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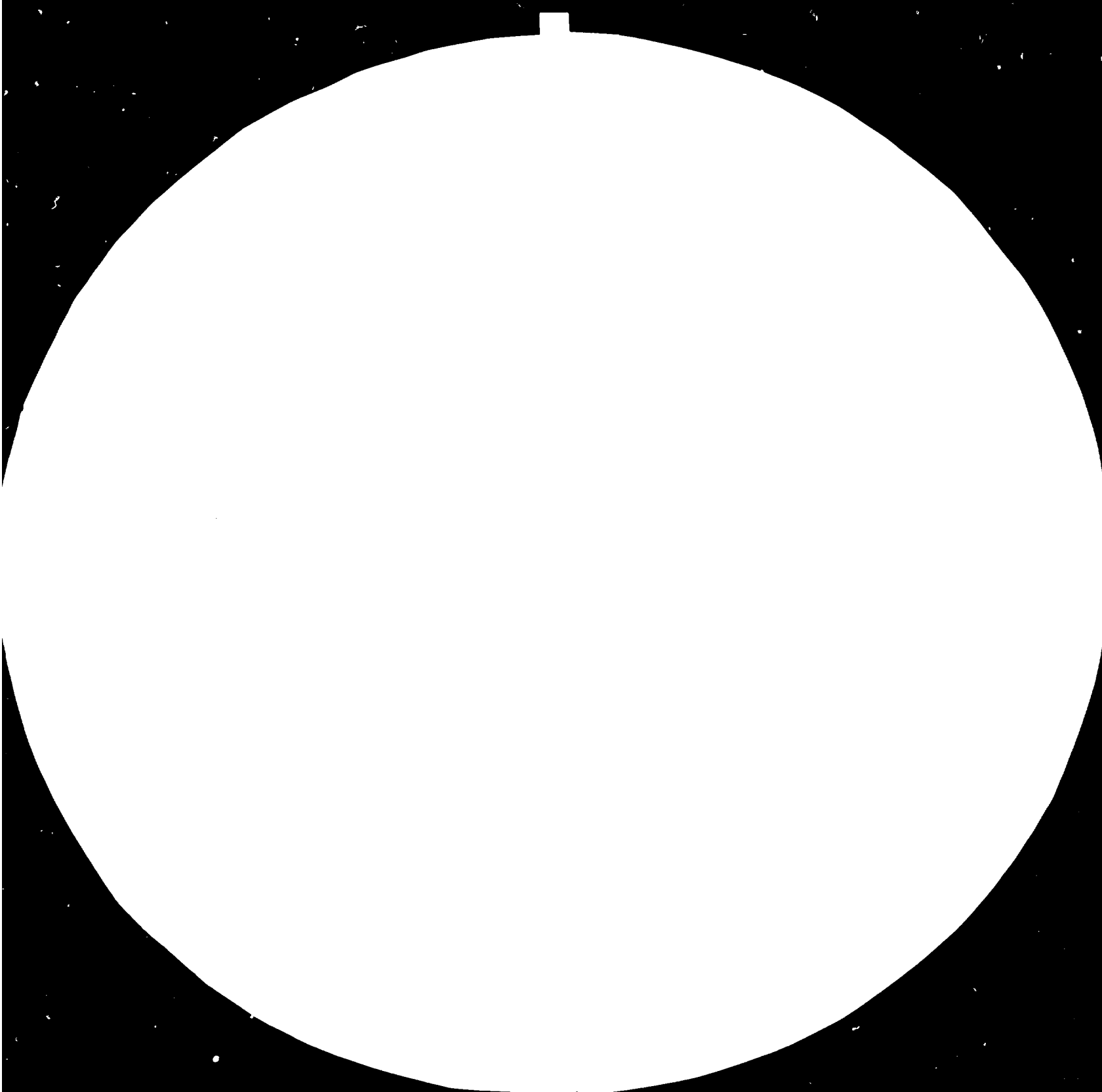

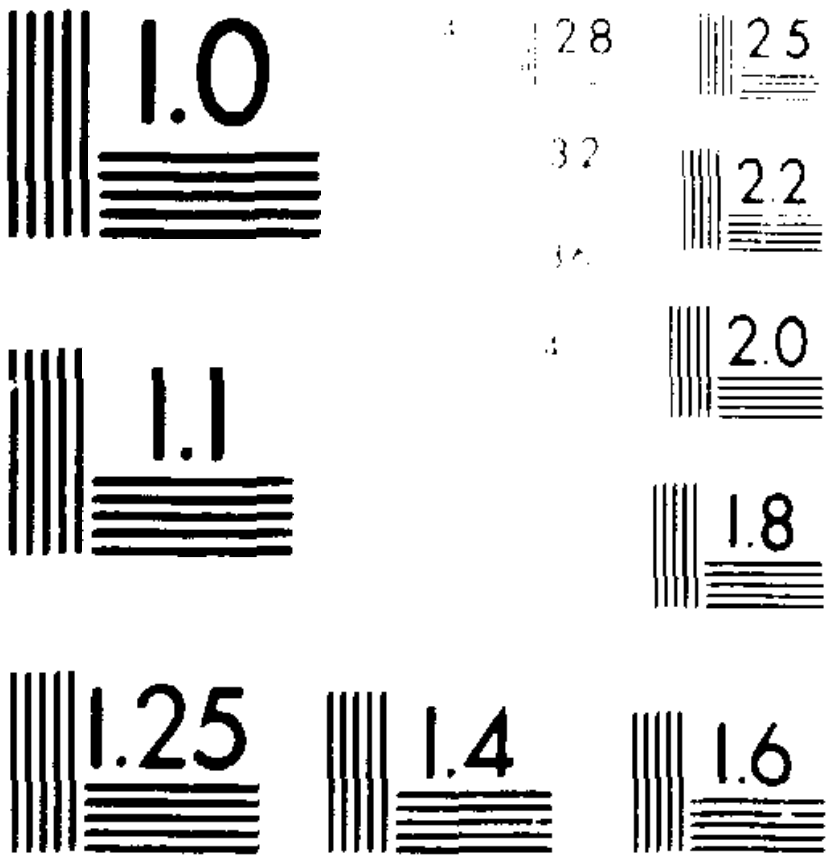

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DEVELOPMENT OF CAPITAL GOODS INDUSTRIES

DP/TUR/76/034

Turkey

Technical Report No.V: Tractors and Tractor Diesel Engines

M.M. Luther

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Technical Report: Tractors and Tractor Diesel Engines

UNITED NATIONS DEVELOPMENT PROGRAMME IN TURKEY

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DEVELOPMENT OF

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Technical Report: Tractors and Tractor Diesel Engines

by

M. M. Luther
Chief Technical Adviser
Capital Goods Development Project in Turkey

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ANNEXTURES

CHAPTER I
SUMMARY

1.1. Diesel engines have been identified as one of the priority sub-sectors by SPO for Capital Goods Development Project. Heavy duty diesel engines were dealt with in Technical Report no 3. This report deals with diesel engines used in tractor industry. Tractor diesel engines have been selected for special consideration in view of the importance of tractor manufacture in Turkey. In this context, this report deals with tractors as the relevant entity for projection of demand and supply.

1.2. Tractors are used mainly for agricultural purposes in Turkey. Transportation of agricultural products is the most important non-agricultural use for tractors and, only small numbers of tractors are employed in industry and in construction work. Thus demand for tractors results mainly from agricultural needs.

1.3. Earlier studies of domestic demand for tractors have given projections of average annual sales varying between 56150 tractors and 113350 tractor (for period 1981-90). It was felt that a new analysis of the demand pattern is necessary in view of the changing techno-economical conditions.

1.3.1. The present tractor park of the country is around 400 000 and the average useful life of a tractor is 11 years. Close examination of sales in the past indicates that average annual replacement demand (for period 1981-90) will be about 40 000.

1.3.2. The total number of tractors required to effectively farm the 24 million Ha cultivated land of the country, estimated from agricultural needs and from comparison with other countries, is 900 000.

1.3.3. Analysis of past behaviour show that the levels of agricultural income, tractor price and agricultural credits (by the Agricultural Bank) are the three most important factors to influence tractor sales.

1.3.4. Prices of energy and materials are likely to keep increasing in future, hence the relative price of tractors with respect to the prices of foodstuffs are also likely to become higher every year.

1.3.5. If agricultural credits are kept at their present level and tractors get more expensive up to 2.5% each year, to achieve a given percentage increase in tractor park, a similar percentage increase in agricultural income is required.

1.3.6. The domestic demand is expected to be around 50 000 pa in the year 1983 and to gradually increase to a level 62 000 pa in 1990 in the worst case and to 87 000 under favourable conditions. These favourable conditions corresponds to the agricultural income increasing at the same rate as GNP and leads to an average park increase rate of 6% while this rate is only 3% for the worst case.

1.3.7. The tractor park is expected to rise to 630 000 in 1990 under favourable conditions and the optimum park level of 900 000 may be reached only towards the year 2 000. This is on the assumption that no special subsidies for purchase of tractors will be involved.

1.4. Farm tractors have good potential for export and at least 10 % of capacity should be earmarked for sale to Africa and Islamic countries including the Middle East, and suitable measures should be taken early. This should include a compact but live marketing organisation.

1.5. Production plans should include export and hence should be made for about 55 000 in 1983 and 96 000 in 1990.

1.6. The total installed capacity for tractors is reported as 122 500. But this capacity is not supported by the level of production reached (maximum 37453 in 1976).

1.7. The degree of integration in the tractor industry appears to be extremely low: The total installed capacity represents capacity to assemble tractors when parts/ components are provided, but not capacity available for manufacturing.

1.8. Engine: The present practice of each manufacturer assembling its own engine from CKD and some locally manufactured parts (mainly from subsuppliers) is uneconomical. Types of engines should be reduced to enable economically viable and internationally competitive engines to be manufactured in Turkey.

1.9. Transmissions (Main Parts): Total installed capacity appears to be about 60 000 pa and its expansion to meet the requirements of tractors (paragraph 1.5) requires to be urgently planned.

1.10. Transmissions (Gear and Shafts): Presently no organised facilities are available. The new Hema Plant in Polatlı, with a capacity to cater for 60 000 tractors pa, is recommended to specialise in tractor gears and shafts so as to supply all tractor manufacturers. Hema should plan its capacity according to tractor demand projections.

1.11. Pressings and semi-complete units: Production capacities presently very limited. Matching capacities in ancillary industries should be encouraged by development banks.

1.12. The tractor engine and tractor plants planned by TÜMOSAN afford a good chance for restructuring the present tractor industry to an economical and competitive level.

1.13. Plan of Action

1.13.1. In the interest of economical manufacture and the optimum use of various equipment and facilities available in the public and private sectors, a plan of action has been proposed.

1.13.2. This plan is based upon cooperation between all tractor manufacturers and TÜMOSAN.

1.13.3. If this plan is accepted, it is recommended that [illegible] and MIT act as coordinators and issue suitable executive instructions for its implementation.

1.14. This report has been discussed with the management of TÜMOSAN who are in agreement with the conclusions and recommendations.

M.M. Luther
Chief Technical Adviser

CHAPTER II

INTRODUCTION

2.1. In the Capital Goods Development Project being conducted by SPO and UNIDO for planning the future of the capital goods industry in Turkey diesel and petrol engines have been identified as one of the priority sectors. One of the principal uses of diesel engines is for tractor industry and, as desired by SPO, tractor industry as a whole with special reference to Tümosan's project for tractor manufacture has been studied.

2.2 Mr. Ali Ünal of Tümosan was deputed by the General Manager of Tümosan to collect data and assist in making projections of demand and supply and he had a series of meetings with Mr. M. M. Luther, Chief Technical Adviser, UNIDO for this purpose. Meetings were also held with the Ministry of Industry and SPO officials who assisted in obtaining information from the industry. Conclusions and recommendations have been discussed with the management of Tümosan.

2.3. CTA, UNIDO would like to place on record his appreciation of the co-operation of officials of the SPO, the Ministry of Industry and the management of Tümosan for their open minded discussions as well as for the very valuable services of Mr. Ali Ünal.

2.4. Tractor as a machine is designed to be a productive input in agriculture. A survey carried out in 1978* has shown that it is used as such in Turkey in that, on the average a tractor is used 769 hours per year for agriculture and related work while non-agricultural uses is only 267 hours. Transportation, mainly of agricultural products, is the most important non-agricultural use for tractors and only small numbers of tractors are employed in industry and construction. Hence, the demand for tractors results mainly from agricultural needs.

