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COST RECOVERY
FOR
THE LEZIRIA GRANDE PROJECT
a case study of a rehabilitation project in Portugal

by

C. de Jong & L.H. Sprey

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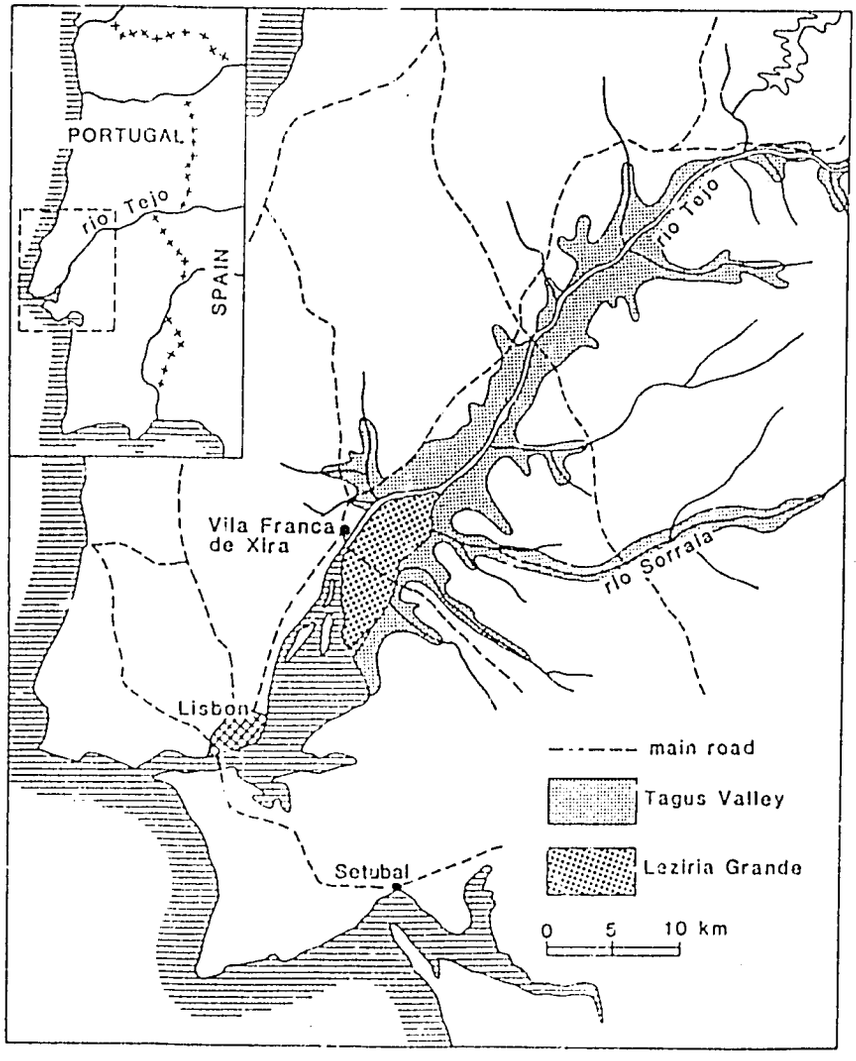

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SUMMARY

In the context of a case study of the Lezíria Grande Project in Portugal, this paper analyses some aspects of cost recovery. The data for the case study were derived from a comprehensive feasibility study, done in the period 1976-1981. Normal feasibility studies usually provide sufficient data to design an equitable repayment system.

In search of a system that would result in equitable sharing of project benefits between the State and the beneficiaries in different income classes, the paper analyses and evaluates the effect of different systems of cost-recovery charges on farmers' net profit and on local income distribution.

Two cost-recovery systems are compared:

- Average cost pricing, based on cost considerations only. If full cost recovery is pursued, this system easily leads to overcharging of large groups of farmers;
- Benefit pricing, based on farmers' repayment capacity. This system results in a high rate of cost recovery, leaving ample incentive.

Differentiation of rates according to differences in project rent have a positive effect on the cost-recovery rate.

Cost recovery through benefit pricing can also be used as a policy tool in the pursuance of efficiency and equity. Charging different rates according to potential use, rather than actual use, stimulates an efficient use of the project's facilities, whilst differentiation of charges considerably influences income distribution.

Administrative ease calls for a limited number of different rates, and prohibits an annual indexation for inflation. Levying only three rates, to be updated for inflation every 5 years, simplifies administration but severely reduces the cost-recovery rate.

1 INTRODUCTION

1.1 Objective and scope

In search of a repayment system that would result in equitable sharing of project benefits between the State and the project beneficiaries in varying income classes, we have analysed and evaluated the effects of different systems of cost recovery on farmers' net profit and on local income distribution.

1.2 Data base

The data we used for our case study were taken from a comprehensive feasibility study that was made to evaluate and compare alternative plans to improve the existing water-management system in the Lezíria Grande Project in Portugal. The feasibility study was based on extensive investigations that had been conducted from 1976 to 1981. The data were analysed on the basis of soil types, in line with FAO's "Framework for Land Evaluation", so a large data base was generated and a great many soil types were distinguished. A normal feasibility study would distinguish no more than two or three soil types.
To simplify the case study, we aggregated the identified soil types into six major groups, whose production potential we considered adequately homogeneous. A further simplification is that, of the five alternative improvement plans, we chose that of the rehabilitation of the existing compound irrigation and drainage system.

2 THE PROJECT AREA

2.1 General

The Lezíria Grande, near the town of Vila Franca de Xira, is a reclaimed tidal flood plain of some 13,000 ha in the highest part of the estuary of the River Tagus, about 25 km upstream from Lisbon (see front cover).
The climate is Mediterranean. The average annual rainfall is 700 mm,

most of which falls between October and March. From April to October, there is a moisture deficit.

About 20 per cent of the area is covered by light-to-medium-textured, mainly fluvial deposits; the remaining 80 per cent is heavy-textured marine deposits, most of which are moderately to very saline. The lighter, non-saline soils are found exclusively in the northern part of the area (see Map 1). In the following Table the soils are characterized.

