AN ECONOMIC ANALYSIS OF ESTABLISHED FAMILY FARMS IN ISRAEL 1953–1958

YAIR MUNDLAK

FALK PROJECT FOR ECONOMIC RESEARCH IN ISRAEL

An Economic Analysis of Established Family Farms in Israel: 1953–1958

by

Yair Mundlak

This study shows that established family farms have made a considerable contribution to the outstandingly high growth rates of Israel's agriculture. The product of family farms rose chiefly because of increased capital inputs and greater productivity. The marginal productivity of irrigated land was very low, owing to the fact that the sample farms concentrated on livestock. The transfer of factors of production to crop-growing—a prerequisite of raising the marginal productivity of land—would not have raised the farms' total product significantly.

Dr. Mundlak concludes that if farmers growing crops are to earn the same income as those specializing in livestock, the relative price of field crops must be raised. Moreover, the farms must be enabled to expand their area, allowing for further mechanization and the consequent reduction of costs.

Underlying the author's conclusions is the assumption that farmers react to changes in the prices of final products and factors of production. This assumption was empirically confirmed by the estimation of a supply function for poultry products and a demand function for various productive assets. Another hypothesis tested is that all farms are not equally efficient. Differences in efficiency were measured by defining a "management" variable. It was found that, given similar inputs, the most efficient farm producted over 58 per cent more than the least efficient farm.

In Mr. Kaddar's appendix the field survey and the structure of the sample are described, and the questionnaire is reproduced.

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with an
APPENDIX
by GERSHON KADDAR

THE FALK PROJECT FOR ECONOMIC RESEARCH IN ISRAEL
JERUSALEM, JULY 1964

Published simultaneously in Hebrew and English

Printed in Israel
at Haomanim Press, Jerusalem

Distributors:
Blumstein's Bookstores, Tel Aviv

FOREWORD

THIS WORK is based on data collected in moshav farms over a number of years. The research was commenced under the auspices of the Falk Project with Gershon Kaddar as project leader and was later transferred to the Ministry of Agriculture under the direction of Dr. Yehuda Lowe.[1] During this period a number of studies were published containing findings on the development of the farms included in the survey.[2] In the present study an attempt has been made to concentrate on a number of problems not hitherto dealt with. Any overlapping that may exist between previous publications and the discussion in Chapters 2 and 3 was considered necessary in order to understand the discussion in the later chapters.

Most of the empirical analysis was completed in 1959 and the draft of the work written in 1961. For technical reasons the final publication was delayed but no changes were made in the material, and more important, no attempt was made to bring the analysis up to date.[3] The problems discussed are basic to the moshav sector and changes in data would not have affected the essential points of the discussion.

The present work would not have been possible without the data collected in previous years. I am indebted to Gershon Kaddar and Dr. Yehuda Lowe for their full cooperation in placing the material at our disposal. Anyone conversant with collated survey material knows that making it available to others demands time and clarification. The help rendered by Theo Gans, Yitzhak Remer and Egon Sternberg—not only in the form of explanation but also through additional visits to the sample moshavim to complete the

[1] A more detailed description of the earlier projects is presented in Appendix F.

[2] See Appendix F, section 5.

[3] The only changes made in the final editing stage appear in the footnotes which direct the reader to later studies. However, the analytical tools used in this work are discussed in greater detail in articles published after completion of the study—some of these are referred to in Chapter 6.

collection of data—made this work possible and they have our sincere thanks.

Special thanks are due to Eitan Hochman, who was my research assistant and constituted the link between planning and performance. He energetic ally assembled the data and participated actively in their analysis. I am also indebted to Shaul Ben-David, Emanuel Dalyahu, and Uri Regev for their help with the calculations, to Susanne Freund for her thorough checking and valuable comments, to Malka Silberstein, Laura Gerson and Naomi Rosenblatt who did the typing, and to Morris Gradel who prepared the study for the press.

The valuable comments on a previous draft by Professor Simon Kuznets, Dr. Daniel Creamer and Yoram Ben-Porath are well reflected in the present volume.

Y.M.

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ABBREVIATIONS

Abstract	Central Bureau of Statistics, *Statistical Abstract of Israel*
CBS	Central Bureau of Statistics, Israel
FP	Falk Project for Economic Research in Israel
IL	Israel Pound (divided into 100 Agorot)

CHAPTER 1

SUMMARY AND CONCLUSIONS

1. *Plan of the Report*

This work analyzes data collected in a sample of 66 established *moshav* farms located in six villages in various parts of the country. The farmers were interviewed annually in the period 1953–59 and a detailed questionnaire was filled in. The present analysis deals mainly with the period 1954–58.[1]

Chapters 2 and of this volume are descriptive, whereas Chapters 4–6 are mainly analytical in nature. Chapter 2 reviews the development in the utilization of productive factors over the period and compares farms, with emphasis on intervillage differences. In Chapter 3 the same pattern is followed from the viewpoint of extent and composition of output. The descriptive chapters serve two purposes: first, they provide information to assist the reader in evaluating the results of the subsequent chapters within the appropriate framework, and second, they discuss in a general way questions not dealt with further in this work.

For reasons which become clear later, the questions dealt with require somewhat technical analysis, and the problem therefore arises of how best to present the findings. It is clearly inappropriate to present conclusions without the underlying reasoning and analysis. Yet the technical aspects may be of interest to only some readers. The present chapter therefore presents some of the substantive results and their implications, while details of the analysis are given in the remaining chapters. Even the latter, however, have been restricted to the specific problems which arose in this

[1] See Appendix F. The original sample included 74 farms but there were some replacements in later years. We chose only those farms present during the whole period. For a definition of terms see Section 2 of this chapter.

All years are agricultural years. Thus, the agricultural year 1953 covers the period October 1952 to September 1953.

The data for 1953 were deficient and those for 1959 became available only after most of analysis had been completed. For this reason, these two years—with one or two exceptions—are excluded from this work.

study, whereas the results of more general methodological developments have been published elsewhere.[2] For this reason the report provides only details of the analysis related to our sample while hinting at some broader methodological implications.

Chapter 4 deals with the estimation of the production function, which is used, among other things, for explaining the sources of income variations among farms over time. Chapters 5 and 6 deal with the measurement of farmers' responses to prices and other market forces.

2. *The Role of Moshavim in Israel Agriculture*

The *moshav* sector with which this study deals is one of the three main types of farm organization in Israel. For the benefit of readers not familiar with these types, a brief indication of their characteristics is given here. This will also be of help in the evaluation of some of the findings.

a. A *moshav* (plural: *moshavim*) is a village of family farms which cooperate in some village operations, mainly in marketing products and in purchasing raw materials and equipment. The cooperative acts on behalf of the farmers in matters of water supply and is also their main credit agency. It also "enters into municipal functions and sometimes even into certain fields of production such as tractor and machine stations, cooperative incubators, grain crop production, and orchards".[3]

A *moshav shitufi* is a *moshav* in which production is collective but members maintain separate households. (In Table 1 it is referred to as a *cooperative moshav.*) Our sample does not include farms of this type.

b. The *kibbutz* (plural: *kibbutzim*) is a collective enterprise based on common ownership of resources and pooling of labor income and expenditure. "No wages are paid, but every member is expected to work to the best of his ability and is supplied with all the goods and services that he needs"[4] and all members have equal rights. The farm is planned, equipped, and managed as a single large-scale enterprise.

Most of the moshavim and kibbutzim are settled on public land admin-

[2] Yair Mundlak: "Empirical Production Function Free of Management Bias", *Journal of Farm Economics,* Vol. 43, No. 1, February 1961, pp. 44–56, reissued as FP Research Paper 9; "Aggregation Over Time in Distributed Lag Models", *International Economic Review,* Vol. 2, No. 2, May 1961, pp. 154–93, reissued as FP Research Paper 10; "Estimation of Production and Behavioral Functions from a Combination of Cross-Section and Time-Series Data", in *Measurement in Economics,* Stanford University Press, July 1963, reissued as FP Research Paper 13.

[3] *The Economy and Agriculture of Israel,* A Report Prepared for the Mediterranean Development Project of the Food and Agriculture Organization of the United Nations, Ministry of Agriculture and Bank of Israel, Jerusalem, June 1959, p. 95.

[4] *Loc. cit.*

TABLE 1. *Jewish Rural Settlements and Population*[a]*: 1948–60*

Type of farm	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957[c]	1957	1958	1959	1960
A. *Number of settlements*														
Moshavim	104 (Moshavim and Cooperative moshavim together)	157	218	233	274	295	302	316	333	347	335	344	345	347
Cooperative moshavim		25	27	28	27	29	24	27	25	25	21	20	19	19
Kibbutzim	177	211	214	217	217	227	223	225	228	230	228	228	228	229
Other types[b]	45	63	95	128	151	147	159	164	157	144	159	148	142	128
TOTAL	**326**	**456**	**554**	**606**	**669**	**698**	**708**	**732**	**743**	**746**	**743**	**740**	**734**	**723**
B. *Rural population (thousands)*														
Moshavim	30.1 (Moshavim and Cooperative moshavim together)	45.4	68.0	85.9	100.6	95.9	108.7	113.7	124.0	134.4	123.9	121.7	117.9	115.1
Cooperative moshavim		2.8	3.6	4.0	4.5	4.9	3.8	4.8	4.2	4.5	3.7	3.9	3.6	3.6
Kibbutzim	54.2	63.5	66.7	68.2	69.1	73.3	76.1	77.8	79.7	80.1	79.9	78.6	77.9	78.0
Other types[b]	26.3	49.3	86.1	152.6	156.5	171.9	172.0	174.9	172.0	177.8	114.3	120.4	121.7	125.7
TOTAL	**110.6**	**161.0**	**224.4**	**310.7**	**330.7**	**346.0**	**360.6**	**371.2**	**379.9**	**396.8**	**321.8**	**324.6**	**321.1**	**322.4**

[a] End of year figures, except for 1948 (November 1st).
[b] Consists mainly of private farms.
[c] New definitions were introduced in 1957 (see *Abstract* No. 9). For comparison, 1957 is shown according to both the old and the new definition.

SOURCES: CBS, *Abstract*—1948–57: *No. 9,* pp. 14, 15.
1958–60: From annual volumes, *Nos. 10–12.*

istered by the Jewish National Fund and operate under long-term tenure. Aside from restrictions on transfer of rights, farmers may operate as if they were the owners.

c. Private farming, which is the oldest type of settlement in Jewish farming in Israel, is mostly found in privately owned land not leased from the Jewish National Fund. The production of this sector as a whole is diversified and involves all products, with citrus being the major crop.

The number of settlements and population by type are presented in Table 1. These figures give some indication of the relative importance of the types of settlement and their growth over the years. At the end of 1948 the population in all moshavim accounted for 27 per cent and that of kibbutzim for 49 per cent of total Jewish rural population. The large expansion in the number of agricultural settlements which followed the establishment of the State of Israel led to a remarkable growth in the number of moshavim and in their population. The total Jewish rural population in 1960 was larger by 266[5] per cent than that of 1948. At the same time, the population in moshavim increased by 329 per cent and that of kibbutzim by only 44 per cent. Consequently, the population of moshavim at the end of 1960 accounted for 37 per cent of the Jewish rural population whereas that of kibbutzim accounted for only 24 per cent.

The data on population and number of settlements are but a limited guide to the extent of production. Thus, additional information for the end of 1959 is given in Table 2.[6] From Table 2 we see that the moshavim accounted for about 38 per cent of the number of agricultural units, with the veteran moshavim (those which had been established before the creation of the State) accounting for 7.8 per cent of the total number of units or 20.6 per cent of the number of units in moshavim. The moshavim in general accounted for more than their proportion in the number of agricultural units in the dairy and poultry branches. To a large extent, this reflects the trend of development in the veteran moshavim which had 17.2 per cent of the dairy cattle, 11.8 per cent of the beef cattle, and 33 per cent of the laying hens, but, on the other hand, only 2.1 per cent of the area devoted to industrial crops such as cotton, sugar beet, and peanuts. The new moshavim accounted for 38 per cent of the dairy cattle

[5] The percentages in this paragraph were calculated by linking on 1957 (see Table 2)

[6] The concept of agricultural unit used in agricultural planning in Israel represents the bundle of resources which, on the recommendation of the planners, is to be allotted to the settler. In the case of private farming or moshavim this is roughly equivalent to a farm. In a kibbutz or cooperative moshav the agricultural units of the members are pooled. Thus, the figures on agricultural units indicate the number of families for which resources were allotted.

