive dependence upon traditional crops, and other related problems.

- In most instances gains in earnings have been at least 20% for farms with cash crops, and yields of corn and beans have approximately doubled for those participating farms which still fall within the "semi-subsistence" sector.

4. General Conclusions

- Maps prepared by Marko Ehrlich showing locations of soil conservation, small-scale irrigation, and rural access road activities indicate little overlapping; that is, sub-projects are rarely combined in one site. Instances were observed where impacts on yields and earnings would probably have been much greater had there been a more "integrated" approach.

- The pending AID Small Farmer Diversification Systems Project (520-0255) logically should be coordinated with soil conservation, small-scale irrigation, and rural access road activities. The largest gains in earnings were found in areas where irrigation was combined with crop diversification.

- Marketing considerations will become increasingly important as farm output continues to rise. Farmers have already noted that second and third-year price levels have significantly declined from high first-year levels, although not sufficiently to offset net gains in post-Project earnings. They have become aware that, within any given year, varying sowing and harvesting times helps "iron-out" seasonal price fluctuations. Strategies should be developed for maintaining existing markets and finding new ones for Project farmers.

- Future evaluations will be greatly improved if baseline studies are undertaken before work begins on new soil conservation, small-scale irrigation, and rural access road sub-projects.

- The "bottom line" is that all three kinds of sub-projects should be continued and expanded. The farmers accept them enthusiastically, and even in "worst-case" scenarios (where high costs and low gross earnings are assumed) real income gains have been substantial (e.g., 20% per year and greater). However, future sub-projects should be coordinated, crop diversification and marketing considerations should be given heavier weight than in the past, and systematic data collection from sub-project sites should be instituted, preferably under the supervision of the Ministry of Agriculture's Office of Sectoral Planning (USPADA) in cooperation with USAID.

SECTION I

INTRODUCTION

A. Background

During the three-week period May 2-24, 1983, I undertook an evaluation of three components of the AID Small Farmer Development Project (520-0233), specifically, soil conservation, small-scale irrigation, and rural access roads. At the outset, I should like to clarify the limitations which affected my evaluation.

First, I was a participant in the early stages of the Project from 1977 to 1981 as an advisor to the Guatemalan Ministry of Agriculture's Sectoral Planning Office (USPA, now USPADA). In that role, I spent considerable time in the field with the Project's soil conservation advisor (Jerry Arledge) and the irrigation advisor (Bert Embry). I formed a strong opinion at that time in favor of continuing and expanding the conservation and small-scale irrigation components, and I expressed that opinion during USAID/Guatemala's preliminary Country Development Strategy Statement (CDSS) meeting in January 1981. Consequently, I could be subject to the charge of bias in the present evaluation report.

Second, there was to have been a four-person team for this evaluation for which I was to undertake an economic assessment of the Project. Subsequent limitations imposed on funding, however, reduced the team to one member, namely me. This resulted in a simultaneous expansion and contraction of my responsibilities: an expansion of the scope of my investigations to include at least a few of the pertinent, non-economic aspects of the Project, and a contraction in the detail, rigor, and statistical reliability of my economic assessment.

Third, during my stay in Guatemala I was asked by USAID/Guatemala and ROCAP to undertake a number of additional tasks which, while individually not excessively time consuming, collectively reduced my time available for the Project evaluation by approximately two days.

B. Conceptual Framework

I was aware from the beginning that time was my biggest problem, and I set about organizing ways of offsetting both that constraint and any intrinsic bias that I might have about the Project.

A major problem affecting the Project throughout its lifetime has been the lack of baseline studies and interim evaluations. The reasons for this are beyond the scope of this study, but the consequence has been the insertion of an inevitable element of subjectivity in any attempts to evaluate the Project now. Only the most carefully designed and executed sample survey could hope to capture data sufficiently detailed to allow the usual calculations of economic impact (e.g., internal rates of return, social costs vs. social benefits). These would necessarily have to depend upon the memories of the respondents, both farmers and public sector officials.

Therefore, I decided on a different approach, one which would yield roughly accurate estimates of benefits in a relatively short time but which would guard against biasing the results excessively in favor of the Project. Together with Marko Ehrlich, a contractor preparing an environmental impact assessment of rural access roads for USAID/Guatemala, I decided upon the following set of "rules-of-thumb":

1. Instead of interviewing a statistically significant sample of the same kinds of individuals in the Project areas (e.g., farmers), I would seek out as many different kinds of people as possible (e.g., farmers, storekeepers, bus drivers). The reasoning was simply that if a consensus in favor of or against the Project activities (roads, terracing, irrigation) emerged from a widely heterogeneous group, there could be reasonable confidence in the information gathered.

2. While I would try to get precise data wherever possible, I would concentrate on (a) orders of magnitude and (b) trends in such things as cash incomes, yields, labor and other costs. In my experience, small farmers in Guatemala have excellent memories, but, like their counterparts everywhere, they tend to think about their individual activities as all-encompassing in terms of orders of magnitude. When pressed for exact figures, they will either toss out a quick estimate (which may be wildly inaccurate) or they will deliberate for more time than I had available.

3. I would seek data in the field before even looking at available data in Guatemala City. The Ministry of Agriculture's Extension Service (DIGESA) has produced numerous estimates of the changes brought about in agricultural yields and net earnings following the Project, and the National Agricultural Development Bank (BANDESA) has published a comprehensive set of production cost estimates by crop and by Department. Prior to looking at this information, however, I wanted to get at least rough estimates from the farmers themselves, especially since some time has passed since the DIGESA and BANDESA figures were published. Since only one or two years have passed since completion of the infrastructural work under the Project, I reasoned that markets, at least, were still structurally adjusting themselves in response to changed patterns and levels of agricultural production in the Project sites.

4. Whenever there appeared to be a conflict in the data, I would intentionally select the least favorable figure, that is, I would bias my results <u>against</u> the Project wherever I had a choice of estimates. That way, if my results were still positive or only marginally negative, decision makers could feel some confidence that the actual situation was better than the one I was describing.

Having followed the above rules, I would sort my information into broad "benefit" and "cost" streams by farm, regional, and national categories and by short versus long-run time spans.

C. Field Work

During my first week (May 2-6) I concentrated on rural access roads, since I had had the least experience with this component of the Project. Together with Marko Ehrlich and officials of the Direccion General de Caminos, I visited several roads completed under the Project in the Departments of Chimaltenango and Guatemala (See map). Mr. Ehrlich and I followed our plan to interview a wide variety of people at each site.

During this time, we decided on the need for a set of overlay maps of DIGESA Regions I and V showing the locations of each kind of activity — roads, soil conservation, irrigation (See Appendix A). These would be useful to us as a guide to sub-projects worth visiting, and as a method of vividly illustrating coordination — or lack of it — among the Project components. Mr. Ehrlich completed work on the maps within two weeks.

I spent my second week (May 9-13) visiting soil conservation and irrigation sites in Region I in the Quezaltenango and San Marcos Departments. Simultaneously, Mr. Ehrlich obtained some of the information I needed at each site he visited in the region.

During my third week (May 16-20) I visited soil conservation and irrigation sites in Region V in the Guatemala and El Progreso Departments.

During the final two days (May 23-24) I did some preliminary calculations and presented a rough estimate of my findings to Harry Wing, Cecil McFarland and other USAID/Guatemala officials during a debriefing session.

MAP 1

Departments of Guatemala

D. Sites Visited

During field work, I visited the following sites and activities:

1. RURAL ACCESS ROAD ACTIVITIES

Montufar - Los Pirir
Certo Alto - Los Ajvix
San Juan Sacatepequez - Los Yax
Las Barrancas
San Juan Ostuncalco - La Victoria

2. SOIL CONSERVATION ACTIVITIES

Los Encuentros
Xepaton, near Patzun
Various areas in the Department of Guatemala

3. SMALL-SCALE IRRIGATION ACTIVITIES

Santa Rita
San Juan Ostuncalco
Rincon Grande
Santiago Sacatepequez/Santa Maria Cauque
Lo de Silva, near Palencia/Los Mixcos

SECTION II

RURAL ACCESS ROADS

A. Short-Term Costs and Benefits

According to data supplied to USAID/Guatemala by the Guatemalan Ministry of Communications and Public Works, approximately 331 kilometers of access roads had been completed under the Project by 1982. Since the data is not organized strictly according to the regional systems used by the Ministry of Agriculture, and since there seems to be no very great differences from region to region in Project characteristics, I have summarized the information in USAID/Guatemala's possession in Table 1.

Table 1 - PROJECT CHARACTERISTICS

PROJECT ITEM	AVERAGE	RANGE	
		MINIMUM	MAXIMUM
Total number of sub-projects	58	---	
Total kilometers constructed	331	---	
Kilometers constructed per sub-project	5.7	1.6	15.0
Total cost for all sub-projects (Q.)	7,040,127	---	---
Cost per sub-project (Q.)	121,381	23,515	345,258
Cost per kilometer (Q.)	21,269	7,300	26,100
Total workers employed in any one day, all projects	3,132	---	---
Cost per worker, all projects (Q.)	2,248	786	7,826
Total man-days employed, all projects	590,489	---	---
Cost per man-day (Q.)	11.92	3.20	27.69
Man-days per sub-project	10,180	4,480	58,016
Man-days per kilometer	3,364	746	8,169
Number of months per sub-project	15	3	36

SOURCE: USAID/Guatemala

Before continuing, I should point out that these figures are suspect. In working with the data to calculate the composite figures on the preceding page, I came across instances where certain figures repeated themselves with suspicious regularity. For example, in calculating man-days per kilometer, I found no fewer than 18 sub-projects where the figure turned out to be exactly 2,170 and five projects where the figure was 5,120. Having had experience with data collected in Guatemala, this wasn't especially surprising, but it does indicate that the "official" data does not lend itself to sophisticated economic analysis.

Although I question the internal consistency of the data, my conversations with Marko Ehrlich and personal observations in the field indicate that the data roughly represent the correct orders of magnitude with respect to costs and numbers of workers. With this in mind, we can proceed cautiously.