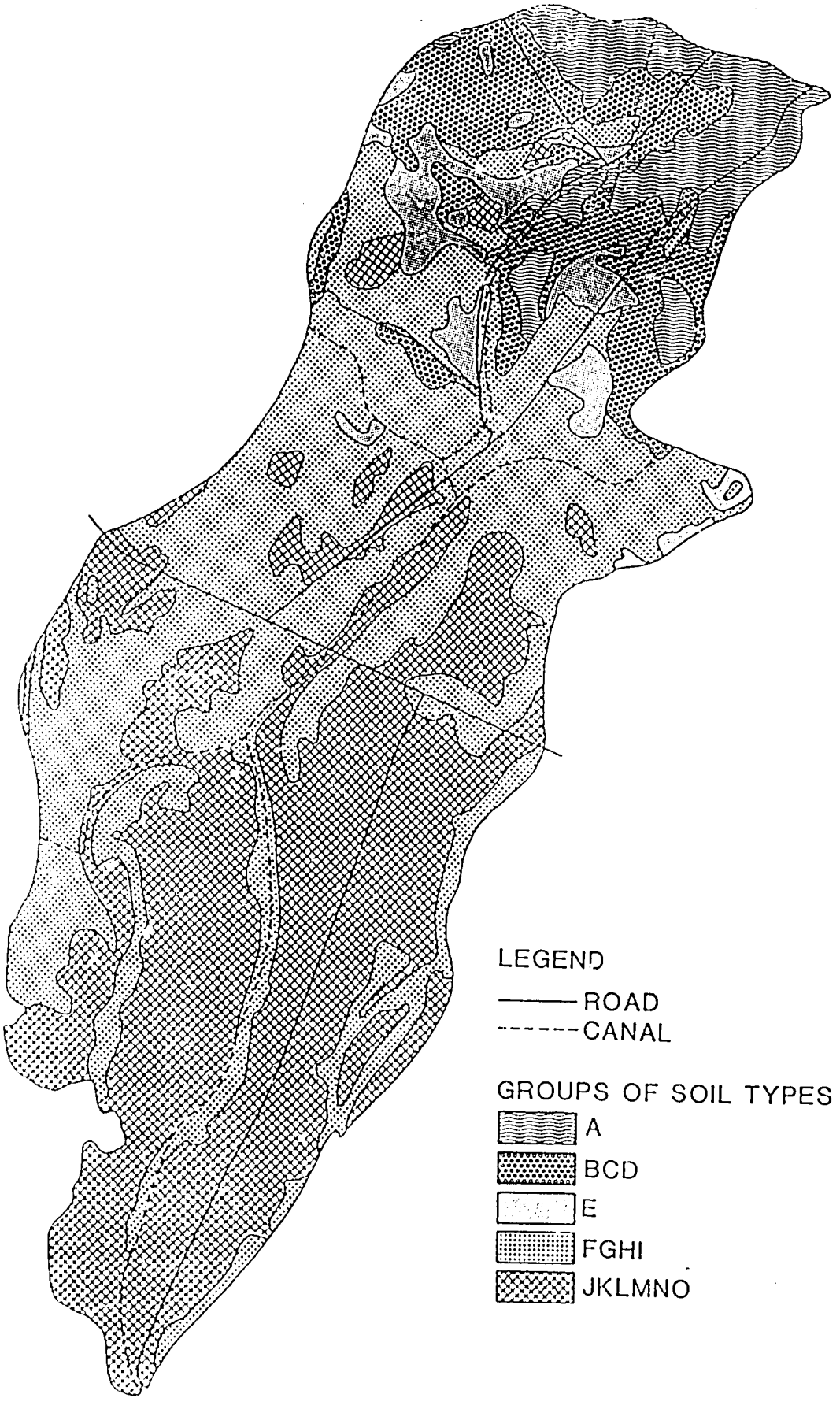
Major characteristics of soil groups in the Lezíria Grande

Soil group	Drainage	Texture	Salinity	Sodicity
A	Well drained	Light	None	None
BC(D)*	Moderately well-drained	Light to medium	None	None
E	Moderately well-drained	Medium	Slight to moderate	Moderate
FGH(I)*	Moderately well-drained to imperfectly-drained	Heavy	Moderate	Moderate
JKN	Imperfectly to poorly-drained	Heavy	High	High
LM(O)*	Poorly-drained	Heavy	Extreme	High

* Soil groups D, I, and O can be considered inclusions in the larger areas

2.2 Present agriculture

Two-thirds of the land is owned by the State, the rest by about 65 private landowners. One-third of the land is operated as a State farm by the "Compagnia das Lezírias", the remaining part by 65 large-scale farmers: some 20 owner-operators and some 45 tenant farmers. The "Companhia" and half of the large-scale farmers lease small areas of land to seasonal workers ("seareiros") for the growing season. Whereas only a few people live permanently in the Lezíria Grande, almost all the "seareiros" live in the vicinity, moving to the Lezíria Grande for the growing season. All in all, there are over 800 "seareiro" families.



Map 1. Simplified land-evaluation map

The land is used almost exclusively for agriculture. About 45 per cent of the area is under cereals, 25 per cent under natural pasture, 20 per cent under tomatoes and melons, and the remaining 10 per cent under oil seeds and fodder crops. Tomatoes and melons are grown exclusively by the "seareiros". Although crop productivity is relatively high, there is still considerable room for improvement.