TABLE 2. *Selected Data by Farm Type: 1959*[a]

Type of farm	*Number of agricultural units*[a]	*Irrigated area*	*Unirrigated area*	*Irrigated orchards*	*Vegetables, potatoes, and melons*	*Cotton, groundnuts, and sugar beets*	*Water consumption*	*Dairy cows*	*Beef cattle*	*Laying hens*
		(Thousand dunams)					*(Million m³)*	*(Thousands)*		
Kibbutzim										
Veteran	11,899	284	317	76	23	24	295	10.0	15.0	984
New	5,272	157	369	45	21	19	131	5.3	8.0	472
Moshavim										
Veteran	4,804	109	86	38	15	3	71	9.7	4.0	1,664
New	18,461	343	297	91	100	41	196	21.4	5.0	1,103
Other types	21,064	381	753[c]	202	43	54	234	10.0	2.0	781
Jewish sector, total	*61,500*	*1,274*	*1,822*	*452*	*202*	*141*	*927*	*56.4*	*34.0*	*5,004*
Non-Jewish sector	*19,000*	*22*	*768*	*5*	*18*	*3*	*11*	*18.3*	..	*220*
TOTAL	**80,500**	**1,296**	**2,590**	**457**	**220**	**144**	**938**	**74.7**	..	**5,224**
Moshavim as per cent of Jewish sector										
Veteran	7.8	8.6	4.7	8.4	7.4	2.1	7.7	17.2	11.8	33.3
New	30.0	26.9	16.3	20.1	49.5	29.1	21.1	37.9	14.7	22.0
TOTAL	**37.8**	**25.5**	**21.0**	**28.5**	**56.9**	**31.2**	**28.8**	**55.1**	**26.5**	**55.3**

[a] Unless otherwise specified, data are for agricultural years in this and subsequent tables.
[b] beginning of year.
[c] Of these, 259 cultivated by 'other types' and 459 temporarily cultivated and not allocated.
SOURCE: *Plan for Development of Agriculture for the Years 1960–65*, Joint Planning Center, Tel Aviv, February 1962, pp. 15–16, (mimeographed, Hebrew, not for circulation).

and thus exceeded their proportion in agricultural units whilst lagging behind in poultry and beef cattle. They also lagged behind in other items, especially in the average allotment of land and water. Their main concentration has been in vegetable production where they accounted for about 50 per cent of the cultivated area.

In the first few years after its establishment, the settlement receives guidance and long-term loans from the Settlement Department of the Jewish Agency, the ultimate aim being to equip the farms according to certain norms. It is then considered an established farm and as such cannot benefit from the Settlement Department's financial aid. This study deals with farms of the latter type.

In 1953 when the sample was drawn, the established farms were only a subgroup of veteran farms. Thus, it may appear that the study has only limited implication for Israel agriculture in general, but this is not the case. As will be seen below, conclusions may be drawn from the subjects discussed here which are applicable to moshavim in general, and in some cases even to private farms.

3. *Background of the Analysis*

The main problems requiring agricultural policy decisions in Israel—as elsewhere—are associated with changes in the basic (or exogenous) determinants of supply and demand and in the ability of farmers to adjust to them. In reviewing Israel's short experience, we observe that over the past decade the position of the agricultural sector and its contribution to the economy have changed considerably. Table 3 shows that in 1960 agricultural production in constant prices was 4.4 times greater than that of 1949 and double that of 1954. Thus, during the first eleven years of the State, agricultural production increased at a remarkable annual rate of about 14.5 per cent.[7] The rate of growth fluctuated somewhat and a definition of subperiods with significantly different growth rates can only be arbitrary. If, however, we divide the period 1949 to 1960 into subperiods, we obtain:

Period	*Average annual growth (Per cent)*
1949–1953	16.3
1953–1958	14.9
1958–1960	9.9

[7] It should be noted that the data on output, as reported in the CBS *Abstracts*, include intermediate products, the main one being feeds.

TABLE 3. *Value of Agricultural Production at 1949 Prices: 1950–60*[a]

(Index: 1949=100)

	1950	*1951*	*1952*	*1953*	*1954*	*1955*	*1956*	*1957*	*1958*	*1959*	*1960*	*1958/1954*	*1950/1954*
Total agricultural output	131	138	169	183	220	240	285	315	366	423	442	1.66	2.01
Field crops	155	119	241	250	323	324	412	511	460	548	502	1.42	1.55
Vegetables and potatoes	151	172	213	245	268	277	304	319	347	345	365	1.29	1.36
Citrus fruit	108	121	116	137	185	165	184	188	194	239	252	1.05	1.36
Other fruit	87	82	158	165	210	174	289	280	365	416	454	1.74	2.16
Milk	122	137	160	177	203	225	237	254	293	342	361	1.44	1.78
Eggs	135	162	151	152	171	213	218	266	373	440	481	2.18	2.81
Meat (live weight)	136	136	138	160	190	339	473	472	686	868	990	3.61	5.21

[a] Agricultural years.
SOURCE: CBS *Abstracts*—1950 and 1951: *No. 9*, pp. 150–51; 1952 to 1959: *No. 11*, p. 170; 1960: *No. 12*, p. 202.

We thus see that there is a tendency for the growth rate to decline, but even in the last two years it is still high.

Both established and new farms shared in the growth of output. A question that springs to mind is the contribution of each of these sources to the growth in production. As is evident from Table 1, practically no new settlements have been established in the last few years. Thus, if the growth is mainly a reflection of the formation of new settlements, it can be expected to decrease in the near future, as these settlements reach the level of the established ones. However, if a considerable expansion of output takes place in the established farms, we can anticipate the continuation of growth at a high rate for a longer period—provided, of course, that other conditions discussed below are met. We shall return to this problem later.

It should be noted that the rate of growth of agricultural output was uneven in the various branches. The production of vegetables showed accelerated growth in the first few years following the establishment of the State and slowed down later when prices started to decrease and surpluses formed. As we now know, the income elasticity of demand for vegetables in Israel is very low and therefore there was little change in the per capita consumption due to changes in per capita income.[8] The main source of increased demand was the growth in population. Thus, later growth in production was mainly directed toward supplying the increase in population. In other branches, output continued to grow at high rates, the extreme case being meat production, where demand is continuously increasing, reflecting high income and price elasticities. These trends are reflected in the composition of agricultural output as shown in Table 4. It thus appears that on the whole production adapted reasonably well to consumer demand. This process of adjustment with its various implications will be examined later in greater detail with regard to the farms in the sample.

The adjustment of production, however, reflects not only response by farmers to market prices but also direct control by government. In the first few years after the establishment of the State much effort was devoted to fostering the growth of agricultural production in order to supply the population with an adequate and varied diet. More recently, supply has exceeded demand in various commodities, at the prevailing prices, and farmers and policy makers have faced new problems. In an attempt to assure farmers a 'fair' income, government agricultural policy has been partly directed toward controlling the supply of various crops. In this connection, the following questions arise: to which activities should the available

[8] FP, *Fifth Report*, Jerusalem, August 1961, Table 2, p. 192.

TABLE 4. *Composition of Agricultural Production*[a] : *1949–60*

(Per cent)

	1949	*1950*	*1951*	*1952*	*1953*	*1954*	*1955*	*1956*	*1957*	*1958*	*1959*	*1960*
Field crops	15	18	13	21	20	22	21	22	25	19	20	17
Vegetables and potatoes	12	14	15	15	16	15	14	13	12	12	10	10
Citrus fruit	16	13	14	11	12	13	11	10	9	8	9	9
Other fruit	7	5	4	7	7	7	5	7	6	7	7	8
Milk	16	15	16	15	16	15	15	14	13	13	13	13
Eggs	15	15	18	14	12	12	13	11	13	15	16	16
Meat	9	9	8	7	7	7	12	14	13	16	17	19
Other products	10	11	12	10	10	9	9	9	9	10	8	8
TOTAL	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Value of agricultural production at 1949 prices (Index: 1949=100)	100	131	138	169	183	220	240	285	315	366	423	442

[a] Computed from data on production at 1948/49 prices.
SOURCES: Computed from CBS, *Abstracts: No. 9*, pp. 150–51; *No. 12*, pp. 202–03.

resources be allocated; should further growth be encouraged; and, if so, at what rate, and for what purpose?

The answers to these questions require knowledge of the nature of agricultural production, of the sources of its growth, and of the extent to which production is affected by market forces and by Government measures. Whatever decisions are made, they will have their implications and effects on income realized by farmers. Such income is determined by the amount of resources possessed by farmers, the efficiency of their use, and the relevant price structure. This complex should be investigated in its entirety in order to understand the mechanism which actually determines farm income, not only at a point in time but also over time as the basic underlying conditions change. It is our objective, therefore, to concentrate on this aspect of the problem. In so doing, we shall here survey the results and at some points investigate their implications. It is hoped that the discussion will shed some light on some of the more important problems which face the moshav sector in particular and Israel agriculture in general.

4. *Output of the Sample Farms*

We shall start by reviewing the development of agricultural production in the sampled farms. The results are summarized in Table 5. In the period 1954 to 1958 output increased by 52 per cent—an average annual rate of growth of 11 per cent. This rate is somewhat smaller than that obtained for agriculture as a whole for the same period, but is still high. As we shall see later, about one-fifth of this increase directly reflects an increase in productivity; the remainder is due to growth in the amount of inputs used.

Various hypotheses with respect to future growth in agricultural production could be drawn on the basis of this finding, although the available data do not permit their detailed examination. It should, however, be emphasized that the rate of growth observed in the sample is very suggestive with respect to the future rate of growth that one can expect from the established farms should the conditions determining supply continue to prevail. This, however, is not the rate that applies to agriculture as a whole. It is believed that the level of efficiency in the new farms is lower than that in the established farms. In view of the elaborate extension work performed in the new farms, it can be expected that whatever gap in efficiency there is between esablished and new farms will close in the future. This means that the new farms will progress at a faster rate than the old. In addition, the investment in the new farms is mainly financed through long-term loans granted by the Settlement Department of the Jewish Agency, which may lead to faster growth than in farms financing expansion by other means. And, perhaps more important, the rate of this investment in the new farms is a reflection of the program of the Settlement Department and is thus to a large extent independent of the prevailing market conditions. It then seems that, should the same conditions which determine supply prevail in the future, agricultural output can be expected to grow at a similar rate. We shall comment further on this point below.

TABLE 5. *Total Output—Average per Sample Farm: 1954–58*

	1954	*1955*	*1956*	*1957*	*1958*
Total output					
1954 IL	15,525	17,392	19,098	19,665	23,557
Index: 1954=100	100	112	123	127	152
As per cent of total output					
Eggs and poultry	*49*	*55*	*57*	*51*	*55*
Dairy and beef	*36*	*35*	*35*	*38*	*36*
Total livestock output	85	90	92	89	91
Other products	15	10	8	11	9

SOURCE: Tables B–1 and B–3.

It is seen from Table 5 that the main growth of output in the sample farms took place in the livestock and poultry branches. The output of the dairy branch increased by 49 per cent, and that of the poultry branch by 73 per cent, whereas output in other branches decreased by 11 per cent (see Table 23). Table 5 shows also that cattle and poultry products accounted for most of the output already at the beginning of the period, and thus we deal with cattle and poultry farms where poultry accounted for some 49–57 per cent and cattle for 35–38 per cent of value output in the various years; the share of the other branches varied in the range of 8–15 per cent. The composition in the sample is compared to that in agriculture as a whole in Tables 4 and 5.[9]

It would seem, therefore, that we are dealing with that part of the moshavim which contributed mainly to the production of livestock and

[9] It should be noted that the data on output in the sample do not include intermediate products apart from grains. However, production of grains was very small and has very little influence on the results. This has two implications on the comparison with agriculture as a whole, where intermediate products are concerned: in the sample farms it tends to inflate the proportion of livestock products and to deflate the rate of growth.

poultry products. Such concentration, though less marked, is typical for the population of established moshavim as a whole, as was learned from Table 2 and as can also be seen from a comparison of the sample with data on a larger sample taken from the same population in 1957 and appearing in Appendix C. The significance of the concentration in production will become clear below.

5. *Changes in Input Utilization in the Sample Farms*

The question that comes immediately to mind when one observes the remarkable growth in output in the sampled farms is: what were the sources of this growth and to what extent can one expect these sources to yield further growth in the future? It is to be noted that whatever is learned here can be applied to the newly-formed farms which will become established farms in a few years.