In the medium-term (from 2 to 5 years) the initial benefit of the rural access roads sub-projects was intended to accrue to workers engaged in building the roads. Hence, the sub-projects were to be as labor-intensive as possible. The data indicate that, on the average, these sub-projects jointly employed 3,132 workers for 15 months; total cost per worker (not total wages) averaged Q.2,248 and total cost per man-day (not a daily wage) averaged Q.11.92.

Assuming at least three persons per household per worker (a husband, a wife and one child), approximately 9,400 persons benefitted from wages earned in road construction. The data at my disposal do not show how many of the 3,132 workers lived in the vicinity of the roads constructed (versus engineers and other technical personnel from outside the construction area), but I presume that most of them did and that they would benefit in the future from payments received for road maintenance. I understand that the maintenance program is presently under review.

From the viewpoint of road construction workers, the benefits of receiving wages for working on the roads would be offset by the opportunity cost of not working on their farms or of other alternative income-generating tasks. In theory, the alternative costs of working on the roads should not be high if the justification for constructing the road in a particular place is the prevalence of low incomes which exist there. Moreover, the worker/farmers are expected to benefit in the longer run from increased commerce which the road allegedly will bring. In practice, the fact that more than 3,000 people were willing to work on the roads suggests that the incomes earned exceeded existing alternatives during the periods of construction.

In the immediate term, the main cost to the national government were the wages paid to the workers and the cost of machinery and tools. In theory, these costs should be offset in the longer run by increased commercial activity, rising local incomes (theoretically leading to a larger tax base), and greater levels of rural savings which could be mobilized for additional capital formation.

B. Longer-Term Costs and Benefits

The ultimate purpose in building or improving a road, of course, is to make it easier and/or cheaper for people and things to go into and out of a given place. Good roads reduce transport costs, and if transport costs have been a barrier to the development of an area, a good road can promote development. Thus, my initial hypothesis was that a crude indicator of the success of a new road would be an increase in the volume and value of commodities moving into and out of the region serviced by the road and a consequent rise in the incomes of farmers and others living near the road.

What Marko Ehrlich and I found was that, in general, a new road by itself does indeed expand pre-existing commercial activity, but that it may have little impact on activities -- mainly agricultural -- constrained by other than transport costs. For example, in several sub-project areas in Region V we visited in the Department of Guatemala (Montufar-Los Pirir, Cerro Alto-Los Ajvix, San Juan Sacatepequez-Los Yax), we found evidence of vigorous new

commercial enterprises: new trucking and bussing firms, increased movement of local handicrafts and charcoal to the capital, increased roadside business, and longer and more frequent visits by government service personnel (DIGESA, Salud Publica, etc.). On the other hand, local farmers told us that prior to road construction they had barely grown enough on their dry, rocky soil to feed their families. Consequently, construction of the road had little impact on their income, because they still had no surplus to sell, either locally or elsewhere. The one exception we saw was an individual from the capital who, having purchased one of the few flat plots of land and having installed his own water system, was growing snow peas for export.

At Los Yax, previously a rather isolated Indian village, the main effects of the new road were increased sales of charcoal to intermediary truckers and a small increase in the number of children attending school near San Juan. There, too, the farmers were not able to produce enough surplus for sale to benefit directly from the road.

In the Western Highlands of Region I, however, transport costs seem to have been a greater constraining factor. Farmers in Las Barrancas (San Marcos Department) told us that, on the average, the new road saved them one day's labor time per week by permitting more rapid access to local markets. The cost of transport via bus along the new road ranged from Q.0.35 to Q.0.50 one way, depending on which market the farmers and/or their wives were bound for. Before road construction several hours on foot or on horseback were required each way to get to market. Assuming that most of the approximately 200 households in the Las Barrancas area saved at least one-half person-day per week due to the road, 100 person-days per week or 2,000 person-days per year (assuming a "low-technology" work year of only 150 days) are saved for the community by a three-kilometer stretch of road.

Wherever farmers had already been selling surplus output (or where they were capable of expanding production, given lower transport costs/times), we found that new or improved roads permitted them to bring up to 30% more

produce to market in any given time period, and reduced the costs of purchased inputs, such as chemical fertilizer and pesticides.

Mr. Ehrlich and I determined from the beginning, however, that few rural access road sub-projects coincided with soil conservation and/or irrigation sites. We were told by both DIGESA and Caminos personnel that the latter usually tried to accomodate Ministry of Agriculture requests for a road in a particular place, but that engineering considerations often ruled out certain locations. On the other hand, it was not clear to us that DIGESA has systematically included the pre-existence of a soil conservation or small-scale irrigation sub-project among its criteria for requesting an access road. While not all the soil conservation or irrigation sub-projects I saw needed a new access road, many of the road sub-projects I saw could have used a soil conservation/irrigation sub-project.

Some irrigation and conservation sub-projects would benefit from a road sub-project. For example, an irrigation sub-project in Lo de Silva (El Progreso Department) seems to be faltering in part due to the miserable state of the road connecting the community with the town of Palencia. The road is in such bad shape that DIGESA extensionists told me land values near the town are triple those further up the hill, even though the quality of the land itself is comparable. The community has other problems, of course, but the poor road contributes strongly to them.

In short, we concluded that the impact of the roads built to date has been positive but uneven, and it could have been much stronger with accompanying soils, irrigation, and other kinds of extension activities. Benefits have generally consisted of increased incomes to persons depending directly on the quality of the roads (truckers, bus operators, roadside businesses, businesses catering to tourists), increased agricultural output and sales for those farmers previously constrained principally by transport costs, and reduced travel times.

Longer-term costs are less tangible, but we found evidence of them. The most obvious of these have been some cases of increased deforestation of the areas penetrated by the roads. In Region V much of this is related to increased production and sale of charcoal, probably due to the region's proximity to the capital city and other urban areas. Also, some rural inhabitants interviewed in Region V mentioned to us an increase in out-migration to Guatemala City and smaller towns from regions serviced by new roads. It is too early to tell what the net effect of such migration will be. One could argue that there will be a longer-term effect leading to a rise in the local population as increased incomes from non-agricultural activities permit greater man/land ratios. In any case, the main negative impacts are likely to be environmental in the near future. The integrated approach recommended in Ehrlich's report (and in Section V below) would significantly reduce these.

C. Recommendations

1. Continue with rural access road sub-projects, but only in the context of an integrated package of sub-projects designed to maximize the potential positive impact of the road (e.g., connecting the road to the existing marketing network, complementary extension services to help farmers exploit the new road, complementary infrastructure such as water and terracing of hillside lands).

2. Insure that decisions regarding location of new roads are coordinated with decisions about priority areas for agricultural and health projects (e.g., the National Economic Planning Council, together with Agriculture and Health sector planning units and the Ministry of Communications and Public Works programming unit, should be encouraged to work out institutional machinery for flexibility in policy coordination, project design and execution).

Although I am not an engineer, I have travelled over a large number of "rural roads", and I was impresed by the quality of the Project-constructed roads I saw. Most were properly crowned and frequent culverts exist to insure adequate drainage. The only problem seems to be difficulty in maintaining the surface on steep grades during the rainy season -- a fairly frequent complaint of people we talked to. It seems to me that construction of cobble-and-cement "tracks", such as those still found on old colonial era roads, would solve that problem. Such tracks, while not "modern" or technologically sophisticated, provide a solid base for tires and seem to last forever.

SECTION III

SOIL CONSERVATION

A. Background

The term "soil conservation" broadly refers to activities designed to protect the qualities of a given area of land (mechanical, nutritive) from degradation due to environmental conditions and cultivation practices. Under this Project, the focus was upon reducing water erosion and increasing agricultural yields via promotion of contour cropping on gentle slopes and bench terracing on steep slopes (over approximately 10%). Since most land slopes in the Central and Western Highlands in Guatemala are more than 10%, and since most sub-project sites contained cultivated areas much steeper than that (up to 80%), bench terracing was and continues to be the primary focus of soil conservation practices in both Regions I and V.

A bench terrace, constructed along level contours of a hillside and characterized by a small "backslope" which encourages water to run away from the edge of the terrace back towards the hill, accomplishes the following:

- Reduction of hillside erosion, thus "conserving" the soil
- Reduction of fertilizer and pesticide runoff with rain, thus contributing to higher yields
- Increase in the effective cropping area of the original hillside plot, thus increasing the farm's land resources
- Increase in the planting density and in the variety of crops which can be sown on a given plot, thus increasing output and marketable surplus
- In conjunction with an assured water supply, an increase in flexibility regarding sowing and harvest times, thus enhancing the farmers' ability to take advantage of shifts in prices and other market conditions

Where soil is easily worked (this was the case in many conservation sites), the terraces can be constructed using the farmers' "digging hoe" and a simple "A" frame levelling device. To anchor the terraces, rye grass, elephant grass and other resiliant varieties of grasses are planted on the facing edges. In addition to protecting the terraces, this grass can be used as forage for cattle (which, of course, are themselves efficient generators of fertilizer).

Beyond providing direct technical assistance to farmers in constructing the terraces, DIGESA soil conservation extension workers have trained more than 50 local farmers (guias agricolas) to promote terracing among their neighbors in communities participating in the Project.

Finally, to compensate farmers for the time needed to terrace their hillside fields, the Project has included "social payments" for those willing to act as "pioneers" in their comunities. The payments have served to reduce the perceived risks of undertaking a significant investment in time and labor. In the longer run, it is expected that such payments would diminish as farmers' incomes improve and as they see advantages in further terracing on their own.

B. Short-Term Costs and Benefits

During my time in Guatemala, the only completed set of data from DIGESA concerning soil conservation available to me was a report entitled Breve Informe: Proyecto de Conservacion de Suelos which covers all projects completed or pending in Region I to date. This summary report gives data aggregated by Department. Assuming the data are approximately correct, they permit a rough estimate of the results of social payments in terms of areas terraced and farm families benefitted. Table 2 is a translated copy of Cuadro No. 1 from the report, showing by Department the numbers of sub-projects, total social payments, hectarage and numbers of families affected with and without social payments. From this I derived Table 3 which converts the data into percentages and average values per sub-project and per family.