2.5. Scope of the study.

This study covers inter alia

(i) Previous demand projections

(ii) Anticipated demand in the present environment in the period 1981-1990

(iii) Capacity available and anticipated for assembly of tractors

(iv) Level of integration achieved and anticipated

(v) Proposals for filling up anticipated gaps

CHAPTER III

ANALYSIS OF PREVIOUS STUDIES

FOR DOMESTIC DEMAND OF TRACTORS

3.1. Although the first legal move for the mechanisation of farming goes back as early as 1862, development was quite slow until 1950s. In the ten years between 1950 and 60, the tractor fleet rose from about 10000 to 40000. However, the main step forward took place in the last ten years, during which the fleet increased four fold from around 100000 to the present level of 400000. Local manufacture was started in 1955 with the establishment of Türk Traktör ve Ziraat Makinaları Fabrikaları A.Ş. in Ankara, and since then many other firms have come into the field and the number of locally manufactured tractors rose as high as 37000 in 1976. Since then, however, local manufacture has steadily fallen principally because of foreign exchange difficulties (required for the import of CKD parts) and unfavourable market forces.

3.2. PREVIOUS DEMAND STUDIES

3.2.1 Tractor demand for the years ahead have been estimated at

various times: Table 1 shows some of the more important forecasts. It will be noted that, the estimates of annual demand for the period 1981-90, has come down from around 110000 predicted in mid-seventies to around 60000 in more recent studies.

In this study, previous forecasts will be briefly examined and the demand of tractors will be estimated with a view to define the minimum level of demand in order to schedule investments in the field. The influence of price and credit policies, customs duties and manufacturing authorisations on forecasts of demand has also been examined.

3.2.2 Tümaş Study (1975): This study appears to be an extrapolation based on the high demand conditions during the five years before 1975.

3.2.3 Boğaziçi University (1975): From linear and logarithmic regression analyses between tractor park and agricultural income and cultivated land, this study predicts park figures. The linear model predicts a park figure of 362014 for the year 1985 while the logarithmic model predicts 946000. The predictions of the linear model are too low and the park figure predicted for 1985 was already exceeded in 1978 (370259). The logarithmic model seems to predict exceptionally high

Table 1: Comparison of demand values projected in five studies.

STUDY	Average demand (1981-1985)	Average demand (1986-1990)	Average demand (1981-1990)	REMARKS
1. TÖMAS (1975)	T 112 000	T 113 500	T 113 500	Estimates, not projections.
	R 30 000	R 55 000	R 42 500	New demand figures too
	N 81 200	N 60 000	N 70 600	high
2. SPC (SCR) (1975)	T 83 900	T 100 200	T 92 050	Estimates of replacement
	R 59 794	R 78 842	R 69 318	demand too high
	N 24 106	N 21 358	N 22 732	
3. WORLD BANK (1977)	T 63 400	T 81 [illegible]	T 68 100	Low limit to total demand
	R 17 400	R 35 [illegible]	R 26 300	[illegible]s 40 000 pa between
	N 38 000	N 45 [illegible]	N 41 800	1981-[illegible]
4. PIAR (1978) I	T 53 570*	T 84 [illegible]	T 72 739	Model based on agricultural
	R 21 270	R 51 9[illegible]	R 4 440	[illegible] rates. Park estimate
	N 32 300	N 32 [illegible]	N 32 300	[illegible]ation = 900 000
PIAR (1978) II	T 58 902*	T 73 [illegible]	T 67 838	Econometric model
	R 34 658	R 35 9[illegible]	R 35 445	
	N 24 244	N 37 [illegible]	N 32 388	
5. AUTOMATIVE IND. ASSOC. (1981)	T 30 280	T 61 8[illegible]	T 56 150	Estimates, not projections.
	R 19 280	R 45 7[illegible]	R 32 500	
	N 11 000	N 16 100	N 13 550	

*Average of 3 years (1983-85)

T,R,N mean total, replacement and new demand, respectively

figures and the differences between the two models appear unreconciliable.

3.2.4 SPO-Special Commission Report (1975): In this study, firstly the tractor park required for the year 1990 is estimated from agricultural requisites and a figure of 625000 is obtained. Then tractor demand figures are calculated for each year between 1977 and 1990 so as to reach the full park at the end of this period. The annual demand values obtained in this study are shown in table 2. Although this study assumes a low rate of growth of the tractor population, and its predictions of park figures for 1977-80 are quite accurate, the replacement demand has been kept excessively high and hence high annual demand figures have resulted. There is no ready explanation for replacements figures being high in this study which seems to be based on a reasonable average useful life of 12 years. On the basis of the assumptions made for the tractor park but using 12 years as an average life, the average annual demand for the period 1981-90 works to around 65000 as against 92050 reported in the study.

3.2.5 TSKB Study (1977): Two regression studies were made to forecast tractor demand until 1982. In the first, fertilizer use per hectare was taken as the variable. The total tractor

Table 2: Annual demand and park figures according to SPO (1975)

YEARS	New demand	Replacements	Total demand	Tractor park
1977	39660	21140	60800	304350
1978	38880	24320	63200	343230
1979	30710	34890	65600	373940
1980	24630	43370	68000	398570
1981	22470	50830	73300	421040
1982	21930	56670	78600	442970
1983	23090	60810	83900	466060
1984	25330	63870	89200	491390
1985	27710	66790	94500	519100
1986	26300	70100	96400	545400
1987	24180	74120	98300	569580
1988	21600	78600	100200	591180
1989	18700	83400	102100	609880
1990	16010	87990	104000	625890
Avg 1981-85	24106	59794	83900	
Avg 1986-90	21358	78842	100200	
Avg 1981-90	22732	69318	92050	

population forecast is 499219 units for 1982, and annual demand is 91100. In the second method, tractor demand was correlated with agricultural income which gives a total tractor population of 410666 for the year 1982 and annual demand of 66705 units. This study is outdated, and does not cover the years examined in the present work.

3.2.6 World Bank Forecasts (1977): Prepared at the end of a reconnaissance mission by a World Bank expert, this study has considered various aspects of tractor demand and has used three alternative methods for projection.

3.2.6.1 Regression Model: Forecasts are based on a model regressing past tractor demand with agricultural production, relative tractor prices and fertilizer use. The equation obtained for new demand is:

$$\log N = 2.4225 + 1.2725 \log A - 0.9502 \log P + 0.3474 \log F^{**}$$

where N = new demand in units of tractor

A = index of agricultural production (1963 = 100)

P = relative tractor price (1963 = 100)

F = fertilizer used in (1000) tons of nutrient.

$R^2 = 0.966$ and the t values are: 1.942 for A, -3.7242 for P and 3.1079 for F.

Table 3: World Bank forecasts from regression analysis. (1000 units)

	at constant prices		at falling prices		at increasing prices	
Years	Park	New dem.	Park	New dem.	Park	New dem.
1976	278	35	278	35	278	35
1977	319	41	319	41	319	41
1978	345	26	351	32	339	20
1979	372	27	386	35	360	21
1980	402	30	425	39	382	22
1981	435	33	468	43	405	23
1982	469	35	516	48	429	24
1983	497	28	546	40	446	27
1984	527	30	576	30	464	28
1985	559	32	615	39	493	29
1986	593	34	654	39	503	30
1987	630	37	696	42	525	22
1988	671	41	741	45	549	24
1989	716	45	790	49	579	30
1990	766	50	843	53	603	24

onwards

ii- prices continue to fall by 2% pa until 1982 and remain constant thereafter

iii-prices increase by 2% pa after 1977.

On the basis of these assumptions on the variables, the future stock demand for tractors was estimated as shown in table 3.

As for replacement demand, this study assumes that

i- from 1976 to 1984 replacement demand is 3% of the previous year's tractor population

ii-from 1985 to 1990, 5% of the previous year's tractor population has to be replaced.

The annual demand for tractors under alternative price assumptions is then found as in table 4. The World Bank study points out that the most probable alternative is the constant prices which predicts on average total demand of 47400 tractors per annum for the first half of 1990s and 73400 tractors per annum for the second half, thus making an overall average of 60400 for the period 1981-1990.

5.7.6.2 Comparison with tractor stocks of other countries: Comparing the agricultural area of Turkey (25 million hectares including fallow land) with that of industrialised countries, the World

Regression was done between 1963 and 1975, thus avoiding the excessive and exceptionally high demands realised in 1976 and 1977. World Bank study notes that tractor demand (new demand) is highly responsive to changes in the relative price of tractors in that, with a coefficient of elasticity of -0.95, a 10% decrease of the relative price results in a 9.5% increase of the tractor stock demand. The more powerful variable in this study is the agricultural production A, since an annual increase of agricultural production of 3% over the period 1962-75 leads to an increase in the tractor stock demand of about 4% per year (elasticity coefficient: 1.27). The elasticity of tractor demand with respect to fertilizer use is 0.35.

To forecast the future demand for tractors using this regression model,

5% rate of growth in A in 1976 and 1977 and 3% thereafter,

12% rate of increase in F between 1976-82 and 6% pa. thereafter

was assumed. Noting that the future development of the relative price of tractors will depend on the agricultural policies pursued by the Government, three alternatives were considered,

i- relative tractor prices remain constant from 1978

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TABLE 4: Predictions of World Bank study for three alternative price assumptions

(1000 units)

YEARS	at constant prices			at falling prices			at increasing prices			
	new	repl.	total	new	repl.	total	new	repl.	total	
1976	35	7	42	35	7	42	35	7	42	
1977	41	8	49	41	8	49	41	8	49	
1978	26	10	36	32	10	42	20	10	30	
1979	27	10	37	35	11	46	21	10	31	
1980	30	11	41	39	12	51	22	11	33	
1981	32	12	44	43	13	66	23	11	34	
1982	35	13	48	48	14	62	24	12	36	
1983	28	14	42	30	15	45	17	13	30	
1984	30	15	45	33	16	69	18	13	31	
1985	32	26	58	36	29	75	19	23	42	
1986	34	28	62	39	31	80	20	24	44	
1987	37	30	67	42	33	75	22	25	47	
1988	41	32	73	45	35	80	24	26	50	
1989	45	34	79	49	37	86	26	27	53	
1990	50	36	86	53	40	93	28	29	57	
Avg 1981-85	31400	16000	47400	38000	17400	63400	20200	14400	34600	units pa
Avg 1985-90	41400	32000	73400	45600	35200	80800	24000	26200	50200	units pa
Avg 1981-90	36400	24000	60400	41800	26300	68100	22200	20300	42500	units pa

The study concludes that the tractor park could reach a relative level corresponding to Italy in 1970, over a period of 20 years (starting from 1977). This would mean that the tractor population will increase 3-4 times in this period and reach 945000-1260000.

For projection of annual tractor demand, World Bank study assumes that

i- from 1978 to 1982 the stock growth rate will be 10% per year

ii- from 1983 to 1990 the stock growth rate will be 5% per year.

With these assumptions, it is concluded that the tractor park will increase to 868000 by the year 1990 and the average demand between 1981-90 will be 67000 tractors per year, table 5. This result is in fair agreement with that described in paragraph 3.2.6.1.

3.2.6.3 Requirements of tractors in agriculture: In this alternative projection, the number of tractors required to meet the needs of the agricultural sector is considered to be a function of the number of farms and the area in cultivated crops. In this method it is assumed that farms below 20ha will

Demand for Tractors 1976 - 1990 Based on Comparison with
ies (World Bank)

	New demand (1000)	Replacement demand (1000)	Total Demand (1000)
	72	7	79
	50	9	59
	36	11	47
	41	12	53
	44	13	57
	48	15	63
	53	16	69
	30	18	48
	31	19	50
	33	32	65
	34	34	68
	35	36	71
	37	37	74
	39	39	78
	42	41	83
	39	20	59
	37.4	37.4	75
	38.2	28.7	67

use, on the average, 0.35 tractor per farm, farms between 20-100ha will use 1.35 tractor per farm and those over 100ha will use 5 tractors. With these assumptions, a total of 471000 tractors are calculated on the basis of farm ownership data of 1963. Calculation is shown below:

Size of farm	No. of farms	No. of tractors per farm	tractors required
5- 20ha	853000	0.35	298500
20-100ha	111000	1.35	150000
Over 100ha	4500	5	22500
			471000

This study notes that this park figure will be reached by the early 1980s and hence concludes that the annual demand thereafter would then be substantially for replacements only at a rate of about 40000 tractors for the agricultural sector.

3.2.6.4 The World Bank study concludes that:

i- The minimum annual demand for tractors until 1990 will be 40000 (results of method indicated in paragraph 3.2.6.3 and paragraph 3.2.6.1, the latter using increasing price alternative).

ii-Under more favourable conditions, the average annual

demand could reach 70000 (method 3.2.6.1 falling prices alternative).