TABLE 6. *Output and Selected Inputs—Average per Sample Farm: 1954 and 1958*

	Unit	*1954*	*1958*	*1958/1954 (per cent)*
Physical area	Dunams	51.6	47.8	93
Irrigated area other than orchards	Dunams	21.9	23.1	105
Irrigated orchards	Dunams	1.7	3.5	205
Water	Thousands of m^3	14.2	19.4	137
Labor	Mandays	627	569	91
Stock of structures and equipment[a]	1954 IL	5,490	10,881	198
Stock of cattle[a b]	1954 IL	7,758	11,021	142
Outlay on raw materials	1954 IL	7,319	11,613	159
Output	1954 IL	15,525	23,557	152

[a] Stock at beginning of 1954 and end of 1958.
[b] Only farms with cattle.
SOURCE: Appendixes A and B.

A detailed description of the changes in input utilization is presented in Chapter 2 and summarized in Table 6. The main features are a small decline in the cultivated area, a slight increase in orchards—which are of little importance in the sampled farms—and a decline in the labor input. On the other hand, there was an increase of 37 per cent in the amount of water used, and a larger relative growth in the use of capital in various forms, mainly in cattle and poultry enterprises. The value of cattle and poultry structures doubled, and the value of the cattle inventory increased by 42 per cent. It is apparent that the growth of output of cattle and poultry enterprises has a more permanent aspect as most of the investment was directed to those branches.[10] Of the total investment, about 83 per cent was directly connected with poultry or dairy enterprises. Of the remaining 17 per cent of total investment, about half was indirectly connected with such enterprises. In conclusion, the main factor of production that was associated with the growth in output was capital.

In evaluating the significance of this finding, it has to be recalled that land and water are allocated by public authorities. The size of the allocation is fixed and transfer of rights is restricted. The growth in water utilization indicated in Table 6 reflects increased water allocation in two villages due to the development of regional projects. The prospects for a substantial increase in water or land quotas to the sector as a whole in the foreseeable future are small. Thus, the only possibility open to the farms for increasing production is the use of inputs on which there exist no physical limitations. In the sample this was done by increasing the amount of capital used, with concentration mainly in the development of the livestock branches.

The far-reaching implication suggested by the foregoing discussion is that the development of the cattle and poultry products was the main possibility for increasing production, in view of the limitations of land and water to which the farms are subjected. We shall see that the expansion of output in cattle and poultry in the past mainly reflected response to market prices which favored the cattle and poultry enterprises. But, the point to be emphasized is that this was a very fortunate situation from the point of view of the moshavim, for if the prices of cattle and poultry products had been unfavorable and those of primary commodities favorable, there would have been less expansion, since this could have been achieved only by increasing land and water input, which was impossible owing to the physical limitations.

The question is, then, whether this process of concentration in livestock and poultry will continue in the future, both in the sample farms and in the moshavim sector in general. There are two aspects to this problem. From a purely physical point of view, the production of poultry products

[10] By this is meant that the investment in structures will affect supply decisions for a long period, since the opportunity cost of structures is very low. That is, even if prices are below the level of long-run equilibrium, production is likely to continue until replacements are needed.

could be expanded considerably in the sample farms and *a fortiori* for the sector as a whole, where the size of this branch is much smaller than in the sample. A similar conclusion, but with some qualifications, applies to the cattle branch. It is the common practice in Israel for farms which raise cattle to grow their own roughage feeds. Thus, further expansion of cattle may eventually be slowed down by the limitation imposed by land and water available for forage. This depends, of course, on the proportion of roughage—which has decreased lately—in the total feed. The data indicate that a diversion of water and land into forage production could still take place in the sample. This applies more strongly to established moshavim in general, where the ratio of cattle to land is smaller than in the sample, as is evident from the comparison in Appendix C. Finally, the ratio of cattle to land is even smaller in the new moshavim, and those also could expand their herds to a large extent.

It should be noted that the diversion of resources from other uses into forage production needed for the growth of the cattle branch represents not only a change in the composition of output (substitution effect), but also in the total volume (expansion effect). This was the case in the sample under consideration, where a small decline in field crop production made possible a substantial increase in output of the cattle enterprise. The only limitation to the expansion of cattle and poultry production could then come from a decline of market prices. We shall comment further on this subject below.

6. *Net Income of the Sample Farms*

The first part of Table 7 summarizes the changes in value added in the sample over the years and shows that it has increased at a somewhat lower rate than total output. This reflects in part the concentration in poultry production where the percentage of value added is smaller than in other branches. The value added represents that part of output that can be attributed to the various factors of production and to fixed costs. Since there were changes in prices, and since the calculations were made in terms of constant prices, the results do not represent correctly the trend in net income.[11]

In order to obtain a more direct measure of net income, we used the results reported by Lowe and Remer for roughly the same group of

[11] The figures of value added were obtained by subtracting the raw materials, valued in 1954 prices, from the output valued in 1954 prices. Thus, if prices of inputs increase more than those of output, the results overestimate the net income.

farms.[12] From these data it appears that real income (in 1954 prices) increased only in the last two years of the period studied. The reason for the smaller rate of growth of net real income is the worsening of the terms of trade of agricultural production as a whole. From Table 27 it can be seen that the ratios of prices of various livestock products to those of concentrated feeds have declined over the years.

TABLE 7. *Value Added and Net Income—Average per Farm: 1954–58*

	1954	*1955*	*1956*	*1957*	*1958*
Gross value added at 1954 prices[a]					
IL	8,206	9,161	9,983	10,493	11,944
Index: 1954 = 100	100	112	122	128	146
Net income[b]					
At current prices—IL	5,600	5,700	6,400	7,300	8,500
At 1954 prices[c]—IL	5,600	5,400	5,700	6,100	6,900
Index: 1954 = 100	100	96	102	109	123

[a] See Chapter 3 for details of computation.

[b] Source for data on net income: Y. Lowe and J. Remer, *The Profitability of Established Moshavim 1959 as Compared to Previous Years,* Agricultural Publication Division, No. 31, Tel Aviv, October 1960, p. 9 (Hebrew). The same authors have reported somewhat different figures in their *Report on the Economic Situation of Established Family Farms during the Years 1952/53 to 1957/58,* Hebrew University, Faculty of Agriculture, December 1958, p. 13 (mimeographed). The source of the discrepancy is not explained. We chose the later information under the assumption that it reflects revised data. See also footnote 2 in Chapter 3.

[c] Obtained by deflating the income in current prices by the cost-of-living index, based on 1954.

The main variations in income in the sample exist among farms rather than over time. We shall, therefore, turn now to examine the sources for these variations. The chart in Chapter 3 indicates that there is a wide spread in net income between the farms in the sample. Similarly, there is a wide spread in output and in the use of inputs. The relation between inputs and output is discussed below where it is indicated that variations in input account for a large portion of the variations in production. It is, however, interesting to note that there are significant intervillage variations in all of these variables. The data appear in Appendix A classified

[12] Y. Lowe and J. Remer, *loc. cit.* The definition used there for net income is value of output minus expenditures on raw materials and hired labor, interest paid on borrowed capital, and depreciation according to replacement cost. The income figures are based on a sample of 74 farms for the years 1954 and 1955 and of 70 farms for the years 1956 to 1958. See also footnote 1 to this chapter.

by village. In Table 21 the villages are ranked according to their use of the various factors of production. It is found that in general the villages which have the largest land holdings and use the largest quantities of water are also the biggest users of the other inputs. They are also the largest producers and highest income earners. Land and water are allocated by public authorities and it is therefore clear that differences in land holdings reflect differences in the original allocation. Whether these differences later led to differences in expansion, it is difficult to say.

In the past the share of eggs, poultry meat, and beef cattle in total output was smaller that at present.[13] It is possible that, at the prices then existing, production was dependent to a greater extent on land and water which made it possible for the larger farms to accumulate the greater amount of capital necessary for subsequent expansion. Another possibility is that the villages with the larger farms are simply better organized and their farms more efficient, which would account for their achievements. The question is complicated, and we shall not attempt to verify which explanation is the pertinent one. We shall only point out that the initial physical allocation of the basic factors of production by the public authorities does not necessarily create equal income, either among individuals or among villages. This is important in view of the increasing interest in physical reallocation of resources at the farm level for the purpose of increasing income.

The wide variation in income reflects variations in output, and the exploration of the factors which lead to income variations might well start with an explanation of the variations in output and then be followed by an examination of possible adjustment which could have led to greater increases in income.

7. *Productivity of Resources*

Variations in output reflect variations in the use of inputs, and it is therefore desirable to quantify the relationships between changes in inputs and the corresponding changes resulting in output. However, in such an

[13] The composition of agricultural output in Jewish farming in 1936/37 was (per cent):

Field crops	9	Milk	14
Vegetables and potatoes	3	Eggs	4
Citrus	60	Meat	2
Other fruits	4	Other	4

These calculations are based on data on agricultural production in Jewish farming in 1936/37 prices reported in CBS, *Abstract No. 9,* p. 151.

It should be noted that at that time the major share of food was supplied from Arab agriculture and from the neighboring countries.

analysis, where the data cover a number of years, it has to be borne in mind that output is determined not only by the use of inputs but also by the level of technology. One way to measure the level of technology is to find the output obtained from a given bundle of resources. It is clear that as technology progresses the output obtained from such a bundle of resources will increase. The corresponding effect on net income is clear. When all other factors are held constant the progress in technology will increase the revenue without increasing cost.

The development of technology has, of course, some further implications for the level of farm income. As productivity increases (given the same prices), it becomes more profitable to employ additional resources. But prices will not remain constant. All producers increase their output; and, unless the demand curve is horizontal (as is the case with some of the products which are traded on the international market), prices will fall. The demand curve itself is likely to change with time, as income—and perhaps other determinants—change. Thus the actual change in prices reflects, among other things, the relative change in supply due to technology and the relative change in demand due to income. At the same time, costs may also increase as the demand for additional factors leads to withdrawal of resources from other uses. Thus the effect of technological improvements on farm income indicates that there are various aspects to the problem. Some of these aspects are dealt with in this work.

Variations among farms at a given point of time reflect, in part, differences in managerial ability; these have two aspects, technical and behavioral. The first accounts for the fact that with the same technology available on equal terms to all farmers, some farms will have consistently better performance than others.[14] More specifically, this aspect may indicate that a more efficient farm will get a larger output than a less efficient one from the same bundle of resources. The second aspect accounts for the fact that with the same set of prices in each year over the years, farmers respond differently and thus attain different incomes.

From all this, it is clear that an analysis which attempts to explain variations in income and output over time and among farms in terms of input variations alone is too restricted and may yield wrong results. We have therefore formulated the problem so that variations in output are explained in terms not only of variations of inputs but also of changes in technology over time and differences in managerial ability.

[14] For an illustration of wide interfarm differences in another case see Y. Mundlak, "Knowledge and Cost in Agricultural Production", *Economic Quarterly*, No. 23, May 1959 (Hebrew).

We shall start with the first factor—the rate of inputs. An attempt to estimate the effects of the various inputs on production was made by fitting a Cobb-Douglas production function.[15] The estimate was made under the assumption that managerial ability varies from farm to farm and that there is technological improvement in the course of time applying to all farmers at the same rate. More specifically, it is assumed that this technological improvement is neutral, that is, does not affect the production elasticities. The coefficients of the Cobb-Douglas function are elasticities, measuring the percentage change in output which is associated with

TABLE 8. *Estimates of Production Elasticities: 1954–58*

Input	*Elasticity*
Capital	0.687
Value of cattle[b]	*0.005*[a]
Value of livestock structures[b]	*0.100*
Raw materials	*0.582*
Labor[c]	0.115
Land (standard dunams)[d]	—0.007[a]
Total for all inputs	**0.795**
Management (residual)	0.205
Total	**1.000**

[a] Not significant at the 20 per cent level. Unmarked figures are significant at the 5 per cent level.
[b] Calculated from beginning-of-year figures.
[c] Mostly own labor.
[d] Dry land, which was an important component of total area in two villages was converted into irrigated area equivalent by assuming that 1 dunam irrigated area = 4 dunams dry area.

a 1 per cent change in inputs. When the firms operate under conditions of pure competition and adjust their inputs in order to maximize their profits, the production elasticities also represent the proportion of the total output which is paid to the particular factor. The estimated elasticities for the period 1954–58 are presented in Table 8.

[15] The function fitted is of the form $y = \alpha_0 \alpha_t \alpha_i x_1^{\beta_1} \cdots x_k^{\beta_k}$, where y is output value, x_j the quantity of the jth input, α_t the level of productivity of the tth year, α_i the mangerial ability of the ith farm, β_j the production elasticity with respect to the jth input, and α_0 a constant.

See Chapter 4 for further details.

The results may be interpreted as follows: on the average for the farms in the sample, an increase of 1 per cent in the use of raw materials was associated with an increase of 0.58 per cent in output. A similar explanation can be provided for the remaining coefficients. As pointed out above, when the individual farm has no influence over prices and it attempts to maximize its net income, the elasticity of a particular input indicates the relative share of the expenditure on that input out of total output. The terms expenditure and output do not necessarily indicate actual spending and production but rather what the firm should have spent and produced at the existing prices had it been at its optimum point.