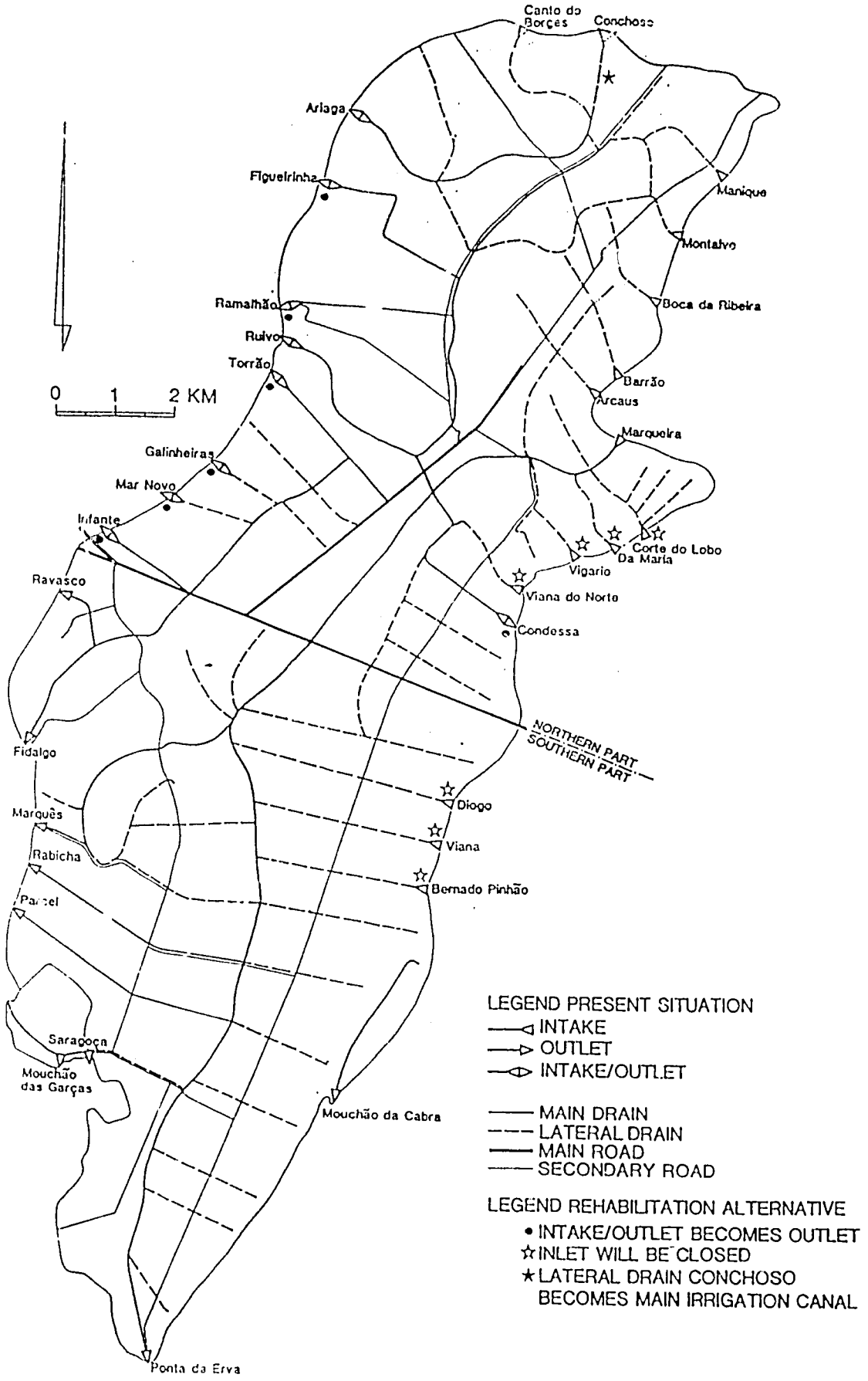
2.3 Water management

The present drainage system of gravity-based, open water courses was constructed in the late fifties. Its total length is about 460 km. Sluices discharge drainage water through the dike during periods of low water levels in the Tagus (see Map 2). Originally, the discharge capacity was sufficient, but, owing to lack of maintenance, the system has deterioriated over the years and is at present incapable of discharging the excess rain water in a normal year.

Irrigation water for the summer crops is distributed through the same system that serves for drainage in winter. Water for irrigation is lifted by small mobile engine pumps. The highest irrigation intensity (50 per cent) is attained in the northern part of the Lezíria, where the lighter, well-drained soils prevail.
Using the drainage system for irrigation in summer creates an ideal situation for the luxuriant growth of water plants, which hampers the flow of water through the canals.
As the discharge of the Tagus decreases in summer, sea water intrudes into the River. In extremely dry years, only the sluice gates in the north can be used for the intake of irrigation water. In practice, irrigation with water of bad quality occurs frequently.

2.4 Future development

The main constraints to the future development of agriculture in the Lezíria Grande are inadequate drainage, soil salinity, soil tillage problems, and uneven rainfall distribution. As well, low winter



Map 2. The compound irrigation-and-drainage system, before and after project implementation

temperatures and restricted marketing possibilities limit the choice of crops and confine the cropping intensity to about 100 per cent.

The proposed rehabilitation project includes:

- Infrastructural works (as shown on Map 2):
  - Rehabilitating and improving the existing surface drainage system;
  - Constructing an inlet for irrigation water at Conchoso and building a main irrigation canal to connect this inlet with the main canal system;
  - Rehabilitating and extending the existing road system.
- On-farm works, such as land levelling and the application of gypsum.
- Improving the operation and maintenance of the water-management system.

The project will considerably improve general conditions of drainage and soil salinity, and is expected to have a marked effect on crop and land productivity. The irrigation facilities will enable the irrigation of some 3,500 ha with water of good quality. This area might increase in the future if a higher irrigation efficiency can be achieved.

The total investment cost of the project was estimated at 689.2 million escudos in 1981 financial prices, or 592.9 million escudos in 1981 economic prices (1 US $ = 61.4 escudos; 1 ECU = 68.5 escudos).

A comparison of the economic costs and benefits of the rehabilitation project in the northern part of the area resulted in an Internal Rate of Return (IRR) of about 10 per cent. Developing the southern half of the area proved to be economically unfeasible, which is the reason why we have confined our case study to the northern area.

3 MAJOR ISSUES IN COST RECOVERY FOR THE LEZIRIA GRANDE

3.1 Introduction

In Portugal, there is a tradition that the direct beneficiaries of public water-management projects finance the system's annual operation

and maintenance costs and repay part of the investment costs. Until recently, the direct beneficiaries had to repay half of the investment costs over a period of 50 years. An interest rate of 4 per cent a year was charged on the outstanding debt. As no indexing was applied to the annual repayments, the high inflation rates that have been prevalent since the early seventies have caused the actual cost-recovery rates to fall below 20 per cent.

In 1982, a new law was passed. This law makes it possible to design systems of water pricing or cost recovery that fit individual projects. The new law also enables a number of other important goals to be pursued:

- Equity in the region. Projects offer substantial incremental income to limited groups of beneficiaries, who consequently become much wealthier than the rest of the region's inhabitants. Cost recovery can limit these induced income differences by tapping off part of the benefits;
- Equity within the project. Even when a project offers the same potential benefits to all beneficiaries, the benefits actually realized will differ. Differences in farm size, farming system, soil type, and so on, will often exaggerate discrepancies in income distribution. The wealthier the beneficiary is, the greater will be his profit, whereas the poor unskilled smallholder will receive only a small profit. Differential rates of cost recovery can counteract this;
- Efficiency. Charging farmers for cost recovery will encourage them to use the land and the project facilities productively, especially when the charges are based on potential use, rather than on actual use. The Government can also stimulate the cultivation of certain crops by reducing the charges for these crops.