3.2.6.5 While, conceptionally speaking, the methods employed by the World Bank study have taken into account essential aspects of tractor usage, a few corrections may be required since:

i- the calculation of replacement demand as 3 or 5% of the previous year's tractor population leads to an underestimate. Secondly applied to the limit of saturated park 5% replacements would assume the average life of a tractor as 20 years. The study has recommended that the average life should be taken as 12 years.

ii- Farm sizes and ownership data used in method 3 is old (1963 data), more recent data (1980) gives a considerably higher tractor requirement of about 700000 as against a figure of 471000 indicated in the report.

iii- Although the regression method used is essentially good, the selection of fertilizer use as a variable may not be appropriate since, fertilizer use has been on the increase all through the period and does not reflect the behaviour of tractor sales or stock demand for tractors. A different

variable, such as ABT* credits which are known to have had a strong influence on the mechanisation of farming, may be more relevant. There is also no explanation for a few apparent inconsistencies in the projections. For example, new demand values show a sharp fall in 1983 which can not be explained by foreseen developments in the independent variables, and for which no separate explanation is available.

iv- Tractor park figures, and hence new demand values calculated from park increases, may not be fully reliable as reports of park figures by SIS and MAF** show variations and inconsistencies as will be explained later. A possibly more reliable measure of demand may be total annual sales of tractors.

3.2.7 Piar (1978): This work, carried out for Tümosan for the appraisal of Tümosan Tractor Project, is one of the most detailed among the recent studies available. It covers demand projections as well as type and power ranges of tractors suitable to the country and those preferred by the farmer.

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* Equipment credits of the Agricultural Bank of Turkey

** SIS: State Institute for Statistics

MAF: Ministry of Agriculture and Forestry.

For projection of tractor demand, the following two approaches have been employed and have shown to give results quite close to each other.

3.2.7.1 Model Based on Agricultural Reqisites: The purpose of using tractors in agriculture is to reduce costs while increasing efficiency. Accordingly, when faced with the alternatives of leasing or choosing among tractors having different characteristics, the farmer will decide on the alternative which minimizes overall cost. This expects a rational behaviour from the farmer. However, a rigid application of such an assumption will require that the whole agriculture be taken as a single enterprise. But there are numerous objective and subjective factors affecting rational behaviour like non-agricultural uses of tractors, market conditions, and personal factors.

The general approach of the study is to ascertain the minimum tractor population assuming rational tractor usage, and top population by considering additions due to the factors affecting rational behaviour, when these can be measured.

The basic assumptions of this model are:

- total cultivated area will stay constant at 24 million ha and products will not change.

- 40-55HP tractors will be used in farms smaller than 500 da.
- 55-65HP tractors will be used in farms of size 500-750da.
- 60-80HP tractors will be used in farms of 750 plus da.

From the distribution of farm sizes in 1970, and with proper corrections for soil characteristics, climatological data etc.. Piar concludes that a total of 900000 tractors are required to effectively mechanize the farms of the country. This total is divided into power groups as follows:

Power group	No. of tractors
40-55 HP	750000
55-65 HP	98000
>65 HP	52000
Total	900000

Piar then accepts that Turkey will reach this park figure by the year 1995 and calculates annual stock demands assuming linear increases in the park and finds that the average annual demand will be 73554.

Tractor life is taken as 12 years.

3.2.7.2 Econometric Model: From multiple linear regression analyses of the tractor behaviour in the past, park figures are predicted for each year from 1983 till 1995. This model gives an average annual demand of 73991 which is remarkably close to that obtained by the first method. However, the following questions arise while considering this model:

- independent variables are not clearly stated
- projection of independent variables are not given, nor is there any indication as to what factors were considered in projecting them
- basis of replacement demand is not stated and figures considerably differ from those used in previous method, although the average demand values per annum are close.

This method predicts a park figure of 807404 for the year 1995 as compared to 900000 assumed in the previous method. With the average annual demands found by the two methods being nearly identical (variation only 0.5%), a difference of 93000 between the two projections in 1995 park is not clear although there is a detailed analysis of the accuracy of the method.

3.2.8 Automotive Industries Association (1981-April): This is not really a demand study, but part of a report on tractor

investments, and the basis of projections is unclear. The domestic demand foreseen for the years 1983-1990 are given in table 6.

As is seen from table 6, AIA foresees annual park increases between 11000 and 21000. The examination of their replacement demand column indicates that the useful life of a tractor is taken 15 years which is rather high. However, AIA has taken into account the fact that tractors imported in large quantities in 1975-77 will require early replacement because of difficulties in servicing and in procurement of spare parts. The way this correction is made is not explained, and despite the correction, the replacement demand figures seem to be low because of the unrealistically high average useful life.

Table 6: Tractor demand according to A I A

YILLAR	Replacement demand		New demand	Total demand
	normal repl.	early replac.		
1983	16 500	8 000	11 000	35 500
1984	14 300	9 000	11 500	35 800
1985	8 300	11 000	12 000	31 300
1986	16 100	12 000	12 500	40 600
1987	26 300	12 000	14 000	52 300
1988	37 400	12 000	15 000	64 400
1989	30 800	10 000	18 000	58 800
1990	32 000	-	21 000	53 000

Avg (1983-90) repl. 32 087 New 14375 Tot. 46 463

CHAPTER IV

PROJECTION OF DOMESTIC DEMAND FORECASTS FOR TRACTORS

4.1. Replacement demand

4.1.1 Average useful life of tractors: In most of the previous studies the average useful life of a tractor is taken as 12 years, for instance the World Bank study comments that "Maintenance is surprisingly good and many tractors over 15 years old are still in operating condition, thus the average tractor life in Turkey should be about twelve years."

ABT assumes an average useful life of 10 years for the purpose of equipment credits granted to the farmers. On the other hand, the Piar survey has brought out an interesting point: 28.6% of Turkish farmers expect a useful life of 15 years, 11.4% expect 20 years and only 9.7% expect 10 years while 21.7% do not know how long they can use their tractors.

A simple exercise was carried for the purpose of this study as follows: Assuming various values for the life of a tractor, the tractor population was accounted for in terms of sales figures reported in previous years. Since tractor park figures

reported by SIS and MAF differ considerably, the exercise was done for both of the two park series, and the best value of average life was calculated. The results are shown in Table 7.

It will be noticed that the average life values obtained for SIS park series show considerable variation. Apparently there is some inaccuracy in this series as is exemplified by the high figure of 15,5 years obtained for 1979 park which results from the anomalous park increase of 70423 reported by SIS for a year when the sales totalled only 15715.

MAF park series, however, gives consistent results. The average of 12 figures obtained is 10.5 years with a standard deviation of only 0.68 years. The figures also indicate that tractor life has improved in recent years, which is reasonable, because servicing conditions and procurement of spare parts are known to have improved. Consequently, it is reasonable to take the average life of a tractor as 11 years for the years ahead.

Table 7: Estimation of average life from sales in previous years.

YEARS	SIS		MAF	
	tractor park	average life	tractor park	average life
1979	4405502	15.5	399892	11
1978	370259	9.5	398145	11
1977	320578	7.5	376635	11
1976	281802	7.2	312323	11
1975	245066	11.2	240866	11
1974	200466	11.2	198003	11
1973	156139	8.5	171003	11
1972	136726	11.5	134165	10.8
1971	118825	> 12	108355	10
1970	-	-	93358	10
1969	-	-	87184	9
1968	-	-	75306	9.5

4.2 Replacement demand:

4.2.1 The number of tractors that will require replacement each year on the basis of the sales reported 11 years earlier have been calculated. To take into account the variation about the average of the tractor life, three and five-year moving averages of the sales figures were also calculated, the results are in table 8. The average annual replacement demand calculated this way varies between 40187 and 42692.

4.2.2 The replacement demand shown in table 8, should be considered a conservative estimate, because, as pointed out by AIA, the large number of tractors imported in the period 1975-77 will probably average a useful life shorter than 11 full years, due to possible difficulties in servicing and in the procurement of spare parts. However, this will only change the distribution of replacement demand into years, but not the annual average obtained above since all tractors imported get replaced before 1990. Hence, it would be appropriate to take the five-year moving averages column as the replacement demand for the years ahead.

Table 8: Replacement demand for the period 1983 - 90

YEARS	Sales reported 11 years earlier	three-year moving averages	five - year moving averages
1980	14370	-	-
1981	8333	12868	-
1982	15900	16780	20410
1983	26105	26448	23544
1984	37338	31162	32309
1985	30042	39846	44764
1986	52159	53459	53580
1987	78177	66840	52476
1988	70185	60059	49611
1989	31816	39239	42997
1990	15716	22208	(22208)
1991	19093	-	-
Avg(1983-90)	42692	42408	40187

4.3 New Demand:

4.3.1 Analysis of past behaviour:

4.3.1.1 Annual sales of tractors from 1963 to date are shown in fig.1. The same figure also shows the park increases (new demand) obtained from park figures reported by SIS and MAF (Annex 1). It will be seen that:

i- new demand calculated from SIS park figures are unreliable since in some cases (1974, 78, 79) park increases have exceeded annual sales.

ii-MAF park demand figures are consistent with annual sales, but it is difficult to ascertain the extent of reliability of the data.

Hence, analysis based on new demand figures calculated from park increases are likely to mislead. Accordingly an analysis using annual sales which are the most reliable statistical data available has been made.

4.3.1.2 Fig.2 shows the variation of three parameters, agricultural income, relative tractor prices and equipment credits of ABT, over the same period. Clearly, agricultural income and relative tractor prices are important parameters and should

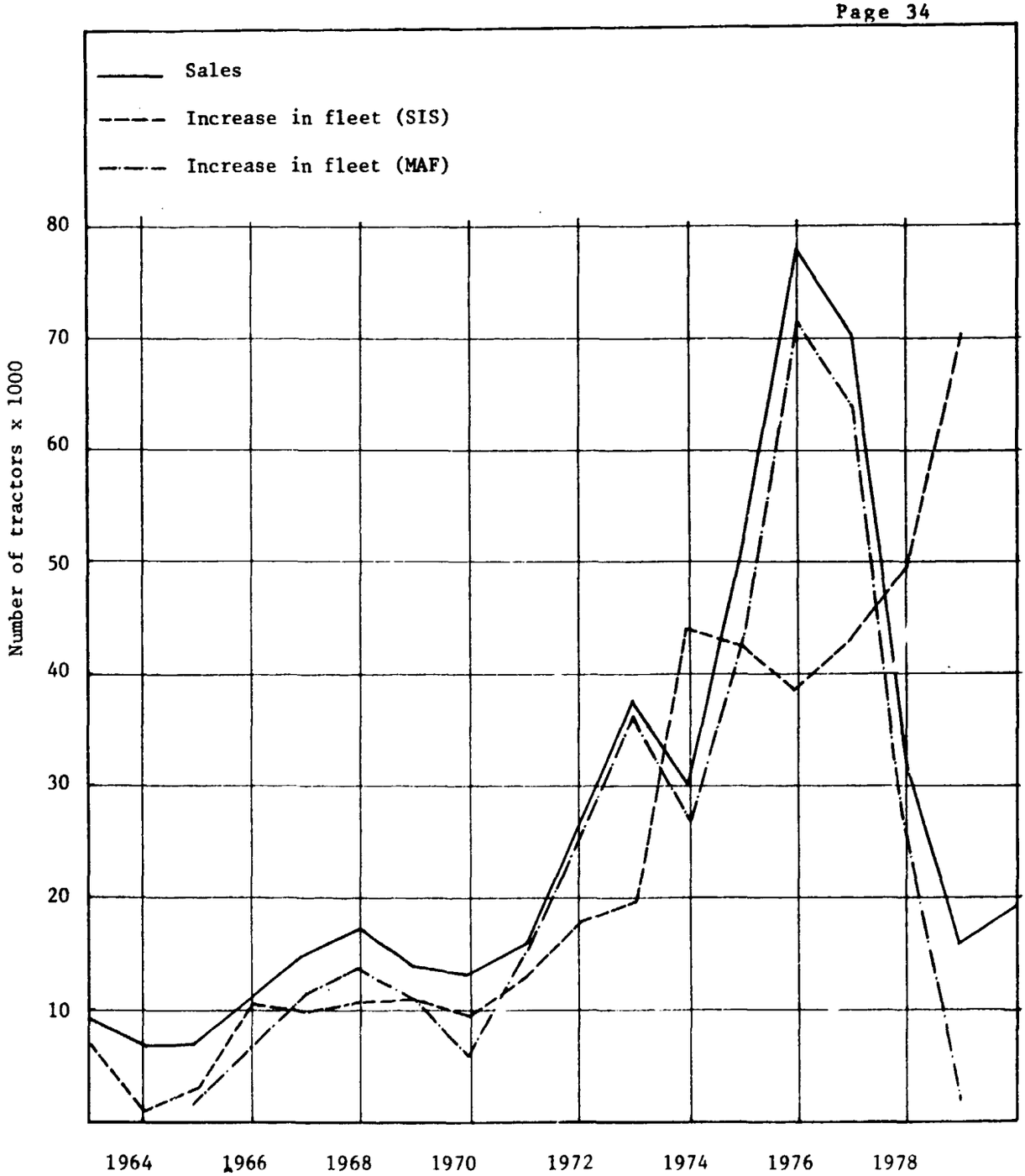

Figure 1: Tractor sales and park increases for the period 1963-80.