An important feature of the results presented in Table 8 is that nearly 69 per cent of the total output is attributed to capital input, a large proportion of it in the form of raw materials—mainly feeds for poultry and cattle. About 11 per cent of the output is attributed to labor, and the remaining 20 per cent to management.

Let us now see whether the farmers could have increased their incomes by changing the scale and proportions of these factors. This may be done by comparing the impact of a change of one unit of a particular factor on the value of output and on cost; in other words, by comparing the value of the marginal product of each factor (at its average point) with its respective market price. As long as equality of the two magnitudes does not exist for all factors simultaneously, income can be increased by changing the pattern of utilization of resources. The results of this comparison at 1954 prices are presented in Table 9.

The main substantial divergence is in the case of labor—a divergence which has been constantly decreasing over the period, and thus indicates that there is a gradual adjustment towards the point of equilibrium. This may reflect the increase in poultry production. Another indication of this trend in production may be reflected in the slight decrease in returns on raw materials. The discrepancy between the value of the marginal product of cattle and the rate of interest is not significant at the 20 per cent level of significance. On the whole, there seems to be quite a close agreement between the value of the marginal products and the corresponding market prices. This may be taken as an indication of the fact that farmers make adjustments to market conditions and, in particular, adjust inputs to factor prices. This point was also investigated directly and will be discussed below.

It will be noted that land is not included in the foregoing comparison. The pertinent measure of the price of using land is the rent obtained for leasing. The information available on this point is limited but indicates that rents were relatively low—somewhere around IL 10–20 per irrigated

TABLE 9. *Value of Marginal Product (VMP) and Factor Prices: 1954–58*
(1954 IL per factor unit[a])

	Labor		*Raw materials*		*Cattle*		*Livestock structures*	
	VMP	*Price*	*VMP*	*Price*	*VMP*	*Price*	*VMP*	*Price*
1954	3.02	4.75	1.16	1.06	0.054	0.10	0.29	0.27
1955	3.58	4.95	1.16	1.06	0.058	0.10	0.30	0.27
1956	4.36	5.75	1.16	1.06	0.053	0.10	0.30	0.27
1957	4.51	6.00	1.11	1.06	0.050	0.10	0.27	0.27
1958	5.12	5.97	1.05	1.06	0.052	0.10	0.28	0.27

[a] Factor units are as follows: for labor—mandays, for other items—IL purchased.

NOTE: An annual rate of interest of 10 per cent was used throughout. It is assumed that a pound spent on raw materials yields a return after six to eight months, and therefore the annual rate that appears in the table is 6 per cent. The rate of depreciation on structures was taken as 8 per cent, and it was assumed that for every pound used in building capacity, which is the variable used in the analysis, there is an additional IL 0.5 invested in equipment. The charge on all structures and equipment is therefore 1.5 *times* the 18 per cent charges on structures alone (10 per cent interest, 8 per cent depreciation). The result is 27 per cent, as appears in the table. The wage rates are obtained by deflating wages of hired labor by the consumers' price index.

dunam. Thus, if rent is taken as a measure of the marginal productivity of irrigated land, our finding of nearly zero elasticity of output with respect to land is substantiated.

8. *Productivity Variations Over Time and Among Farms*

Agriculture in Israel displays a continuous increase in productivity as it does in many other countries. By that is meant that from the same bundle of resources higher production is obtained from one year to the next. The consequence of an increase in productivity is an upward shift of the supply function of agricultural products. If demand conditions are given, production then increases and prices decrease. As indicated above, the extent of this process—for given factor prices—depends on the rate of change of productivity and on the particular demand conditions and their change over time. The future increase in demand for agricultural products in Israel is evaluated in a study now in progress.[16] In the present study, we have only attempted to arrive at a measure of the increase

[16] For a preliminary description, see FP, "Long-Term Projections of Supply and Demand for Agricultural Products in Israel", *Fifth Report*, pp. 189–96.

in productivity over time for the farms in the sample. It is clear from the foregoing discussion that this measure does not represent the overall increase in productivity in Israel agriculture, and not even in all the moshavim producing livestock products.

The measure of the change in productivity is presented in the form of an index whose geometric average is 100. The index measures the level of production in a given year, after allowing for the level of the inputs used in that year.

TABLE 10. *Relative Change in Productivity Over Time: 1954–58*

Base	*1954*	*1955*	*1956*	*1957*	*1958*
Geometric average = 100	94.7	98.6	102.3	100.8	103.8
1954=100	100	104	108	106	110

The results appear in the first line of Table 10; they are then converted to the basis of 1954=100. The figures show an average annual increase in productivity of approximately 2.3 per cent. It should be recalled that in 1957 there was a severe shortage of feed, which had a negative effect on poultry production. It therefore seems reasonable to assume that the 4.0 per cent annual increase obtained for the years 1954–56 is more typical of the productivity process. It should be emphasized that if prices do not fall with expanded output the actual increase in production will be higher, since the increase in productivity leads to larger employment of the factors by the individual farmers. This is demonstrated in our case where the increase in production over the period studied was 52 per cent, whereas the increase in productivity was 9.6 per cent. Thus the shift in supply which is brought about by an increase in productivity reflects two aspects: employment of more inputs and greater productivity of the enlarged bundle of resources.

A similar measure of productivity is used for interfarm comparison, and indicates that the most efficient farm produced from a fixed bundle of resources 58 per cent more than the least efficient. Furthermore, it was found that management was positively associated with most inputs and, in particular, with labor and use of raw materials.

The point to be emphasized here is that there exist wide variations in productivity among farms. These variations are clearly reflected in net income. At the same prices, the more efficient farms will employ more inputs and also obtain larger output from the enlarged bundle of resources. A range of income was constructed so that 94 per cent of the farms in the sample were included in it, and it was found that the upper limit of the range is about seven times larger than the lower limit.[17] Our analysis suggested that about one-half of this range can be accounted for by management productivity, which was reflected in two ways: directly and through the use of more inputs. The rest is postulated to reflect random factors, price variations, and variations in behavior.

In this respect, it is suggested that in terms of functional remuneration to management as a factor of production, management on the average accounted for about 20 per cent of total output. This amount is not merely net income, for it covers fixed costs and other expenses not reflected in the inputs used in the analysis to account for output variations.

9. *Productivity of Land and Water and Its Implications*

A notable finding of the study is the zero output elasticity with respect to land. Land in this case is measured in terms of irrigated area equivalent and constitutes a composite input of land and water.[18]

A possible statistical explanation for the low value of output elasticity of land is that the results presented in Table 8 were obtained from an analysis of the changes in output and inputs which take place in the individual farms in the course of time. Landholdings per farm changed relatively little over the years, and therefore their full impact on production may not have been detected. The main variations in landholdings are those between one farm and another at a given moment rather than those in a given farm over time. Thus, in order to estimate the effect of land on output, it would be better to analyze the variations in output and inputs which existed in different farms. Such an approach is subject to limitations of a different kind. Productivity of management is an important source of variations in output between farms. As it is not directly measurable, it cannot be accounted for in an analysis based on interfarm differences; as a result, the estimates obtained from such an analysis are likely to be positively biased. Nevertheless, such a regression was computed in order to get some notion of the possible magnitude of the elasticity of land, and the result obtained is a value of 0.032. Since this value is likely to show an upward bias, the true value is probably somewhat lower, but even if this is not so, the value obtained is not high, for it means that irrigated land accounts for only 3 per cent of total output. Other modifications of the analysis were tried, but in no case was a higher elasticity obtained.

[17] This was done by ranking the farms by their actual net income in 1958 and by eliminating the two farms with the highest and the two farms with the lowest income.

[18] See footnote d to Table 8.

The validity of this finding is further corroborated in various ways in Chapter 4, and the result of near-zero elasticity for the land-water input is substantiated. An additional check is provided by comparison with the rent paid for the use of land. It was indicated above that the rent for irrigated land was in the range of IL 10–20 per dunam, and this figure is in full agreement with our finding. In fact, it is interesting to note that the positively biased estimate of the elasticity of land mentioned above (0.032) leads to a value of marginal product of land equal to IL 25 per dunam.

This means that marginal increases in the landholdings of the farms would not have resulted in any significant change in the overall value of their outputs. This is a contradiction of our intuitive feeling that land in these smallholdings constitutes a scarce resource and should therefore be earning a positive share of the output value.

In explaining this finding, it should be borne in mind that the marginal productivity of land is the change in production which is brought about by a marginal change in the amount of land, while the quantity of the other factors remains constant. This means that in order to facilitate cultivation of an additional unit of land, resources must be drawn from other branches, which in our case are mainly poultry or livestock. The value of the marginal productivity of land is thus the difference between the value of production on the additional unit of land and the value of the decrease in production in the branches which provide the resources necessary to cultivate the additional land.

Before exploring the implications of this finding, it should be emphasized that the value of the marginal productivity of an operating firm is an economic rather than a physical measure. This is very often misunderstood, and the point at which the firm operates is confused with the range of possible points of a conceptual experiment where the ratio between the particular input and other inputs is allowed to vary. The choice of the particular point out of all points depends on the prices which exist at the time. As prices vary, the optimum point will vary accordingly and with it will vary the value marginal productivity of the various factors. To be more specific, we indicate that the value marginal productivity of land is defined as the difference between the yield (average productivity), measured in value terms, and the payments to the various factors which are employed in production.[19] To simplify the ex-

[19] Strictly speaking, this only holds at the point of equilibrium; but it serves as a good approximation to the sampled farms which, on the average, are not far from this point. See Chapter 4 for further discussion on the subject.

position, we assume that there are only two production processes: one which requires land, say field crops, and one which does not, say livestock. The value marginal productivity of land, then, depends on: (a) the price ratio of field crops to that of livestock, (b) the ratio of the price of these products to that of the inputs other than land, and (c) the level of technology as reflected in the yield per dunam of land.[20] The higher each of the ratios, the higher will be the marginal productivity of land.

Our hypothesis is, accordingly, that the low value of the marginal productivity of land is related to the relative prices which existed during the period under review. Judging by the large expansion of the cattle and poultry branches, one would say that these branches were relatively more profitable. Possible alternatives to cattle and poultry were forage or other crops. Increasing the production of forage would reduce the purchase of feeds for which forage is a substitute. Apparently, the purchased feeds were relatively inexpensive. In fact, the proportion of the home-grown feeds in the total feed consumption of the dairy branch decreased from 55 per cent in 1954 to 46 per cent in 1958. Vegetables—which were still grown in 1953/54—almost disappeared afterwards. This reflects a decrease in prices, which were also subject to wide fluctuations. Such fluctuations lead to price uncertainty and this usually tends to depress production.

To sum up: the low marginal productivity of land was a reflection of the fact that, in the light of the existing price structure, a shift of resources from the cattle and poultry branches (which do not require much land) into the production of crops or forage (which do) would not have resulted in any substantial gain in the value of production. Conversely, a different price structure—favoring the primary commodities relative to livestock products—would have led to an allocation of resources characterized by a more intensive utilization of land and, hence, by a higher marginal productivity. We shall return to the implications of this below.

10. *Farm Size, Income, and Productivity of Resources, as Related to Prices*

As a result of the foregoing discussion, it may be asked whether the price structure existing at the time of the study was a desirable one from the point of view of the economy as a whole. It is difficult to give a conclusive answer on the basis of the study alone. It should, however, be

[20] It also depends on the productivity of resources in the livestock enterprises. We shall, however, conduct the discussion under the assumption that this productivity remains constant.

noted that the existing prices did not reflect the relative scarcity and productivity of resources. Prices were administered in the various markets, with different exchange rates for factors used in agricultural production and for farm products in which there was foreign trade. Moreover, prices of a whole range of agricultural products were subject to either direct control without produciton quotas (dairy products, eggs, and industrial crops) or direct administration implemented through production quotas (vegetables).

If prices were determined in the free market, they would reflect the level of prices in the international market. This is particularly the case when agriculture is directly related to such a market by the export of some products and the import of others. That is, there exists some price structure at which it would be desirable to switch resources from products marketed domestically and not traded internationally (most vegetables, milk, some fruits, etc.) to products which are traded on the international market, in order to avoid a further decline of prices and profitability of the first group of products. In this event, the prices at which such a shift takes place are determined by the prices existing in that market, since these prices (in terms of foreign exchange) are unaffected by possible variations of production in Israel. In turn, these international prices are determined largely by the relative scarcity of land, as well as by the agricultural and trade policy, in other countries.