Table 2 - SOCIAL PAYMENTS, AREAS TERRACED AND FAMILIES BENEFITTED BY DEPARTMENT IN REGION I (1978 - 1982)

DEPARTMENT	NUMBER OF PROJECTS	SOCIAL PAYMENTS (Q.)	HECTARES TERRACED			FAMILIES BENEFITTED		
			WITH SOCIAL PAYMENT	WITHOUT SOCIAL PAYMENT	TOTAL	WITH SOCIAL PAYMENT	WITHOUT SOCIAL PAYMENT	TOTAL
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Huehuetenango	28	34,906.82	86.23	51.52	137.75	440	97	537
Quezaltenango	72	43,371.43	154.48	28.50	183.34	310	104	414
El Quiche	13	7,744.00	23.51	12.97	36.48	185	49	234
Solola	34	14,486.47	60.52	26.16	86.72	219	102	321
Totonicapan	65	12,362.69	39.46	14.17	56.62	313	81	394
San Marcos	29	31,306.33	59.57	17.01	76.58	280	67	347
TOTAL REGION I	241	144,177.74	424.07	152.39	577.49	1,747	500	2,247

SOURCE: Cuadro No. 1, Breve Informe: Proyecto de Conservacion de Suelos, Ministerio de Agricultura, Ganaderia y Alimentacion, DIGESA, Region I, Quezaltenango (n.d.).

Table 3 - SOIL CONSERVATION IN REGION I — ADDITIONAL DATA

DEPARTMENT	NUMBER OF PROJECTS	HECTARES PER PROJECT	CUERDAS 1/ PER PROJECT	FAMILIES PER PROJECT	CUERDAS PER FAMILY	SOCIAL COST PER FAMILY (Q.) 2/	SOCIAL COST PER PROJECT (Q.)	SOCIAL COST PER CUERDA (Q.)	FAMILIES PAID (%)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Huehuetenango	28	4.9	112.7	19	5.9	79	1,247	11.00	82
Quezaltenango	72	2.5	57.5	6	10.0	140	602	10.30	75
El Quiche	13	2.8	64.4	18	3.6	42	596	9.20	79
Solola	34	2.6	59.8	9	6.2	66	426	7.30	68
Totonicapan	65	2.6	20.7	6	3.3	39	190	9.50	79
San Marcos	29	2.4	59.8	12	5.0	112	1,080	17.70	81
TOTAL REGION I	241	2.4	55.2	9	5.6	83	598	10.90	78

SOURCE: Derived from Table 2.

1/ One hectare = 25 cuerdas of 25 x 25 varas

2/ These data include only those families actually having received social payments; some families did not (see column 10).

I have used the data in Table 2 because the derived values shown in Table 3 which are based on them come close to the ones I've observed in the field -- number of families in a given sub-project area, surface terraced per sub-project and per family, and the approximate amounts of social payments per family (according to the responses of individual farmers interviewed).

It should be noted that the Project was intended to consist of a number of pilot activities of which soil conservation was one. It was not expected that all farms in a given area would necessarily be terraced by the end of the Project. Thus, the global averages of 9 families per site (Table 3, column 5) is not as trivial as it might seem to someone unacquainted with the levels of poverty found among these farmers. DIGESA extension workers told me that approximately 15% of all farmers in any one sub-project area have terraced to some extent, and new terraces are being constructed with the aid of guias agricolas independently of the Project. It should be noted, too, that approximately 22% of all farmers terracing have done so without any social payment at all (Table 3, column 10).

A total social payment cost of Q.144,000 for Region I over a four-year span (1978-1982) does not seem excessive, especially when that figure is expressed in terms of payments per cuerda (Q.10.90) or per family (Q.83). If we assume a low figure of three family members, the payments per capita come to Q.28. This payment is on a one-time basis; once constructed, the terraces are to be maintained by the farmers without further input from the government. Presumably the terraces will improve output enough to more than offset such maintenance costs as purchasing seed for the grass to be planted on the facing of the terraces and repair of occasional cave-ins and erosion channels.

The social payments presumably represent roughly the opportunity cost, as perceived by the farmers, of working on the terraces rather than on more traditional tasks. This could include an allowance for risk, at least at the beginning of the Project. Once farmers see what terracing can do for their yields, the risk element theoretically should diminish and the necessary

social payments with it. This does seem to be happening. Farmers I saw terracing in the Patzun/Lake Atitlan area were voluntarily extending areas initially terraced under the Project.

Thus, social payments in the short run are substitutes for alternative sources of income as the farmers see them; at the margin there would be no net benefit. In the longer term, of course, there is a net benefit, if the terraced land proves to be more profitable than it was unterraced.

From the government's standpoint, social payments (and salaries of extensionists, payments for vehicles and gas, etc.) are short-run costs which represent an investment one hopes will yield a longer-term social benefit to the country. As in the case of rural roads, any innovation which raises rural incomes will contribute to the rural sector's ability to accumulate capital and to the overall decline in the costs of feeding the population, including the urban/industrial sector. Viewed in this perspective, the government's expenditure to date in Region I does not seem unreasonable.

Unfortunately, I was unable to obtain detailed information on soil conservation sub-projects in Region V. However, I see no reason to believe those data to be significantly different. The terracing activity observed in Region V (near Patzun, San Juan Ostuncalco, and El Progreso) was similar to that in Region I and, if anything, the social costs should be even smaller. The land in the Western Highlands, especially in the San Marcos, Huehuetenango, and Quezaltenango Departments, can be difficult to manage, since it is steeper and more severely eroded to start with.

C. Longer-Term Costs and Benefits

Unfortunately, no baseline studies of pre-Project farming, marketing, and household consumption activities were made. To assess changes brought about by soil conservation in a short time requires faith in the memories and

veracity of both farmers and DIGESA extensionists. 1/ In Table 4 I have summarized information given me by farmers in both Region I and Region V concerning pre and post-terracing yields.

Table 4 - REPORTED INCREASES IN YIELDS PER CUERDA* OF CERTAIN CROPS FOLLOWING TERRACING IN REGION I AND REGION V

CROP	DATA REPORTED BY FARMERS		PROJECT DATA	DIGESA DATA	ARLEDGE REPORT
	PRE-PROJECT	POST-PROJECT			
CORN	2-3 qq	5-6 qq	100-133	50	141
BEANS	1.3 qq	3 qq	131	—	95
WHEAT	2.0 qq	3.5-5 qq	75-250	70	81
POTATOES	5-6 qq	9-11 qq	80-120	110	98
BROAD BEANS	1.5 qq	2 qq	33	—	—
ONIONS	5 qq	7 qq	40	—	—
GARLIC	4.5 qq	6 qq	38	—	—
CABBAGE	35 bunches	47 bunches	34	—	—
CARROTS	38 bunches	55 bunches	45	—	—

SOURCE: My own interviews, Breve Informe: Proyecto de Conservacion de Suelos, and Jerry Arledge's Informe Final.

* 1 cuerda = 25 x 25 varas = 0.043 hectare

1/ If time and resources permit, I would recommend a more detailed survey of (a) farmers having participated in the Project and (b) a set of closely-matched farmers who have not. This would probably require two or three months of field work, but it is something that the Guatemalans could do for themselves with a bit of instruction.

These data, sparse as they are, seem roughly of the same magnitude. Many of the farmers I spoke with have continued to raise the traditional corn, beans and wheat on their terraces, and there seems to be an overall consensus that yields of these crops have "about doubled". Other farmers, especially in Region V who already were growing non-traditional vegetable and root crops for cash prior to terracing, reported increases in yields varying from about 30% to nearly 100%. The following are additional non-traditional crops for which a scattering of farmers provided "on-the-road" estimated yield increases from 45% to 100%: radishes, strawberries, snow peas, lettuce, beets, and squash.

For the most part, farmers continuing to raise traditional crops on their terraces reported that, prior to terracing, their families had consumed most of their own output and often had to purchase additional corn and beans prior to the next harvest. Some of those living in the Patzun area (Region V) earned the necessary cash by seasonal migration to the coastal sugar and cotton plantations. With the increased output on their terraces, these farmers still seem to be consuming rather than selling corn and beans, but they are purchasing considerably less. A few indicated that they no longer migrate seasonally. 2/

Most of the conservation sites I visited during the evaluation (and, in fact, during my travels with Jerry Arledge) had no supplementary irrigation. Since the greatest increases in yields, incomes, and crop varieties appear in the irrigation sites, there is a strong likelihood that a combination of irrigation and terracing sub-projects would make the farmers I saw even better off than they presently are.

2/ One hypothesis that appears frequently is that innovation in the Highlands will raise the cost of labor in the lowlands because of the drying-up of seasonal migrants. If profitable labor-intensive crops continue to proliferate in the Highlands, this would seem to be a persuasive argument. It is certainly one meriting empirical investigation.

In sum, taking the lowest reported figures, terracing alone — without irrigation, additional access roads or crop diversification — permits a sustained increase in yields of traditional crops (corn, beans, wheat, potatoes) of about 75% and of vegetables of about 35%. In the case of the traditional crops, this additional output seems mainly to be consumed by the family, thereby releasing resources which otherwise would have been used to obtain additional food or for seasonal migration. Since most vegetable crops seem to be raised mainly for cash, the addition represents an increase in gross cash income, assuming no significant change in prices.

I asked most farmers what they did in instances where their cash incomes rose as a result of both soil conservation and irrigation sub-projects. I was interested specifically in whether or not their food consumption habits had changed. Surprisingly, very few farmers reported changing the pattern of their diets. Where the volume of traditional corn and beans rose as a result of terracing, families eat about the same daily diet as before but are not obliged to purchase as much of it as before. Farmers with cash crops tend to use the cash for specific purposes: some said that they spent the money on further improvements to their land and/or houses (i.e., investment); others said they used some of the increased earnings to hire an extra hand and let their older children go to school. Virtually no one said they bought more food, although I expect a more detailed survey would find that at least some of them did (e.g., snacks at the local store, extra liquor). This suggests a version of the "permanent-income" hypothesis: farmers are not sure that their recent gains in earnings are sufficiently permanent to justify significant intrafamily changes in habits, including diets. Instead, the money is used to finance deferred "one-shot" expenditures such as home repair, another year of school for the children, additional seed and fertilizer. This kind of information is very important from a development perspective, and the "tracking" of changes in household behavior with technological change is a major justification for baseline and follow-up studies. It is also a justification for using anthropologists and/or sociologists in future evaluations.