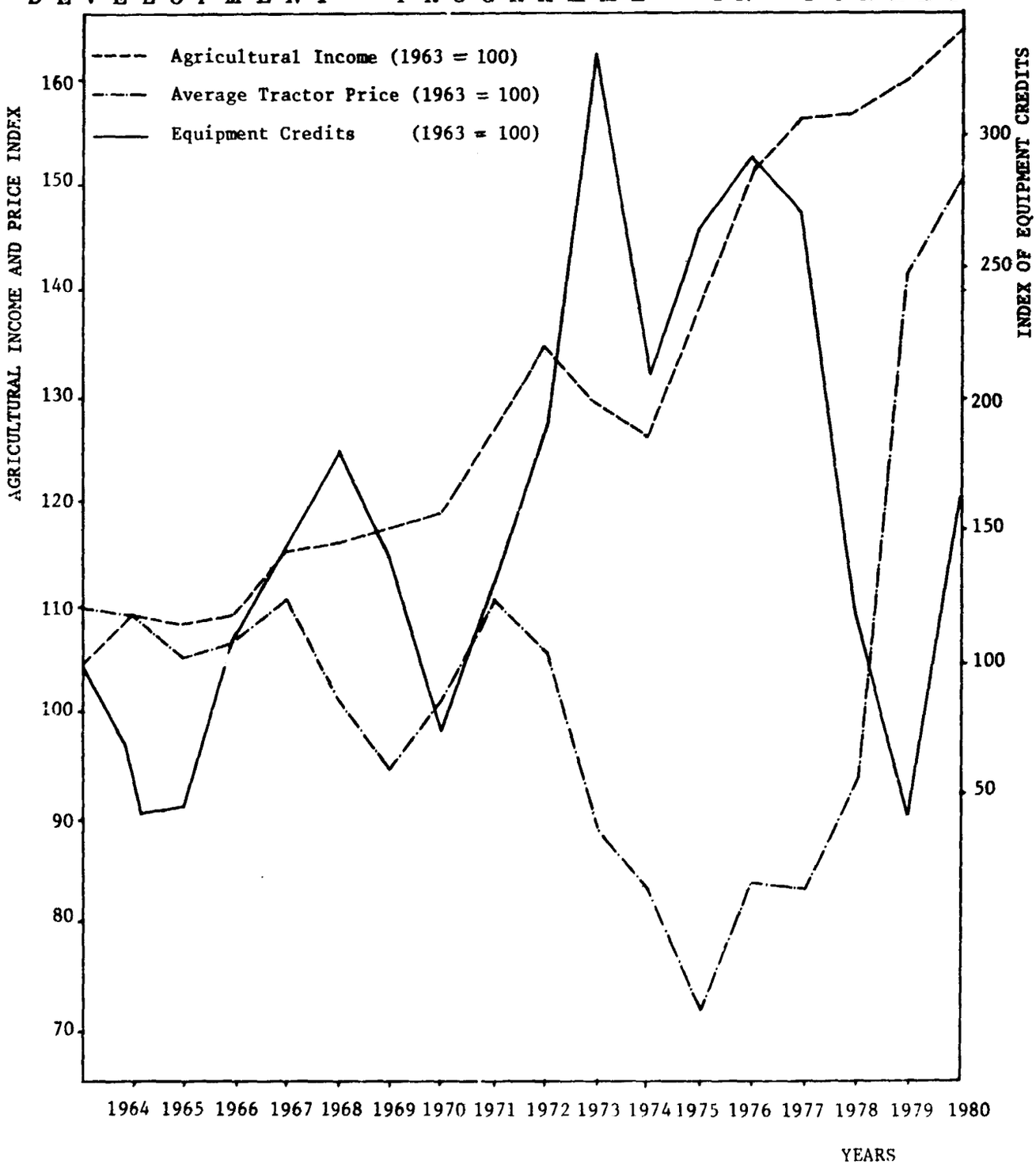

Figure 2: Variation of the indexes of agricultural income, tractor prices and ABT credits over the period 1963-1980.

be taken into account in any analysis of past behaviour. The equipment credits of ABT, too, has been important in the mechanisation of agriculture as shown in table 9 by the number of tractors bought on credit terms.

These parameters were indexed as follows:

i- agricultural income: Producers values at constant prices of 1968 were taken and indexed on the basis of 1963=100. Agricultural income is obtained in the autumn after the harvest. Piar survey has shown that 57% of tractors sold in a year is bought between the months of January and mid-July. Hence, 57% of the previous year's and 43% of the current year's income are responsible for the total sales in any one year (see annex 2), i.e.

$$X_{in} = 0.57\ X_{(n-1)} + 0.43\ X_n$$

ii- the current prices of the average of two most favoured tractors, Fiat 480 and MF135, were divided by the wholesale price index for foodstuffs and were indexed taking 1963=100 (see annex 3)

Table 9: Comparison of tractors bought on ABT credits to total sales.

YEARS	Total sales no of tractors	Tractors bought with ABT credits	Percentage of tractors bought on ABT credits
1975	52159	9242	17.7
1976	78177	18344	23.5
1977	70185	16243	23.14
1978	31816	6884	21.6
1979	15716	1940	12.3
1980	19093	6800	35.6

iii- ABT equipment credits: Equipment credits also include items for animal husbandry and irrigation, but the percentage of agricultural equipment credits to the total is about constant until 1976 and proper adjustment was made for the period 1976-80. ABT equipment credits were divided by the current tractor price and were indexed taking 1963 = 100. (see annex 4).

The variation of these three parameters are given in annex 5 together with the tractor sales over the period 1963-80.

4.3.1.3 Linear regression analyses were made to account for tractor sales in terms of the three parameters described above. The model (see annex 6) covering the whole period 1963-77 had a low correlation coefficient and a high standard error, which is considered to be a result of the high rates of import in the years 1976-77 and the high rate of inflation from 1977 onwards. However, when the analysis was done on data between 1965-75, a good correlation was found:

$$X_4 = \underset{(140.53)}{550.36\ X_1} - \underset{(102.2)}{363.24\ X_2} + \underset{(14.85)}{74.3\ X_3} - 20955.5$$

The multiple correlation coefficient and the standard error of estimate values were:

$$R_{4.123} = 0.976 \qquad \hat{s}_{4.123} = 3273.74$$

The F_c value of the correlation was 40.7 indicating a very high level of significance.

4.3.1.4 It will be seen from fig.3 that this equation successfully predicts the jumps in total sales in the period 1965-75. This equation also gives reasonable predictions for the period 1976-80 as shown in table 10.

The large differences for 1976-78 [illegible] pointed out earlier, are attributed to high [illegible] and high rates of import.

4.3.1.5 It will be noted that agricultural [illegible] has the highest coefficient of elasticity, in that a 1% increase in agricultural income will increase total sales to increase [illegible]s, while a 1% decrease in price will [illegible] increase the sales by 3 units. although, [illegible] credits has a very low coefficient of elasticity, [illegible] credits can be varied by large amounts. It is therefore safe to keep this variable

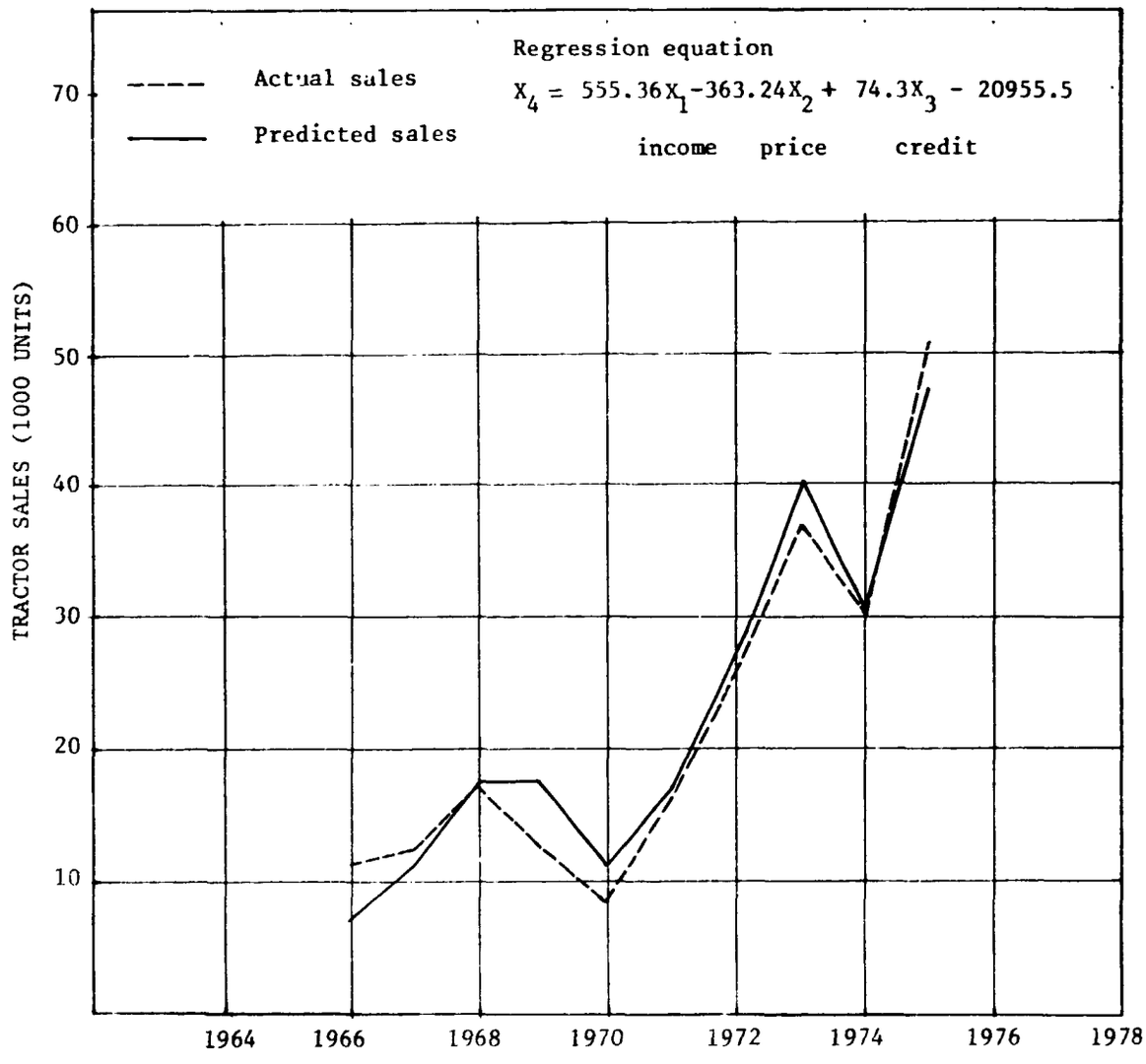

Figure 3: Comparison between the predictions of the regression equation and actual sales for period 1966-1975.

Table 10: predictions of the regression model for 1976-80 period.

YEARS	Index of Agricultural income	Relative tractor prices	ABT equipment credits	Sales predicted	Sales realised
	X_1	X_2	X_3	X_4 pred.	X_4 act.
1976	141.2	74.3	291	51390	78177
1977	146.9	74.0	270	53073	70185
1978	147.2	83.7	118	38422	31816
1979	150.8	132	47	17583	15716
1980	154.1	140	85	19317	19093

in the equation.

4.3.2 Fleet required for effective farming

4.3.2.1 Method of Indices: Using the same indices as those employed in the World Bank Study on the results of 1980 agricultural sensus we can estimate the tractor fleet required to effectively farm the 24 million ha cultivated area:

Size of farm	Number of farms	Number of tractor per farm	Tractors required
5- 20 ha	1074035	0.35	375913
20-100 ha	204012	1.35	275416
> 100 ha			51600*
			702929

It will be seen that the tractors required for the farming of the country is 702929 compared to the 471000 found by the World Bank using 1963 data on the number of farms.

4.3.2.2 Piar Approach: The assumptions of this approach were discussed earlier. Piar first finds that, if all cultivated areas are sown in the most economical way possible, 610600 tractors would be required to effectively farm the country. This calculation does not take into account the influence of farm ownership,

* Figure taken from Piar Study.

hence the figure obtained should be modified. Piar recommends a total of 900000 tractors.

