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STRENGTHENING OF EXPERIMENTATION  
TRAINING AND EXTENSION IN THE  
OLIVE PRODUCTION SECTOR

T U N I S

Feasibility Study

November 1977

T U N I S

# T U N I S I A

## BASIC DATA IN 1976

Surface	155,000 Km <sup>2</sup>	
Population	571,000	
Annual rate of growth of population	2.41	
Density	36 inhabitants per Km <sup>2</sup>	
Gross domestic product at factor cost in million Dinars 1/	1254.2	
National income in million Dinars 1/	1167.1	
Per capita income in Dinars 1/	204.4	
Per capita private consumption in Dinars 1/	163.5	
Gross fix capital formation in million Dinars 1/	352.0	
Imports in million Dinars (CAF)	623.0	
Export of commodities in million Dinars of which:	351.5	
Phosphates and other raw materials	179.8	51.2%
Semi-manufactured and manufactured products	102.8	29.2%
Agricultural products: Olive oil	36.6	10.4%
Wine	4.8	1.4%
Fresh fish	4.2	1.2%
Other	23.3	6.6%

1/ In constant 1972 prices

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## SUMMARY AND CONCLUSIONS

1. Olive production is an important sub-sector of Tunisia's agriculture. Olive trees cover 48 per cent of arable land and constitute the main source of living to 29 per cent of farmers, giving employment to 28 per cent of the population active in agriculture. Olive oil participates by some 60 per cent in agricultural exports.
2. Tunisia's olive oil exports represent some 25 per cent of the world's olive oil exports thereby making Tunisia the second largest exporter of olive oil in the world, the first place being held by Spain.
3. Tunisia's olive production has shown a marked tendency to increase in the last decade. This is mainly due to the fact that young trees are coming gradually into full bearing in orchards established during the massive planting programmes of the 1960's. Since then no new important plantings have been undertaken nor are foreseen in as far as olives for oil are concerned. This source of production increase will be almost exhausted in the following decade and consequently the only source of production gain will be the rise of yields per hectare of adult trees.
4. This rise is necessary to enable Tunisia to satisfy the domestic demand which is constantly growing and will continue to do so at a high rate during the next two decades and to maintain her position in world olive exports.
5. If this rise is properly managed, it could increase essentially gross and net returns per hectare and per farm which, in turn, would make olive growing an attractive proposition. Indeed, this has not been the case during the last years mainly because costs of inputs, and in particular of labour, have grown at a higher rate than olive and olive oil prices.
6. Essential increase in yields per hectare and per adult tree may help to cut down unit costs of olives and thereby strengthen the competitiveness of Tunisia's olive oil on both the domestic and the world market.
7. The increase in olive production is not conceivable without an essential reinforcement of the extension and training activities backed by an adequate experimentation programme together with appropriate credit facilities.

8. Hence the Government of Iraq and the Government of Tunisia have agreed to launch a project "Strengthening of Experimentation, Training and Extension in the Olive Production Sector" which should help to lay down the necessary structures to cope with the above task.

The project is for two years but its activities will be carried out, in full, after this period and eventually be institutionalised.

9. In this context the Government of Iraq sponsoring the project to be jointly executed by FAO and the Tunisian Government requested the Project Document to be complemented by a Feasibility Study.
10. The Feasibility Study is based on the assumption that the project will start an intensive extension and training programme in selected areas where an increase in the quantity and quality of outputs would gradually bring up the yield per adult tree, gross income per hectare and farmers' gross and net returns, thus cutting down the unit cost of olives produced.
11. This Feasibility Study team came to the conclusion that the effort of the project should at least, in the initial stage, be concentrated in areas with the highest potential for production increase and offering the best conditions for exploiting this potential.
12. The Study recommends that the project launches a comprehensive extension and training programme on 500 farms each with an average of 4 hectares of adult olive trees in the North and on 250 farms each with an average of 8 hectares of adult olive trees in the Centre. The "intake" of integrated farms would be in the second year 750 in the North and 500 in the Centre gradually growing thereafter to cover in 10 years 15,000 farms in the North and 12,500 farms in the Centre. Apart from this, long-term high density replantation/regeneration schemes should be launched on 200 hectares in the North and on 1,000 hectares in the Centre, in the first year, on 400 and 2,000 hectares, in the second year, to cover eventually 5,000 and 20,000 hectares in the North and Centre respectively.
13. The application of the "package" of inputs recommended by the Project will be gradual and last six years in the North and 5 years in the Centre. Each farmer will start his participation in the programme with one hectare in the North and with two hectares in the Centre and continue with the same additional acreages in the subsequent years.
14. The increase in the quality and quantity of inputs results in an essential gain in yields per hectare and per farm. Farms integrated in the programme will produce in the final year thereof 485,000 tons of olives compared to 165,000 in its initial year. The incremental production will be 308,000 tons of olives which corresponds to 58 per cent of the present national production of 533,000 tons (1970/71 - 1976/77 average). Production increase by region and operation will be as follows:

	Yield/ha in Tons		Areas in 1,000 ha	Total Production in Tons	
	Initial Year	Final Year		Initial Year	Final Year
Extension/training North	1.2	3.5	60	72	210
Extension/training Centre	1.0	2.5	80	80	200
Replantation North	1.0	5.0	5	5	25
Regeneration Centre	1.0	2.5	20	20	50
T O T A L	1.1	2.7	165	177	485

15. Annual economic results of all programmes together are as follows: (Crop protection included in costs)

	In million Dinars for all programmes			In Dinars per Farm		
	Gross Income	Costs	Benefit	Gross Income	Costs	Benefit
Initial year	10.6	8.7	1.9	369	302	66
Final year	29.1	21.2	7.9	1,012	724	275

16. Costs of the one ton of olives will be cut from 49 Dinars in the initial year to 44 Dinars in the final year or by 10 per cent if the subsidy on crop protection is withdrawn. Should the subsidy continue then at farm level the cost would be cut from 45 to 37 Dinars per ton or 18 per cent.
17. The costs mentioned in paras. 15 and 16 include the project costs which are 604,000 Dinars in the first year, 548,000 Dinars in the second year and thereafter from the third year up to the twenty-second year 318,000 per year. For the duration of the programme they would amount to 8.8 million Dinars.
18. The internal rate of return of the project is 19 per cent over the required period of 22 years if the stabilized input/output ratio is to be obtained. This rate corresponds to the point of view of the community.
19. From the point of view of the farmers involved this rate would increase to 42 per cent if the subsidy on crop protection was maintained. The "real" internal rate of return for the farmers involved would thus be within the range of 19 and 42 per cent depending on when and if at all the subsidy on crop protection is abandoned.

## CONCLUSIONS

The programme to be launched by the project corresponds to the vital interests of the country and of the olive production sector. It contributes essentially to olive and olive oil production increase, thereby satisfying the growing demand and simultaneously maintaining a high level of exports or increasing them. The programme will also increase the production per hectare, cut down the unit cost of olives and increase considerably the farmers' net return.

The internal rate of return as far as the community is concerned is 19 per cent which for perennial crops project is fairly satisfactory. This rate would be 42 per cent for the farmers involved if the present subsidy on crop protection continues. "Real" rate - with regard to farmers - will then be within the range of 19 to 42 per cent which should be a sufficient guarantee to secure for them credit facilities.

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## I. INTRODUCTION

The present feasibility study has been conducted on the request of the Iraqi Government and its purpose is to complement the Plan of Operation of the IRAQ/FAO/TUNISIA Project "Strengthening of Experimentation, Training and Extension in the Olive Production Sector".

The Plan of Operation gives a full background of the project and describes, in depth, its various activities. The role of the present study is to complement the Plan of Operation, in particular, as far as its medium and long-term impact on the country's economy and its olive production sub-sector is concerned. This has made it necessary to evaluate incremental outputs and inputs in olive production and to undertake their economic appraisal.

The project, however, as its title rightly indicates, is not a direct production project but, ultimately, all its activities should aim at increasing production and productivity. The strengthened extension and training network, equipped, through the experimentation programme, with first class information should advise the farmer on how to produce more, how to reduce unit costs and ensure the best conditions for long term sound development of the olive production sector.

In the olive production business there is no measure which can be expected to give spectacular results overnight. The olive tree comes into full bearing after 20 years of age and thereafter keeps on bearing for a century and sometimes more but, in most cases, only gives a full harvest every other year. Hence the question arises how to figure out the impact of the project during its two-year run on the olive production sector.