With respect to changes in cost, the most important of these in soil conservation sites seems to be increased labor. Aside from the labor needed to construct the terraces originally, the increased density of planting permitted by terracing requires more work at sowing and harvest time and more attention to interim weeding. When I asked how much labor was needed, I got answers ranging from 15% to 25% more than pre-Project levels where traditional crops were involved, and 50% or more where vegetable and root crops (intrinsically more labor intensive) were grown. In a few instances, farmers growing the latter reported increases in expenditure for fertilizer and pesticides, although still others reported a reduction in these costs due to the reduced levels of water runoff from the new terraces.

D. Recommendations

1. Continue with soil conservation sub-projects, with special emphasis upon training of additional guias agricolas.

2. Future soil conservation projects should be built in conjunction with irrigation and access roads sites wherever possible.

3. Where farmers continue to grow traditional crops on terraced land, follow-up extension services should be considered to help such farmers benefit from crop diversification.

SECTION IV

SMALL-SCALE IRRIGATION

The purpose of the irrigation component of this Project was to increase small-farm incomes by insuring a reliable supply of water throughout the calendar year via relatively inexpensive, simple technologies which exploit existing supplies of ground water and/or nearby river water.

In Region I, virtually all sub-projects use a gravity/sprinkler system whereby water from nearby springs is concentrated in a catchment basin and led to simple sprinkler systems via low-cost plastic piping. Aside from simplicity, this system has the virtue of very low maintenance costs, involving mainly the care of valves and the sprinker mechanisms. The mountainous terrain in Region I contains many springs with adequate water flow throughout the year.

In Region V, however, 10 of the 20 sub-projects involve pumping water from nearby rivers, often requiring electric pumps from 25 to 50 hp, in some cases two connected in series, to hoist water as much as 200 meters to the level of the fields. Three Region V sub-projects (El Tempisque, San Jose Pacul, and La Vega I) do not use sprinklers, the water being turned directly into furrows from small canals. Sub-projects involving pumping also involve significant maintenance and electricity costs.

A. Short-Term Costs and Benefits

Table 5 summarizes salient features of irrigation sub-projects in Regions I and V. Region I data at my disposal was broken down by Departments and the scale of operation there was larger than in Region V. Hence I have lumped the 20 Region V sub-projects together. Since this lumping tends to mask some of the higher costs of pumped irrigation sub-projects in Region V, I have broken out the latter and listed them in Table 6.

Table 5 - SMALL-SCALE IRRIGATION IN REGION I AND REGION V -- BASIC DATA

REGION/ DEPARTMENT	NUMBER OF PROJECTS	HECTARES IRRIGATED	CUERDAS 1/ IRRIGATED	COST OF MATERIALS (Q.)	COST PER CUERDA (Q.)	TOTAL FAMILIES BENEFITTED	COST PER FAMILY (Q.)	FAMILIES PER PROJECT
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
REGION I								
Huehuetenango	6	258.8	5,952	147,100	24.71	305	482.30	51
San Marcos	20	244.9	5,633	136,934	24.31	509	269.03	25
Quezaltenango	3	16.5	379	30,100	79.46	397	75.81	132
Totonicapan	1	3.7	85	1,600	18.80	8	200.00	8
TOTALS/AVERAGES	30	523.9	12,050	315,734	26.20	1,219	259.01	41
REGION V								
All Departments	20	172.2	3,961	188,559	47.61	349	540.28	17

SOURCES: DIGESA report sent to USAID/Guatemala by Ing. Agr. Francisco Jose Mazariegos on October 19, 1982 (tables on pages 3 and 4 containing data for Region V projects); the author's calculations.
DIGESA, El Sub-programa de Mini-riego: Sus Logros y su Necesidad de Implementacion — DIGESA Region I, November 1982 (tables on pages 5-7); the author's calculations.

1/ One hectare = 25 cuerdas of 25 x 25 varas

Table 6 - ELECTRIC PUMP IRRIGATION SUB-PROJECTS IN REGION V

SUB-PROJECT	COST OF MATERIALS (Q)	AREA IRRIGATED (Cuerdas) 1/	NO. OF FAMILIES	COST PER CUERDA (Q)	COST PER FAMILY (Q)
(1)	(2)	(3)	(4)	(5)	(6)
El Tempisque I	2,383	92	4	25.90	595.75
El Tempisque II	3,750	35	1	108.70	3,750.00
San Jose Pacul	3,876	58	7	66.83	553.71
Rincon Grande	30,500	460	46	66.30	663.04
Santa Maria Cauque	25,000	472	50	52.97	500.00
San Francisco	2,900	28	2	103.57	1,450.00
San Jose	4,100	58	2	70.69	2,050.00
Paso Ancho	2,400	46	2	52.17	1,200.00
Tempisque III	2,400	46	2	52.17	1,200.00
Santiago Sacatepequez	30,000	460	40	65.21	750.00
Tulio Garcia	1,000	81	11	12.35	90.91
AVERAGES	9,846	167	15	61.53	1,163.95

1/ One cuerda of 25 x 25 varas = 0.043 hectare

A comparison of the average cost of materials per irrigated cuerda of Q.26.20 in Region I (Table 5, column 6) with that of electric pump sub-projects of Q.61.53 per cuerda (Table 6, column 5) gives some idea of the differences between pump and gravity irrigation. The figures for average cost per family are even more striking (Q.259 for gravity vs. Q.1,164 for pump). Comparable figures for soil conservation social payments from Table 3 are Q.11 per terraced cuerda and Q.83 per participating family.

Costs of installation of pipes, catchments, pumps, sprinkers and other materials are financed by the individual families participating in the sub-projects, either individually or collectively with loans from BANDESA. In some of the larger-scale sub-projects such as Rincon Grande (Chimaltenango Department), participating families contributed labor to the construction of the system for laying pipe, aiding in the installation of pumps, etc. Participants also contribute to maintenance of the systems, with the help of teams of extensionists from DIGESA.

Unlike the soil conservation sub-projects, there are no "social payments" for irrigation sub-projects. BANDESA loans carry the immediate burden of the farmers' expenses, and at least those farmers I talked with did not seem to regard this work they did installing the systems as excessive. In the longer term, of course, the loans must be repaid out of the expected increases in earnings.

B. Longer-Term Costs and Benefits

Of the many impacts expected for small-scale irrigation sub-projects, the following three are especially important:

- A reliable year-round water supply permits significant diversification into a variety of crops, including fruits, vegetables, and tubers.
- For any given crop, two or more harvests per calendar year are possible; some vegetables can be harvested as many as four times per year.

- The farmer can, through diversification of his "expanded portfolio of crops", vary sowing and harvesting of certain crops to take advantage of price fluctuations; in the longer term, all farmers acting in this way should contribute to a reduction in traditional wide swings in commodity prices over any given calendar year.

In short, farm incomes are expected to rise and become more secure.

I was able to visit the following six irrigation sites where systems had been in operation for one year or more: Santa Rita, San Juan Ostuncalco, Santiago Sacatepequez, Santa Maria Cauque, Lo de Silva, and Rincon Grande.

Each of these sub-projects is different from the others, but collectively they give a feeling for how irrigation has affected yields, incomes, and participating farmers' outlooks.

Santa Rita is doubtless one of the more impressive sub-projects. This is partly due to the fact that this community of some 17 families lies along the main highway connecting the cities of Quezaltenango and San Marcos. Both are large vegetable and fruit market centers. Thus, this site is a good example of how a mix of more than one kind of activity (e.g., marketing, crop diversification and irrigation) can interact synergetically. The farmers in Santa Rita report that, prior to the Project, they were earning an average of Q.10 to Q.15 per cuerda from sales of surplus corn and beans. Since the average holding is 5 to 6 cuerdas, this amounted to a yearly cash income of Q.50 to Q.90. Additional cash income had to be earned from off-farm sources (including seasonal migration) and sale of handicraft. Following installation of gravity/sprinkler irrigation, most Santa Rita farmers began diversifying into such crops as cabbage, lettuce, carrots, onions, radishes, and garlic. Irrigation water permitted 2 to 3 crops per year for most of these crops, and sales to Quezaltenango and San Marcos were uninterrupted during the first year. Average earnings from land under the new crops rose to Q.80 to Q.100 per cuerda (counting sales from multiple crops during the calendar year), and several farmers gave up corn and beans entirely, preferring to purchase these in the market rather than "waste" irrigated land on them. In the second year, prices declined and total earnings fell to an average of Q.60 to Q.80 per cuerda.

Prices seem to be stabilizing for the present. Meanwhile, a farmer I talked with said that he and some of his neighbors were continuing to experiment with new crops and different sowing/harvesting times. In addition, some farmers were using their new earnings to purchase additional cattle, both for milk and reproduction purposes, as a source of additional income. Finally, most of the farmers at Santa Rita had received extension help in constructing compost pits to augment the quality and quantity of fertilizer.

In Santiago Sacatepequez and Santa Maria Cauque, areas of relatively flat land not far from Guatemala City, several of the crops presently irrigated were being sown prior to the Project. Here the main impact has been the opportunity to sow an extra harvest during the dry season: snow peas, radishes, lettuce, beets, carrots, guicoy, and watercress. The main cash crop -- snow peas -- now sells for about Q.150 per cuerda per year, up about 50% since installation of irrigation. In general, the "rule of thumb" is about 50% increase in earnings for most crops, since the second harvest does not bring as high prices as the original main harvest. Farmers in both areas commented on the decline in prices due to the increased supplies, but they emphasized that the decline has not been in proportion to the increase in marketed volume (i.e., total earnings are still significantly above pre-Project levels).

Both areas, however, are irrigated with electric pumps, and this has added to monthly costs of production. Labor requirements have increased by about 100%, counting additional time needed for second and third cropping, more attention given to field preparation and weeding, and occasional work on the irrigation system itself.