4.3.2.3 HP per ha Approach: The value of HP per ha for Europe in 1975 was 2.25 and the ideal figure for Turkey has been taken as 2.5. The cultivated area, excluding fallow land, is 19 million ha, hence a total of 47.5 million HP is required to effectively farm the country. Piar study recommends an average HP of 52 for the ideal tractor park, which means that 913460 tractors will be required, which is consistent with the result obtained in the method referred to in paragraph 4.3.2.2. A more detailed study by Harzadin** on this basis has produced a very similar figure of 934415. But Harzadin considers that 225551 out of this total should be of smaller HP range more suited to horticulture.

4.3.2.4 Other Methods: Among other methods the one used most often is comparison with tractor parts of other countries. For example, Onur* sets a target of 36.6 tractor per 1000 ha, the level of Italy in 1966, and taking cultivated land as 28.25 million ha, calculates a fleet of 1034000.

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* T. Onur: Tractor in Turkish Farming, March 1977.
** G.Harzadin: Proc. Symp. on Farm Tractor Industry, 1976.

It will be noted that there is fair agreement on the tractor fleet required for farming: Although the lowest and highest estimates differ by a large amount, 900000 park figure seems to be favoured in quite a few studies.

4.4 Sales forecasts:

In forecasting future sales of tractors:

i- behaviour in the past (regression model),

ii- absolute minimum needs as represented by replacement demand,

iii-possible Government plans to mechanize agriculture

must be taken into account. In the present study, past behaviour has been used for forecasting and influence of the other two factors on forecasts has been examined. As noted in paragraph 4.3.1 (table 10), the tractor sales especially, in 1976 and 1977, were above that expected from the level of agricultural output,ABT credits and prices, and in 1980, there was an excess of 35000 tractors in the park. The sales are expected to be low this year and next year, and thus this excess may level off by 1983. Accordingly, sales forecasts have been made only from 1983 onwards (until 1990).

4.4.1 Projection of Independent Variables:

4.4.1.1 Agricultural Income (X_1): The average rate of increase of agricultural income in the past (1963-80) has been 2.63%. SPO has recommended the alternative I pattern of increase (table 11) until 1990, which should be considered a minimum. A second pattern of increase may also be considered, and, that is, assuming the ratio of agricultural income to GNP will stay constant, and agricultural income will increase at the same rate as GNP. This is also shown in table 11 together with rate of GNP increases being considered by SPO.

4.4.1.2 Average Tractor Prices (X_2): The price index of tractors are closely related to the total local production, as shown in table 12, and have got cheaper over the years. Although the price index rose as high as to 140 in 1980 when total domestic production was about the half of the 37453 tractors produced in 1976, it fell down to a level of around 80 this year. Since, even only the replacement demand in 1980s will run around 40000 tractors a year, it is reasonable to assume that tractor prices will have the benefit of scale economics in manufacturing in the years ahead. However, as the cost of energy and materials are likely to rise, it would be

Table 11: Alternative methods of projecting agricultural income.

YEARS	Alternative I			Alternative II		
	Rate of increase %	Index for agr.income (1963=100)	X_1	Rate of increase %	Index for agr.income	X_1
1981	2.6	159.5	157.2	3	160.0	157.4
1982	2.6	163.7	161.3	3.5	165.8	162.5
1983	2.6	167.9	165.5	4	172.4	168.6
1984	2.6	172.3	169.8	4.5	180.2	175.8
1985	2.6	176.8	174.2	5	189.2	184.1
1986	2.6	181.4	168.8	6	200.6	194.1
1987	3	186.8	183.7	6	212.6	205.8
1988	3	192.4	189.2	6	225.3	218.0
1989	3	198.2	194.9	6	239.0	231.2
1990	3	204	200	6	253.0	245.0

TABLE 12: DOMESTIC PRODUCTION vs PRICE FOR TRACTORS

YEARS	Total Domestic Production of tractors	Tractor Price (1000 TL)	Price index
1963		35,5	100
1964		35,5	99.8
1965		37,58	96.0
1966	10575	39.95	96.8
1967	12933	44.48	101
1968	15281	41.23	91.9
1969	13548	41.23	85
1970	7921	45.75	91.4
1971	15660	58	101.5
1972	22819	63.5	96.5
1973	32816	63.7	79.6
1974	25616	79.8	73.6
1975	32691	79.8	62.8
1976	37453	108.6	74.3
1977	30814	132.7	74
1978	18202	218	83.7
1979	15157	512	132
1980	16936	1090	140
1981		1245	~80

proper to assume that tractor prices will also increase. For the purpose of this study, it has been assumed that, tractor price rise will be 2.5% higher as compared to the prices of foodstuffs. Taking the price level 80 for this year, tractor price indexes in future as shown in table 13, have been calculated. With this assumption it is seen that tractor prices will rise to the level of 1963 in 1990.

4.4.1.3 ABT Equipment Credits (X_3): Changes in ABT credits in the past have been very erratic and the average for the period 1963-80 is 129.1 ($s = 71.92$), while the average of the last five years is 162.2 ($s = 99.4$). The level for 1980 is 85 and as discussed with SPO, it has been assumed that, for projection purposes, ABT credits will not be less favourable in the future than it has been in the past. Under these circumstances, it is assumed that X_3 will stay around 125 until the year 1990.

4.4.2 Projection of Sales:

4.4.2.1 Alternative I for the growth of agricultural income is a conservative pattern, and hence sales projections made on the basis of this pattern should represent the minimum demand.

Table 13: Projected tractor price index

YEARS	rate of increase of price index	X_2
1981		80
1982	2.5	82
1983	2.5	84
1984	2.5	86
1985	2.5	88.3
1986	2.5	90.5
1987	2.5	92.8
1988	2.5	95.1
1989	2.5	97.5
1990	2.5	99.9

Projections are shown in table 14: It will be seen that a total of 442217 tractor sales are predicted for the eight year period between 1983 and 1990, and the annual average of sales is 55277. Since the replacement demand in the same period is expected to run at 40187 pa, this means that, even under these conditions, the tractor fleet will keep on growing. The growth rate, however, is low, about 3.5%. Under these conditions the fleet grows by 120000 to about 520000 in 1990 from the present level of 400000 (MAF).

4.4.2.2 When alternative II is used for the growth of agricultural income, keeping X_2 and X_3 the same as in the preceding projection, the average annual sales rises to 66627 tractors. Under these conditions, the tractor park will increase by 211520 to a level of 610000 in 1990. This will correspond to an average growth rate of about 6%.

4.5 A comparison with the growth rates predicted with the experiences of industrialised and other developing countries is relevant.

4.5.1 As reported in the World Bank report, the average annual growth rates of tractor populations in different areas during recent years (1962-1972) were as follows:

South America : 6%

TABLE 14: PROJECTION OF TRACTOR SALES

ALTERNATIVE I: Agricultural income increases 2.6/% pa and 3% pa.
Tractor prices increase 2.5% pa, ABT credits constant at a level of 125

YEARS	Agricultural income	Tractor Price level	ABT equipment credits	Tractor sales predicted
	X_1	X_2	X_3	X_4
1981	159.5	80		
1982	161.3	82		
1983	165.5	84	125	48904
1984	169.8	86	125	50545
1985	174.2	88.3	125	52131
1986	178.8	90.5	125	53863
1987	183.7	92.8	125	56560
1988	189.2	95.1	125	57916
1989	194.9	97.5	125	60182
1990	200	99.9	125	62116

Σ 442217

(1983-90) avg 55277 tractors p.a

TABLE 15: PROJECTION OF TRACTOR SALES

ALTERNATIVE II : Agricultural income increases parallel to GNP

Tractor price level increases 2.5 % pa

ABT credits constant at a level of 125

YEARS	Agricultural income	Tractor price level	ABT credits	Tractor Sales predicted
	X_1	X_2	X_3	X_4
1981	157.4	80	-	-
1982	162.5	82	-	-
1983	168.6	84	125	50610
1984	175.8	86	125	53847
1985	184.1	88.3	125	57579
1986	194.1	90.5	125	62283
1987	205.8	92.8	125	67888
1988	218.0	95.1	125	73766
1989	231.2	97.5	125	80160
1990	245.0	99.9	125	86882

Σ 553015

(1983-90) avg. 66627 pa

TABLE 14: PROJECTION OF TRACTOR SALES

ALTERNATIVE I: Agricultural income increases 2.6/% pa and 3% pa. Tractor prices increase 2.5% pa, ABT credits constant at a level of 125

YEARS	Agricultural income	Tractor Price level	ABT equipment credits	Tractor sales predicted
	X_1	X_2	X_3	X_4
1981	159.5	80		
1982	161.3	82		
1983	165.5	84	125	48904
1984	169.8	86	125	50545
1985	174.2	88.3	125	52131
1986	178.8	90.5	125	53863
1987	183.7	92.8	125	56560
1988	189.2	95.1	125	57916
1989	194.9	97.5	125	60182
1990	200	99.9	125	62116

Σ 442217

(1983-90) avg 55277 tractors p.a

TABLE 15: PROJECTION OF TRACTOR SALES

ALTERNATIVE II : Agricultural income increases parallel to GNP

Tractor price level increases 2.5 % pa

ABT credits constant at a level of 125

YEARS	Agricultural income	Tractor price level	ABT credits	Tractor Sales predicted
	X_1	X_2	X_3	X_4
1981	157.4	80	-	-
1982	162.5	82	-	-
1983	168.6	84	125	50610
1984	175.8	86	125	53847
1985	184.1	88.3	125	57579
1986	194.1	90.5	125	62283
1987	205.8	92.8	125	67888
1988	218.0	95.1	125	73766
1989	231.2	97.5	125	80160
1990	245.0	99.9	125	86882

Σ 553015

(1983-90) avg. 66627 pa

Asia (including Turkey): 13%

Europe : 5%

Growth rates in some European countries during the same period were:

Spain : 13%

Italy : 10%

France: 5%

Available statistics show that high hectare/tractor ratios are related with high rates of growth in tractor population, and vice versa. Thus, in countries with 40-100 hectars per tractor, the growth rate is between 10-15%; countries with a lower hectare/tractor ratio tend to have growth rates of 5% and below.

4.5.2 The hectare/tractor ratio for Turkey in 1981 is around 60. But, it is doubtful whether the high rates of growth, associated with this hectare/tractor ratio in the period 1962-72, may still be achieved in the immediate future with increasing prices of energy and materials. Table 16 shows the rate of agricultural growth required to achieve various values of park increase rate in four different alternative cases. In the first case, the tractor price is assumed to rise 2.5% per annum from 1983 onwards while ABT credits are kept constant at a level of 125. It is seen that to achieve an

Table 16: Agricultural growth required for various values of park increases.

Target for average % rate of fleet growth	Total sales required for 1983-90 period	Growth rate of X_1 required to achieve target			
		X_2 rises 2.5% p.a $X_3 = 125$	X_2 rises 1.5% p.a $X_3 = 125$	X_2 rises 1% p.a $X_3 = 125$	$X_2 = 84$ $X_3 = 125$
4	468924	3.65	3.4	3.1	2.85
4.5	490336	4.35	4.2	3.9	3.6
5	512478	5.1	4.8	4.6	4.3
6	559035	6.6	6.3	6.1	5.7
7	608770	8	7.8	7.6	7.3
8	661868	9.5	9.3	9.1	8.8
10	778931	12.6	12.2	12.1	11.9
12	911882	15.4	15.2	15.1	14.9

average growth rate of 10% between 1983-90, the agricultural income must increase 12.6% per annum. The other alternatives consider different rates of increase for tractor prices and in the most optimistic case of constant prices, 11.9% annual increase is required in agricultural income. Although, the prices of agricultural products, hence agricultural income, is also likely to increase in the years ahead, this sort of increases are considered unlikely. It is therefore felt that a 10% rate of growth in tractor fleet is untenable.

4.5.3 Examination of table 16 shows that to achieve a given rate of growth in tractor fleet, the agricultural income must also increase by a similar rate, This leads to the conclusion that the growth pattern of agricultural income under favourable conditions (Alt.2 in table 11) should give the highest rate of park increases tenable. Any higher rate of increase would necessitate special Government intervention in favour of the mechanisation of agriculture.

Domestic demand for tractors under these two conditions are shown together in table 17.

4.5.4 With the above two high and low sets of projections it has been concluded that it will be reasonable to plan the capacity

Table 17: Domestic demand under unfavourable and favourable conditions.