The solution, perhaps not the best one but most likely the only one, consists in considering the project as laying down a permanent institutional framework to care for the olive production development on a long term basis. This is perfectly consistent with the Plan of Operation which assumes that when the project winds up its activities will be carried out by the Tunisian Government.

In spelling out in more detail the project programme and in attempting to quantify it, it has been necessary to limit project activities to certain areas considered most promising for further development and to certain operations offering reasonable returns when the present level of knowledge has been exploited. Hence three main fields have been retained:

- Extension and training (limited zones)
- High density replantation in the Northern Region (5,000 ha)
- Regeneration in the Central Region (20,000 ha)

This impact of actions initiated by the project in each of the above fields has been figured out for a period of 20 years. This impact has, however, only an indicative value because it assumes to apply various methods of cultivation which the experimentation programme of the project may modify entirely and recommend, in due course, other more efficient and/or less expensive ones.

## II. BACKGROUND

### A. The Role of Agriculture and Its Olive Production Sub-sector in the National Economy

Agriculture remains in Tunisia an important sector of the national economy. Its share in the GDP was in 1976 about 17.5 per cent (see Table I/1 - Annex I) and it provided employment for some 37.5 per cent of the active population <sup>1/</sup>. Its contribution to foreign exchange earnings fluctuating considerably from one year to another came over the 1972-1976 period to about 26 per cent of Tunisia's commodity exports (See Table I/2 - Annex 1).

The Government of Tunisia allocates important resources towards the development of agriculture aiming in particular at food self-sufficiency, increase of productivity and creation of new employment opportunities. Agricultural investments which amounted in the Fourth Development Plan 1972-1976 to 197 million Dinars were brought up to 500 million Dinars in the Fifth Development Plan (1977-1981).

A specific feature of Tunisian agriculture is the very important role played by arboriculture. Tree crops occupy almost a half (48 per cent) of arable land (reference Table I). In terms of acreage the olive tree is the most common tree in Tunisia. Out of 2,189 thousand hectares of tree crops, 1,407 thousand hectares or about 64 per cent are under olive trees.

Olive production is the most important agricultural sub-sector as far as foreign exchange earnings are concerned. As inferred by Table I/3 in Annex I, olive oil exports varied over the 1972-1976 period from 41 to 72 million Dinars and made up for 53 to 71 per cent of total food exports.

Tunisian olive oil exports are very significant on the olive oil world market. For many years Tunisia has been the second largest olive oil exporter, the first place being occupied by Spain. As pointed out in Table 2, Tunisia even occasionally exports more than Spain as, for example, in 1971/72 and 1973/74 crop years, Tunisia's and Spain's exports together represent 60 per cent of the world olive oil exports.

Olive production is an important source of employment. Maintenance and harvesting of olive orchards annually require more than 43 million working days which is equivalent to 145,000 permanent labour opportunities (reference: Table I/4 in Annex I).

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<sup>1/</sup> 513,000, out of the total of 1,366,520, "occupied" persons (unemployed and seeking for jobs not considered).

TABLE 1

T U N I S I A

Utilization of Arable Land in 1976 <sup>1/</sup>

C r o p	1000 ha	Per cent
Cereals	1,895 <sup>2/</sup>	41.9
Other annual crops	435	9.6
Olive tree pure	1,085	24.0
Olive tree in association	322	7.1
Other tree crops "pure"	382	8.5
Other tree crops in association <sup>3/</sup>	400	8.9

<sup>1/</sup> Fallow not included

<sup>2/</sup> Gives only order of magnitude because the acreage of cereals varies from one year to another

<sup>3/</sup> Excluding association with Olive trees

Source: Ministry of Agriculture:  
"Enquête Agricole de Base 1976"

TABLE 2

TUNISIA AND SPAIN  
Olive Oil Exports  
(1970/71 - 1976/77)

Y e a r	In 1,000 metric tons			Percentage of share in world exports		
	Tunisia	Spain	World	Tunisia	Spain	Tunisia and Spain
1970/71	59	205	316	18.7	64.9	83.6
1971/72	124	72	303	40.9	23.8	64.7
1972/73	56	157	351	16.0	44.7	60.7
1973/74	82	75	251	32.7	29.9	62.6
1974/75	52	60	184	28.3	32.6	60.9
1975/76	71	78	242	29.3	32.2	61.6

Although olive production is practised almost everywhere in Tunisia, north of Medenine it is, in particular, concentrated in three zones: Sfax, the Sahel and the Mejerda Valley. As shown in Table 3 below, in the Central Littoral zone, olives are the predominant crop and the growing of olive trees, the principal activity of almost three quarters of the farmers. It is worthwhile mentioning that a considerable proportion of the areas under olive trees is unsuitable for other crops.

Table I/5 in Annex I indicates that most of the 94,140 farmers specialized in the olive tree sub-sector are small farmers, 64 per cent of them having less than 10 hectares of arable land.

TABLE 3

Farms Specialized in Olive Production by Zone

Zone	Provinces Covered	Number of Farms		
		Total	Specialized in Olive Production	Specialized in Olives in % of Total
North-Eastern	Tunis, Bizerte, Nebeul	62,000	7,220	11.6
North-Western	Beja, Jendouba, Siliana, Kef	67,000	3,680	5.5
Central Littoral	Mahdia, Sfax Sousse, Monastir,	69,000	49,820	74.4
Central	Kairouan, Kasserine, Sidi Bouzid	79,000	18,210	23.1
Southern	Gafsa, Gabès, Medenine	49,000	15,210	31.0
T O T A L		326,000	94,140	28.9

Source: Ministry of Agriculture:  
"Enquête Agricole de Base 1976"

B. Evolution of and Prospects for Olive and Olive  
Oil Production, Consumption and Exports

Olive production, despite its marked fluctuations (Table I/6 in Annex I), has a tendency to increase. This is more perceptible if data for longer periods are compared. For this kind of comparison oil production figures are perhaps more reliable than olive production ones.

Such a comparison based on four seven-year averages is shown in Table 4 below:

TABLE 4

Evolution of Olive Oil Production  
(1949/50 - 1976/77)

Years	Annual Average in 1,000 tons	I n d i c e s		
		1949-1955 =100	1956-1962 =100	1963-1970 =100
1949-1955	378	100	75	97
1956-1962	507	134	100	131
1963-1970	388	103	77	100
1971-1977	844	223	166	218

The considerable increase in olive production which has actually doubled in the last seven years compared to the preceding seven-year period can probably be explained by a number of factors of which favourable climatic conditions are quite essential. But another and probably the most important reason is the increase of acreage under trees which have reached productive age. Under the various development plans of the 1960's a huge planting programme was carried out, the effects of which are already being felt. Young trees planted in the past are gradually coming to full maturity and this feature pushing up the output is likely to continue throughout the late 1970's and 1980's.

In years to come, because of the scarcity of suitable lands, competition of other crops and various other reasons no new planting is foreseen apart from 28,000 hectares (roughly 2 per cent of the present acreage of olive tree amounting to 1,407,000 hectares) earmarked in the 1977-1981 Five-year Plan to be planted with special varieties for table olives. Hence the number of young trees will no longer increase and when the trees planted in the past reach the age of full bearing, this source of production will be in principle exhausted.

Acreage under olive trees of all age groups were converted into so-called "productive acreage" which is the equivalent of acreage on which all trees are full-bearing using the following coefficients:

Tree Age	Coefficient of Conversion into full-bearing acreage (trees)
Very young (0-10 years)	0
Young (10-20 years)	0.5
Adult (20-70 years)	1.0
Old (above 70 years)	1.0

Source: République Tunisienne, Office National de l'Huile - Projet FAO/SIDA - TUN 2, Vol. II (Réédition Oct 1975). "Inventaire de l'Olivaire Tunisienne".

The result of the above conversion extended for 1986 and 1991 benchmarks is shown in Table 5. The table suggests that gradual "maturing" of olive trees may contribute to production increase up until 1986 when almost all trees planted in the past will have reached full maturity. Thus, the output of olives may be expected to grow - if no other source of production increase is considered - from 658 thousand tons in 1976 to some 925 thousand tons in 1986 and 934 thousand tons in 1991. Accordingly, additional output over 15 years (1976-1991) would be 276 thousand tons of which a considerable proportion might be needed to cover the increase in domestic demand.