To give a simple example of how these farmers may be doing, given the "worst-case" situation, suppose a farmer with 10 cuerdas of snow peas had been earning the following before irrigation:

Gross income (10 cuerdas @ Q.100)		Q.1,000
Less costs:		
Fertilizers and		
Insecticides (10 cuerdas x Q.37)	Q.370	
Soil Preparation (10 cuerdas x Q.7)	70	- 440
		Q. 550

However, with irrigation and an extra crop:

Gross income (10 cuerdas @ Q.150)		Q.1,500
Less costs:		
Fertilizers and		
Insecticides (10 cuerdas x Q.56)	Q.560	
Soil preparation (10 cuerdas x Q.9)	90	
Electricity (10 cuerdas x Q.19)	190	- 840
		Q. 660

In this scenario, net income has gone up by Q.110 per year or by about 20% despite increased costs.

It should be emphasized that these figures do not take into account the opportunity cost of the farmer's extra labor time, nor extra earnings/costs associated with other crops.

Assuming the 20% figure to apply to all farmers in the Santiago Sacatepequez/Santa Maria Cauque areas, it is clear that irrigation has not had as strong an impact on net earnings as in Santa Rita. But Santa Rita does not have electricity costs. If we eliminated the Q.190 electricity costs above, the increase in net earnings would be Q.300 or 60%, a figure more in line with what I was hearing from farmers using a gravity flow-system. Nevertheless, a 20% gain, if sustained, is significant by most investment standards and is a low estimate.

San Juan Ostuncalco and Lo de Silva are examples of how, unless a good road exists and/or crop diversification takes place along with irrigation, there may be relatively little impact. Although a gravity-flow sub-project, San Juan was relatively costly -- Q.22,000 total costs of installation and materials, or Q.70 per cuerda and Q.73 per family — due to the large area irrigated (316 cuerdas) and the large number of households connected to the system (300). I originally visited this sub-project with Bert Embry about four years ago and remember being impressed with its scale; it is the largest single sub-project in the irrigation component of this Project. What struck me this time was the fact that, although the system is still functioning well and the farmers seem to be content with it, many are still sowing traditional corn and beans, similar to that in the terraced areas near Patzun. The ability to sow two staple crops instead of one in a given year and to get measurably better yields (10% to 20%) mean that farmers have more staples to eat and fewer to purchase. But it doesn't mean the impressive gains in cash incomes seen in other, diversified irrigation areas. The problem, according to three farmers I talked with, is the cost of getting produce out of the area to vegetable consuming centers like Quezaltenango or Guatemala City. Some farmers, however, are diversifying, judging from some of the fields I observed, and I suspect this giant sub-project deserves closer study.

In the case of Lo de Silva (a community near Palencia, El Progreso Department) a number of circumstances — including a very poor road, disputes over rights to water use from certain springs, plant diseases affecting the area's two main crops (guisquil and potatoes), and a decline in the national market for these same crops — have combined to cancel any advantages which the gravity-flow system may have contributed. The road is so bad that it took our four-wheel drive vehicle more than an hour to travel the relatively short 14 kilometers from Palencia to the far end of the sub-project area. An extension agent who accompanied us commented that land values fall by some 300% from plots near the town to similar plots near the end of the road. While we were unable to get good production data, it is clear that an improved road and help with crop diversification would be welcome.

Finally, Rincon Grande (near Zaragoza, Chimaltenango Department) -- with a reported gross income of Q.130,000 per year for its 46 families from the sale of strawberries, vegetables and flowers -- is certainly one of the more commercially active Indian regions participating in the irrigation system. It also has been experiencing some of the highest monthly electricity costs, about Q.5,000 per month, or some Q.30,000 per year, assuming irrigation during the full 6-month dry season. The farmers I talked to complained about this, but my impression was that the sub-project, nevertheless, has been moderately successful despite occasional problems with the electric pumps. I think a full economic analysis of this sub-project would be worthwhile to determine whether or not Q.5,000 per month is, in fact, excessive and, if so, how alternate power sources (e.g., wind) could be tapped for extra power generation.

In summary, where farmers have access to good roads and have been able to introduce a variety of short-season crops, irrigation has had a major impact on net earnings. Where traditional crops continue to be grown, the result has been similar to that found on terraces planted to the same crops -- approximately a doubling of total output over the calendar year due to at least one extra crop permitted by a reliable water supply. Only where a sub-project has been severely handicapped by lack of complementary infrastructure and/or resources, such as Lo de Silva, are the merits of even a gravity-flow irrigation system in doubt. Clearly, gravity-flow systems are more economical than pumping systems, but it is not clear that pump unreliability and seemingly high power costs have necessarily offset the gains in outpout and incomes generated by the irrigation. If pressed, I would say probably not. Even at Rincon Grande, the prosperous appearance of the farmers and the excellent condition of their fields and buildings suggests that they still are doing very well indeed.

C. Recommendations

1. Expand gravity-flow irrigation systems wherever reliable water sources can be found, especially in areas such as San Marcos where deforestation has severely diminished the quality of the land and the yields of even non-traditional crops.

2. As before, any new irrigation sub-project should be viewed in the total context of the agronomic and economic environment of the proposed site. Attention should be given to the quality of the road system nearby, the location of the markets for potential non-traditional crops, and whether or not terracing would be indicated. In short, irrigation should form part of an integrated package including soil conservation measures, crop diversification and roads.

3. Where electric pumps are needed, local opportunities to augment electric power supplies (windmills, pelton wheels) should be explored. Forms of irrigation other than sprinklers (e.g., trickle) should not be ignored in some cases where water might be saved through reduced evaporation.

SECTION V

CONCLUSIONS AND RECOMMENDATIONS

Given limitations on time and resources, this evaluation has unavoidably been sketchy and impressionistic. Fortunately, the kinds of activities discussed herein are conceptually simple and technologically straightforward. It does not require a great deal of economic or social sophistication to see the strengths and weaknesses of this Project.

A. Conclusions

First, it is clear that the majority of farmers participating in soil conservation and small-scale irrigation sub-projects have benefitted economically. Most are conscious of having made what they see as an important commitment in their lives, and many are beginning to make long-run adjustments in their work and lifestyles in response to gains in income. The few figures I was able to obtain directly from the farmers range from gains of 20% to [illegible] 6 00 in net income in the first two to four years following termination of the sub-projects. Even those continuing to sow traditional crops on newly-terraced or irrigated plots report an approximate doubling of total annual output.

As we have seen, rural access roads by themselves seem to benefit non-farmers more than farmers -- at least in the short run -- except in those areas where transport costs, rather than poor or insufficient land, are the principal barriers to expanded agricultural sales. In San Juan Ostuncalco and Lo de Silva, for example, there is evidence that improved roads and/or diversification would significantly increase the impact of the irrigation sub-projects there.

Second, there is evidence that most soil conservation, irrigation, and access road sub-projects would have had a much greater impact if they had been accompanied by complementary activities: terracing and irrigation, roads and terracing, all infrastructure projects coupled with crop diversification assistance, etc. As the maps prepared by Marko Ehrlich show (See Appendix A), most of DIGESA's and Caminos' sub-projects have been constructed independently of each other. While it is obvious that not all soil sites, for example, need a new road, or not all irrigated fields need to be terraced, both Mr. Ehrlich and I observed enough to convince us that attention to coordinated planning by DIGESA and Caminos will greatly increase the yield of their sub-projects in the future.

Third, since the overall number of farms participating in sub-projects was relatively small, the impact of their increased production on local markets so far has been small, but noticeable. Farmers in both Regions I and V commented on declines in prices in the year following their increased sales of crops from terraced/irrigated plots, and it was clear they understood why. Some even seem to have a dim sense of price elasticities in that they spoke of prices not declining as much as their saleable produce had increased. But, unless attention is given to new market channels for non-traditional crops, — both domestic and foreign -- the more trouble farmers will have clearing the local markets at prices which will motivate them to continue improving productivity.

Fourth, a complementary conclusion is that there should be coordination between the infrastructure sub-projects which have been discussed, on the one hand, and the up-coming Small Farmer Diversification Systems Project, on the other. For one thing, the largest gains in earnings encountered occurred on farms which have combined soil terracing or irrigation with crop diversification; the smallest gains were observed on farms which have not. Logically, the wider the range of crops the farmer has at his disposal, the greater the flexibility in response to fluctuating relative prices, the less prices will be likely to fluctuate, and the smaller the likelihood that prices of any single commodity will decline precipitously relative to others in the longer run. Finally, larger volumes of a wider variety of food crops will ultimately benefit the consumer via lower aggregate food costs and improved nutrition.

Fifth, the limited information I was able to compile regarding the impact of altered technology and enhanced incomes on the family life of partipating farmers suggests that, while family labor patterns have accomodated to the needs of the altered technology, traditional expenditure and consumption patterns have yet to adjust to enhanced incomes. For instance, soil terracing, irrigation and crop diversification have meant longer hours in the fields for the men; where vegetables and fruits have been introduced, women are busy preparing these for the market -- cleaning, sorting, bunching, storing. On the other hand, extra cash has been used mainly for reinvestment on the farm and/or to finance deferred "one-shot" expenditures (e.g., home repairs, a new cow, new clothes) and/or to send one or more children for an extra year of schooling. None reported significant changes in diet, although a few farmers at Santa Rita said they were "eating a little more vegetables" than before.

Nevertheless, there is definitely a need for a closer look at intrafamily changes accompanying these sub-projects, both now and in the future as families continue to adjust. Among other things, we need to know not only how a family adjusts, but how long the adjustment takes, how changes in expenditures will affect the markets for commodities purchased, how changes in consumption affect the health of family members (and the quality of agricultural labor), and how all these things are likely to interact with other projects (e.g., health, home economics, education) affecting the family.

Sixth, there is a serious lack of hard data concerning all sub-projects under this Project. No baseline studies were made back in 1977, and only one was attempted by the Ministry of Agriculture in 1979 (Santa Rita). This by itself need not have been a calamity, had there been time to make a detailed survey of both participating and non-participating farm households later in order to do an indirect comparison of pre and post-Project farm characteristics. But lacking time for that, these findings have been sketchy and the conclusions necessarily broad. There definitely should be baseline studies made of farms in future soil conservation, small-scale irrigation, roads and diversification sites. This is the sort of thing planning units

should be able to coordinate and oversee, and the USPADA is no exception, especially since it supervises a well-established area sample frame. The studies themselves need not be exhaustive; doubly stratified samples (by site and by farms within sites) chosen for each region (I and V) with carefully worded questions designed to capture both production and household characteristics (including family expenditures) would be sufficient and well within USPADA's capabilities with some technical assistance, say, from USDA/SRS. If done well, final evaluations would be immeasurably improved and simplified, and USAID could start lobbying Washington earlier and more effectively.