YEARS	Unfavourable conditions			Favourable conditions		
	New demand	Replacement demand	Total	New dem.	Replacement demand	Total
1983	25360	23544	48904	27066	23544	50610
1984	18236	32309	50545	21538	32309	53847
1985	7367	44764	52131	12815	44764	57579
1986	283	53580	53863	8703	53580	62283
1987	4084	52476	56560	15412	52476	67888
1988	8305	49611	57916	24155	49611	73766
1989	17185	42997	60182	37163	42997	80160
1990	39908	22208	62116	64674	22208	86882
Avg (1983-87)	12811	38550	51361	17530	38550	56080
Avg (1987-90)	17371	41823	59194	35351	41823	77174
Avg (1983-90)	15090	40187	55277	26440	40187	66627

for tractors on the basis of their average.

4.5.5 With tractor life anticipated to increase from 11 years in the study to 12 years in nineties and an optimal park of 900000 in the country the annual requirement for replacement thereafter may be taken as 75000.

4.5.6 With this background, capacity may be planned on domestic consumption being 75000 per annum, additional demands being met either by imports or restricting exports which are recommended in chapter VI at around 7-8000 pa.

Table 18 : Supply of farm tractors in the period 1966-80.

YEARS	Total sales	Locally manufactured	imports	percentage of demand met by local production %
1966	10982	10575	407	96
1967	14690	12933	1757	88
1968	16986	15281	1706	90
1969	14370	13548	882	94
1970	8333	7921	412	95
1971	15900	15660	300	98.4
1972	26105	22819	3286	87.4
1973	37338	32816	4922	88
1974	30042	25616	4453	85
1975	52159	32691	19468	62.7
1976	78177	37453	40724	48
1977	70185	31814	40279	45
1978	31816	18202	17939	57
1979	15716	15157	1321	96.4
1980	19093	16936	3753	89

CHAPTER V

CAPACITY FOR MANUFACTURE OF TRACTORS

5.1 - SUPPLY IN PREVOIUS YEARS

5.1.1 Table 18 shows the distribution of total sales into local production and imports for the period 1966-1980.

5.1.2 It will be seen that except for the four year period between 1975-78, about 90% of the domestic demand is met by local production. The years 1975-78 are exceptions, because in these years the Government encouraged the import of tractors

and imported tractors were made available to the farmer at prices around 10% higher than that of local production. As a result of this, the percentage of demand met by local production fell as low as 45 in 1977. With restrictions on imports, in recent years the percentage has again risen to the normal level of 90%.

5.2 LOCAL MANUFACTURE

5.2.1 Installed Capacity:

Theoretical capacities of the eight manufacturers presently active in production are shown in table 19.

5.2.2 Local Production and Capacity Utilization:

Annual production figures of the eight local manufacturers for the period 1968-1980 are given in table 20. It will be seen that out of the 285444 tractors manufactured in this period,

37% are Fiat tractors manufactured by Türk Traktör,

30% are Massey Ferguson manufactured by Uzel,

17% are Ford manufactured by TZDK before 1975,

and the remaining 16% were manufactured by other firms and this 16% comprise 10 different models of tractors.

Table 19: Theoretical capacities of local manufacturers

Name of Firm	Licensor	Percentage of Foreign Capital	HP	Theoretical Capacity Units/year (1980)
Türk Traktör	Fiat	25	48-64	22500
Uzel	Massey-Ferguson	Licence	47-64	15000
TZDK	Steyr	License	' 45	10000
	Başak	–	12	5000
BMC	Leyland	26	32	5000
TOE	Int.Harvest.	10	44-65	12000
Iltor	Goldoni	Licence		8000
Burtrak	Ihi-Shiabura	Licence	40	20000
Hema	Ford	Licence	47-78	25000

Σ 122500

TABLE 20 : ANNUAL PRODUCTIONS OF LOCAL MANUFACTURERS

YEARS	TTF	Uzel	TZDK	BMC	TOE	Burtrak	Hema	Iltor	Total*
1968	3.200	6.692	3.699	1.100	445	-	-	-	15.281
1969	3.944	5.550	2.824	1.046	74	-	-	-	13.548
1970	2.281	2.250	1.930	636	571	-	-	-	7.921
1971	5.087	5.750	4.319	376	128	-	-	-	15.660
1972	7.549	7.550	5.700	870	1.100	-	-	-	22.819
1973	9.533	10.149	8.500	2.574	1.650	-	-	-	32.636
1974	9.075	8.315	4.295	1.946	1.740	-	-	-	25.616
1975	12.090	9.500	5.229	3.144	2.402	-	-	-	32.691
1976	15.006	9.180	5.147	3.876	3.433	-	-	-	37.453
1977	14.075	9.270	3.243	3.218	2.008	-	-	-	31.814
1978	8.571	5.018	1.253	735	2.106	500	-	-	18.202
1979	7.644	2.930	1.254	361	2.307	200	-	180	14.867
1980	7.710	2.832	2.204	1.633	1.240	480	600	237	16.936
TOTAL	105.765	84.986	49.588	21.515	19.204	1.180	600	417	285.444

* Totals of rows do not add up because productions of Pancar Motor and Fidan (which have closed down) are not shown.

5.2.3 Local production fell continuously after a peak in 1976, despite the fact that theoretical capacity was increased more than two fold since then.

5.2.4 Production levels reached in 1979 and 1980 are shown in table 21 together with the capacity utilization ratios.

5.2.5 As will be noted that the overall capacity utilization ratio in the last two years is around 13% while the highest reached by one manufacturer is 34%. In 1981, total of planned production is 27216 tractors which corresponds to a planned capacity utilization of 22.2%.

5.3 Highest Levels of Production Realised:

5.3.1 The highest level of total production reached was in 1976 when the total no. of tractors produced by five manufacturers was 37453. The theoretical capacity in the same year was around 44900, thus the capacity utilization ratio was 83.4%, the highest ever reached.

5.3.2 It is useful to examine the highest levels of production for each firm which are shown in table 22. It will be seen that, except for Uzel which had the highest production in

Table 21: Production and capacity utilization ratio of local manufacturers for the last two years.

Name of Firm	Theoretical capacity	1979 Production	1979 CUR (%)	1980 Production	1980 CUR (%)
Türk Traktör	22500	7644	33.9	7710	34.3
Uzel	15000	2930	19.5	2832	18.9
TZDK	15000	1245	8.3	2204	14.7
BMC	5000	361	6.2	1633	32.7
TOE	12000	2307	19.2	1240	10.3
Burtrak	20000	200	1	480	2.4
Hema	25000	-	-	600	2.4
Iltor	8000	180	2.2	237	3.0
Total	122500	14867	12.1	16936	13.8

Table 22: Highest levels of production reached by local manufacturers.

Firm	Year of highest Production	Production	Theoretical capacity	Capacity utilisation ratio
Türk Traktör	1976	15006	20000	75
Uzel	1973	10149	10000	101
TOE	1976	3433	4000	86
TZDK	1976	8500	10000	85
BMC	1976	3876	5000	77.5

1973, all other firms reached their highest levels in 1976 when foreign currency reserves of the country was high. All of the manufacturers (except BMC) have extended their capacities since, but none has managed to raise the level of production. This cannot be attributed to the shortage of demand because in the following two years tractors had to be imported in quantities similar to total local production.

5.4 Level of Integration:

5.4.1 Engines: Tractor manufacturers used to import the engines in CBU form until recently. There has been a move towards local production of engines in order to increase the local content of tractors produced. As a result, almost all manufacturers now have assembly and test facilities, that is, every manufacturer assembles his own engine from CKD and components procured from local sub-suppliers. The local content of engines so assembled ranges between 20-45%. No manufacturer has yet set up facilities for the production of main parts, and some of the main components such as fuel injection pumps, starter, generator, water pump and oil pump are imported. As facilities do not exist for machining the main parts (cylinder block, cylinder head, crankshaft, camshaft, connecting rod, etc.), local foundries and forges

have at least required to produce these parts.

As will be understood from above, the level of integration for engines is extremely low and sub suppliers of engine equipment are faced with the problem of producing many parts in small numbers.

There is only one exception to this scheme and it is BMC which has attained a certain degree of integration in engines. BMC has foundries to cast the main parts of engines and also has machining facilities, but forged parts are mainly imported (machined here, (A number of the same engine models used in the MAN products) by the same firm).

5.4.2 Transmissions:

5.4.2.1 Main Parts (Cast iron): The following parts are required to machine: the main parts such as the gear box, transmission box, rear axle housing and the differential case. 4 manufacturers have machining facilities - Türk [illegible], Kurtrak, TOE and BMC, and the total installed capacity is 40000 castings. for these parts are procured from local foundries but it is known to have had problems with local castings. All others import these parts.

5.4.2.2 Gears and Shafts: As the manufacture of gears and shafts require special techniques and machinery, tractor manufacturers do not produce gears and shafts. Some gears and shafts are locally manufactured, but most have to be provided by imports. A new plant in Polatlı (Hema) is about to be commissioned at a rated capacity to provide gears and shafts to equip 60000 tractors pa. When this plant goes on full stream, the local forges will not be able to supply blanks at the required rates. This matter will be taken up separately in a report on Tümosan's foundry+forge project later.

5.4.3 Pressings: Tractor manufacturers do not have facilities for pressings and most of the pressings come from one supplier in Bursa (Coşkun Öz).

5.4.4 Assembly: All manufacturers have assembly facilities for tractors and the installed capacities reported are in general assembly capacities. But it is difficult to assess whether these figures are actual capacities because, the level of productionsince 1977, when most of the firms expanded, has not reached beyond 38% at the best and have been below 20% for seven of the nine firms involved. None of the firms were able to get close to the capacity before expansion and actual capacities as reported would stand a closer scrutiny.

Information available on the degree of integration is summarised in table 23. It will be seen that in the local tractor industry:

i- the level of integration is extremely low

ii- reported capacities are too high compared to the production levels reached and hence these capacities could possibly represent "theoretical assembly facilities"

iii- with the imbalance between the capacity to manufacture parts/components and the capacity to assemble tractors, present tractor industry would find it difficult to manufacture 122500 tractors pa even if this capacity is available for assembly. One of the main obstacles in the way of integration is that the number of firms and types of tractors involved appear to be too large for economical manufacture of parts/components to meet a production demand which for all types may be around 55000 in 1983 and 96000 in 1990.

5.5 Local Manufacturers:

5.5.1 The nine local manufacturers may be grouped as follows:

i- Manufacturers that produce only tractors: In this group we have Türk Traktör and Burtrak. Both have facilities for the production of main parts in addition to assembly. Türk Traktör reports an installed capacity

TABLE 23 : Degree of Integration in Turkish Tractor Industry

PARTS/UNITS /OPERATION	Total capacity available (2 shifts) Castings	Forgings	Machining/ Forming	Assembly Reported	Max.achieved	REMARKS
1. ENGINE	50 ^	-	5000	91000	(17 000)	Only BMC manufactures, all others "Assemblers"
2. TRANSMISSIONS						
2.1. Main parts	22500		60000[x]	60000[x]		Only Türk Traktor has foundry facilities[xx]
2.2. Gear and shafts						
3. PRESSINGS	-	-	-	-	(37453)	Coşkun Öz - Bursa
4. TRACTOR ASSEMBLY	-	-	-	122500	37453	

Notes: 1- Total capacity available is given in "number of tractors per annum"

2- Figures shown in"castings/forgings" columns represents capacities of the manufacturers but not total capacity of the country. Total capacity of country will be treated in a separate report.

[x] Includes facilities at TOE (12 000) and BMC (5 000) - both these firms may in future leave tractor business and concentrate on main activity of truck production. The capacity for transmissions (main parts) would then be 43 000 per annum.

[xx] Hema plant in Polatlı to create gear and shaft capacity sufficient for 60 000 tractors pa

of 22500, and Burtrak 20000, thus making a total of 42500.

ii- Automotive firms that also produce tractors: We can put Uzel, BMC, TOE and TZDK into this group. The main activity of BMC and TOE is vehicle production while Uzel is an automotive sub-supplier for parts such as springs and rims and TZDK is a state owned company set up to produce agricultural equipment. These firms, except for TOE have only assembly facilities i.e. no production facilities suitable for the manufacture of tractors. TOE, does have machines specially bought for some tractor parts which has not yet been commissioned.

iii- Firms about to start assembly: Çukurova, Iltor and Hema come under this group. All three are new in the field, and it is understood that they have completed construction of buildings and have had assembly facilities set up, but not fully commissioned.

CHAPTER VI

TÜMOSAN PROJECTS

6.1. TÜMOSAN is investing to set up a tractor and an engine (specifically for tractors) manufacturing facility in the Konya Integrated plants. The engine plant started assembly in March 1981 and has plans for 2645 engines this year. The tractor plant is expected to start production towards the end of 1982. Both projects are licensed by Fiat of Italy and the main features are described below.