Table I/7 in Annex I reveals that domestic consumption of edible oils may grow from 107 thousand tons in 1976 to 162 thousand tons and 177 thousand tons in 1991 and 1996 respectively. This increase in olives equivalent would correspond to some 272 thousand tons for the 1976-1991 period and to 351 thousand tons for the two decades to come (1976-1996). It is obviously understood that part of this increase in the demand could be satisfied by imports of vegetable oils cheaper than olive oil, such as Soyabean and palm oil. But because these oils are put on the market mixed with olive oil, the increase in the domestic demand for edible oils would require, at any rate, an additional quantity of olive oil.

As far as the period 1991-1996 is concerned, domestic demands for edible oils might be expected to increase by 79 thousand tons, but if output per hectare of trees in full bearing (productive hectare) remains the same as in the 1972-1976 period, no additional domestic production would be available.

TABLE 5

Evolution of Olive Production derived from  
Development of Acreage of "Productive Trees"

	Year	In 1,000 hectares			
		Northern	Central	Southern	Total
Total acreage of olive trees	1972	197	351	694	1,242
Acreage of "productive" trees	1972	111	231	438	780
	1976	128	254	500	882
	1981	155	297	592	1,044
	1986	189	351	694	1,242
Average production per production hectare in kg.	1972-1976	1,200	1,000	500	747
Production in 1,000 tons (Assuming 1972-76 average yield per hectare as constant)	1972	133	231	219	583
	1976	154	254	250	658
	1981	186	297	296	779
	1986	227	351	347	925
	1991	236	351	347	934

Source: République Tunisienne, Office National de l'Huile -  
Projet FAO/SIDA - "Inventaire de l'Olivaire Tunisienne"  
TUN 2, Vol. II (Réédition Oct. 1975).

From the above it follows that measures should be taken to increase output per productive hectare and per productive tree.

This is important not only because of the expected growth of domestic demand but also bearing in mind export prospects.

Because of the labour-intensive nature of olive cultivation, the world's largest olive oil producers, Italy and Spain, find it more and more difficult to keep their olive orchards in production. In both of these countries the rise of labour cost has outpaced considerably the evolution of olive oil prices.

TABLE 6

SPAIN  
Indices of Olive Oil Prices and of  
Cost of Olive Harvesting  
(1953-1973)

Year	Olive Oil Price Index	Labour Cost of Olive Harvesting
1953	100.0	100.0
1958	152.7	175.2
1963	275.4	415.1
1968	310.8	636.3
1973	440.5	1,068.3

Source: Manuel d'Oléiculture, FAO - 1977 - p. 254

The above development, more or less the same in Spain and in Italy, is slowly making olive cultivation a marginal occupation. This is moreover the case in Italy in spite of massive support of olive oil production from the Common Market Agricultural Fund. Bearing in mind that olive oil prices are not keeping pace, and are unlikely to do so, with salary increase and that various methods of mechanical harvesting have not as yet proved quite satisfactory because of various constraints (slopes, several trunks), the economic difficulties of the olive production sector in Italy and Spain could be aggravated.

Tunisia is experiencing the same trend as far as the olive oil price/agriculture labour cost concerned, but to a far lesser degree. This is because the absolute level of agriculture labour cost is still essentially lower in Tunisia than in Italy or Spain and their increase less abrupt. Consequently, Tunisia is, in principle, and may stay for some time, in a comparatively good position as far as the competitiveness of its olive oil industry is concerned.

### C. Potential for Olive Production Increase

If Tunisia wishes her olive oil to remain competitive on the world market on a long term basis, it is imperative that she engages energetic measures to increase its productivity. As it takes a long time for such measures to be generally applied, the relevant work should be started with the least possible delay if the results are to be expected in the next ten to fifteen years.

The main way to increase the Tunisian olive production is by increasing the output per adult tree or per hectare of trees in full bearing age. Such an increase, if properly managed, could cut down the unit cost of olives produced.

It is well known that in olive cultivation a considerable portion of the cost is little dependent on the quantity of fruit subsequently harvested. Ploughing, weeding, trimming, etc., represent expenditures per hectare which, in principle, would tend to diminish per ton of olives harvested almost in direct proportion with the increase in yield per hectare.

The present cultivation practices leave considerable room for an essential increase of hectare yields of olive orchards. In fact, in most areas olive cultivation follows extensive rather than intensive patterns. Quite often the farmers limit themselves to the strict minimum of maintenance work and are not convinced that additional inputs could bring up their production and cut down their cost per ton of olives produced.

An example of this kind of attitude on the part of the tunisian olive tree grower is the application of fertilizers. For example, in the north of the country it is recommended to apply about 3 kg per tree or 300 kg per hectare of ammonium nitrate, but its actual consumption in arboriculture is about 84 kg in the North-Eastern region and 25 kg in the North-Western region of the country (reference Table 7). In other regions fertilizer application in the whole of arboriculture (data for olive production only are not available) falls far below the recommended dosage, and apart from certain limited zones, is almost negligible.

Considerable potential for increase of hectare yields lies also in better and more frequent ploughing, weeding and pruning and in improving plant protection.

In 1974, the National Oil Bureau (Project FAO/SIDA/TUN 2) undertook the difficult task, in liaison with the inventory of olive plantations, of estimating for each region and district the potential of the olive production increase on the area already planted. From this exercise (bearing in mind certain factors, such as soil fertility, annual precipitation, cultivation habits, etc.), it followed that there are zones where olive production could be doubled, tripled, or quadruplicated over a period of ten years whereas in others only 40 or 50 per cent increase can be expected over the same lapse of time. This is

TABLE 7

Utilization of Fertilizers in Arboriculture  
during the 1975-76 Campaign

Regions	Area under tree crops in 1000 Ha	Total Utilization in tone		Utilization per Ha. in kilos	
		Ammonium-Nitrate	Super-Phosphate	Ammonium-Nitrate	Super-Phosphate
North-Eastern	182.0	15,314	8,254	84.1	4.5
North-Western	93.3	2,295	346	24.6	3.6
Central-Littoral	748.5	4,745	192	6.3	0.3
Central	499.7	296	405	0.6	0.8
Southern	265.9	649	102	2.4	0.4
TOTAL	1,789.4	23,299	9,290	13.0	5.2

- (1) Total amount of 5,690 tons is given for all three zones broken down according to the structure of utilization during the period September 1975 and March 1976 - 83.4 per cent Central Littoral; 5.2 per cent Central and 11.4 per cent Southern.
- (2) Total amount of 638 tons for Central Littoral, Central and Southern regions broken down according to the structure of utilization during the period September 1975 and March 1976 - 20.5 per cent Central Littoral; 63.5 per cent Central and 16.0 per cent Southern.

Source: Ministry of Agriculture, Agricultural Conjuncture, Enquiry of December 1976.

summarized, insofar as the Northern and Central regions of Tunisia are concerned, in Tables I/8 and I/9 in Annex I. These two tables, however, indicate the overall olive production increase potential and, therefore, two factors are combined. One is the change in the age structure of trees which are gradually reaching full bearing age and the other is the increase of yield per hectare or tree already in full production. However, these two factors could be separated as shown for Northern region in Table 8.

Table 8 shows that in selected Zones in the Northern Region the potential of hectare yield in olive orchards is very high exceeding in 1982 the 1972 level by 144 per cent. In this context, however, it should be pointed out that most of the measures required to make such an increase possible have not as yet been taken and, therefore, most of the olive production gain in 1976 compared to 1972 is due to the growth of the portion of trees in full production out of the total number of olive trees as discussed in the previous sub-chapter.

In this connection, it should be noted that it is not just a question of somewhat increasing yields per hectare and per tree, but rather of increasing them essentially and, if possible, at a higher rate than the overall agricultural production. The reason being that otherwise the gap between the productivity of the olive production sub-sector, on the one hand, and other agricultural sub-sectors as well as non-agricultural branches of national economy, on the other, may widen to such an extent as to make olive production entirely unattractive.

In table 9 one can see that the productivity of the olive production sub-sector is lagging behind other fields of agricultural activities. This could create problems for the sub-sector when it comes to paying the essential manpower on a competitive basis.