This level of international prices is transmitted to the Israel market through the effective exchange rate which exists for products imported or exported. Since the publication of the preliminary results of this study,[21] the Israel pound has been devalued. This may increase the domestic price of the commodities traded on the international market and, in particular, change the price ratio in favor of field crops as against livestock and in favor of agricultural output as a whole as against prices of inputs.[22] Such a change may shift resources into products traded on the international market and thus expand exports, decrease imports, and increase the contribution of the agricultural sector toward closing the gap in the balance of payments. At the same time, it is likely to raise the level of the free-market price of the products marketed domestically, increase the ratio of capital and labor to land (in the branches which require land), and thus raise the value of marginal productivity of

[21] FP, *Fifth Report,* Jerusalem, August 1961, pp. 179–89.

[22] The actual change need not necessarily be at the same rate as the official devaluation; the effective rate in the past was different from the official rate. The change will, therefore, depend on the relative level of the effective rate in the future as compared with that which existed in the past.

land and water. The main thesis underlying the discussion here is that Israel agriculture is related to the international market, both in import and export of products and in import of some raw materials; and that in free-market pricing, the direction of production and its profitability, and consequently the use of resources and their productivity, should be determined by the prices of that market.

Some readers may by now feel that too much attention has been devoted to examining the marginal productivity of land and water. After all, such a measure plays no explicit role in deciding the allocation of land and water to the settlers. Theoretically, these allocations are determined so as to provide the settler with employment for his labor resulting in income comparable to that of urban workers. The planning requires, of course, a whole set of assumptions with respect to variables such as prices, inputs and yields. But as a rule, the allocation is not sensitive to changes in the variables assumed in planning and, as a consequence, the income actually realized is different from the one anticipated in the plan.

To relate this situation to our discussion, we should recall that: (a) on the average, the farms in the sample are at least as large, in terms of land and water, as the farms in the moshavim in general, and (b) they have had to rely heavily on cattle and poultry production for their livelihood. The question is then: what would happen if prices of cattle and poultry products dropped to a level that would make it desirable to decrease their production? This, of course, might happen if all moshavim had to rely on the same pattern of production for gaining their livelihood.

One possible consequence of such a change in price is that resources will be shifted to the production of field crops. Such a shift would decrease the farm income, for—presumably—there will be no change in field crop prices. The question than arises whether employment opportunities for the resources that would be released from cattle and poultry production exist on the farm. This brings us to the problem of farm size which, as is clear by now, is not independent of the other subjects discussed above. The fact that farm income will decrease is another way of saying that the value productivity of the resources that will be shifted into field crops will be lower than in present utilization. Thus, if they are to obtain the same returns as at present, they will more than exhaust the product, without even considering any returns to land—that is, if wages are predeermined, there will be overpayment to labor (and capital, for that matter), and nothing will be left for land. Yet it is not certain that all labor could be employed on the farm. In this connection, we have to emphasize that although technology has changed much over the years farm size, in terms of land and water, has changed little, and this spite of the fact that one important aspect of the change in technology is that less labor is required to perform the same operations.

There is always the possibility of using the old technology, but that would imply lower productivity and lower income. In order to achieve higher productivity, the new technology will therefore have to be employed. This, however, requires a solution to two problems. First, can more efficient methods of production be adopted in the moshavim and, second, how will the excess labor resulting from their use be employed? As to the first problem, it is well recognized that labor-saving methods of cultivation require equipment which farms of the size of the moshav cannot afford. This is a problem of indivisibility which limits the adoption of such methods. Attempts to overcome the problem have been made in the form of joint ownership of the equipment by the cooperative or, more lately, in the form of tractor stations which serve a whole region. The performance of such organizations was not analyzed in our study, and it certainly deserves careful study in the future. Yet, it is safe to say that at present there is still much to be done in this sphere.[23]

Even if this problem is overcome, a solution is needed for the second problem of finding employment for excess labor. This can be done only by increasing the allotment of land and water.[24] At first sight, this solution may seem to contradict our conclusion with respect to the low value marginal productivity of land and water—but a moment's reflection will indicate that this is not so. Our results indicate the productivity of land and water when there is concentration in cattle and poultry production—which set the levels of productivity of the other resources. However, we are primarily concerned here with organization of agriculture in circumstances which require a smaller proportion of these branches in total output. Further, we claim that such organization requires the adoption of labor-saving methods of production, for otherwise it would be impossible to remunerate labor with the accepted wage rate, which is constantly increasing. The employment of such methods of production will have the corollarly effect of leading to a positive marginal productivity of land and water.

To put it differently, the scale of operation of the sampled farms is

[23] See, for instance, the discussion in A. Sternberg and N. Dimor, *Economic Analysis of Services in Cooperative Smallholder Settlements,* Agricultural Publication Division, No. 39, Tel Aviv, October 1961, pp. 26–28 (Hebrew).

[24] This in itself is not a new proposal. See for instance, A.G. Black, "Reflections Upon Israel's Recent Agricultural Development and Its Relationship to General Development", *Challenge of Development,* The Eliezer Kaplan School, The Hebrew University, Jerusalem, 1958.

relatively small and thus limits the choice of production activities to those which are highly labor-consuming. With a high wage level, there may be little surplus for remuneration to other factors, mainly land and water. So there are two ways out: either lower wages or increase in the size of farms. It is along these lines that one can classify the big exporters of agricultural products, which are either countries with relatively large holdings per family, such as the United States, or with low wages, such as the underdeveloped countries, or countries with both factors combined.

This analysis does not imply that farm size should increase to that in some of the exporting countries. The size depends on the product produced, existing technology, the level of wages, and price of capital inputs, as well as prices of other inputs and outputs. It is, however, clear that farms of the size intended to produce income comparable to that earned in the urban part of the economy in the beginning of Jewish settlement in Israel, or even in the 1920's to 1930's, cannot be expected to fulfil a similar function in the 1960's.

The alternative is to try to secure income by means of various control mechanisms which would lead to hidden unemployment of farm resources and would thus fail to utilize those resources efficiently. This problem was not so serious in the period investigated, since it was still possible to shift resources into cattle and poultry production, which provided most of the income. But this could be done only because the new settlements had neither the experience nor the capital to embark on a similar venture and were also restricted administratively from doing so. Consequently, it was the older and established sector of agriculture which could benefit most from the relaxation of controls on consumption which took place around 1954 and which left an unsaturated market for cattle and poultry products. The growth, however, progressed at such a rate that surpluses began to form a few years later.

It should be pointed out that expansion in the size of moshav farms will lead to a decline in the number of families in moshavim. For a long time it was assumed that agriculture should be the main instrument in more equable distribution of the population. At present, however, there would appear to be other, and more efficient, means of achieving the same goal. Hence, there should be no objection to the expansion in farm size on that ground.

It seems that the main problem is how to increase the size of farms in moshavim. The approach followed by public institutions in allocating resources has been to rely on planning, one of whose aims is to create equal distribution of income. We have, however, already seen that this has not been achieved even in a sample of moshavim which is more homogeneous than the whole population.[25] Furthermore, the existence of small farms which cannot reach the same level of income earned by urban workers does not contribute to a more equal distribution of income in the economy as a whole. Thus, one can make the contrary statement by saying that if the farmers find it to their advantage to hire out their resources to agriculture or outside sectors their welfare will be improved. This statement could not be made in the case of economic organizations where there are restrictions on mobility and imperfections in the agricultural labor market. There is a need here for policies to protect farmers against exploitation in the form of their farms being acquired and themselves employed as labor. In view of the ease of mobility to other sectors, and in view of the geographical distribution of education, it would seem that such a problem does not exist in Israel.

What is therefore to be gained from trying to allocate resources in accordance with planning all the way down to the farm level? Agriculture may be considered a competitive industry, which means that the individual farmer has no control over prices but can decide the use and allocation of his resources. The most efficient use of resources in a competitive industry (and thus in agriculture) should be achieved at the point of market equilibrium. Therefore, the most that allocation of resources in accordance with planning at the farm level can achieve is also attainable through the free play of market forces. At the same time, there is a great deal to be lost. Rigid allocation—that is, allocation which restricts transfer of rights—leads to inefficient use of resources. This is, of course, clear from the very fact that restrictions on the flow of resources have to be imposed. The word resources in a controlled economy has a broad meaning, and includes, among other things, production quotas. Statements are sometimes made to the effect that a certain size for a particular farm branch is the most efficient or optimum one. Such statements are based on a complete misunderstanding of the concept of economic efficiency. In particular, they overlook the fact that there exist interfarm differences in managerial ability, in behavior, and in the opportunity costs of the available resources, as well as in prices. Consequently, it is inconceivable that the optimum size and composition of each individual farm can be catalogued.[26] This is particularly true when

[25] See also Chapter 3.

[26] This is in fact acknowledged, in different phrasing, by the advocates of planning implementation through administrative orders. See Raanan Weitz, *Toward Specialized Farms,* Agricultural Publication Division, Tel Aviv, January 1961, pp. 6–7 (Hebrew).

the exogenous factors determining the level of supply and demand in the industry change continuously over time. For all that, one cannot escape the conclusion that the best procedure to follow in allowing expansion of farm size, as well as composition of output, is to allow free flow of resources and, in particular, unrestricted purchase of farms.

Our main purpose is to raise this point for discussion and we will therefore not elaborate on it here, except to note that the foregoing statement would have to be modified in regard to new moshavim, or to a discussion on the upper limit of farm size.

11. *Do Farmers Respond to Price?*

In the foregoing discussion we based some far-reaching conclusions on the hypothesis that farmers respond to prices. The fact that the value marginal productivity of resources was relatively close to market prices serves as empirical evidence in favor of this hypothesis, but in view of its importance, it is desirable to test the hypothesis more directly. The verification of its validity is desirable not only to explain the developments in the past but, even more important, for future reference. When policy measures are reflected in the price structure, their possible repercussions on production should be taken into account.

The direct approach to the problem was to estimate the response to prices. This was done for poultry products, which account for over 50 per cent of total production. In such an analysis we must differentiate between short-run response (when some fixed factors limit the response) and long-run response (which takes into account changes in the level of these factors). In the short run, the production of poultry products is determined mainly by (a) the price ratio of product to feeds, and (b) the initial capacity of poultry runs. The respective short-run supply elasticities of these two variables are 0.6 and 0.4. This means that, on the average, a 1 per cent increase in the price ratio of product to feeds, with the capacity of runs being fixed, was associated with a 0.6 per cent increase in the quantity produced within the year.

It was also found that the short-run supply was subject to pronounced changes from one year to the next. This is seen from the indexes in Table 11 which represent the relative level of the short-run supply function. In other words, they indicate the amount supplied in a given year at a given level of prices and of structures in that year. The index is constructed so that the geometric average of all the values is equal to one.

The value of 0.789 indicates that for given prices and capacity of poultry runs, the amount of eggs supplied in 1955 was nearly 79 per cent of the average amount that would have been produced during the period had prices and capacity remained constant. To some extent, the upward trend of the level of the short-run supply function reflects the upward trend in productivity. The low values for 1957 reflect the recession in this branch mentioned earlier. It would seem, however, that the jump in the values of the index for eggs in the last two years is too great to be accounted for by the increase in productivity alone. The explanation offered for this jump is that in October, 1957, an agreement was signed between the Government and the marketing agencies guaranteeing the price of eggs and thus eliminating price uncertainty. Consequently, the egg supply jumped from a level of 0.813 in 1957 to 1.244 in 1958 and 1.420 in 1959.

TABLE 11. *Index of Relative Level of Short-Run Supply Function for Poultry Products: 1955–59*

Product	*1955*	*1956*	*1957*	*1958*	*1959*
Eggs	0.789	0.883	0.813	1.244	1.420
Poultry meat	0.949	1.178	0.795	1.118	1.007

A similar jump is not detected in the supply of poultry meat. The reason is that poultry meat is not covered by the agreement. The index for poultry meat displays wide fluctuations, which may be explained by the fact that laying hens account for an important proportion of total sales of poultry meat. The number of laying hens sold within a given year depends to a large extent on the age distribution of the flock. This variable, which is not taken into account in the analysis, is subject to wide variations from one year to the next.

The implication is that intervention in the market affects production not only through the established price level but also, and to a very large extent, through its effect on price uncertainty.