6.2. TRACTOR ENGINE PROJECT

6.2.1. Products: 8000 series diesel engines of Fiat Trattori. These engines are specially designed for application to tractors but may also be used in automative industry, pumps and generators. Some of the main specifications of the products are as follows:

Table 24: Main specifications and applications of TÜMOSAN diesel engines

Engine type	no of cylinders	Max.power range DIN 70020 HP/rpm	Applications (Direct)
8035	3	49/2400 58/2700	Fiat tractors 380,500,540 and 580
8045	4	66/2400 76/2500	Fiat tractors 640,680,780 and DT types
8065	6	100/2400	Fiat tractor 980

These engines may also be used, following successful adaptation work, on tractors of suitable HP range. For example, 8035 on MF 135, Ford 3600, IH 444, Steyr 548, JD 1130 and 8045 on MF 165, Ford 6600, IH 654, Steyr 768 and JD 2030.

6.2.2. Capacity and Investment programme: The final capacity of the plant is to be 100 000 diesel engines pa, and master plans are prepared accordingly. However, the investment is to be carried out in two stages. In the first stage the installed capacity will be for 50 000 engines (expect cylinder block and cylinder head lines where phasing of investment is considered uneconomical) and the plant is to reach this production level by 1986. The second stage of investment, that is, the expansion of capacity to 100 000, is to be timed according to market conditions. Tentative timetable foreseen for this stage starts in 1987. The cost of investment is as follows:

First stage:

Capacity : 50 000 diesel engines per annum

Investment cost (1000 $):

Foreign currency : 104331

Total : 147775

Second stage:

Foreign currency: 29 000

Total : 44 000

6.2.3. Production programme: Production programme for the first phase is shown in table 25, together with the foreseen local content. It will

Table 25: Production programme and local content ratio for TÜMOSAN engines

YEARS	3 cylinder 8035	4 cylinder 8045	TOTAL	Average local content %
1981	2645	-	2645	46.2
1982	8900	6100	15000	52.3
1983	16500	8500	25000	54.5
1984	16500	8500	25000	78.7
1985	25000	14500	39500	97.9
1986	31000	27000	58000[x]	99

[x] With overtime working

be noted that the 6-cylinder engine, 8065, does not appear in the production programme. This engine is to be produced according to market conditions. Because the engines are of the same series, changes in the type of product can be easily effected and hence programme suited to the market conditions.

6.3. TRACTOR PROJECT

6.3.1. Product: TÜMOSAN plans to manufacture popular Fiat tractors. Two main groups of tractors will be produced:

Type 40 : Fiat 500 (50HP) and 540 (54HP)

Type 80 : Fiat 580 (58HP), 680 (68HP), 780(78HP), 980 (98HP).

Type 40 tractors are of customary design and specifically suited to the needs of the farmer while type 80 tractors are a more modern design suitable also for the purposes of road construction work and forestry work. TÜMOSAN has also licensed the DT types (double traction) of the 80 group of tractors which have a good export potential and is planned to be produced according to developments in marketing conditions.

6.3.2. Capacity and Investment programme: Tractor manufacturing facility, located in the Konya Integrated plants, is designed for a total capacity of 50 000 tractors per annum (two shifts), the capacity for the first phase of investment is 25 000 pa and expansion to 50 000 is foreseen in the year 1987. The cost of investment is as follows:

First stage: Capacity : 25 000 tractors pa (two shifts)

Investment cost (1000 $):

Foreign currency : 53 000

Total : 97 000

Expansion (1987): Capacity : to be increased from 25 000 to 50 000 pa
Investment cost (1000 $):
Foreign currency : 19 600
Total : 28 540

Diesel engines for tractors are to be provided by the engine factory located in the same integrated plants (see section 2) and the tractor factory will have manufacturing facilities for the following parts /units: gear box, transmission box, front axle support, rear cover, planet gears, rear axles, rear axle housing and reductors will be machined in flow line type of machining units. Less complicated parts such as shafts, forks, levers, and round castings and forgings are to be machined in batch type production units. (Casting and forging requirements of TÜMOSAN projects to be taken up in a separate report).

6.3.3. Production Programme:

Production programme for the first phase is shown in table 26 below together with the percentage of local content foreseen. As the production facilities in the plant are so selected as to be able to manufacture parts for both groups of tractors, this permits a flexibility in the production programme and hence types may be changed to suit market conditions.

Table 26: Production programme and local content ratio for TÜMOSAN tractors (Local content includes the engine)

YEARS	Tractor Production Group 40	Group 80	Total	Local Content %
1982	4000	-	4000	6.4
1983	8000	-	8000	74.7
1984	9000	2000	11000	93.3
1985	10600	5000	15600	96.6
1986	13600	5800	19400	96.6
1987	14500	10500	25000	96.6

It will be noted that the local content of tractors will rise to above 95% by 1985. This high local content is made possible by the integrated character of TÜMOSAN projects.

The production programme of the tractor project from 1988 onwards is expected to be made according to market conditions and the realization of the expansion tentatively planned for 1987.

CHAPTER VII

EXPORTS

7.1. There is a good potential for the export of farm tractors to the Islamic countries particulary in the Middle East and in North Africa. Type 80 tractors which are suitable for use in construction work as well as in farming are considered to have an increasing market as these countries have a growing construction industry.

7.2. The credit granted by the Islamic Development Bank to the tractor project, to the order of 10 million Islam Dinar (approx. 13 million US $) is an acknowledgement of the importance of tractors to the Islamic World.

7.3. Although tractor engines, as single units, are unlikely to be required, since matching assembly/production facilities are not yet set up in Islamic countries, automative versions of the engines may be exported to countries, like Saudi Arabia, which have started automative assembly industries. The position of Iran, in this respect, is uncertain because this country has plans for engine production but has been slow in setting up manufacturing facilities. Hence, the Iranian market should be carefully watched for exports of automacive engines. (Clearly, Iran is likely to be a good market for tractors until they start manufacturing their own Massey-Ferguson tractors)

7.4. It is felt that a minimum of 10% of the tractor production should be earmarked for exports. The optimal geographical situation of Turkey to the Islamic markets is an advantage and these export markets should be fully utilized.

7.5. The license agreements between TÜMOSAN and the Licensor, Fiat, provide for the export of both tractors and engines to Middle East and African countries through Fiat distribution channels. These parts of the World are, as pointed out earlier, likely to be good export markets specially for the tractors and the use of Fiat distribution channels will be an advantage.

7.6. EXPORT PROJECTIONS AND TÜMOSAN'S ROLE

A detailed analysis of Middle East and African markets has not been undertaken but it is felt that TÜMOSAN should undertake the responsibility of realising a minimum export level of 10%. It is important that TÜMOSAN should make the best use of this potential because with exports, apart from getting itself a firm place in foreign markets, TÜMOSAN will also offset the cost of KD parts to be procured from the Licensor for its own manufacture and could thus become self-sufficient with respect to foreign exchange.

CHAPTER VIII

CONCLUSIONS AND RECOMMENDATIONS

8.1. CONCLUSIONS

8.1.1. The domestic demand for farm tractors is expected to be around 50 000 pa in the year 1983 and to gradually increase to a level of 62 000 pa in 1990 in the worst case and to 87 000 pa in under more favourable conditions. These favourable conditions, which corresponds to the agricultural income increasing at the same rate as GNP, leads to an average park increase rate of about 6%, while this rate is only 3% for the worst case. The tractor park will rise from the present level of 400 000 to 520 000 in the worst case and to 630 000 under more favourable conditions until the year 1990.

8.1.2. The cultivated area of the country, 24 million ha, corresponds to one third of the whole country and is thus unlikely to significantly increase in the near future. The total number of tractors required to effectively farm this land is estimated to be around 900 000. When the park saturates at this level, and the average tractor life improves to 12 years from the present level of 11 years, 75 000 replacement tractors per annum will be required to sustain the park. With possible increases in the use of tractors for industrial purposes and for construction works, this could rise to the level of around 85 000 pa. -(At a constant supply of 75 000 tractors per annum to the farm sector the optimum park of 900 000 may be reached by the year 2000)

8.1.3. Farm tractors have a good chance of export to the Islamic countries. Export possibilities should be a minimum of 10 % of the domestic demand. Hence, production plans for tractors should be made for about 55 000 in 1983 and should be increased to the level of 96 000 in 1990. However, developments in market conditions and the low

limit for domestic demand should be carefully watched in order to prevent wastage of resources.

8.1.4. Long term tractor production plans of the country should take into account both the demand forecast for the years ahead and the level of replacements reguired at saturation point and should be made for 96 000 tractors per year (export included).

8.1.5. The level of integration in the present tractor industry appears to be extremely low: number of manufacturers and models are too many and the production level of many of the manufacturers are too low to permit economical manufacture. Degree of integration varies greatly among manufacturers: Only three of the present producers (Türk Traktör , BMC and TOE) have attained a degree of integration and a fourth, Burtrak, is understood to be investing. All other producers are "assemblers" with almost no degree of integration, and hence heavily dependent on the availability of foreign exchange for CKD.

8.1.6. The total installed capacity reported, 122500, is not supported by either the level of production reached (max 37453 in 1976 when installed capacity was 44900) since the expansion of capacities or the degree of integration in the manufacturing facilities. Total installed capacity (including Burtrak) for transmissions appears to be between 43 000 - 60 000 pa[x] and it is understood that Hema plant in Polatlı will be able to supply gears and shafts to the same extent. Except BMC, there is almost no engine manufacturing facilities[xx], and the production level of each manufacturer is too low to enable them to set up their own units. The total capacity reported, 122500, is capacity to assemble tractors when parts/components/semicomplete units are available. It appears that matching capacities for pressing, and semi complete units are also not available. This adds to the imbalance in this industry.

[x] Assuming production facilities of firms involved are matched with the assembly capacities reported and see note in caption of table 23).

[xx] BMC uses engine of own manufacture, 30 HP, 5000 pa. Iltor uses locally manufactured small engine (about 10 HP).

8.2. RECOMMENDATIONS

Any recommendations for the tractor industry should take into account the following factors:

- optimum use of existing facilities
- reduced dependency of manufacture on CKD imports
- integration to lead to economic and competitive manufacture to the extent that export potential be effectively utilized. Various measures may be taken to rench the ultimate goal of economic and competitive production. Considering the present state of this industry, it is recommended that the following principles on the organisation of tractor industry be followed:

8.2.1. Organisation of Tractor Industry

8.2.1.1. Engine: The present practice of each manufacturer assembling its own engine from CKD and some locally manufactured parts (mainly from sub suppliers) is uneconomical. Types of engines should be reduced. For this purpose, the engines manufactured in Konya by TÜMOSAN should be fully utilized. It is understood that TÜMOSAN started engine assembly in March 1981 on a 50 000 engine pa capacity assembly line and considers expansion to 100 000 in 1986. Expansion plans of TÜMOSAN should be matched with the development of tractor demand and all manufacturers should adapt TÜMOSAN engines to their tractors.

In the interest of economical manufacture of engines, the initial capacity of TÜMOSAN appears to be justified. However, their absorption in the market will depend on the acceptability of the engines by other tractor manufacturers and this is an issue which, beside aspects of price and delivery, will involve consideration of commitments with licensors and technical/economical feasibility of the adaptation of these engines to their tractor desings.

8.2.1.2. Gears for Transmissions: As gear manufacturing is a special type of production, tractor manufacturers do not produce gears. Although some facilities are known to be available locally, it is understood that most of the gear requirements are met by import. Hema Polatlı plant, which is about to start operation at a capacity to meet gear requirements for 60 000 tractors (two shifts) p.a., is expected to fill this gap for gears. This firm should specialize in the field and should extend its capacity from 1985 onwards, or a new investment should be started, in parallel with demand development for tractors. It is felt that tractor manufacturers should not get involved with gear manufacturing

8.2.1.3. Pressings: Pressings could be provided by sub-supliers as is the case presently. However, the capacity of the only supplier in Bursa (Coskun Öz) is unlikely to meet the future demand. It will be desirable to encourage a second manufacturer to get into the field to make available sufficient capacity and to create competitive marketing conditions.

8.2.1.4. Forgings and Castings: The supply of good quality forgings and castings is of crucial importance to the success of any manufacturing unit. This importance is only acknowledged here, as the subject will be treated separately affter all TÜMOSAN projects are examined.

8.2.1.5. Semi complete Units: Steering box, brake, clutch and hydraulic lifts should be procured from sub-suppliers. It is understood that only hyraulic lifts, at present, are locally manufactured. Production facilities of matching capacities of other semi complete units in ancillany industries should be encouraged.

8.2.2. TÜMOSAN Tractor Plant: It is understood that TÜMOSAN has already invested at least 13 million dollars for production facilities to manufacture main parts of tractors (gear box, transmission box rear cover and transmission box machining lines) at the rate of 50 000 pa (two shifts). As there is a large gap between the capacity for

assembling and the capacity for part production, two possible solutions may be considered.