Seventh, the field personnel I encountered in both DIGESA and Caminos, both in Region I and Region V were, without exception, hard-working, competent technicians who enjoy an informal and friendly relationship with the farmers we encountered in the sub-projects under their supervison. Judging from what I observed, I can only echo Bert Embry's positive comments about the continuing momentum of the soil conservation and irrigation sub-projects. Especially impressive has been the "guia agricola" system, designed to enhance acceptance by local farmers and to relieve extensionists of the burden of frequent visits to many sites. In a different context, I heard the Vice Minister of Agriculture comment that the Ministry's goal is to broaden local participation and leadership in the implementation of rural development projects, a policy I solidly endorse.

Eighth, at the risk of being accused of polishing apples, I want to go on record here as having been agreeably surprised at the interest taken in my field work by USAID officials, especially "Doc" Odle, Cecil McFarland, and George Like, and their willingness to visit the field themselves. This is in very pleasant contrast to my experience in Guatemala and elsewhere in years past. There is no substitute for direct, personal contact with project sites and participating families from time to time to "flesh out" dry reports and columns of data. Equally important, if not more so, is the need to encourage Guatemalan planners and public sector officials to do the same thing. The ones I know who have done this have acquired a sense of commitment to their work they hadn't had before.

B. Recommendations

In summary, my recommendations are as follows:

1. Move ahead with sub-projects to expand soil conservation, small-scale irrigation, and rural access roads. Such projects, even undertaken in isolation from each other, have been profitable in most instances, and the changes they impose on beneficiaries have been acceptable and often enthusiastically received.

2. Future sub-projects should be coordinated wherever it is clear that an integrated approach is indicated.

3. Baseline studies should be made of selected sites (selected randomly or by some carefully considered criteria), and sites for all kinds of activities -- including crop diversification and marketing -- should be reconsidered on the basis of a systems analysis of longer-term strategies for the Highlands. (Incidentally, studies and coordination should include activities promoted not only by the GOG and USAID but all other significant donor agencies, such as IDB, FAO, IICA, etc.).

4. There should be additional assistance to enhance the capability of USPADA and the National Economic Planning Council to coordinate, monitor, and evaluate integrated rural development projects.

SECTION VI

MINIMUM CRITERIA FOR ECONOMIC STUDIES OF INFRASTRUCTURE PROJECTS

A proper economic study of a project, whether it be a feasibility assessment or a final evaluation, would seek to determine its "cost effectiveness" or "economic efficiency", that is, the spread (presumably positive) between the value of the project outputs in comparison with the value of its inputs and to compare this with similar calculations for alternative projects or activities, either in the same place or elsewhere.

This sounds simple on the face of it, but in practice project design and justification can be a very complex business. Much depends upon the definition and context of terms like "efficiency" and "cost effective", and upon whose definitions are used. For budgetable time periods like one year, it is fairly easy to define costs of resources to be used for the project. Complications arise in attempts to define returns when they are expected to be more than strictly economic and to accrue over extended time periods.

For rural infrastructure projects such as access roads, hillside terracing, and simple irrigation, economic costs in the short run include those of initial construction and (possibly) curtailment of other activities through switching resources to road, terrace, or irrigation system construction, (i.e., opportunity costs). In the longer term, recurring costs include operation and repair.

In the case of returns, it is necessary to make three distinctions: (a) returns to whom? (b) returns over what time period? (c) what kind of returns (economic, social, environmental)?

The simplest case from a narrowly economic point of view is the small-scale activity. Participating farmers — individually or collectively -- take out twenty-year BANDESA loans to finance installation of pipes, sprinkers, pumping systems, catchment construction, etc. The cost to the Bank is the initial opportunity cost of lending money to specific groups for this purpose rather than doing something else with it. Over twenty years, the minimum expected return to the Bank should be 5% per year. Since, according to Embry, many irrigating farmers have been paying off their loans much faster than this, the Bank's rate of return is correspondingly higher.

But since BANDESA is a government bank, this really means that the GOG gets the return. Again, whether or not this represents an economic gain or a loss (i.e., a subsidy) depends on what BANDESA/GOG could get for the funds used for other purposes. If the economic opportunity costs exceed the returns from investment in small-scale irrigation, then other than strictly economic criteria enter the equation, and we need to look at longer-term development strategies and project priorities. If, on the other hand, investment in irrigation does represent the best economic return, then the overall gain to the GOG will depend on what is subsequently done with the government's "profits" and on the long-run impact on Guatemala's economy and society of irrigated farmlands. Farmers with higher incomes can pay higher taxes and they can save. Higher taxes mean higher government revenues, and higher savings mean more rural capital available for further investments in all sectors, both public and private.

For the farmer, the long-term costs of irrigating include amortization of loans, maintenance and repair costs for the irrigation system, plus costs of any additional inputs necessitated by altered cropping patterns and new production techniques (e.g., fertilizers, pesticides, opportunity costs of additional labor). To cover these additional costs over a twenty-year span (or less), he expects an increase in annual earnings of at least 5% or more in order to make the change worthwhile in the first place. The precise figure for an acceptable rate of return for the farmer also will be a function of certain intangibles; his perception of risk and his desire for the increased

security that dependable water and more stable market prices presumably will bring are probably the most important of these. Others include attitudes towards self-improvement, consumption propensities and elasticities. Some of these things can be estimated through sample surveys undertaken as part of baseline studies. Since much of development involves changing some of the basic parameters of a society (e.g., consumption elasticities, production functions), such studies -- before, during, and after a project -- should be integral parts of a project.

Soil conservation projects in principle involve consideration of the same kinds of variables as those for irrigation projects. In practice, the analysis is simplified from the viewpoint of costs and returns to the government. Terracing is very labor intensive, and it was originally thought that farmers would have to be subsidized by the government ("social payments") to get farmers to take enough time off from their other tasks to build terraces. While this was initially true, there is evidence now that the farmers' main concern is not labor itself (i.e., the opportunity cost of terrace construction) but risk. Once farmers begin to see the advantages terracing brings, they continue to build them without additional inducements. We have seen that more than one-fifth of the terraces completed under Project 520-0233 did not require social payments, and, according to Embry, this trend is continuing. As a matter of fact, it is possible to overestimate the opportunity costs of terrace building in the first place, since studies have shown that traditional, near-subsistence farmers have literally months of idle time between sowing and harvesting of traditional crops.

In the longer run, the farmer doesn't have to amortize his terrace building labor. However, even if he continues to plant corn and beans on the terraces, he will have more work to do than before -- including maintenance of the terraces, more dense planting of individual crops, greater attention to weeding and compost management, and, possibly greater applications of chemical fertilizers and pesticides. Moreover, if the terraces absorb enough water, more than one corn crop per year may be possible. The offset, again, will be increased earnings (if crop surplusses are marketed) and/or increased

consumption (if surplusses are consumed at home or if the family splits the difference between increased sales and consumption). Again, the marginal return that will induce the farmer to make the change is difficult to measure without asking him, (i.e., undertaking carefully structured baseline studies).

The sketchy evidence from this evaluation suggests that 20% increases in annual earnings or less is a conservative estimate of returns to farmers of irrigation and soil conservation activities. How much less than 20% which would continue to motivate farmers needs to be determined in specific cases. If market prices for commodities produced by participating farmers begin to fall, such questions will be of more than academic interest.

Access road projects are more difficult to evaluate, since many kinds of people and enterprises are affected by them and since they span relative large distances. Roads are effectively "public domain", and although initial construction costs can be readily quantified, how these costs are to be amortized and who will be responsible for maintenance are debatable issues. The GOG seems to have adopted a relatively straightforward division of responsibility: the government will build (or renovate) the road and major infrastructural items such as bridges and culverts, while local residents and users will be responsible for routine maintenance (filling potholes, removing stones, digging out from minor slides). An issue right now is whether or not to pay the latter for these activities and, if so, how much and over what lengths of road would individuals/communities have responsibility.

Whether or not they participate in maintenance, users of the road presumably will benefit from increased earnings via lower transport costs and a rise in the volume of potential transiting customers. The impact upon each kind of enterprise would have to be estimated separately, since each will enjoy a different kind of utility from the road. Farmers presumably would benefit from easier physical access to traditional market centers and access to new ones; this was the benefit I heard cited most often by the farmers themselves, especialy in Region I. However, it has been seen that farmers may not benefit at all, if transport costs are not their principal barrier to increased production.

From a national point of view, roads stimulate commercial activity, raise incomes and broaden savings and tax bases. They also are essential complements to any activities undertaken to assist communities in remote locations, including extension, soil conservation, irrigation and health projects. We have also seen that roads can cost the nation trees and other forms of environmental quality. The acceleration of deforestation observed in the vicinity of new roads is more than merely an academic, environmentalist matter. If unchecked, it can lead to serious offsets to any gains engendered by other development projects, as the terrible erosion and desertification of western San Marcos attest.

All of these considerations make life difficult for the economist. If he wishes to make a real contribution to development analysis, the economist is obliged to recognize that an optimum, all-encompassing strategy for development will involve less-than-optimum economic components in some instances. If optimum economic strategies are not consistent with existing political realities or if they conflict with desired social changes, trade-offs need to be recognized and balances struck. Nevertheless, it is the responsibility of the development economist to point out where strategies involve compromises with economic optima so that decision makers will understand and properly weigh the economic consequences of their policies.