3.2 Project costs

The cost of rehabilitating, operating, and maintaining the Lezíria Grande Project will consist of the initial investment costs and the additional O&M costs throughout the project's lifetime. While the initial investment costs are quite high, the additional O&M costs are negligible.

Investment costs

If the system is rehabilitated, the drainage of all the farmland will be improved, but it will provide irrigation water only for about 50% of the area. As all farmers have equal access to the irrigation water, irrigation is spread fairly evenly over the northern area. The investment costs of improving irrigation and drainage can therefore also be spread evenly over the area. The water-management system is indivisible, so differentiating the costs for the infrastructural works is not desirable. The on-farm works - a considerable factor in the implementation costs - differ according to soil group, mainly because of the differences in the amount of gypsum required. Here, the project is not indivisible because an individual farmer can decide not to apply gypsum in a certain area without other farmers' benefits being affected. Cost diversification may therefore be necessary to establish different investment costs for each soil group (see Table 1).

Operation and maintenance costs

The farmers themselves should be fully responsible for proper O&M, not only to alleviate the burden on public finance, but also to strengthen their involvement in the project. Only part of the area is being irrigated, but the whole area is being drained, so the O&M costs must be differentiated.

The actual O&M costs for both irrigation and drainage have been calculated on an area basis. These costs can differ depending on the length of the canal system required for each unit of area for each soil group. The calculated rates are shown in Table 1. The differences are so small, however, that, for administrative ease, one rate has been set for irrigation and another for drainage. This is a simplification of the current three-rate system: one rate for drainage, one for irrigating tomatoes or melons, and one for irrigating all other crops.

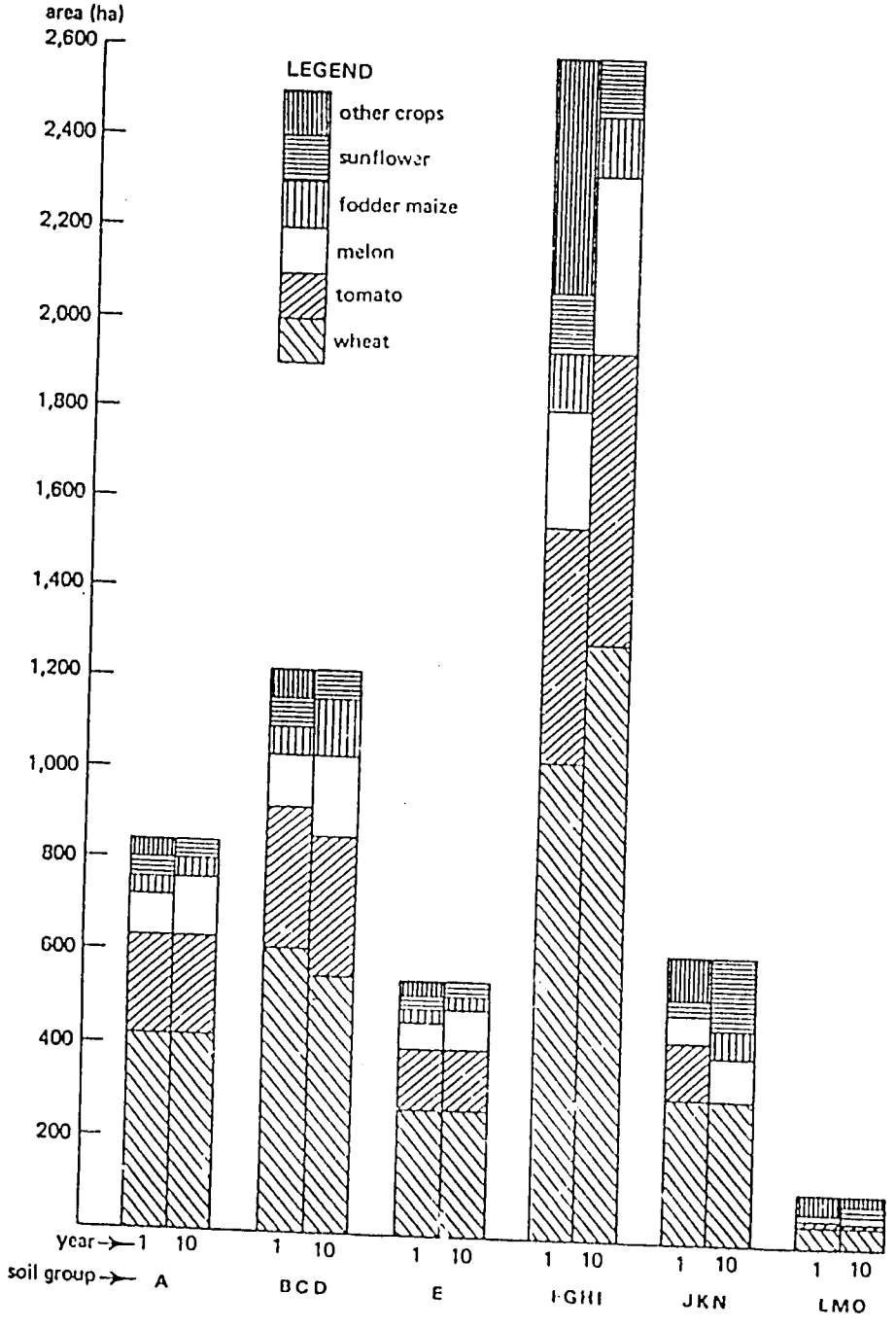


Figure 1. Cropped areas and cropping patterns for the soil groups, with and without project

Opportunity cost of irrigation water

When the cost of irrigation is being established, the actual value of the water can be important, especially when it is scarce. The value of water can be defined as its economic or opportunity cost. The opportunity cost of the Tagus water that enters the Lezíria Grande at Conchoso is zero, because if the water is not used for irrigation, it simply flows into the ocean. Once the water enters the area, however, it becomes scarce. The farmers, to keep their costs down, will certainly not pump more water onto their fields than is needed. Thus water-use efficiency is assured. Water pricing to pursue allocative efficiency is not needed either because the combination of irrigated crops is close to the optimum.

3.3 Project benefits

The project will result in an increase in agricultural production (see Figure 1 and Table 2). The project rent can therefore be defined as the incremental net value added because of the project, minus the value of the additional production factors of land, labour, capital, and management employed in obtaining the incremental production.
The land rent is derived from the official 1981 prices for long-term land leases. It is obvious that the land rent after rehabilitation will be higher than before rehabilitation. But, as the farmers have not contributed to increasing the potential of their land, this incremental land rent is considered part of the project rent. The project rent is the basis for the recovery - partial or otherwise - of the project's investment costs.