The purpose of the long-run analysis was to trace the impact of changes in the level of production on investments made in durable factors of production. It is postulated that when production increases with the available capacity, a pressure is created for expanding the capacity of the durables, and a gap is thus formed between the available capacity and the desired one. The closure of the gap was found to occur at the rate of 50 per cent of the gap per year. This means that if output goes up as a result of an upward change in price or an increase in productivity, or as a response to the elimination of uncertainty, the capacity of the durables, which were considered as fixed in the short-run analysis, will increase, and at a relatively rapid rate. Since the capacity was taken as fixed in the short-run supply function, an upward shift in the capacity will cause the short-run supply function to shift. Consequently, at any given price, output will increase. This in turn will affect the level of durables. Thus, there is a dynamic process of adjustment of output and capacity to any change in prices or in other factors which affect the level of production. The process congerves fast, in the case of poultry. After convergence, when farmers are at their new equilibrium point, we find that the long-run effect of any change in prices, as in the other variables affecting the supply, is 1.67 times as large as that of the short-run effect. Thus, if the short-run elasticity of price is 0.6, the long-run elasticity is 1.0. Similarly, if the effect of the agreement on the marketing of eggs was to raise the supply in the short run by 50 per cent, its long-run effect was an 83 per cent increase.

The main significance of the conclusions with respect to farmers' behavior is the simple assertion that, both in the short and long run, there is a supply response to prices. As elementary as this assertion is, it seems that some of its implications have not been given due attention in the past, and this negligence may have serious repercussions in the future.

The point to be emphasized is that a divergence between the actual market price and the equilibrium price will lead to either excess supply or excess demand. The main reason for emphasizing this rather obvious point is that such divergence in prices frequently reflects price-fixing by the government.

Setting a price higher than its equilibrium level, and making it effective, can only be achieved if accompanied by some sort of production control to avoid excess supply. The best way to avoid such an excess supply is to make other alternatives more attractive so that there will be a voluntary flow of resources to such activities. This problem has been discussed above where it is indicated that in the particular situation dealt with in this study, it will require some basic changes in the organization of Israel agriculture.

Of course, there always exists what may seem to be an alternative approach—practised extensively in the past—which calls for destruction of excess supply, such as in vegetables; or dumping at a loss on the international market, as in the case of eggs. Such an approach has nothing to recommend it. It leads to misallocation of resources at heavy direct expense to the public. As was repeatedly emphasized above, the problem has a time dimension and for the next few years, in view of the development of the new settlements, is likely to become more serious unless more profitable alternatives are found.

The results of the supply analysis also have implications for what may be called a positive policy toward agriculture, which aims at assisting the flow of resources to where they could serve consumers' demand. It is well-known that prices of agricultural products are subject to fluctuation as a result of random variation in supply. Thus, if farmers react to actual prices, they plan their production according to values which are different from the long-run equilibrium price, that is, the price at which the market will be cleared, and no reorganization of resources could benefit the farmers. As a consequence, there would be two sources for deviations between actual production and the desirable level of production: first, random variations due to weather and other factors, and, second, planning not in accord with the appropriate price level. The second source could be eliminated by fixing the price at its long-run equilibrium level. Such a price should be declared in advance and then maintained. As a result, production would be planned by farmers according to the equilibrium price. Any deviations between actual and planned production would, of course, lead to market forces which would tend to change actual price from its declared level. It should, however, be indicated that this source of randomness is inherent in the problem and could not be avoided unless one gained complete control of all factors which determine demand and supply. The maintenance of the declared prices could be achieved either by trading on the international market or, in times of overproduction, by allowing the market to clear itself and pay farmers the difference between the market and the effective price. Such devices have long been under discussion, although they have not received appropriate consideration by policy makers.[27] It is not our purpose here to go into the actual details of such a program. We only want to emphasize that such an approach will avoid response to prices which are not equilibrium prices and will thus decrease fluctuations around the equilibrium point. In view of the fact that investments in durable assets seem to follow variations in output which may well be of short duration, such a program will also avoid overinvestment and the serious financial problems which follow when such investment remains idle.

[27] A more elaborate discussion of desirable policies will take us beyond the scope of this work. Yet, it should be indicated that similar problems exist elsewhere and that a conceptual framework was suggested for their solution. In view of this, we ask to be forgiven if we mention only two sources. See, for instance, D. Gale Johnson, *Forward Prices for Agriculture,* University of Chicago Press, 1947; and William H. Nicholls and D. Gale Johnson, "A Price Policy for Agriculture, Consistent with Economic Progress, That Will Promote Adequate and More Stable Income from Farming", *Journal of Farm Economics,* Vol. 27, No. 4, November 1945, pp. 347–72.

Furthermore, such a policy will remove price uncertainty and, as a consequence, foster more efficient use of resources. As we saw in the case of poultry, the elimination of price uncertainty with respect to the price of eggs had a remarkable effect on the supply of eggs. This effect was not only one of the short run but also had long-run repercussions by causing further expansion in poultry housing capacity.

12. *Concluding Remarks*

The above discussion of our sample of moshavim may be summarized as follows:

(1) The low value of marginal productivity of land and water was only one facet of a process of concentration of production of livestock products, with larger weight for poultry.

(2) This process is postulated as reflecting a price structure favorable to livestock products, compared to field crops, and an unfavorable price ratio of field crops, compared to prices of the various inputs, part of which are determined in the livestock branch—the remainder being determined in the other sectors of the economy.

(3) The concentration in livestock production made it possible to employ the farmers' own resources on the farm and to earn, on the average, what may be considered a level of income comparable to that of the urban sector.

(4) The process of concentration in livestock production has already led to serious surpluses in poultry and to the policy of closing dairy farms in urban regions in order to avoid such surpluses in dairy products. All this happened before most of the moshavim had reached the level of production experienced by the ones in the sample. Hence, it is obvious that the pattern of earning income comparable to that of the urban sector, followed by the farms in the sample, cannot be recommended to the population as a whole by policy makers unless outlets are provided for their produce. Such outlets are not available at the present time.

(5) The annual increase in technology releases factors of production. Their employment on the farm could only be achieved if there were no size limitations, either on output—such as with production quotas on livestock enterprises—or, as with land and water, limitation in field crops.

(6) If the farmers are to earn incomes comparable to those earned by wage earners in the other sectors of the economy, they should first be allowed to employ all their labor on their farms in such production processes as would render it possible to make payments at the accepted wage rate. Since both the wage rate and productivity in farming by itself are constantly going up, there should be a continuous trend of increasing farm size.

(7) The size of the farm can best be represented by output, as it makes no difference whether the income comes from livestock, field crops, or other branches. If there are market limitations on one product, say livestock, no choice remains but to increase other products. It seems that the alternatives require land which, with more favorable price situations and different technology, will have positive marginal productivity in itself, as well as providing employment for the family labor at acceptable wages.

(8) Land and water in Israel agriculture being fixed, it would seem that the solution can only be found by consolidating farms into larger units. No indication is contemplated here of an optimum size for present conditions in technology or prices. Instead, it is suggested that institutional arrangements be made so that the consolidation process could be followed without restriction, thus allowing the more efficient farms to purchase the least efficient ones.

(9) If, for any reason, it is desirable to maintain the density of the population in the rural regions, it will have to be maintained by industrialization or other measures.

(10) All programs designed to keep the prices of products produced for the domestic market above the equilibrium market price will help only those farms which have substantial production. These are mainly the established farms which account for only a small fraction of the moshav population, and which are by and large in better locations. Such programs, therefore, do not by themselves lead to a solution for the moshav sector as a whole.

CHAPTER 2

PRODUCTION FACTORS

1. *Preface*

The production possibilities of a given farm are determined by the extent and composition of the bundle of resources at its disposal. This includes all productive factors which can be considered as fixed for the period under discussion. The period in which a factor is fixed differs according to the various factors considered; thus both the dimensions and composition of the bundle depend on the time range. It is therefore of special interest to ascertain the size and composition of the productive services available to the farms and to examine the changes they underwent during the period surveyed. Some of these changes were reflected in the amount of produce and its composition in a later period. The degree of dependence of changes in output on changes in the limiting resources available itself depends on the degree of utilization of the factors. If they are not fully exploited, or, in other words, if excess capacity exists, it is possible to expand output without enlarging capacity. It is not easy to measure the degree to which production factors—individually or collectively—are utilized in each and every case, but because of the importance of this point an attempt will be made to examine the utilization of a few of the more important factors.

In a discussion on farms it is reasonable to examine the following factors separately: land, water, capital, raw materials, labor, and management. Under present conditions land and water represent the fixed factors in agriculture as a whole, i.e. it is impossible to expand the cultivated areas or quantities of water by any great amount even if we ignore the costs connected with such an expansion. Water and land for cultivation are supplied to the farms, and the institutional framework of settlement prevents changes of any importance in the quotas available to them—at any rate, it prevents expansion. Limitations on transfer of ownership prevent the merging of farms under a single owner. On the other hand, there are certain possibilities for renting land, but this is against the principles of settlement and such possibilities are therefore limited in practice.

The situation with input of capital and labor is different. These productive services are available to the individual farm at the prevailing prices, without limitations, except in the case of labor. Farmers accepting the principle of own-labor limit themselves when it comes to hiring labor. This principle exists throughout the cooperative settlement movement, although it is not always observed. However, it can be suggested that even where there is hired labor, it does not reach the dimensions possible were such a principle non-existent. Even so, it is clear that as far as the two factors—labor and capital—are concerned, there is much more manoeuverability than with land and water. The managerial factor, which is fixed for each farm, is not given to direct measurement and will therefore not be dealt with in this chapter, but because of its importance will be discussed later in this study.

This chapter is devoted to a description of the use of various inputs in the farms of the sample—and to the changes which occurred during the period discussed. In addition, a comparison will be made of the differences in size and composition of inputs in the various villages.[1] Finally, we shall compare the data gathered from the sample with other data for the moshav sector[2] with the purpose of finding how representative the sample is and to what extent it is possible to generalize the findings of the analysis. The reader who is mainly interested in the analysis is referred to Chapters 4–6.

2. *Land*

During the period discussed very small changes occurred in the land area at the disposal of the farms, as may be seen from Table 12. Average area per farm fell 7 per cent as a result of organized land contributions

TABLE 12. *Physical Area in Dunams: 1954 and 1958*

	Physical area (1)	*Irrigated area (2)*	*Unirrigated area (3)*	*Irrigated orchards (4)*
1954	51.6	23.6	28.0	1.7
1958	47.8	26.6	21.1	3.5
1958/1954 (per cent)	93	113	76	205

SOURCE: Appendix Table A–1.

[1] The tables presented in the discussion are extracts from more detailed tables that appear later as Appendix A and to which we shall refer both in this and in later chapters. All figures are per farm averages.

[2] This point is discussed in Appendix C.

towards the establishment of new farms in two villages. On the other hand, area under irrigation rose by 13 per cent.

An examination of the individual village averages, which appear in Table A–1, reveals great differences in village land areas. In 1954 the smallest average unit was in village B—23.9 dunams, and the largest in village E—122.5 dunams. Similar differences existed in 1958. It was plausible to think that villages with relatively little land at their disposal would have an advantage in area under irrigation over villages with more land, but this was not so. The *irrigated area* in the 'large' village D was larger than the *physical area* of the 'small' village A or B.

It is sometimes assumed that the average rate of substitution between unirrigated and irrigated land is four dunams of unirrigated to one irrigated dunam: i.e. the income from one dunam of irrigated land under normal cultivation is equal to that of four dunams not under irrigation. On this basis, in 1954 an average farm in village C had 11 standard dunams (the equivalent of 11 irrigated dunams) compared with 50 standard dunams per average farm in village E and 40 per average farm in village D. The findings are similar for 1958. The allocation of both land and water by public institutions constituted in itself an advantage for certain villages. There are doubtless historical reasons for this; settlement conditions in the past were such that it was not possible to establish farm units of equal size. However, understanding the motives should not blur the fact that distribution of productive factors was unequal—a fact of great importance in analyzing the various farms. There is also considerable variability in size among the farms, although this is partly reflected in differences between villages. In 10 of the 66 farms in the sample the physical area was less than 20 dunams in 1958; in 25 farms there was no unirrigated land; and in 12 others the area not under irrigation was less than 10 dunams. Similar differences exist in the irrigated areas, as may be seen from Table A–3.

Although the changes in physical area were comparatively small, those in the composition of the crops were more conspicuous. These are summed up in Table 13.

The increase in irrigated crop area was approximately the same as the increase irrigated area. The relative increase in orchards was large, but in absolute terms the area was small in both years. The principal change was the steep rise in the area under fodder and the big drop in marketed field crops which were mainly vegetables. Even in 1954 fodder comprised 66 per cent of the entire irrigated area (excluding orchards) and in 1958 its weight rose to 91 per cent. A similar rise occurred in the cultivated area not under irrigation. The data in Table A–4 show

TABLE 13. *Utilization of Irrigated Area: 1954 and 1958*

(Dunams)

	Green fodder (1)	*Field crops for sale* (2)	*Total irrigated crop area*[a] *(1)+(2)* (3)	*Green fodder as per cent of total crop area*[a] $\frac{(1)}{(3)} \times 100$ (4)	*Coefficient of utilization of irrigated area* (5)
1954	19.4	10.1	29.5	66	1.34
1958	28.8	2.9	31.7	91	1.37
1958/1954 (per cent)	150	29	107		

[a] Excluding orchards.
SOURCE: Table A–2.

that unirrigated fodder crops formed 51 per cent of the unirrigated cultivated area in 1954 and 64 per cent in 1958. Enlargement of the area under fodder is a result of the expansion of dairy herds, as will become clear subsequently.