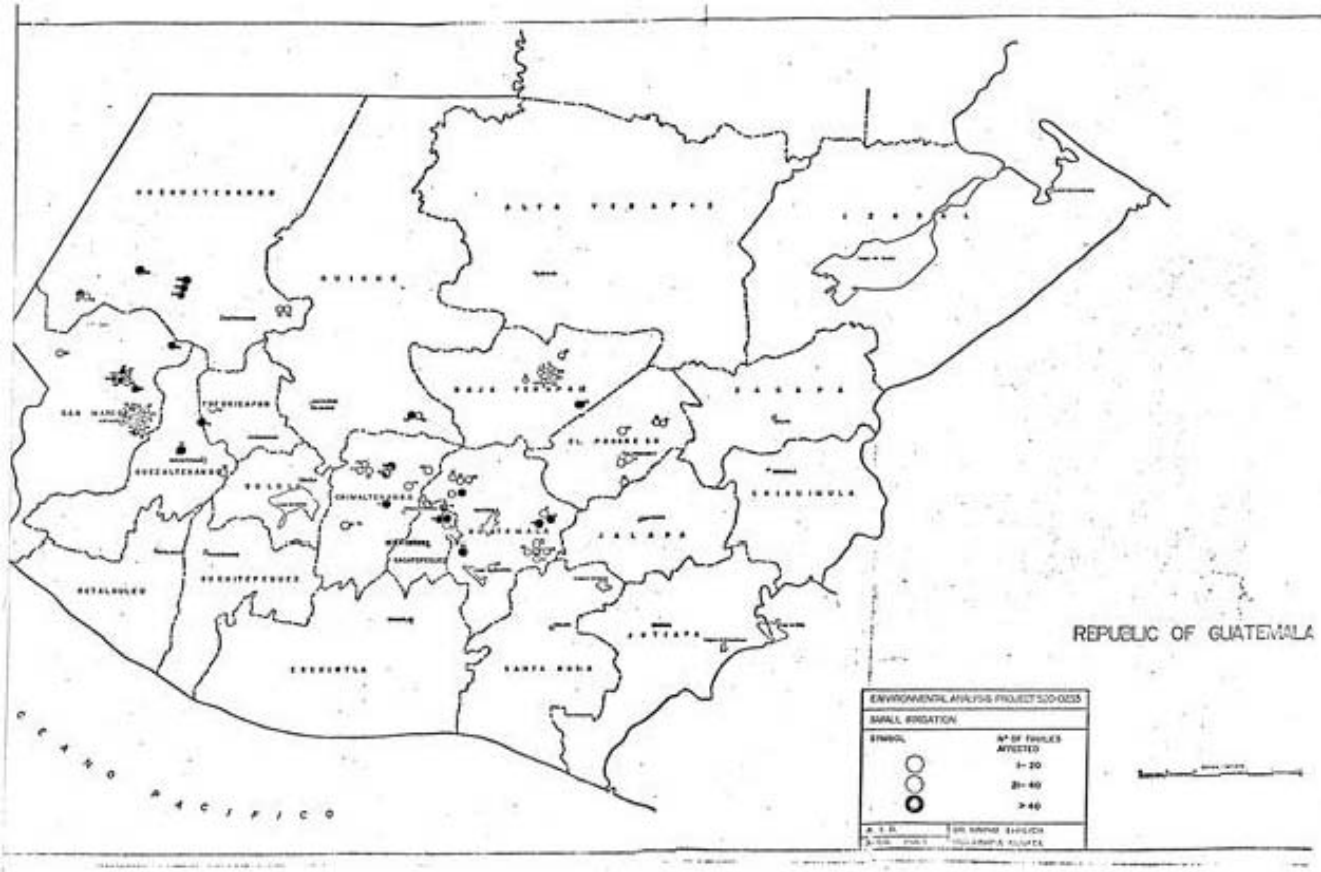
To help sort out some of these things, I have listed them schematically in Table 7. For each of the items listed (the list is not intended to be exhaustive), a quantifiable indicator should be specified (as is done in logframes, for example). In general, the items listed under "long term" are related to project GOALS, and the "short term" items to project PURPOSE(S).

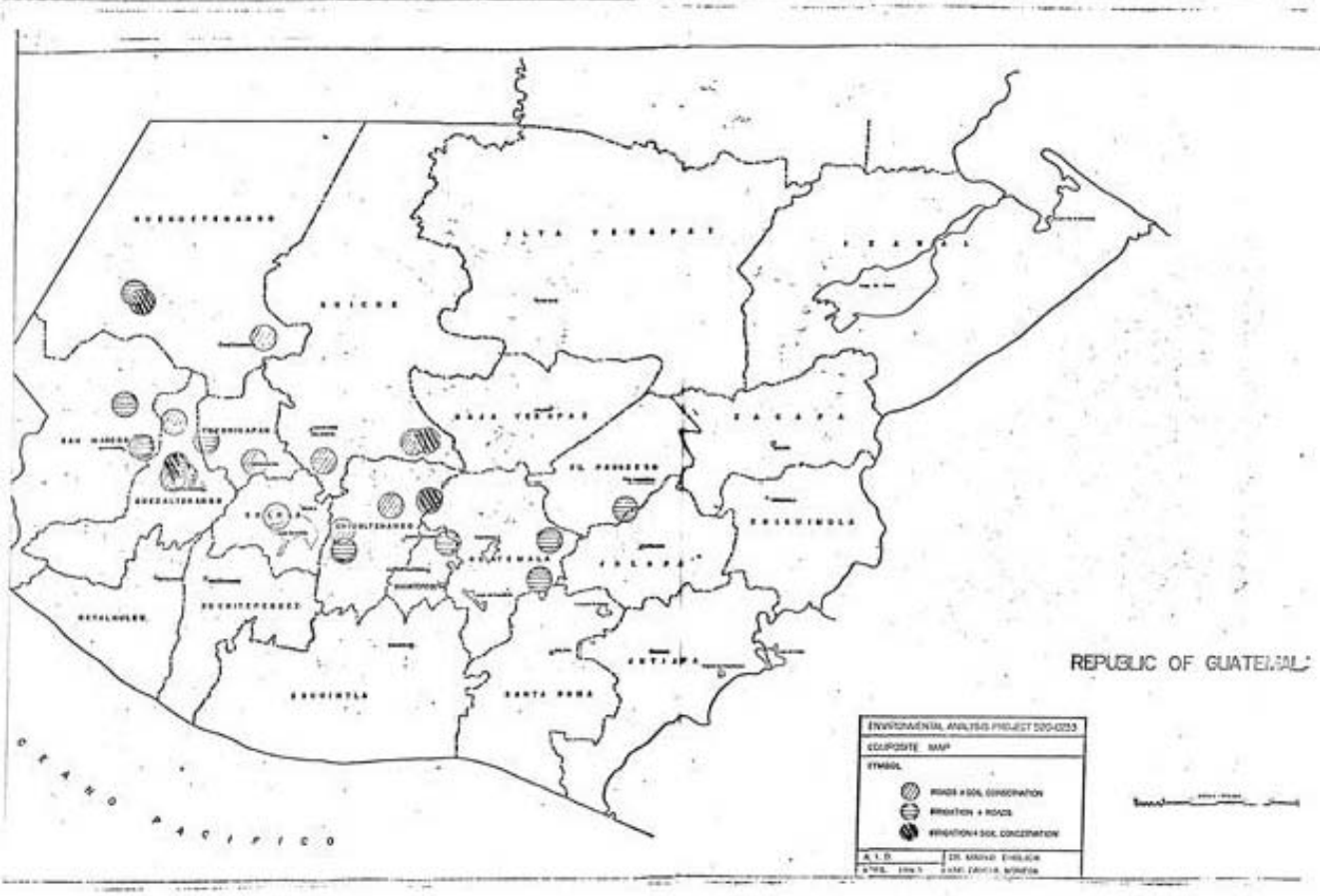
Whatever variables and indicators are used, I hope I've made clear the most important thing I think we can do at the outset: get enough data and qualitative information about prospective project sites so that intelligent decisions can be made about (a) priorities (geographic, project, time), (b) resources needed for given sub-projects vs. returns to be expected, and (c) ways and means of combining two or more sub-projects at the same site where

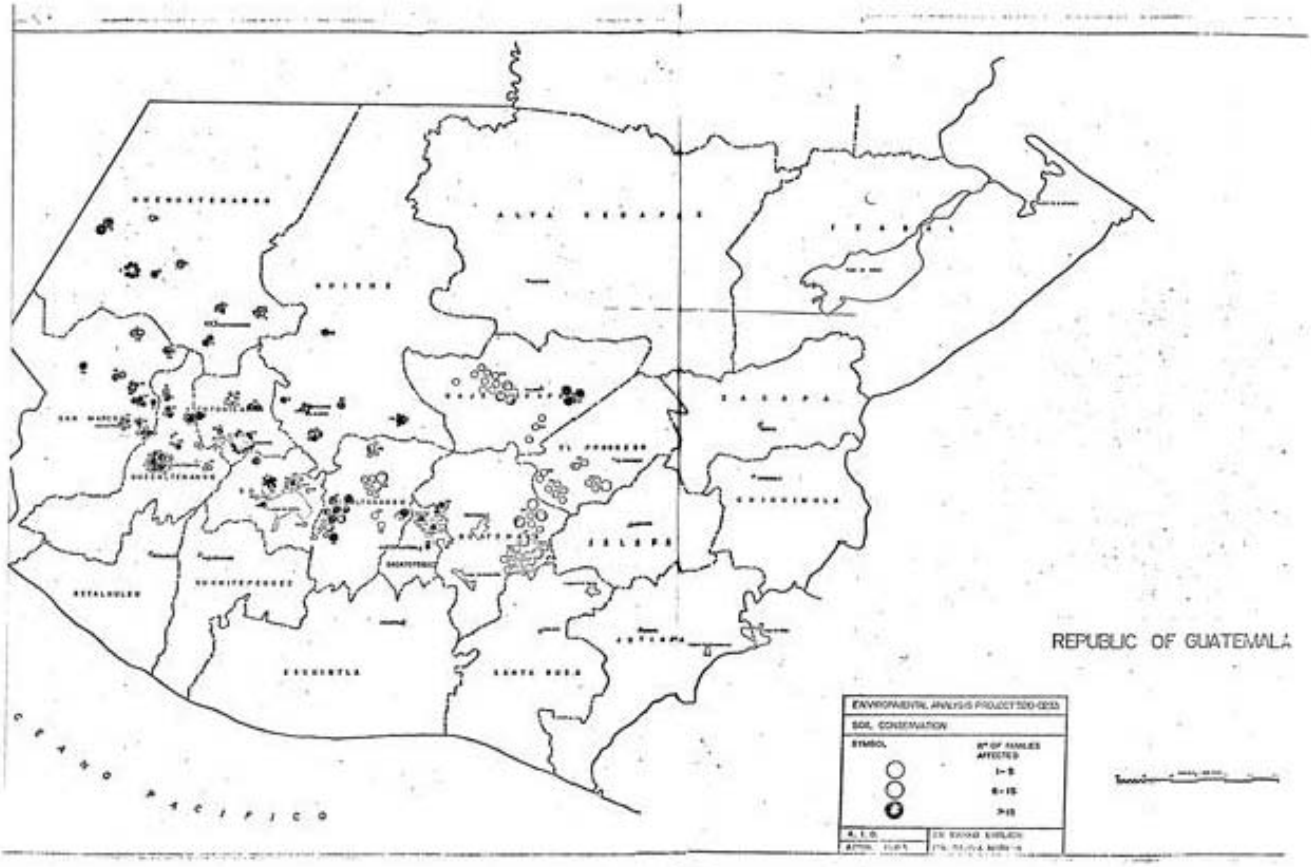
needed. Baseline studies can also yield clues about the kinds of institutional structures and resources needed to implement and manage projects in the field, that is, ways of improving the performance of DIGESA, Caminos and other public sector personnel.