Benefits will vary widely throughout the project area. The average project rents are given in Table 3, together with the net profits - with and without the project - from which they were derived. A comparison of the development costs (Table 1) and the resulting project rents (Table 3) indicates no positive correlation.

3.4 Acceptability and administrative ease of charging

Cost-recovery rates cannot be fixed in isolation; the beneficiaries must feel that the level of the rates is fair in relation to the improvements offered. Moreover, when different rates are charged, the reasons for these differences should be clear and acceptable to the beneficiaries.

The acceptability of any charges for operation, maintenance, and cost recovery of a water-management project will depend on the farmers' belief in the project. This, in turn, depends on the degree of their participation in project affairs and on the economic incentives given or promised by the project.

Administrative ease, which calls for simplicity in charging, is a must in most countries.

A related question is whether a uniform charge should be levied in a project area, or whether the charge should be varied according to soil type, farm type, or crop. This question will be evaluated as to its possible effects on the cost-recovery rates and the benefits to the farmers, taking the administrative consequences into account.

For the sake of simplicity in this case study, we regard the large-scale farm, with its "seareiros", as one entity.

3.5 Charging agencies

Charging for operation and maintenance

The Associação de Defesa da Lezíria Grande de Vila Franca de Xira is responsible for O&M. This organization operates under the Direcção-Geral de Hidraulica e Engenharia Agricola (DGHEA) of the Ministry of Agriculture and is directed by an official of the DGHEA. The Associação receives eighty per cent of its funding from the landowners and the rest from the Government. These funds and the available equipment are inadequate, the main reason for this being the high rate of inflation, which has increased the costs whereas the charges have not been increased accordingly. In future, the O&M charges will have to be indexed to ensure that the Associação receives adequate funding to strengthen its O&M organization and thus ensure that the expected project benefits are indeed realized.

Repayment of project costs

The Associação should not act as the collection agency for cost recovery because this is not compatible with its function as a farmers' organization. Cost recovery is a sort of benefit taxing, and its charges should be collected by the tax department.
To facilitate cost recovery, the tax department should fix the rates (in real terms) beforehand, for the entire 30-year period. Periodic indexing should ensure that costs are recovered according to plan.

4 ASSESSMENT OF FARMERS' REPAYMENT CAPACITY

The assessed project rent forms the basis on which the farmers' repayment capacity is established. The project rent will generally be determined as an average of more-or-less homogeneous groups of farms, which here coincide with groups of soil types.
Since the project rent is also determined by a farm's cropping pattern, there are a range of possibilities for selecting the basis for the repayment capacity: "average" cropping pattern, cropping pattern most frequently encountered, and so on. The analysis in Section 5 is made on the basis of the "average" cropping pattern.

Theoretically, the entire project rent could be used to recover the project's investment costs. However, the farmers's project rents are spread around the average, so that part of the average project rent should be deducted to prevent any over-charging of large groups of farmers.
Farm surveys have shown that in areas which are fairly homogeneous in their climate and soils, most of the farmers will have a project rent higher than 60 to 70 per cent of the average. Further, the farmer is entitled to at least 15 per cent of the project rent as an incentive that more than compensates for the extra risk and uncertainty involved in changing his agricultural system. Therefore, no more than half of the calculated project rents should be levied on the direct beneficiaries. Although this percentage is somewhat arbitrary, charging up to that level would seem to be feasible.

With an increasing variation in project rents within a soil group, the share that can be levied must be lowered accordingly.

In establishing the repayment capacity of the beneficiaries, one should also prevent overcharging by taking into account the current and expected income levels of the groups of farmers. In the Lezíria Grande, however, even the smallest farms produce incomes that exceed the national average and are much higher than the critical consumption level. This allows full cost recovery to be pursued.

5 COMPARISON OF APPROACHES TO COST RECOVERY

5.1 Introduction

Apart from alleviating the burden on public finance, cost recovery should also pursue two other - generally conflicting - objectives: efficiency and equity. In setting the level and structure of the charges for the project facilities, one should take into account both the cost of providing these facilities and the incremental benefits to be derived from them. Until recently, the cost considerations carried the most weight, but nowadays the benefit considerations are gaining ground. We shall therefore discuss the following approaches to cost recovery:

- Average cost pricing, based on cost considerations only;
- Benefit pricing, based on farmers' benefits.

We must first define some crucial elements, namely the discount factor to be used and the extent to which cost recovery should be pursued.

Investments in project development are mainly made at the start of the project, whilst project benefits are generated over the whole project lifetime, which is generally set at 30 years. We have excluded inflation from the assessments of project costs and benefits by using 1981 constant prices, so the same should be done for the discount factor. The discount factor can be assessed at 4 per cent a year, which represents the real interest rate at which private farmers can borrow money. The remaining part of the market interest rate is the compensation for inflation.

The extent of cost recovery through ordinary taxes should not be taken into account. Nor is it considered reasonable to charge the project's beneficiaries more than the costs they would have incurred if they had implemented a similar project themselves. Exceeding this amount would go beyound cost recovery as such, and turn it into taxation. As the economic costs indicate the true costs to society, it would suffice if the beneficiaries were to repay those costs.
As the proposed project was found to be the best alternative for the development of the area, it is realistic to assume that the financial costs of the project represent the costs of the alternative that the farmers could have implemented themselves. Since in the Lezíria Grande, different groups of soil types have been distinguished and the development costs for these soil types differ, we could thus assess the limit to cost recovery as the average financial cost per unit area, differentiated per soil type.
It would also be possible, however, to regard the project as an indivisible entity. The limit to cost recovery of all farm land together could then be set as the total financial costs of the project. This would result in a uniform target amount for cost recovery, charging some groups of farmers - those on relatively easy to develop soils - more than the average costs incurred on their land, whilst other groups of farmers - on relatively hard to develop soils - would be charged less than the average costs incurred on their land.
The choice of the upper limit will considerably influence the cost-recovery rate, especially if there is a great variation in project rents.