TABLE 8

NORTHERN REGION

Potential of Olive Production Increase  
(By Province)

Province	Zone	Indices 1981 (1972 =100)		
		Hectares of trees in full production	Yield per Hectare in Kg.	Overall Production Increase
Tunis	Selected	167	224	374
	Other	140	201	282
Beja	Selected	202	256	516
	Other	127	111	134
Jandouba	Selected	163	251	409
	Other	152	105	159
Nabeul	Selected	132	251	331
	Other	131	118	154
Bierte	Selected	178	249	444
	Other	127	108	137
Total	Selected	172	244	419
	Other	128	149	191

TABLE 9

Output per Active Person in  
Various Sectors of Economy  
(1975)

S e c t o r	Value added at Factor Cost in mil- lion Dinars	Number of Active Persons in 1000	Annual Output per Active Person in Dinars
Non-agricultural sector	1,242	853	1,456
Agriculture, except olive production	280	368	161
Olive Production	30	145	269

Source: World Bank, Memorandum on the Economic Position  
and Prospects of Tunisia - September 1976.

République Tunisienne: V Plan de Développement  
Economique et Social - 1977-1981.

### III. CONCEPT OF THE PROJECT

#### A. Area Covered by the Project, Inputs and Production Increase

##### 1) Area Covered

The basic idea of the project was to develop efficient extension and training activities in the field of olive production and consequently to contribute to the creation of conditions allowing for essential and sustained growth of olive production per hectare and per unit of labour and other inputs. The experimentation programme would provide backstopping to this extension work and furnish fresh information on further possibilities for production increase. It was felt that all recommendations coming from inside the project as well as from outside should be carefully evaluated <sup>1</sup> insofar as economic repercussions are concerned in order to diffuse the most efficacious measures possible so as to ensure the highest return for any additional inputs.

All project results are to be made available through the extension framework to each interested olive grower from whatever part of the country he may come. In this sense the project is a nationwide one. But when complementing the Plan of Operations by the Feasibility Study, it was realized that intense project activities should be concentrated in certain zones if some tangible results are to be obtained in a reasonable length of time. The actual area under olive trees is some 1.24 million hectares. <sup>1/</sup> The project staff, even though it was backed by relevant national institutions in each region, could not cope with the whole area without dispersing itself in bits and pieces of extension work with little or no impact on olive production and productivity levels.

Therefore, it was agreed to limit the project to selected zones where the soil fertility, climatic and socio-economic conditions guarantee the highest potential for an essential production and productivity increase. Hence, it was decided that the project and its "follow-up" would cover by concentrated activities 65,000 hectares in the Northern Region and 100,000 hectares in the Central Region. In the Southern Region, however, it was impossible to identify ones for sustained extension and training activities and it was felt that such ones could be better identified at a later stage when the project would become operational. In the meantime, the intervention in the

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<sup>1/</sup> This figure is from the "Inventory of Olive Plantations in Tunisia" compiled in 1975. The statistical figure of 1976 1.4 million ha. takes into consideration all kinds of association between olive tree and/or any other annual or perennial crop as an area under olive tree. The former figure was preferred since it gives the breakdown of the area by age groups of olive trees.

Southern Region would have rather an "ad hoc" character compared to the systematic approach conceived for the Northern and Central Regions. Apart from the intense extension and training programme in these two regions limited replantation and regeneration schemes could be carried out in the North (5,000 ha) and in the Centre (20,000 ha).

Therefore, the area covered by the project's sustained activities compared to the total area under olive trees is as follows:

TABLE 10

Area Covered by Intense Project Activities

	Northern	Central	Southern	Total
Total olive tree area in 1000 hectares	197	351	694	1,242
Promotion and extension activities (1000 ha)	60	80	*	140
Replantation of old trees (1000 ha)	5	-	-	5
Regeneration of old trees (1000 ha)	-	20	-	20
T o t a l	65	100	*	165
Acreage covered by the project in % of total acreage	33.0	28.5	*	11.8

\* To be identified at a later stage.

The area under olive tree on an average farm specialized in olive growing is about 4 hectares in the North and 8 hectares in the Centre. Consequently, the acreages in Table 10 correspond to 16,520 farms in the North (15,000 in the extension and promotion programmes and 1,250 in the replantation scheme) and 12,500 farms in the Centre (10,000 in the extension and promotion programmes and 2,500 in the replantation scheme).

## 2) Increase in Inputs and Hectare Yields

As soon as it was decided in which region the sustained project activities would be concentrated, it was possible to advise what inputs could be used to exploit the production potential to the highest possible extent. In this context, however, it might be recalled that the type and quality of inputs correspond to the present state of knowledge and that this may undergo some modification during the project's lifetime.

The proposed level of physical inputs and corresponding costs checked against the production response and gross income change. This exercise made it clear that the increase of inputs should be effectuated, step by step, as otherwise it would not be closely followed by an appropriate production increment and this might discourage farmers and prevent them from acceding to the programme. Apart from this, the gradual approach was indispensable also because of a series of other reasons of a technical, economical and socio-economical nature. Thus, it was estimated that the necessary delay required to obtain in full the recommended level of inputs on one hectare of olive orchard would be 6 years in the North and 5 years in the Centre.

As shown in Table I/2 in Annex II, the inputs in the Northern Region would rise from the present level of 60 Dinars per hectare to 119 Dinars, without plant protection and, 113 Dinars with, in the sixth year. In this context, it might be mentioned that presently plant protection is fully subsidized by the Government and consequently does not incur any cost to farmers. Because it is not known whether or not the Government will in future maintain this policy, these costs in the present study always figure separately and all economic evaluation, at farm level, is made twice, i.e. with and without subsidy. But once the farm level evaluation is left out and the appraisal made from the point of view of the community, the cost of crop protection must be taken into account at any rate, i.e. regardless of whether the subsidy continues or not.

The following measures correspond to the above-mentioned increase of inputs from 60 D. to 143 D. (including plant protection) :

- Introduction of deep ploughing once a year
- Trebling of shallow ploughing frequency (from 2 x a year to 6 x a year)
- Introduction of the application of 300 kg of fertilizer in each subsequent year
- Improve the quality of pruning (10 days instead of 8.5)
- Intensification of plant protection to 1.5 applications per hectare each year. Special attention will be given to wood pest treatment.

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\* These inputs will be refined or modified in the light of the findings of the planned applied research programme.

In the Central Region the inputs would increase from the present level of 50 Dinars per hectare to 115 Dinars (including plant protection) and would eventually reach the same level as in the North except for shallow ploughing (4 x a year instead of 6 x) and crop protection (16 Dinars per hectare to 24 Dinars in the North). The relevant figures are presented in Table 2/II in Annex II.

To the marked increase in inputs corresponds a considerable increase in yield per hectare as shown in Table 11 below:

TABLE 11

Increase of hectare yields in the Selected Zones  
Covered by the Intense Activities of the Project

R e g i o n	In kilograms per Hectare		
	Present	Target	Increase
Northern - Extension	1,200	3,500	2,300
Northern - Replanta- tion	1,000	5,000	4,000
Central - Extension	1,000	2,500	1,500
Central - Regenera- tion	1,000	2,500	1,500

The above hectare yields applied to the areas covered by intense project activities show the foreseen production increase. In the Northern Region olive production would rise from 77 to 235 thousand tons and in the Central Region from 100 to 250 thousand tons. Thus, in the areas covered by intense project activities in the two regions combined an additional 258,000 tons of olives could be produced. This is a marked increase representing almost 50 per cent of present national olive production notwithstanding that the project covers 12 per cent of the area under olive trees.

B. Intense Extension and Training Activities on one Hectare  
of a Model Farm

1) Evolution of cost, gross income and benefit

The increase in cost per hectare, in hectare yields and in cost per one kilogram of olives with respect to the extension/training section of the project programme, is shown in Table 12. This table reveals that the proposed programme would involve a considerable increase in cash expenditures which would not be compensated even by the increment of gross income in the first and second years if plant protection remained subsidized and furthermore in the third year if this subsidy is withdrawn.

TABLE 12

NORTHERN AND CENTRAL REGIONS

Evolution of Unit Cost of Olives With and Without Subsidy for Plant Protection

Year	Yield per Hectare in Tons		Cost per Hectare in Dinars				Unit Cost of One Kilo of Olives			
			Without		With		Without		With	
			Plant Protection				Plant Protection			
	North	Centre	North	Centre	North	Centre	North	Centre	North	Centre
0	1.2	1.0	60	42	60	50	50	42	50	50
1	1.2	1.0	76	63	132	69	63	63	110	69
2	1.6	1.3	85	68	141	84	53	52	88	65
3	2.1	1.7	95	76	119	92	45	45	57	54
4	2.7	2.1	104	88	128	104	39	42	47	50
5	3.1	2.5	113	99	137	115	36	40	44	46
6	3.5	2.5	119	99	143	115	34	40	41	46

This development called for caution when working out the programme for the "model" farm of 4 hectares in the North and 8 hectares in the Centre. It was felt that in the North the programme should start on each farm on one hectare and in the Centre on two hectares. Thereafter, one more hectare should be integrated in the programme each year in the North and two more hectares in the Centre.