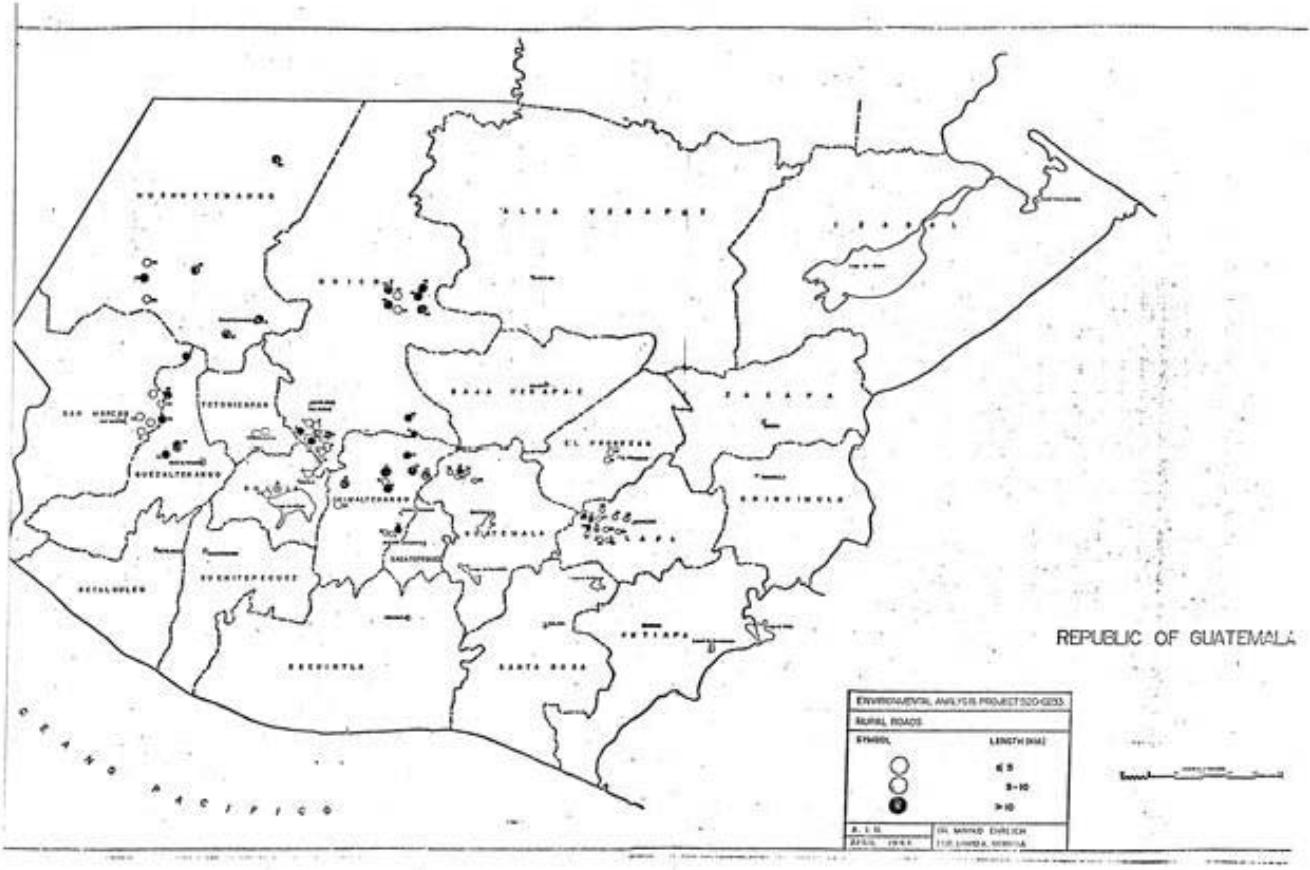
ANNEX 7 - SOME ECONOMIC SYSTEMS INCLUDING SOIL CONSERVATION, [illegible]

KIND OF PROJECT	SCALE	PRIVATE [illegible]		SOCIAL BENEFITS & COSTS	
		BENEFITS	COSTS	BENEFITS	COSTS
SOIL CONSERVATION	SHORT TERM (1-3yr)	50% increase in yields traditional crops (corn and beans) 50% increase in yields vegetables and root crops; Sustained increase in earnings and/or consumption; Increased use of family labor, less "under employment"; Improved production efficiency overall: more output for given inputs.	Initial labor of constructing terraces (if not offset by social payments); Increased production costs stemming from additional inputs to traditional crops and fertilizers, seed, pesticides on new crops; Risk of decline in earnings from sales as prices fall in response to aggregate increases in supply.	Increased and more reliable supplies of food to both rural and urban sectors; Increased incomes for farmers; Increased overall commercial activity as farmers spend their increased incomes; More efficient use of national agricultural resources; Increased prospects for food exports and exchange savings from reduced food imports.	Social payments made to cover farmers' opportunity costs in building terraces; Need for greater investment in complementary activities: roads, irrigation, extension services and accompanying institutional improvements.
	LONG TERM (Over 5yr)	Improved farm family food consumption and nutritional status; Increased specialization in production for market; less dependence upon traditional "milpa" agriculture; Smaller families; Increased rate of savings and returns from saving	Increased tendency to purchase relatively costly processed food; Greater vulnerability to market forces, less self-reliance.	Lower overall costs of food, especially to urban/industrial sector; Shift of grain crops to coast, labor-intensive fruits/vegetables/roots to highlands; promotion of private agroindustry; Improved general public health and physical quality of labor--increased returns to investments in education and health programs; Lower population growth; Lower capital costs due to increased rural savings rates; Increased sales of consumer goods and agricultural inputs to rural sector; Increased flow of labor from rural to urban areas.	Greater dependence on international markets; Increases in sizes and capitalization of farms; reduced farm and increased urban population; Risk of urban unemployment
MINI-SCALE IRRIGATION	SHORT TERM	Increase from one to two crops per calendar year of traditional corn and bean crops; Increase in variety of crops--fruits, vegetables, roots; 3-4 crops per calendar year; Sustained increases in earnings from sales; ability to take advantage of shifts in relative food prices by altering sowing and harvesting times; Improved drinking water and sanitation.	Amortization of loan contracted to finance construction and materials. Monthly electricity charges (where water is pumped only); Maintenance of pipes, catchment, sprinklers; Increased production costs stemming from additional inputs to traditional crops and fertilizers, seed, pesticides for new crops; Risk of decline in earnings from sales as prices fall in response to aggregate increases in supply; Maintenance of pumps (where applicible).	Returns to BANDESA from loans made to finance installation of irrigation systems; Increased and more reliable supplies of food to both rural and urban sectors; etc. (same as for conservation projects)	Essentially the same as for soil conservation projects.
	LONG TERM	More efficient use of water resources within the household; improved family health; Greater prospects for family employment (e.g., in agroindustry, off-farm work, etc.).	Increased likelihood of purchasing more expensive processed foods.	More stable seasonal and secular prices; More efficient use of national water resources; etc. (Same as for Conservation projects)	(Same as for conservation projects)
RURAL ACCESS ROADS	SHORT TERM	Increased commercial activity for roadside business and connecting urban areas; Lowered transport costs for agricultural and other commodities and for passengers (busses); Stimulation of new agricultural and supporting commercial activity.	Increased variable costs of commercial enterprises stimulated by roads; Labor contributed by residents for road maintenance.	Accelerated commercial activity in areas serviced by roads and increased incomes generally; Improved articulation and coordination of national road system; Stimulation of new kinds of commercial and agricultural activity.	Accelerated deforestation; Unpredictable shifts in population through migration--rapid movement of farmers to city, increased density of overall population in rural areas; Increased costs of maintenance of road system and related infrastructure;
	LONG TERM	Sustained higher incomes for all local residents Increased opportunities for children to go to school and for household to [illegible]	Road maintenance (via contributed labor or increased taxes).	Increased incomes throughout system; Increased articulation and coordination of nation's marketing system: agricultural and nonagricultural commodities; Improved food storage	Accelerated exploitation of land resources--trees, water; Need to divert development resources to maintenance of system (especially bridges and culverts).


REPUBLIC OF GUATEMALA
ENVIRONMENTAL ANALYSIS PROJECT 520-0253
SMALL IRRIGATION
SYMBOL
Nº OF FAMILIES AFFECTED
1- 20
21- 40
> 40
A. I. D.
OCEANO PACIFICO


REPUBLIC OF GUATEMALA
ENVIRONMENTAL ANALYSIS PROJECT 520-0253
COUPOSITE MAP
SYMBOL
IRRIGATION + SOIL CONSERVATION
A. I. D.
OCEANO PACIFICO


REPUBLIC OF GUATEMALA
ENVIRONMENTAL ANALYSIS PROJECT 520-0233
SOIL CONSERVATION
SYMBOL
Nº OF FAMILIES AFFECTED
1-5
6-15
>15
OCEANO PACIFICO


REPUBLIC OF GUATEMALA
ENVIRONMENTAL ANALYSIS PROJECT 520-0233
RURAL ROADS
SYMBOL
LENGTH (KM)
≤ 5
5-10
>10
OCEANO PACIFICO