5.2 Cost pricing

In view of the nature of the project, only average cost pricing, or a variant thereof, would be eligible for consideration - if, that is, cost pricing were to be considered at all.
Designing a system for average cost pricing is fairly straightforward. With an interest rate of 4 per cent, the investment costs of the project (in economic terms) can be expressed in a 30 year annuity. This can be done for the project as a whole and apportioned over all the land, or be diversified per soil group. The latter diversification

could be justified, since the costs of on-farm works differ significantly per soil group.
Recovering the financial investment costs could also be defended. This would significantly increase the burden on the project beneficiaries. Table 4 shows the annuitities for full cost recovery through average cost pricing, as well as the maximum chargeable amounts, representing the repayment capacities.

Comparing the various annuities (based on economic costs) with the corresponding repayment capacities (based on financial prices), calculated as indicated in Section 4, reveals that pursuing full cost recovery through average cost pricing would lead to the considerable overcharging of large groups of farmers for periods of 3 to 8 years. If costs are not differentiated, this period would be 4 to 5 years. Charging the financial costs would worsen this problem.
Allowing a five-year grace period would eliminate, or considerably alleviate, the problem for most groups of soil types, apart from the heavy-structured, highly-saline soils, J-O. On the other hand, introducing a grace period could undermine the farmers' willingness to repay at a later stage.
Because of the inherent danger of overcharging, full cost recovery through average cost pricing is rarely practised, since it could easily jeopardize the cooperation of the intended beneficiaries. Therefore, if repayment systems are designed on the basis of average cost pricing, their aim is usually to recover only a part of the investment costs.

5.3 Benefit pricing

A benefit approach to cost recovery is - in principle - based on the repayment capacity of the project's beneficiaries . Although the determination of these capacities is somewhat arbitrary, acceptable values can be assessed, as was explained earlier.
Cost recovery through the tapping-off of project benefits requires data on the size and distribution of these benefits, as was summarized in Table 3. The project rents are given for the Reference Years 1 and 10 after project implementation. It is assumed that project rents will stay at the level of Year 10 over the remaining 20 years of the

project's lifetime. The project rents for Years 2 to 9 can be found by interpolation. In the more-or-less homogeneous groups of soil types, the various repayment capacities can be assessed at 50 per cent of the project rents.
These repayment capacities are - in our view - the maximum chargeable amounts of cost recovery.
Assuming an interest rate of 4 per cent and a project lifetime of 30 years, the cost recovery rate (CRR) can be found by calculating the sum of the Present Values of the 30 chargeable amounts, and dividing this by the discounted investment costs. Adopting the above repayment system would lead to optimum cost recovery, while leaving sufficient incentive to the beneficiaries. The results of adopting this repayment system for the northern part of the Lezíria Grande are summarized in Table 5.
It appears that full cost recovery can only be achieved for the soil groups A-I, if cost recovery per soil group is limited to the cost incurred for that soil group. The percentage of the repayment capacities to be charged for the different soil groups then varies from 44 per cent for soil group F-I, to 100 per cent for soil group I-O, the cost-recovery rate for the whole area being 97 per cent.
However, if the project is regarded as an indivisible unit, full cost recovery is possible by uniformly charging 55 per cent of the repayment capacity on all soil groups.

Apart from the cost-recovery rate, the distribution of the net profits is also of importance. Table 6 shows the increases in net profits, after project implementation, for the two different ways of charging: 1) charging such a part of the repayment capacities per soil group that their investment costs can be completely recovered - or at least as far as possible - and 2) charging such a uniform percentage of the repayment capacities per soil group that full cost recovery is achieved. The figures reveal that there is ample economic incentive in all soil groups, although the variation is large. They also reveal that charging a uniform percentage of the repayment capacities has a positive effect on the cost-recovery rate, whilst it also has a levelling effect on income distribution. One has to accept, however, that farmers on some soils repay more than the financial investment costs incurred in developing their soils. Table 6 also shows that one can actively influence income distribution through cost recovery.

In practice, however, the need for administrative ease will call for a smaller number of different charges. Here, a subdivision into three groups of soil types, viz. A-E, F-I and J-O, would be logical. But then, the variation in project rents within the less homogeneous groups of soil types would be larger. Consequently, the repayment capacity should be fixed at a lower percentage of the project rent than the 50 per cent that was assumed for the more homogeneous groups in order to avoid over-charging of significant groups of farmers. If, for that reason, the repayment capacity of the aggregated soil group is fixed at the level of the lowest repayment capacity within the soil group, the repayment capacity might fall to 40 per cent of the average project rent in the aggregated soil group, or even less (see Table 4). Of course, this would reduce the cost recovery rate for the project as a whole.

In principle, charges for cost recovery would have to be adjusted every year because of inflation and the increase in repayment capacity during the first decade. For the sake of administrative ease, the rates should not be adjusted annually, but, say, every 5 years, taking as a basis the average repayment capacity, in real terms, over the 5-year-period. Indexing should be done according to the increase in the cost-of-living index. Of course, this simplification would lower the attainable cost recovery rates.

If charges are levied according to soil type (taking into account the actual investment per type of soil), the cost-recovery rate for the whole project would decrease some 30 per cent, assuming an inflation rate of 15 per cent. The results would differ strongly for the various soil groups.
If the aim is full cost recovery and a uniform percentage of the repayment capacity is charged, the corresponding decrease would be more or less the same, but the charges would be spread more evenly over the soil groups.

6 CONCLUSIONS

1) This case study shows that, if a project is assessed as being feasible in economic terms, a high level of cost recovery from the beneficiaries can be pursued, provided there are no constraining factors such as:
   - Large differences between economic and financial price levels for project costs and/or benefits;
   - A wide variation in farm incomes in the project area;
   - Too-low incomes of large groups of farmers, even after project implementation, so that these farmers would have to be exempted from cost recovery.

2) The upper limit of the charges is defined as the financial cost of the project if all farmers together had implemented the project themselves. This limit can be defined in two ways:
   - The project is seen as a cluster of independent sub-areas and the farmers are charged up to the actual or average costs that will be incurred on their land;
   - The project is regarded as an indivisible entity which the farmers will have to finance together. This will provide the highest repayment capacity.

3) Benefit pricing proves to be a more realistic approach to cost recovery than cost pricing, because benefit pricing takes into account - in principle - the farmers' repayment capacity.

4) The design of an equitable cost-recovery schedule that results in a fair distribution of the project benefits between society and the direct beneficiaries requires no more information than is collected for a normal feasbility study. However, one must also have information on the size and distribution of the project rents and on income distribution in the project area.

5) Differentiation of rates, based on a differentiation of the repayment capacities of farmers' groups, will increase the rate of cost recovery.