Considering that on one hectare the programme has already been going on for 6 years in the North and 5 years in the Centre, the whole programme on one farm would, therefore, need 9 years in the North and 8 years in the Centre. On that basis detailed tables have been worked out (Tables 3/II, 4/II, 5/II and 6/II in Annex II) figuring out the evolution of production and cost on a model farm of 4 hectares in the North and 8 hectares in the Centre. The evolution of benefit reflected in these detailed tables is summarized in Table 13.

Table 13 reveals that the farmer adopting the programme may experience temporarily considerable difficulties, particularly if the subsidy is withdrawn. In that case in the North the benefit would disappear during the first year of the farmer's embarking upon the scheme and reappear only after 5 years and exceed its present level only in the sixth year. In the Centre the temporary loss would seem to be less important and with respect to the North start one year later and end one year earlier.

From Table 13 it follows that the programme would require special credit arrangements without which it would not be feasible particularly if the subsidy on crop protection is withdrawn. The figures in Table 13, however, suggest that in normal conditions the farmer would be in a position to repay his loan between 6 and 8 years after his adherence to the scheme.

## 2) Evolution of a Number of Farms and Other Area Covered

It is obvious that the programme in as far as the extension/training activities are concerned cannot be started on 15,000 farms in the North and on 25,000 farms in the Centre simultaneously. A special scheme was, therefore, drawn up to integrate only a limited number of farms in the programme each year. This yearly "intake" starts with 500 farms in the North and 750 in the Centre and gradually grows to reach 1,750 and 1,250 farms respectively in the North and Centre as indicated in Table 14. This table is complemented by Table 15 which shows the cumulative area subject to intense project extension/training activities.

TABLE 13

NORTHERN AND CENTRAL REGIONS

Evolution of Benefit With and Without Subsidy  
on Crop Production

Year	Benefit per Farm in Dinars			
	North Subsidy		Centre Subsidy	
	Maintained	Withdrawn	Maintained	Withdrawn
0	48	48	144	30
1	32	-24	102	22
2	31	-81	86	-10
3	50	-86	102	-10
4	96	-64	143	15
5	173	45	251	123
6	253	157	333	205
7	313	217	383	255
8	346	250	408	280
9	364	268	408	280

C. High Density Replantation/Regeneration Schemes

A similar approach as to the extension/training part of the project programme was adopted for the replantation/regeneration scheme, i.e. first of all, costs and returns on one hectare were analyzed. This was done in the North for regeneration as well as for the high density replantation alternatives. After carefully comparing the results over a period of 15 years needed to attain stabilized input/output ratio, the replantation was adopted as a more efficient and more economic solution for the North. As Table 16 indicates the regeneration alternative would eventually give 180 Dinars of gross income which would require 120 Dinars of cost whereas the replantation would bring 300 Dinars of gross income compared to 138 Dinars of cost.

For the Central Region, however, no replantation alternative was considered because of limited output potential (2.5 tons per hectare compared to 5.0 tons in the North). The details of the Central Region regeneration programme are presented in Tables 7/II and 8/II in Annex II.

The technical and economic parameters for one hectare have been thereafter applied to a programme which starts with 200 hectares in the North and 1,000 hectares in the Centre gradually increasing so as to cover the total area earmarked for the scheme in the North in the seventh year and in the Centre in the tenth year (Table 9/II in Annex II).

TABLE 14

NORTHERN AND CENTRAL REGIONS

Number of Farms and Area Entering Annually  
the Scheme of Project Activities

Year	NORTHERN		CENTRAL		NORTHERN AND CENTRAL	
	Farms entering the Scheme	Area in 1000 Ha	Farms entering the Scheme	Area in 1000 Ha	Farms entering the Scheme	Area in 1000 Ha
1	500	2	250	2	750	4
2	750	3	500	4	1,250	7
3	1,250	5	750	6	2,000	11
4	1,750	7	1,000	8	2,750	15
5	1,750	7	1,250	10	3,000	17
6	1,750	7	1,250	10	3,000	17
7	1,750	7	1,250	10	3,000	17
8	1,750	7	1,250	10	3,000	17
9	1,750	7	1,250	10	3,000	17
10	2,000	8	1,250	10	3,250	18
TOTAL	15,000	60	10,000	80	25,000	140

TABLE 15

NORTHERN AND CENTRAL REGIONS

Cumulative Acreage Covered by  
Project Activities

Year	NORTHERN	CENTRAL	TOTAL
	(In 1000 Hectares)		
1	2	2	4
2	5	6	11
3	10	12	22
4	17	20	37
5	24	30	54
6	31	40	71
7	38	50	88
8	45	60	105
9	52	72	124
10	60	80	140

#### IV. ECONOMIC APPRAISAL

The tables required for the economic appraisal of the project are presented in Annex III. Table 1/III of the Annex shows the evolution of olive production by year and by type of intervention. It goes from year 0 to year 22 covering the whole period during which changes occur in production. After year 22 production is stabilized, the last changes taking place between year 21 and 22 in the regeneration programme in the Central Region. Table 1/III is the basis for calculating gross income. As far as replantation and regeneration schemes are concerned, incomes derived from wood sales and inter-cropping should be added to the gross income from olive production (Table 2/III). Wood sale and inter-cropping incomes are rather important and contribute essentially to the second balance of the project's gross income over the first ten years of its duration when returns from olive production are still far from their target level.

The cash flow based on these tables as well as on Table 3/III in Annex III spelling out the cost of plant protection, by region and by operation, is presented in Table 4/III. This last table enables one to figure out and compare the project results in the initial and in the final year of its duration. This comparison is presented in Table 16 which shows that the Project's economic results are fairly satisfactory. Gross income, per farm, rises from 64 to 176 Dinars or 175 per cent. The increase in cost, per hectare and per farm, although quite high, is in relative terms less important than that of gross income thereby leaving adequate room for benefit increase which would rise, per farm, from 67 Dinars to 275 Dinars, and per hectare, from 12 to 30 Dinars, if the subsidy on crop protection is withdrawn. Should this subsidy continue, the benefit would rise from 89 Dinars to 383 Dinars per farm and 16 to 67 Dinars per hectare. This is relatively a very high increase which would definitely contribute to making the olive production sub-sector of the national economy an attractive proposition. In this context it is worth noting that most of the farmers would achieve the above results about 8-9 years after integrating the project.

As shown in Table 18 another positive aspect of the project consists in reducing the unit cost of olives produced.

TABLE 16

NORTHERN REGION

Comparison of Economic Results of Regeneration  
and Replantation of one Hectare of Old Trees

Year	Regeneration (Dinars/ha.)			Replantation (Dinars/ha.)		
	Cost 1/	Receipts	Benefits	Cost 1/	Receipts	Benefits
1	576	600	24	476	600	124
2	20	15	-5	128	-	-128
3	20	15	-5	39	15	-24
4	27	33	6	20	15	-5
5	46	51	5	22	15	-7
6	56	75	19	29	27	-2
7	68	105	37	50	47	-3
8	87	120	33	57	60	3
9	106	150	44	82	90	8
10	116	180	64	96	120	24
11	118	180	62	128	180	52
12	120	180	60	136	210	74
13	120	180	60	146	240	94
14	120	180	60	154	270	116
15	120	180	60	162	300	138
16	120	180	60	162	300	138
17	120	180	60	162	300	138
18	120	180	60	162	300	138
19	120	180	60	162	300	138
20	120	180	60	162	300	138

TABLE 17

Comparison of Project Results  
Per hectare and per Farm

	Year	Total (1000 D)	Per farm in D	Per hectare in D
Production in 1000 tons	0	177	6.2 T	1.1 T
	22	485	16.9 T	2.9 T
Gross Income	0	10,620	369	64
	22	29,100	1,012	176
Cost with Plant Protection	0	8,690	302	53
	22	21,205	737	128
Cost without Plant Protection	0	8,050	280	49
	22	18,091	629	110
Benefit (Subsidy withdrawn)	0	1,930	67	11
	22	7,895	275	48
Benefit (Subsidy included)	0	2,570	89	15
	22	11,009	383	66

TABLE 18

Unit Cost of Olives during the Various Stages  
of the Project's Duration

		0	5	10	15	22
Production of Olives in 1000 tons		177	178	289	447	485
Cost in million Dinars	With plant protection	8.7	11.7	17.2	20.3	21.2
	Without plant protection	8.1	10.3	14.2	17.2	18.1
Cost per ton in Dinars	With plant protection	49	66	60	45	44
		45	58	49	38	37

Table 18 reveals that the project would succeed in cutting down the unit cost of olives from 49 Dinars per ton to 44 Dinars per ton or 10 per cent if the subsidy on crop protection is withdrawn and from 45 Dinars to 37 Dinars or 18 per cent if the subsidy is maintained. This cut in unit cost would make it possible to gradually increase salaries without undermining the economic viability of the sub-sector. This is a rather important feature of the project because this increase in salaries is likely to become a necessity in time.