3. *Water*

Data on water use, which appear in Table 14, were available for only four of the five villages.

TABLE 14. *Water Utilization: 1954 and 1958*

(Thousands of cubic meters)

	Average per farm	*Average per irrigated dunam*
1954	14.2	0.610
1958	19.4	0.729
1958/1954 (per cent)	137	120

SOURCE: Table A–5.

During the period there was a steady rise in water utilization—average use per farm rose by 37 per cent between 1954 and 1958. Examination of the data on the various villages in Table A–5 shows that the rise mainly took place in two villages whose water allocation was increased during the period. The ranking of villages by water use is similar to that of land area. The two villages which are the largest water consumers also have the largest land allocations and thus enjoy superiority in the two scarcest productive factors in Israel agriculture.

The rise in water consumption was steeper than the increase in irrigated land which meant that average quantities per dunam rose by 20 per cent during the period. These changes accompanied the changes in crops grown. The transition to fodder crops, and to a lesser extent to orchards, was perhaps the cause of the increased quantity per dunam.

4. *Capital in Structures and Equipment*

For the purpose of the analysis we divide farm assets into three main parts: structures and equipment, livestock, and orchards. The extent of the orchards was mentioned in the discussion on land usage, whilst livestock will be discussed later. This section is therefore devoted to an examination of the extent and composition of structures and equipment.

In 1954 a detailed evaluation was made of the property on the sample farms. For this purpose a complete inventory was taken, noting the age and type of structure or equipment. With the aid of engineers an index was compiled for evaluation of the various types of structures according to the materials used in their construction. The basis for the index was renewal value, i.e. the object of the appraisal was to determine the cost of a new structure of the same type as the old one. From the value thus obtained depreciation was deducted according to the age of the structure to yield the renewal value minus depreciation.

Evaluation of equipment was conducted on similar lines except that purchase value at 1954 market prices was taken as renewal value. The results of both evaluations will hereafter be referred to as 'value of structures and equipment'. The average value per farm of capital in structures and equipment in 1954 was IL 5,490. Average values for each village are given in Table A–6. It will be seen from these data that villages with the largest land units also have the largest assets in the form of structures and equipment.

Without entering into a discussion of the problems of measuring capital, it should be noted that the method of evaluation mentioned above is subject to limitations when the results are used as indications of production potential. The value was given on the basis of 'cost of building the same structure anew' (allowing for age) but the existence of 'above-average' structures on any farm does not mean that that farm is capable of producing more than its neighbour. It would not be proper to speak of 'above-average' construction of farm buildings as though this were akin to conspicuous consumption. The structures of a farm may vary widely from those of another farm as regards form and materials—perhaps out of totally divergent considerations—and yet possess the same productive capacity. The reason for structural differences may be historical, as there were different building patterns in different periods. This would lead to differing evaluation of property, although from the production viewpoint the two structures may be more or less equal. A similar result occurs with two buildings identical in form and materials but differing in age. Here too—even if productive capacity is the same—their value will vary according to age.

To surmount this difficulty production capacity was calculated for livestock structures. Thus, it was possible to get an idea of the livestock producing potential of the farms according to existing structures. Data on these values, rechecked in 1959, will be presented later.

5. *Investment*

Details on types of investment by villages appear in Table A–7. The main findings on average investment per farm, for the period 1954–58 at 1954 prices, are as follows:

Total investment (in IL)		**10,632**
of which:	structures and equipment	5,391
	livestock	4,614
	orchards	627.

The above includes investment in productive factors only and not in durable consumer goods. During the five-year period farms roughly doubled their property value in structures and equipment. This rate of investment, equal to a yearly increase of approximately 15 per cent, is high both absolutely and compared with the investment rates of previous years. Although no specific data are available, it may be deduced that as these villages were established many years ago the extent of their property in 1954 would have been much greater than it was if they had continuously invested at the same proportional rate. Moreover, if they continued to invest in the future at the same rate, at the and of the next five-year period, i.e. in 1963, the property value of structures and equipment would have risen to about four times the 1954 value. It is therefore of the utmost importance to attempt an explanation of the rate of investment and to learn from it about future investment. We shall return to this point in Chapter 6.

Table A–8 shows that 83 per cent of all investment was directed to poultry and dairy enterprises. Most of the remainder served these same branches indirectly, since most of the cultivated area was used for producing fodder. This points to a definite trend in livestock development not only in the present, but in developing tools for future production as well, i.e. the transition to livestock production involves not only the use of existing factors for increasing production in the branch, but also—and more fundamentally—the expansion of specifically livestock-producing factors. This is liable to make a future change to production of other commodities more difficult, should such a transition prove necessary.

A more accurate picture of the growth in the production potential of the farms may be obtained by examining the changes wrought in the factors which limit, or might limit, the expansion of production. An examination of the livestock branches on these lines follows.

6. *Investment in Poultry Housing*

To observe changes in the capacity of poultry production potential, the maximum number of birds that could be housed at one time was calculated. This calculation was carried out for the end of each year, and the value arrived at is the 'poultry housing capacity'. Capacity was found separately for structures specific to layers and to broilers. Since there is a certain amount of substitution between housing for layers and for broilers it would be helpful to determine the general growth in the productive capacity of poultry. The two categories are aggregated in value terms. This was done by weighting the investment prices according to the following key: housing for a layer—IL 4; for a broiler—IL 2.7.

TABLE 15. *Capacity and Consumption of Concentrates for Poultry: 1954–1958*

	End of year capacity			*Consumption of concentrates*
	Laying birds	*Broilers*	*Total*	
	Places		*IL: fixed prices*	*Tons*
1954	647	104	2,869	25
1955	802	168	3,662	29
1956	914	268	4,380	33
1957	993	299	4,779	31
1958	1,131	341	5,445	40
1958/1954 (per cent)	174	328	190	160

SOURCE: Tables A-9 through A-12.

Average farm capacity rose from IL 2,869 at the end of 1954 to IL 5,445 in 1958—an increase of 90 per cent or an average annual gain of 17.4 per cent. This rise was accompanied by an increase in the use of concentrates. Since capacity was calculated for the year's end and concentrated feed use for the entire year, there is a certain lag in the rate of increase of chicken feed. Housing capacity at the end of 1957 was 167 per cent of that of 1954. This figure agrees with the increase in feed use from 1954 to 1958. The situation is similar when the individual villages are compared, as can be seen from the tables in Appendix A. Accordingly, we can examine the implications of capacity enlargement. The continuation of such a rate of growth for another four years would result in structure capacity value of about IL10,000, or 361 per cent of 1954. If this is true of all farms, including those not in the sample, the growth of production could continue without lowering prices *only* if a market for poultry produce is found. It is not plausible that the demand for this produce will grow to the extent indicated here. Therefore prices will fall and further expansion will slow down. If we accept this assumption, we also accept the assumption that investments are made according to price conditions and thus we arrive at a hypothesis which explains the behaviour of poultry producers. The fault with this explanation is that we cannot prove that production will not expand at the same rate in the future; the subject is therefore taken up again in detail in Chapter 6.

A coefficient of utilization was calculated to find the degree to which the poultry structures were used each year. This was done by dividing farm average annual concentrate consumption by farm average housing capacity for the middle of the year. Detailed data on the villages appear in Table A–13; the annual average is shown in Table 16.

TABLE 16. *Utilization of Poultry Structures: 1954–58*

	1954	*1955*	*1956*	*1957*	*1958*
Utilization coefficient[a]	8.7	8.8	8.2	6.7	7.8
Index: 1954=100	100	102	94	78	90

[a] Kilograms of concentrates per IL of annual average capacity.
SOURCE: Table A–13.

A slight trend towards decreasing utilization is discernible. This means that the increase in capacity was greater than that of production; it is also possible that this trend reflects an increase in feeding efficiency. We may conclude that in 1958, for instance, it was possible—with the same structures—to enlarge poultry production above that actually achieved.

7. *Investment in Dairy Herds*

The changes in dairy herd capacity may be measured by the number of livestock the barns are capable of housing under ordinary conditions.

Since each cow has its own stand in the barn, the number of stands is a criterion of capacity. This will not, however, give a complete picture, since, if necessary, animals can be housed temporarily in unfurnished buildings or tin shacks. This is not merely a theoretical possibility but is actually practised. Lately there has been a trend towards fattening calves for meat. They were housed in the dairy barns if there was excess capacity that could be used for this purpose. On reaching full capacity, the surplus calves were transferred to temporary structures. Some farms later built permanent housing for this purpose, assuming that the industry would continue to be profitable in the future.

Since it is impossible to define maximum capacity under temporary conditions, it was decided to list only those stands found in apparently permanent barns. Capacity was divided into stands for dairy cows and heifers and stands for calves, in order to examine the trend in construction of new barns. Averages were calculated only for farms which had cows in those years. Results for individual villages are given in Table A-14.

Figures for 1954 and 1959 are presented in Table 17.

TABLE 17. *Number of Stands and Dairy Cattle*[a]*: 1954 and 1959*

Beginning of year	*Stands*[b]		*Cattle inventory*	
	Total	*Cows and heifers*	*Total head*	*Value (1954 IL)*
1954	10.0	9.3	10.0	7,758
1959	16.1	10.7	15.6	11,021

[a] Only farms with cattle.
[b] 1954 figures are for the end of the year.
SOURCE: Tables A-14 through A-16.

It will be seen that the number of stands rose by more than 60 per cent over the period. The main increase was in stands for calves and beef cattle; simultaneously the number of head rose by a similar percentage. The number of calves rose proportionately more than the rest and thus the total increase in value of livestock only reached 42 per cent. Variations in inventory were more or less parallel to those in structures and the livestock/stand ratio was approximately 1 both at the beginning and at the end of the period. These figures relate to the sample as a whole—but examination of individual farms shows large fluctuations. The livestock/stand ratio for total livestock ranges from 0.4 to 1.6. This fact is significant with regard to the actual limitations to cattle raising on farms.

On the one hand, approximately one-third of the farms have a very low utilization coefficient, i.e. their structures have excess capacity. On the other hand, there are farms with a coefficient greater than unity, indicating that permanent quarters do not constitute serious limitations to cattle raising. Usually only the young stock is raised in temporary quarters; this enables the mature cows to be kept in the permanent structures.

Another trend in the development of the dairy industry is the transition to machine milking. The number of milking machines in the sample farms rose from 8 in 1954 to 23 in 1958.[3]

Comparison of investments in poultry and in cattle shows that poultry capacity rose by 90 per cent whereas the number of cattle stands increased by 67 per cent. Investment in structures and equipment rose by IL 5,391 from a value of IL 5,490 for this item at the beginning of the period (1954); fixed investment rose by 98 per cent. In the main, these investments were directed at raising physical capacity in the livestock branches. Capacity expansion creates a need for investment in other items such as storage space, hay barns, etc. At the same time investment was directed to milking machines and replacement of deep litter poultry runs by chicken batteries. These expenses, along with investment in tools and machines, explain the difference between the increase in the value of structures and equipment and that of physical capacity, as measured above, in the two main branches.

8. *Expenditure on Raw Materials*

If expansion of farm property permits the farms to expand output, even though quantities of land and water are fixed, then the additional production must be reflected in the increased inputs of raw materials.

TABLE 18. *Expenditure on Raw Materials: 1954–58*

	Current IL	*At 1954 prices*	
		IL	*Index: 1954=100*
1954	7,319	7,319	100
1955	9,466	8,231	112
1956	11,941	9,115	125
1957	13,239	9,130	125
1958	17,535	11,613	159

SOURCE: Tables A–17 and A–20.

[3] In many farms the reason that machines have not been introduced is the difficulty in buying them, and each farmer must wait his turn.

These consist of purchase of feed, seeds, fertilizers, insecticides, etc. Data on the magnitude of these costs, and their distribution among villages and branches appear in Tables A–17 to A–20; a resume is given in Table 18.

Feed costs were 77 per cent of all 1954 raw materials outlay and 76 per cent in 1958. These are only part of the total expenditure on cattle and poultry. It is obvious from this that most of the costs were incurred by these branches. Since purchased feed supplies comprised most of the total costs, deflation was carried out by adjusting for the rise in poultry concentrate prices. The price index for concentrates, with 1954 as the base year, is given in Table 19.