Alt. 1: TÜMOSAN facilities be used for manufacturing main components/ parts for the existing five tractor "assemblers". However, this will mean that TÜMOSAN will produce 9 different types (for five firms) in small quantities and the problems presently met with sub-suppliers will continue. Hence, this solution will not improve the tractor industry and may even be a hindrance.

Alt.II: TÜMOSAN manufacture tractor parts for the licensed Fiat Tractors and give these to the "assemblers" for assembling. This way, existing assembly facilities of these five firms will have been put to good use. But, some of these firms, especially those that have other lines of products, may leave tractor assembly, The gap in assembly capacity that results from this could be filled up by facilities to be set up by TÜMOSAN. This alternative seems to be the only solution and has the following advantages:

- Standardisation in farm tractors
- economical manufacture
- better use of sub suppliers' facilities and restructuring of sub suppliers to higher efficiency
- ease of servicing and of spare part procurement
- export potential of tractors and servicing for exported tractors.

8.2.3. Proposed plan of Action: To implement alternative II solution above, the following line of action is recommended.

i - *Engine adaptation work with TOE and Burtrak should be immediately* started and a plan should be drawn out for the use of TÜMOSAN engines by these firms. Adaptation work is not necessary for Türk Traktör since they use Fiat engines. TÜMOSAN's engine production programme does not seem to provide engines for others who need to adapt them until 1985, hence TÜMOSAN should be asked

to make appropriate changes, if necessary, in engine production programme to suit the agreed plans for adapted engine use. In parallel with this, these two tractor manufacturers should be requested to phase out their engine assembly work according to the plan.

ii- A study should be undertaken to ascertain the investments already made by the five "assemblers" and the suitability of their equipment for working in accordance with Alt II. This study could be jointly organized by SPO and MIT in cooperation with TÜMOSAN, and should be completed within the next six months. At the end of this study, the plans for manufacturing/assembly of tractors by all existing units can be determined. This study may also examine, inter alia, the possibility of other uses for existing equipment and, when possible, clearly, alternative uses are recommended.

iii- Organisation of marketing of tractors under alternative II is of paramount importance for the success of this scheme of action. MIT, SPO and TÜMOSAN should jointly decide on the organisation of marketing in collaboration with the present manufacturers. It is difficult to make a recommendation for this, but TZDK may, be considered as a possible unit for distribution, marketing and after-sales services.

iv- The relation between TÜMOSAN and the "assemblers" could take one of the following two forms:

(i): The assemblers to work as subcontractors to TÜMOSAN

(ii): TÜMOSAN to sub-license the assemblers to manufacture Fiat tractors. Both forms will need negotiations with the main licensor Fiat and the existing assemblers.

In following this line of action, care will have to be taken to honour the present license agreements of the manufacturers and plans for the implementation of alternative II should allow sufficient time for adjustment.

v- The restructuring of the tractor industry, which is badly needed, is dependent on economical manufacture and maximum standardisation of main parts. TÜMOSAN plans, looked at with this background and subject to successful negotiations with other tractor assembler / manufacturers should, for the time being, be limited to

25 000 tractors in 2 shifts

and 50 000 tractor engines in 2 shifts.

8.2.4. Availability of TÜMOSAN Engines

With the above background table 27 shows the number of TÜMOSAN engines that will be available to other tractor manufacturers. It is seen that in 1982, 83 and 84 the engines manufactured will be just sufficient for TÜMOSAN and Türk Traktör.

Table 27: Availability of TÜMOSAN engines to other manufacturers.

YEARS	No of engines planned by TÜMOSAN	no of tractors by TÜMOSAN	Engines available to other manufact.	Remarks
1982	15 000	4 000	11 000	Just sufficient for Türk Traktör
1983	25 000	8 000	17 000	" " " " "
1984	25 000	11 000	14 000	" " " " "
1985	39 500	15 600	23 900	" " " " "
1986	58 000	19 400	38 600	16 100 units available to others.

Some engines may be available for adapted use in 1985 depending on the production programme of Türk Traktör (capacity 22 500 tractors per annum), but real availability will come in 1986 when TÜMOSAN's engine production can rise to 58 000. Since total tractor demand in 1986 is expected to be between 54 000 and 62 000 (see table 17), it would appear that TÜMOSAN will be able to provide all the engines needed. It is presumed that there are no other plans for the manufacture of tractor engines in Turkey and hence from 1986 onwards TÜMOSAN should plan engine production so as to meet the reqiurements of all tractor manufacturers.

ANNEX 1 : TRACTOR PARK ACCORDING TO SIS AND MAF

Years	SIS Records	MAF Records	Years	SIS Records	MAF Records
1950	16 585	-	1966	65 103	49 846
1951	24 000	-	1967	74 982	61 415
1952	31 415	-	1968	85 475	75 306
1953	35 600	-	1969	96 407	87 184
1954	37 743	-	1970	105 865	93 464
1955	40 282	-	1971	118 825	108 355
1956	43 727	-	1972	135 726	134 271
1957	44 144	-	1973	156 139	171 187
1958	42 527	-	1974	200 466	198 117
1959	41 896	-	1975	243 066	240 950
1960	42 136	-	1976	281 802	312 407
1961	42 505	-	1977	325 225	376 719
1962	43 789	44 688	1978	370 259	398 145
1963	50 844	42 463	1979	440 502	399 892
1964	51 781	41 123			
1965	54 668	42 817			

Sources : State Institute of Statistics (SIS), Ministry of Agriculture and Forestry (MAF)

ANNEX 2: AGRICULTURAL INCOME FOR PERIOD 1963 - 1980 (Million TL)

Years	Current Producers' Value	At 1968 Producers' Value	Index of Agricultural Production (1963= 100)
1963	23 727.4	28 749.9	100
1964	23 713.6	28 615.8	99.5
1965	23 226.0	27 394.8	95.3
1966	28 204.2	30 376.2	105.7
1967	29 539.4	30 273.5	105.3
1968	30 832.1	30 832.1	107.2
1969	33 054.1	31 044.0	108
1970	38 286.5	31 820.5	110.7
1971	49 373.9	35 949.3	125
1972	58 543.7	35 799.9	124.5
1973	71 958.5	32 124.7	111.8
1974	104 455.3	35 657.8	124
1975	134 737.1	39 213.5	136.4
1976	175 296.5	42 412.6	147.5
1977	214 678.6	41 991.6	146
1978	294 505.3	42 905.4	149
1979	455 236.1	44 046.8	153
1980	904 778.6	44 701.6	155.5

Source : State Institute of Statistics

ANNEX 3: TRACTOR PRICE INDEX FOR PERIOD 1963 - 1980

YEARS	Current Average Price (1000 TL)	Wholesale Price Index For Food Stuffs	Price Index For Tractor (1963 = 100)
1963	35.5	100	100
1964	35.5	100.2	99.8
1965	37.58	110.3	96.0
1966	39.95	116.3	96.8
1967	44.48	124.0	101.0
1968	41.23	126.4	91.9
1969	41.23	136.6	85
1970	45.75	141.0	91.4
1971	58	161.0	101.5
1972	63.5	185.4	96.5
1973	63.7	225.3	79.6
1974	79.8	305.4	73.6
1975	79.8	357.9	62.8
1976	108.6	411.6	74.3
1977	132.7	505.6	74.0
1978	218	733.7	83.7
1979	512	1092.8	132.0
1980	1090	2189.7	140.0


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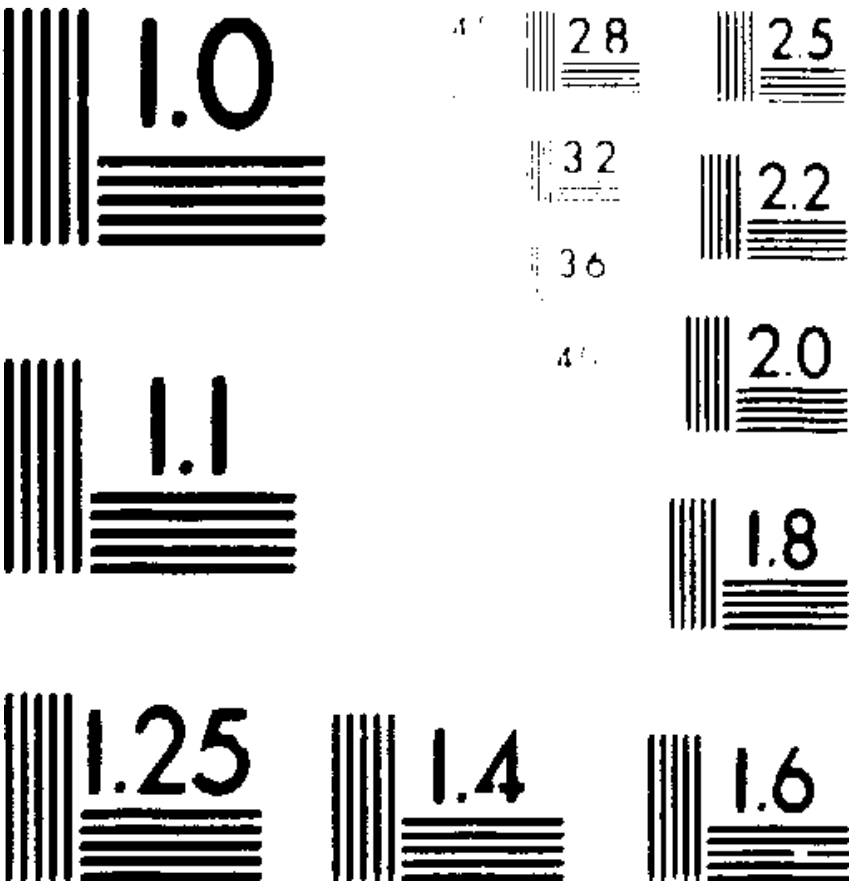

ANNEX 4 : EQUIPMENT CREDITS GRANTED TO THE FARMERS BY THE AGRICULTURAL BANK OF TURKEY

YEARS	Equipment Credits (Million TL)	Average Tractor Price Current value 1000 TL	Index for Equipment credit (1963 = 100)
1963	188.6	35.5	100
1964	87.6	35.5	46.5
1965	94.5	37.6	47.3
1966	231.7	40	109.2
1967	333.7	44.5	141.2
1968	394.2	41.2	180
1969	304.4	41.2	139
1970	179.8	45.8	74
1971	418.1	58	135.7
1972	625.7	63.5	185.5
1973	1114.2	63.7	329
1974	886.4	79.8	209
1975	1123.7	79.8	265
1976	1745.5	108.6	291x
1977	2155.9	132.7	270x
1978	2054.3	218	118x
1979	2996.2	512	47x
1980	8555	1090	85x

x Corrected for varying percentage of agricultural equipment credits in total credits.

Source : The Agricultural Bank of Turkey.

ANNEX 3: TRACTOR PRICE INDEX FOR PERIOD 1963 - 1980

YEARS	Current Average Price (1000 TL)	Wholesale Price Index For Food Stuffs	Price Index for Tractor (1963 = 100)
1963	35.5	100	100
1964	35.5	100.2	99.8
1965	37.58	110.3	96.0
1966	39.95	116.3	96.8
1967	44.48	124.0	101.0
1968	41.23	126.4	91.9
1969	41.23	136.6	85
1970	45.75	141.0	91.4
1971	58	161.0	101.5
1972	63.5	185.4	96.5
1973	63.7	225.3	79.6
1974	79.8	305.4	73.6
1975	79.8	357.9	62.8
1976	108.6	411.6	74.3
1977	132.7	505.6	74.0
1978	218	733.7	83.7
1979	512	1092.8	132.0
1980	1090	2189.7	140.0

ANNEX 5 : DATA FOR REGRESSION ANALYSES

YEARS	Tractor Sales (units)	Index of Agricultural income (1963 = 100)	Index of average tractor price (1963 = 100)	Equipment credits by ABT (1963 = 100)
	X_4	X_1	X_2	X_3
1963	9325	94.9	100	100
1964	6720	99.8	99.8	46.5
1965	6791	97.7	96.0	47.3
1966	10982	99.8	96.8	109.2
1967	14690	105.5	101.0	141.2
1968	16986	106.1	91.9	180.0
1969	14370	107.5	85.0	139.0
1970	8333	109.2	91.4	74.0
1971	15900	116.9	101.5	135.7
1972	26105	124.8	96.5	185.5
1973	37338	119.0	78.6	329.0
1974	30042	117.0	73.6	209.0
1975	52159	129.4	62.8	265.0
1976	78177	141.2	74.3	291
1977	70185	146.9	74	270
1978	31816	147.2	83.7	118
1979	15716	150.8	122	47
1980	19093	154.1	140	85

ANNEX 6 : REGRESSION ANALYSIS OF TRACTOR SALES FOR PERIOD 1963 - 1977