The above cut in the unit cost of olives, however, is not the same in the two regions involved and differs also by type of operation as revealed in Table 18 which summarizes and compares the basic results of the project in its initial and final year by region and by kind of intervention.

According to Table 19 the cut in unit costs is most important in the replantation operation in the North where costs per ton of olives would decrease from 50 Dinars to 34 Dinars per ton or by 32 per cent if the subsidy on crop production is withdrawn and to 29 Dinars or by 42 per cent if it is continued. This rather drastic cut in costs is linked with the high yield per hectare foreseen in this operation (5 tons of olives per hectare) whereby the "fixed" costs per hectare are spread over a considerably larger quantity of olives produced than is the case in their operations of the project.

If the subsidy on crop protection is maintained, the project's other interventions would also secure a satisfactory lowering of unit costs. This is valid as well for the promotion/extension programmes in the case of the subsidy being withdrawn whereas in this case the regeneration scheme in the Centre would not cut down unit costs at all (increase from 42 to 45 Dinars per ton).

TABLE 19

## NORTHERN AND CENTRAL REGIONS

Summary of Project Results by Operation

	Year	Promotion and Extension		Replant-	Regene-
		North	Centre	ation North	ration Centre
Production in 1000 tons	0	72	80	5	20
	22	210	200	25	50
Receipt in million Dinars	0	4.32	4.80	0.30	1.20
	22	12.60	12.00	1.50	3.00
Cost without plant protection in million Dinars	0	3.60	3.36	0.25	0.84
	22	7.14	7.92	0.73	1.92
Plant protection cost in million Dinars	0	-	0.64	-	-
	22	1.44	1.27	0.12	0.32
Total cost in million Dinars 1/	0	3.60	3.90	0.25	0.84
	22	8.58	9.19	0.85	2.24
Benefits in million Dinars (No subsidy considered)	0	0.72	0.90	0.05	0.36
	22	4.02	0.81	0.65	0.76
Cost without plant protection in Dinars per ton	0	50	42	50	42
	22	34	40	29	38
Total cost including plant protection in Dinars per ton	0	50	49	50	42
	22	41	46	34	45

1/ Project cost not considered.

The cash flow incremental costs and benefits are presented in Table 5/III in Annex III and summarized in Table 20. This table reveals that the project's internal rate of return is 19 per cent which is a comparatively high rate for arboriculture. This rate could be 42 per cent if the subsidy on crop protection remains. In fact, for the time being, this subsidy holds valid and its withdrawal may occur only in due course. Therefore, the period of such a possible withdrawal would depend on the "real" internal rate of return which would be within the range of 19 to 42 per cent as far as the farm level is concerned. From the point of view of the community the internal rate of return is 19 per cent notwithstanding whether the subsidy is withdrawn or continued.

TABLE 20

Summary of Project Results

	With subsidy on crop protection	Without Subsidy
Incremental cost in million Dinars	135.5	176.3
Incremental benefit in million D.	86.1	46.3
Discount rate	35.1	12.1
Present worth of cost in million D.	6.3	40.3
Present worth of benefit in million D.	0.3	3.6
Present worth benefit/cost ratio in %	2.82	8.83
Internal rate of return in %	42%	19%

ANNEX I

Tables on olive production in Tunisia  
its position in national economy past  
evolution and prospects for development

(Tables 1-I to 9-I)

Table 1-I

GROSS DOMESTIC PRODUCT (GDP)

BY ORIGIN

Year	GDP at factor cost in constant 1972 prices		
	Agriculture	Other sectors	Total
1973	199,7	882,7	1082,4
1974	233,3	948,1	1181,4
1975	229,2	1073,3	1302,5
1976	250,5	1180,9	1431,4
Percentages			
1973	18,4	81,6	100,0
1974	18,9	81,1	100,0
1975	17,6	82,4	100,0
1976	17,5	82,5	100,0

Table 2-I

FOOD AND OVERALL  
COMMODITY EXPORTS  
(1972, 1974 and 1976)

Year	In million Dinars		
	Food	Other	Total
1972	61,9	88,4	150,3
1974	100,6	297,1	397,7
1976	68,9	282,6	351,5
Average	77,2	222,7	299,8
Percentages			
1972	41,2	58,8	100,0
1974	25,3	74,7	100,0
1976	19,6	80,4	100,0
Average	25,8	74,2	100,0

Table 3-I

OLIVE OIL AND OVERALL  
FOOD EXPORTS

Year	In million Dinars		
	Olive oil	Other	Total
1972	41,1	20,8	61,9
1974	71,7	28,9	100,6
1976	36,6	32,3	68,9
Average	49,8	27,4	71,2
Percentages			
1972	66,4	33,6	100,0
1974	71,3	28,7	100,0
1976	53,1	46,9	100,0
Average	64,5	35,5	100,0

Table 4-I

EMPLOYMENT IN OLIVE  
PRODUCTION  
(Average 1972 - 1975)

Region	In 1000 working days			Manpower equivalent in 1000 <sup>1/</sup>
	Maintenance of olive tree yields	Harvesting	Total	
Northern	3330	2485	5815	19,4
Central	6700	3015	9775	32,6
Southern	18420	9430	27850	92,8
Total	25450	14930	43440	144,8 <sup>2/</sup>

<sup>1/</sup> Using 300 working days a year as a conversion ratio.

<sup>2/</sup> Total number of population active in agriculture was estimated in a 1975 survey at 513.000.  
(Figures from the Fifth Plan of Economic and Social Development)

Table 5-I

FARMS SPECIALIZED IN OLIVE PRODUCTION  
BY SIZE OF TOTAL ACREAGE

Groups of farms by size in hectares	Number of farms	Percentage Share
0 - 2	13 710	14,6
2 - 10	45 400	49,4
10 - 50	31 180	33,1
50 - 200	3 220	3,4
200 and more	490	0,5
TOTAL	94 000	100,0

Source: Ministry of Agriculture: "Enquête Agricole de  
Base 1976"

Table 6-I

OLIVE PRODUCTION BY REGION

(1970/71 - 1976/77)

	Olive production in 1000 tons			
	Northern	Central	Southern	Total
1970/71	32	86	263	381
1971/72	120	227	454	801
1972/73	41	86	169	296
1973/74	84	184	305	573
1974/75	47	165	253	465
1975/76	110	213	480	803
1976/77	72	130	209	411
Average 1970/71-1976/77	72	156	305	533

Table 7-I

Estimated consumption of edible oils  
(1976 - 1996)

Year	Population in 1000 <sup>1/</sup>	Annual consumption of edible oils		Edible oils in equivalent of olives in 1000 t. <sup>3/</sup>
		Per capita in kilos	in 1000 tons	
1976	5737	18,7 <sup>2/</sup>	107,3	537
1981	6437	19,8 <sup>1/</sup>	127,5	638
1986	7146	20,3	145,1	726
1991	7893	20,5	161,8	809
1996	8617	20,6	177,5	888

<sup>1/</sup> Fifth Plan of Economic and Social Development estimates

<sup>2/</sup> Adjusted figure of the 1975 food consumption survey which gave 18,5 kg of edible oil per head