6) Cost recovery through benefit pricing can also be used as a policy tool to pursue the objectives of efficiency and equity. Differential rates can be charged according to potential use rather than actual use, in order to stimulate an efficient use of the project facilities.

7) Variations in the charges for different groups of beneficiaries can considerably influence the distribution of project benefits and incomes.

8) Farmers should pay the annual cost of O&M to their own organization which carries out the work. This is fair, since the facilities are highly beneficial to them.

9) While O&M costs are clearly related to services rendered, cost-recovery charges are often regarded as a kind of tax. The collection of cost-recovery charges should therefore not be done by the farmers' organization which carries out the O&M.

10) The assessment of the repayment capacity is based on arbitrary assumptions. The validity of these assumptions has to be tested in practice and their values adjusted accordingly. In this, monitoring of project performance would be of great help.

11) The payment schedules should be fixed at the beginning of the project so that the farmers know beforehand what basic amount they will have to pay each year. They must also be informed in good time of the periodic adjustment of the rate due to inflation.

12) Farmers' participation in project affairs will strongly affect their willingness to pay the charges for cost recovery and those for operating and maintaining the system.

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Table 1. Investment cost and cost of operation and maintenance for the irrigation and drainage system in 1981 constant prices (x 10^3 Esc/ha)

Soil group	Area in ha	Investment cost (10^3 Esc/ha)		Drainage cost in year 1 and 10 (10^3 Esc/ha)	Irrigation cost Year 1		Irrigation cost Year 10	
		Economic	Financial		Without project (10^3Esc/ha)	Rehabilitation (10^3Esc/ha)	Without project (10^3Esc/ha)	Rehabilitation (10^3Esc/ha)
A	838	82.8	97.1	2.2	3.2	3.1	2.8	2.8
B-D	1,220	82.8	97.1	3.9	3.1	3.2	2.8	2.6
E	546	95.7	110.5	3.9	3.1	3.2	2.8	2.6
F-I	2,586	103.2	119.4	2.9	3.8	4.3	7.6	2.9
JKN	614	141.7	159.6	2.9	3.8	4.3	7.6	2.9
LMO	116	141.7	159.6	2.9	3.8	4.3	7.6	2.9
A-O	5,920	100.2	115.8	3.1	3.4	3.7	4.3	2.8

Table 2. Yields of major crops in the northern part of the Lezíria Grande as projected for Years 1 and 10, with and without project (in ton/ha)

	Yields in ton per ha											
	Without project						Rehabilitation					
	Soil group						Soil group					
Type of crop	A	B-D	E	F-I	JKN	LMO	..	B-D	F	F-I	JKN	LMO
Year 1												
Wheat	3.1	3.0	2.8	2.4	2.0	2.0	3.4	3.2	3.0	2.6	2.2	2.2
Melons	16.0	15.0	14.0	12.0	11.0	10.0	17.0	16.0	15.0	13.0	12.0	11.0
Tomatoes	63.0	60.0	55.0	50.0	45.0	42.0	66.0	63.0	58.0	54.0	48.0	45.0
Sunflowers	1.7	1.5	1.4	1.2	1.2	1.2	1.8	1.7	1.5	1.3	1.3	1.3
Fodder maize	37.0	34.0	30.0	23.0	23.0	23.0	41.0	36.0	32.0	25.0	-	-
Rice	-	-	-	4.3	3.9	3.9	-	-	5.0	5.0	4.8	4.6
Nat. pasture (1)	-	-	-	5.0	3.8	2.0	-	-	-	5.0	4.2	2.4
Nat. pasture (2)	1.4	1.4	1.4	1.2	1.2	1.2	1.6	1.6	1.6	1.2	1.2	1.2
Year 10												
Wheat	3.4	3.3	3.1	2.7	2.0	2.0	4.5	4.3	4.2	3.1	3.1	3.1
Melon	17.0	16.0	15.0	12.0	11.0	-	19.0	18.0	17.0	15.0	15.0	-
Tomato	63.0	60.0	55.0	47.0	-	-	70.0	67.0	60.0	55.0	-	-
Sunflower	1.9	1.8	1.6	1.3	-	-	2.0	1.9	1.8	1.6	1.6	1.6
Fodder maize	40.5	37.2	32.8	-	-	-	52.7	47.8	45.3	30.5	30.5	30.5
Rice	-	-	-	4.6	4.2	-	-	-	5.4	5.4	5.4	5.4
Nat. pasture (1)	-	-	-	5.0	3.8	2.0	-	-	-	5.0	4.2	2.4
Nat. pasture (2)	1.6	1.6	1.6	1.4	1.4	1.4	1.8	1.8	1.8	1.4	-	-

(1) Throughout the year;
(2) During winter season only

Table 3. Summary of net profit and project rent per soil group in Years 1 and 10, with and without project (x 10^3 Esc/ha, 1981 constant prices)

Crop	Net profit without project for Soil group (x 10^3 Esc/ha) A	B-D	E	F-I	JKN	LMO	Average
Year 1							
Tomato*	44.7	36.0	21.4	7.2	-0.5	-9.6	21.2
Melon*	100.0	87.8	75.7	44.7	36.2	20.7	63.1
Other irrigated*	19.7	15.3	8.6	3.5	2.3	0.4	9.1
Wheat	20.5	19.6	16.9	11.5	6.9	6.9	14.6
Other non-irrigated*	14.0	11.9	9.3	2.2	3.4	3.0	6.6
Pasture	-	-	-	16.5	11.5	2.6	14.4
Average	34.6	30.0	22.8	13.3	7.9	3.3	20.1
Year 10							
Tomato*	249.5	232.2	203.6	161.2	-	-	209.4
Melon*	98.1	86.0	73.9	27.5	16.3	-	61.1
Other irrigated*	39.2	29.3	27.4	-	39.6	-	33.9
Wheat	23.7	21.8	19.7	14.6	5.9	-	17.1
Other non-irrigated*	-	-	-	16.3	-	-	16.6
Pasture	-	-	-	15.5	10.5	1.5	9.0
Average	91.4	83.9	73.5	33.7	12.8	1.5	53.2