<sup>3/</sup> Assuming 20% extraction rate

Table 8-I

NORTHERN REGION  
OLIVE PRODUCTION POTENTIAL  
IN SELECTED ZONES  
BY PROVINCE

Province	Year	Gross product in 1000 D			Index 1981 (1972 = 100)		
		Selected Zones	Other zones	Total	Selected Zones	Other zones	Total
Tunis	1972	844	1 316	2 160			
	1981	3 156	3 704	6 860	374	282	318
Beja	1972	434	160	594			
	1981	2 246	215	2 461	516	134	414
Jendouba	1972	259	103	362			
	1981	1 058	164	1 222	409	159	338
kef	1972		537	537			
	1981		564	564			105
Nabeul	1972	215	1 244	1 459			
	1981	711	1 915	2 626	331	154	180
Bizerte	1972	165	174	339			
	1981	732	239	971	444	137	286
TOTAL	1972	1 887	3 564	5 451			
	1981	7 903	6 801	14 704	419	191	270

Source: Office National de l'Huile: "Inventaire de l'Olivaie Tunisienne"  
Vol. 2 (October 1975)

Table 9-I

CENTRAL REGION  
OLIVE PRODUCTION POTENTIAL  
IN SELECTED ZONES  
BY PROVINCE

Province	Year	Gross product in 1000 D			Index 1981 (1972=100)		
		Selected Zones	Other Zones	Total	Selected Zones	Other Zones	Total
Sousse	1972	2 130	5 141	7 271			
	1981	3 398	6 821	10 219	160	133	141
Kairouan	1972	1 755	191	1 946			
	1981	3 415	217	3 632	195	114	187
Kasserine	1972	799	97	896			
	1981	1 433	102	1 534	179	105	171
TOTAL	1972	4 684	5 429	10 113			
	1981	8 246	7 140	15 385	176	132	152

Source : Office National de l'Huile : "Inventaire de l'Olivaie Tunisienne"  
Vol. 2 (October 1975).

ANNEX II

Tables on conception of the project, its technical  
and economic parametres and scheduling.

(Tables 1-II to 9-II)

TABLE 1-II

NORTHERN REGION

Inputs and Cost on one Hectare of Olive Orchard

Input or Operation	Unit Price	Year 0		Year 6	
		Quantity	Cost in Dinars	Quantity	Cost in Dinars
Deep ploughing	2D/hour	-	-	1x2 hrs	4
Shallow ploughing	2D/hour	2x1 hr	4	6x1 hrs	12
Weeding	10D/ha	1	10	1	10
Manure	10D/ha	-	10	-	-
Fertilizer	50D/ton	-	-	0.3 t	15
Application of fertilizers	1 Dinar application	-	-	2 applications	2
Trimming	2D/day	8.5 d	17	10 days	20
Sub-Total I			41		63
Crop Protection	16D/application		-	1.5 application	24
Sub-Total II			41		87
Harvesting	16D/ton	1.2 t	19	3.5 t	56
Total I without plant protection cost			60		119
Total II with plant protection cost			60		143

TABLE 2-II

CENTRAL REGION

Inputs and Cost on one Hectare of Olive Orchard

Input or Operation	Unit Price	Year 0		Year 5	
		Quantity	Cost in Dinars	Quantity	Cost in Dinars
Deep Ploughing	2D/hr	1 hr	2	2 hrs	4
Shallow ploughing	2D/hr	2 hrs	4	4 hrs	8
Weeding	10/ha	1 ha	10	1 ha	10
Fertilizer	50D/ton	-	-	0.5 t.	15
Application of fertilizers	1D/appli- cation	-	-	2 appli- cations	2
Trimming	2D/day	5 days	10	10 days	20
Sub-Total I			26		59
Crop Protection	16D one full ap- plication	0.5	8	1	16
Sub-Total II			34		75
Harvesting	16D/ton	1 ton	16	2.5 t.	40
TOTAL I without crop protection costs			42		99
TOTAL II with plant protection costs			50		155

TABLE 3-II

NORTHERN REGION

Olive Production Development on a Model Farm with  
4 Hectares of Olive Trees in Selected Zones

Year	Yield per Hectare in Metric Tons				
	Ha 1	Ha 2	Ha 3	Ha 4	Total
1	1.2	1.2	1.2	1.2	4.8
2	1.6	1.2	1.2	1.2	5.2
3	2.1	1.6	1.2	1.2	6.1
4	2.7	2.1	1.6	1.2	7.6
5	3.1	2.7	2.1	1.6	9.5
6	3.5	3.1	2.7	2.1	11.4
7	3.5	3.5	3.1	2.7	12.8
8	3.5	3.5	3.5	3.1	13.6
9	3.5	3.5	3.5	3.5	14.0

TABLE 4-II

CENTRAL REGION

Olive Production Development on a Model Farm with  
8 Hectares of Olive Trees in Selected Zones

Hectares	Yield per Hectare in Metric Tons							
	1	2	3	4	5	6	7	8
Ha 1	1.0	1.3	1.7	2.1	2.5	2.5	2.5	2.5
Ha 2	1.0	1.3	1.7	2.1	2.5	2.5	2.5	2.5
Ha 3	1.0	1.0	1.3	1.7	2.1	2.5	2.5	2.5
Ha 4	1.0	1.0	1.3	1.7	2.1	2.5	2.5	2.5
Ha 5	1.0	1.0	1.0	1.3	1.7	2.1	2.5	2.5
Ha 6	1.0	1.0	1.0	1.3	1.7	2.1	2.5	2.5
Ha 7	1.0	1.0	1.0	1.0	1.3	1.7	2.1	2.5
Ha 8	1.0	1.0	1.0	1.0	1.3	1.7	2.1	2.5
TOTAL	8.0	8.6	10.0	12.2	15.2	17.6	19.2	20.0

TABLE 5-II

NORTHERN REGION

Evolution of Cost of Olive Production on a Model Farm  
with 4 Hectares of Orchards in Selected Zones

Year	Cost Without Crop Protection Cost in Dinars per Hectare					Crop Protection Cost in Dinars per Hectare				
	Ha 1	Ha 2	Ha 3	Ha 4	Total	Ha 1	Ha 2	Ha 3	Ha 4	Total
0	60	60	60	60	240	-	-	-	-	-
1	76	60	60	60	256	56	-	-	-	56
2	85	76	60	60	281	56	56	-	-	112
3	95	85	76	60	316	24	56	56	-	136
4	104	95	85	76	360	24	24	56	56	128
5	113	104	95	85	397	24	24	56	56	128
6	119	113	104	95	431	24	24	24	24	96
7	119	119	113	104	470	24	24	24	24	96
8	119	119	119	119	476	24	24	24	24	96

TABLE 6-II

CENTRAL REGION

Evolution of Cost of Olive Production on a Model Farm  
with 4 Hectares of Orchards in Selected Zones

Year	Cost without crop protection Cost in Dinars per Hectare					Crop Protection Cost in Dinars per Hectare				
	Hectares					Hectares				
	1+2	3+4	5+6	7+8	Total	1+2	3+4	5+6	7+8	Total <sup>1/</sup>
0	84	84	84	84	336	16	16	16	16	64
1	126	84	84	84	378	32	16	16	16	80
2	136	126	84	84	430	32	32	16	16	96
3	152	136	126	84	498	32	32	32	16	112
4	175	152	136	126	589	32	32	32	32	128
5	198	175	152	136	661	32	32	32	32	128
6	198	198	175	152	723	32	32	32	32	128
7	198	198	198	175	769	32	32	32	32	128
8	198	198	198	198	792	32	32	32	32	128

<sup>1/</sup> Additional treatment due to project activities amounts to 16, 32, 48 and 64 Dinars per farm in the 1st, 2nd, 3rd and 4th year respectively.

TABLE 7-II

CENTRAL REGION

Evolution of Cost of Regeneration of one Hectare  
(In Dinars)

Year	Stumping and Related Cost	ploughing	Fertil- izers in- cluding appl'on	Trimming	Crop Protect- ion	Harvest- ing	Total
1	422	12	-	-	-	-	434
2	-	12	-	4	-	-	16
3	-	12	-	4	4	-	20
4	-	12	-	6	4	4	26
5	-	12	12	6	4	8	42
6	-	12	12	8	6	12	50
7	-	12	12	10	8	16	58
8	-	12	19	14	10	20	75
9	-	12	24	16	12	24	88
10	-	12	24	20	16	28	100
11	-	12	24	20	16	32	104
12	-	12	24	20	16	36	108
13	-	12	24	20	16	40	112
14	-	12	24	20	16	40	112

TABLE 8-II

CENTRAL REGION

Evolution of Gross and Net Income of  
Regeneration on one Hectare  
(In Dinars)

Year	Receipts				Cost		Benefit	
	Wood Sale	Inter Crop	Olives	Total	Crop Protection		Crop Protection	
					Included	Excluded	Included	Excluded
1	600	-	-	600	434	434	166	166
2	-	15	-	15	16	16	-1	-1
3	-	15	-	15	20	16	-5	-1
4	-	15	15	30	26	22	4	8
5	-	15	30	45	42	38	3	7
6	-	-	45	45	50	44	-5	1
7	-	-	60	60	58	50	2	10
8	-	-	75	75	75	65	-	10
9	-	-	90	90	88	76	2	14
10	-	-	105	105	100	84	5	21
11	-	-	120	120	104	88	16	32
12	-	-	135	135	108	92	27	43
13	-	-	150	150	112	96	38	54
14	-	-	150	150	112	96	38	54

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TABLE 2-II

NORTHERN AND CENTRAL REGIONS

Area of Replantation in the North and  
Regeneration in the Centre Entering the Scheme

Year	Hectares Replanted	Hectares Regenerated	Total
1	200	1,000	1,200
2	400	2,000	2,400
3	600	2,000	2,600
4	800	2,000	2,800
5	1,000	2,000	3,000
6	1,000	2,000	3,000
7	1,000	2,000	3,000
8	-	2,000	2,000
9	-	2,000	2,000
10	-	3,000	3,000
TOTAL	5,000	20,000	25,000

ANNEX III

Tables on cash flow and economic appraisal

(Tables 1-III to 5-III)

Table 1-III

NORTHERN AND CENTRAL REGIONS

Olive production in zones

covered by the project

(in 1000 metric tons)

. Year	Extension activities		Replan- tation	Regene- ration	Total
	North	Centre			
0	72,0	80,0	5,0	20,0	177,0
1	72,0	80,0	4,8	19,0	175,8
2	72,2	80,2	4,4	17,0	173,8
3	73,0	80,8	3,8	15,0	172,6
4	74,9	82,5	3,0	13,3	173,7
5	77,8	86,0	2,0	12,0	177,8
6	85,3	91,9	1,0	11,2	189,4
7	94,7	100,5	0,2	11,0	206,4
8	106,8	111,5	0,5	11,3	230,1
9	120,9	124,5	1,2	12,0	258,6
10	136,2	138,7	2,2	12,3	289,4
11	152,2	153,5	3,8	16,0	325,5
12	167,8	167,8	6,0	19,5	361,1
13	182,0	180,3	8,6	25,3	396,2
14	193,7	190,0	11,5	30,0	425,2
15	202,0	196,0	14,5	34,3	446,8
16	206,9	199,0	16,6	38,0	460,5
17	209,2	200,0	20,1	41,3	470,6
18	210,0	200,0	23,0	44,0	477,0
19	210,0	200,0	24,5	46,3	480,8
20	210,0	200,0	25,0	48,0	483,0
21	210,0	200,0	25,0	49,3	483,3
22	210,0	200,0	25,0	50,0	485,0

Table 2-III

NORTHERN AND CENTRAL REGIONS  
Development of gross income in areas  
covered by project activities (in 1000 Dinars)

Year	Olives	Sale of wood and inter crops		Total
		North	Centre	
0	10620	-	-	10620
1	10550	120	600	11270
2	10430	240	1215	11885
3	10360	363	1245	11968
4	10420	489	1275	12184
5	10670	616	1305	12591
6	11360	629	1320	13309
7	12384	645	1320	14349
8	13810	97	1320	15187
9	15520	66	1320	16906
10	17360	60	1970	19340
11	19530	45	135	19710
12	21670	30	105	21805
13	23770	15	75	23860
14	25510	-	45	25555
15	26810	-	-	26810
16	27630	-	-	27630
17	28240	-	-	28240
18	28620	-	-	28620
19	28850	-	-	28850
20	28980	-	-	28980
21	29060	-	-	29060
22	29100	-	-	29100

1) Using constant price of 60 D per ton of olives.

Table 3-III

NORTHERN AND CENTRAL REGIONS  
Subsidy for crop protection treatment  
(In 1000 Dinars)

Year	Promotion and extension		Replantation	Regeneration		Total
	North	Centre		North	Centre	
0	-	640	-	-	-	640
1	28	644	-	-	-	672
2	98	656	-	-	-	754
3	222	680	1	4	-	907
4	420	720	2	12	-	1154
5	648	774	5	20	-	1447
6	876	832	8	30	-	1746
7	1092	914	12	44	-	2062
8	1276	994	20	62	-	2352
9	1444	1074	27	84	-	2629
10	1626	1154	31	116	-	2927
11	1710	1214	38	144	-	3105
12	1688	1254	48	180	-	3170
13	1624	1274	55	204	-	3158
14	1504	1274	62	228	-	3068
15	1440	1274	70	252	-	3035
16	1440	1274	76	276	-	3066
17	1440	1274	80	298	-	3092
18	1440	1274	80	308	-	3102
19	1440	1274	80	320	-	3114

Table 4-III

Economic results in the Zones  
covered by the project  
(in 1000 Dinars)

Year	Gross income	Cost except crop protection	Crop protection (subsidy)	Total farm cost	Project cost	Total cost	Benefit with subsidy	Benefit without subsidy
0	10620	8050	640	8690	-	8690	2570	1930
1	11270	8546	672	9218	604	9822	2120	1448
2	11885	9069	754	9823	548	10371	2268	1514
3	11968	9238	907	10145	381	10526	2349	1442
4	12184	9535	1154	10689	381	11070	2268	1114
5	12591	9922	1447	11369	381	11750	2288	841
6	13309	10457	1746	12203	281	12584	2471	725
7	14349	11174	2062	13236	381	13617	2794	732
8	14187	11554	2352	13906	381	14287	3252	900
9	16906	12429	2629	15058	381	15439	4096	1467
10	19340	13866	2927	16793	381	17174	5093	2166
11	19710	13709	3105	16814	381	17195	5620	2515
12	21805	14731	3170	17901	381	18282	6693	3523
13	23860	15632	3158	18790	381	19171	7847	4689
14	25555	16256	3068	19324	381	19705	8918	5850
15	26810	16863	3035	19898	381	20279	9566	6531
16	27630	17139	3066	20205	381	20586	10110	7044
17	28240	17414	3092	20506	381	20887	10445	7353
18	28620	17562	3102	20664	381	21045	10697	7595
19	28850	17636	3114	20750	381	21131	10833	7719
20	28980	17680	3114	20794	381	21175	10919	7805
21	29060	17698	3114	20812	381	21193	10981	7867
22	29100	17710	3114	20824	381	21205	11009	7895

Table 5-III

Project Results

Year	Incremental cost without plant protection cost		Incremental cost including plant protection cost		Incremental benefit Plant protection			
	1000D	Present worth at 35%	1000D	Present worth at 12%	Subsidized		Not subsidized	
					1000D	Present worth at 35%	1000D	Present worth at 35%
1	1100	814	1132	1011	-540	-333	-482	-430
2	1567	861	1681	1340	-302	-166	-416	-332
3	1569	638	1836	1307	-221	-90	-488	-347
4	1866	562	2380	1512	-302	-91	-816	-519
5	2253	502	3060	1734	-282	-63	-1089	-618
6	2788	461	3894	1973	-99	-16	-1205	-610
7	3505	429	4927	2229	224	27	-1198	-542
8	3885	352	5597	2260	682	62	-1030	-416
9	4760	320	6749	2434	1526	102	-463	-167
10	6197	308	8484	2732	2523	125	236	76
11	6040	223	8505	2445	3050	112	585	168
12	7062	193	9592	2462	4123	112	1593	409
13	7963	161	10481	2402	5277	107	2759	632
14	7587	114	10015	2049	6348	95	3920	802
15	9194	102	11589	2117	6996	78	4601	841
16	9470	78	11896	1940	7540	62	5114	834
17	9745	59	12197	1776	7875	48	5423	790
18	9893	46	12355	1607	8127	37	5665	737
19	9967	33	12441	1444	8263	27	5789	672
20	10011	25	12485	1294	8349	21	5875	609
21	10029	18	12503	1157	8411	15	5937	550
22	10041	13	12515	1034	8439	11	5965	493
TOTAL	136492	6312	176314	40267	86097	282	46275	3556

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VUES