Crop	Net profit after rehabilitation for soil group (x 10^3 Esc/ha) A	B-D	E	F-I	JKN	LMO	Average
Year 1							
Tomato*	52.9	44.3	30.1	23.6	7.5	-1.0	32.7
Melon*	116.5	98.6	86.7	50.0	39.1	28.2	71.9
Other irrigated*	25.7	17.8	10.8	1.6	-	-	12.0
Wheat	24.4	21.8	19.1	13.4	9.1	9.0	17.2
Other non-irrigated*	16.9	14.3	11.9	3.7	4.5	-	8.9
Pasture	-	-	-	15.5	11.2	3.3	13.5
Average	40.8	34.5	27.6	17.9	11.7	7.2	24.9
Year 10							
Tomato*	285.5	268.6	229.4	195.9	-	-	231.9
Melon*	128.2	116.3	104.5	70.8	71.8	-	92.6
Other irrigated*	58.4	45.7	48.3	38.2	42.8	34.0	43.5
Wheat	34.3	31.7	30.4	14.9	15.9	15.9	22.9
Other non-irrigated*	-	-	-	-	-	-	-
Pasture	-	-	-	8.2	10.8	2.9	6.2
Average	111.9	104.0	91.5	68.8	32.5	20.9	79.9

Crop	Project rent for soil group (x 10^3 Esc/ha) A	B-D	E	F-I	JKN	LMO	Average
Year 1							
Tomato*	8.2	8.3	8.7	16.4	(8.0)	(8.6)	11.5
Melon*	16.5	10.8	11.0	5.3	2.9	7.5	8.8
Other irrigated*	6.0	2.5	2.2	-1.9	-	-	2.9
Wheat	3.9	2.2	2.2	1.9	2.2	3.9	2.6
Other non-irrigated*	2.9	2.4	2.6	1.5	1.1	-	2.3
Pasture	-	-	-	-1.0	-0.3	0.7	-0.9
Average	6.2	4.5	4.8	4.6	3.8	3.9	4.8
Year 10							
Tomato*	36.0	36.4	25.8	34.7	-	-	22.5
Melon*	30.1	30.3	30.6	43.3	55.5	-	31.5
Other irrigated*	19.2	16.4	20.9	-	3.2	-	9.6
Wheat	10.6	9.9	10.7	0.3	10.0	-	5.8
Other non-irrigated*	-	-	-	-	-	-	-
Pasture	-	-	-	-7.3	-0.3	1.4	2.8
Average	20.5	20.1	18.0	35.1	19.7	19.4	26.7

* Includes natural pasture in winter season

Table 4. Comparison of annuities at 4 per cent interest over a period of 30 years, for full cost recovery, with repayment capacity of beneficiaries per soil group, in 1981 constant prices (10^3 Esc/ha)

Soil group	Annuity Financial prices (10^3 Esc/ha)	Annuity Economic prices (10^3 Esc/ha)	Repayment capacity (× 10^3 Esc/ha) in year:									
			1	2	3	4	5	6	7	8	9	10-30
A	5.6	4.8	3.1	3.9	4.7	5.5	6.3	7.1	7.8	8.6	9.4	10.2
B-D	5.6	4.8	2.2	3.1	3.9	4.8	5.7	6.6	7.4	8.3	9.2	10.0
E	6.4	5.5	2.4	3.1	3.9	4.6	5.3	6.1	6.8	7.5	8.2	9.0
F-I	6.9	6.0	2.3	4.0	5.7	7.4	9.1	10.8	12.4	14.1	15.8	17.5
JKN	9.2	8.2	1.9	2.8	3.7	4.5	5.4	6.3	7.2	8.1	8.9	9.8
LMO	9.2	8.2	1.9	2.8	3.6	4.5	5.4	6.3	7.1	8.0	8.9	9.7
A-O	6.7	5.8	2.4	3.6	4.8	6.0	7.2	8.5	9.7	10.9	12.1	13.3

Table 5. Present value of 30 annual repayment capacities at 4 per cent interest, per soil group in 1981 constant prices (× 10^3 Esc/ha)

Soil group	Present value 30 annual repayment capacities (10^3 Esc/ha)	Present value investment costs (10^3 Esc/ha)	% of repayment capacity to be charged for full cost recovery
A	145.6	82.8	57
B-D	139.2	82.8	59
E	126.9	95.7	75
F-I	236.6	103.2	44
JKN	135.2	141.7	100
LMO	134.0	141.7	100
A-O	182.6	100.2	55

Table 6. Farmers' net profit in two reference years (× 10^3 Esc/ha, in 1981 constant prices)

Soil group	Year 1: Net profit rehabilitation (10^3 Esc/ha)	Year 1: Repayment charged (10^3Esc/ha)	Year 1: Net profit minus repayment (10^3 Esc/ha)	Year 1: Net profit without project (10^3Esc/ha)	Year 1: Net increase %	Year 1: Net increase (10^3Esc/ha)	Year 10: Net profit rehabilitation (10^3Esc/ha)	Year 10: Repayment charged (10^3Esc/ha)	Year 10: Net profit minus repayment (10^3Esc/ha)	Year 10: Net profit without project (10^3Esc/ha)	Year 10: Net increase %	Year 10: Net increase (10^3esc/ha)
Charging up to actual investment cost for each soil group												
A	40.8	1.8	39.0	34.6	13	4.4	111.9	5.8	106.1	91.4	16	14.7
B-D	34.5	1.3	33.2	30.0	11	3.2	104.0	5.9	98.1	83.9	17	14.2
E	27.6	1.8	25.8	22.8	13	3.0	91.5	6.8	84.7	73.5	15	11.2
F-I	17.9	1.0	16.9	13.3	27	3.6	68.8	7.7	61.1	33.7	81	27.4
JKN	11.7	1.9	9.8	7.9	24	1.9	32.5	9.8	22.7	12.8	77	9.9
LMO	7.2	1.9	5.3	3.3	60	2.0	20.9	9.7	11.2	1.5	647	9.7
Charging all farmers 55% of repayment capacity (project is one indivisible unit)												
A	40.8	1.7	39.1	34.6	13	4.5	111.9	5.6	106.3	91.4	16	14.9
B-D	34.5	1.2	33.3	30.0	11	3.3	104.0	5.5	98.5	83.9	17	14.6
E	27.6	1.3	26.3	22.8	15	3.5	91.5	5.0	86.5	73.5	18	13.0
F-I	17.9	1.3	16.6	13.3	25	3.3	68.8	9.6	59.2	33.7	76	25.5
JKN	11.7	1.0	10.7	7.9	35	2.8	32.5	5.4	27.1	12.8	112	14.3
LMO	7.2	1.0	9.2	3.3	178	5.9	20.9	5.3	15.6	1.5	940	14.1