TABLE 19. *Index of Concentrate Feed Prices: 1954–58*

	1954	*1955*	*1956*	*1957*	*1958*
For cattle	100	119	130	144	146
For poultry	100	115	131	145	151

SOURCE: Y. Lowe, T. Gans, Y. Remer, ***Report on the Economic Situation of Established Family Farms during the Years 1952/53 to 1957/58***, Faculty of Agriculture, The Hebrew University, December 1958, Table 5 of the appendix.

It is clear that over the period the use of raw materials rose noticeably. Fifty-nine per cent more materials were used in 1958 than in 1954 (at fixed prices), which means that the increase in fixed factors was accompanied by a rise in variable inputs—although the increase of the latter was the smaller of the two.

9. *Labor*

Summaries of labor input by villages and by livestock branches appear in Table A–21. There is a noticeable trend to lower labor input, as can be seen from the following data for all farms. Average annual labor input per farm (in work days) was: 1954—627; 1955—602; 1956—562; 1957—549; 1958—569. The fall in labor was mainly in villages which grew vegetables and other field crops at the beginning of the period and later turned to livestock production. But since the decrease in area sown to vegetables etc. was accompanied by an increase in fodder area and other crops, this alone cannot explain the decrease in the use of labor; a rise in productivity of labor may, however, provide the explanation. Increased productivity may be a result either of labor-saving innovations or of better organization under the existing system, or of both together. It is plausible that both factors were active, although it is difficult to calculate the relative importance of each. In addition, with the fall in labor-input, the number of hired farm hands was reduced, which in itself may explain the increased productivity. In 1954 hired labor comprised 18 per cent of all labor, dropping to 11 per cent in 1958.[4]

10. *Conclusion*

Two points are reflected in the discussion of scale of productive factors and their use over the years. The first touches on changes over time and the second on intervillage differences.

TABLE 20. *Selected Inputs: 1954 and 1958*

Factor	*Unit*	*1954*	*1958*	*1958/1954 (per cent)*
Physical area	Dunams	51.6	47.8	93
Irrigated area other than orchards	Dunams	21.9	23.1	105
Irrigated orchards	Dunams	1.7	3.5	205
Water[a]	Thousands of m^3	14.4	19.4	137
Labor	Mandays	627	569	91
Stock of structures and equipment[a]	1954 IL	5,490	10,881	198
Stock of cattle[a b]	1954 IL	7,758	11,021	142
Outlay on raw materials	1954 IL	7,319	11,613	159

[a] Stock at beginning of 1954 and end of 1958.
[b] Only farms with cattle.
SOURCE: Appendixes A and B.

Over the period only slight changes occurred in area cultivated by or at the disposal of the sample farms (see Table 20). A relatively large change took place in orchard area, but in absolute terms it is insignificant. There was also a certain reduction in labor input. In contrast, quite significant changes occurred in three groups of inputs: water use, stock of fixed assets, and raw materials. The rise in water consumption actually reflects an increase in two villages (D and E), and it may be assumed that uninterrupted increased use will not be possible since there are external limitations beyond the control of the individual village. This is not true of increasing the volume of capital in its various forms. It was shown that great changes took place, which have much significance for the future. In the sample farms productive factors were greatly expanded. As was seen, the expansion was directed mainly towards production in the livestock branches: poultry and cattle.

[4] Lowe, Gans, Remer, *op. cit.*, Table 1 of the appendix.

The questions with which we shall have to deal are: What were the reasons for such expansion and why was it directed mainly to the livestock branches? How did the change affect the scale of production and its composition? What effect did production composition have on factor productivity? What significance has this process on development prospects?

A second point reflected in the discussion is the fact that great differences exist in the size of individual farms. Actual size must be measured according to all factors; but it is difficult, both technically and conceptually, to combine them. That is why we have chosen a simple method for comparison by ranking the farms according to volume of factors (stock or flow as the case may be) in two years. Results appear in Table 21.

TABLE 21. *Ranking of Villages by Factors of Production at Their Disposal, and Their Utilization:*[a] *1954 and 1958*

		Village				
		A	*B*	*C*	*D*	*E*
External limitations						
Physical area	1954	4	5	3	2	1
	1958	4	5	3	2	1
Irrigated area	1954	3	4	5	1	2
	1958	3	4	5	1	2
Water[b]	1954	3	4	5	1	2
	1958	3	4	5	1	2
Internal limitations						
Labor	1954	4	2	5	3	1
	1958	3	4	5	2	1
Capital structures and equipment	1954	5	3	4	2	1
	1958	5	3	4	2	1
Poultry structure capacity[c]	1954	3	2	4	5	1
	1958	3	2	4	5	1
Total constructed cattle stands	1954	5	2	4	3	1
	1958	3	5	4	2	1
Value of cattle inventory	1954	3	4	5	1	2
	1958	3	5	4	1	2
Raw materials	1954	3	2	5	4	1
	1958	4	2	5	3	1

[a] In all items the intervillage differences are statistically significant at a 1 per cent significance level.

[b] No data were available on water use in village A, and the ranking shown is that for irrigated area. For the remaining villages there is complete correlation between the ranking of these two variables.

[c] For concentrates villages B ranked fourth and village C fifth, the ranking of the other villages being the same as for capacity.

SOURCE: Appendix A.

Villages D and E lead in area and quantity of water at their disposal. Although C is third in land area its water supply is very low compared to the rest and this village should be ranked last from the point of view of the water-land combination.

Villages D and E also lead in size of capital and labor input. Without further examination there is no way of knowing whether, historically, this is the result of the relatively large quantities of land and water at the disposal of the farms. There are certain intervillage differences in the composition of production which will have some bearing on subsequent analysis. Village D concentrated more on cattle and B changed from vegetable production to poultry. The relative importance of cattle raising is great in A as well. Village E which is the 'largest' of all concentrated on both livestock branches. This can be seen from the ranking of both the particular capital items and the expenditure on raw materials. The comparatively low level of raw materials in village D reflects the fact that there poultry runs were relatively few. The question then arises: why are there differences among villages? Is it mainly a reflection of different organization of productive activity within the villages themselves or is it a result of unequal distribution of productive factors by the settlement institutions? We shall not deal directly with these questions in this study but they have been mentioned here as meriting further deliberation.

CHAPTER 3

OUTPUT, ADDED VALUE, AND INCOME

1. *Data*

This chapter analyzes the changes in extent and composition of output throughout the years and the correspondence between them and existing trends in the use of productive factors as described in the previous chapter.

Output includes all current sales by farms during the year, plus changes in value of livestock, poultry, and orchards. Changes in other inventories, including stands in the field, are not included for lack of data. Thus it is possible that the output of a certain year includes the value of stock which existed at the beginning of the year, or that part of the output is not included since it was in the form of appreciation of one of the abovementioned items. It may be assumed that even if data were available the results would not vary much since the weight of such items is small; in addition, the changes in stock from year to year are not large.

The particulars connected with output calculations appear in the first section of Appendix B.[1] As was the case in the previous chapter, detailed results on the individual villages appear in the appendix.

2. *Output*

Average output per farm, at 1954 prices, rose from IL 15,525 in 1954 to IL 23,557 in 1958, an increase of 52 per cent (see Table 22).

TABLE 22. *Output: 1954–58*

	1954	*1955*	*1956*	*1957*	*1958*
Output: 1954 IL	15,525	17,392	19,098	19,665	23,557
Index: 1954 = 100	100	112	123	127	152
Index of output/raw materials ratio: 1954 = 1	1.00	1.00	0.98	1.02	0.96

SOURCE: Tables B–1 and B–2.

[1] Tables 22–25 in this chapter are extracted from Appendix B and all figures are per farm averages.

The annual rate of increase was 12 per cent the first year and 10 the second; in 1957 it slowed down but the following year jumped to 20 per cent. This was probably a compensation for the small increase in 1957—the year of the Sinai campaign. All in all there was an average compounded annual increase of 11 per cent. The differences in output levels among villages are greater than the differences in the relative increase among villages from 1954 to 1958.

In the last line of Table 22 the relative increase in output is compared with that of expenditure on raw materials. There is complete accord between the two, i.e. a 1 per cent increase in costs was accompanied by a similar rise in output. During the period changes were made in other productive factors as well, and it is therefore appropriate to examine the significance of the above comparison. In the preceding chapter we noted that cattle and poultry structure capacity was expanded relatively more than raw materials. In contrast, there were insignificant changes in land area, while labor input was even reduced. From this we learned that the expansion created excess cattle and poultry structure capacity. Since most of the raw materials were used in these branches there were no changes in the ratio of raw materials and active capacity. Hence the unit value in Table 22. On the other hand, the ratio between land and raw materials declined, since acreage did not change much over the period. This, however, is not reflected in Table 22—and in fact, as we shall see in the following chapter, there is a relative excess of land in these farms.

3. *Composition of Output and Growth of Branches*

Detailed annual figures for the individual branches appear in Table 23. While cattle and poultry production increased considerably, an absolute decrease occurred in other branches. The main drop was in field crops for, as seen in the preceding chapter, orchard area increased somewhat and output rose with it. Cattle and poultry comprised 85 per cent of total output in 1954 and 91 per cent in 1958. The interesting point is that this percentage is more or less identical in all villages, although the relative importance of poultry and cattle is different in individual villages. For the period as a whole cattle accounted for 36 per cent and poultry for 53 per cent of total production. It is thus clearly seen, as could well be anticipated from the previous discussion, that the sample farms engaged mainly in poultry and cattle production.

There were only slight variations in composition of output within branches. As shown in Table 24, milk output rose from IL 3,788 in 1954 to IL 5,259 in 1958—an increase of 39 per cent. The proportionate increase in milk production was slightly less than of total dairy and meat pro-

TABLE 23. *Output by Branch: 1954–58*

	1954	1955	1956	1957	1958
1954 IL					
Cattle	5,612	6,046	6,630	7,525	8,382
Poultry	7,576	9,576	10,946	9,959	13,091
Other	2,337	1,770	1,522	2,181	2,084
Per cent of total					
Cattle	36	35	35	38	36
Poultry	49	55	57	51	55
Other	15	10	8	11	9
Index: 1954=100					
Cattle	100	108	118	134	149
Poultry	100	126	144	131	173
Other	100	76	65	93	89

SOURCE: Tables B–3, B–4, B–7, and B–9.

duction, which means that the weight of the second component—meat output and calves—rose. This same fact may be seen from the fall of milk output from 67.5 per cent of total production of livestock in 1954 to 62.7 per cent in 1958.

TABLE 24. *Milk Output: 1954–58*

	1954 IL	Per cent of total cattle output	Index: 1954=100
1954	3,788	67.5	100
1955	3,933	65.1	104
1956	4,268	64.4	113
1957	4,607	61.2	122
1958	5,259	62.7	139

SOURCE: Tables B–4 and B–5.

The second component—cattle production—rose from IL 1,824 in 1954 to IL 3,123 in 1958, an increase of approximately 71 per cent. Of this output 85 per cent was marketed and 15 per cent was devoted to replenishing the herds. These facts are of interest in the light of the occasional import of dairy cows. This is not the place to analyze the motives for these imports but it should be pointed out that findings show that it is possible to enlarge local herds considerably from local sources (see Tables B–5 and B–6).

The rise in poultry output of the entire sample was larger than that of cattle. The average increase in poultry output per farm was from IL 7,576 in 1954 to IL 13,091 in 1958. The steepest rise was in 1958, following a 1957 fall in output due to the Sinai campaign. The increase of 31 per cent in 1958 was above the output growth rates of previous years and also of other branches. It may perhaps be assumed that part of the output increase in 1958 would normally have been achieved in 1957 were it not for the disturbing effect of the Sinai campaign on the poultry industry. The structure capacity needed for such output already existed and was even enlarged in 1957, though to a lesser degree than in previous years. However, this increase reflects to a large extent the price guarantee for eggs initiated at that time. We shall return to this problem in Chapters 5 and 6.

The composition of output was subject to certain intervillage and intravillage fluctuations from year to year. These were not extreme and, on the average, egg production comprised 50 per cent of total poultry output. The remaining components are: meat sales (broilers and culls), and increase in inventory value. Accordingly, increased output is the result of approximately equal growth in egg production on the one hand and various forms of meat production on the other.

4. *Added Value*

To arrive at the contribution to production of the farms themselves the difference between output and raw materials was calculated. The result is the gross added value, which equals added value plus depreciation. These figures appear in Table 25. The sample average for the period shows that gross added value was 52.4 per cent of total output. This percentage differs for individual villages. In village B, where poultry output is a large part of total production, average gross added value for the entire period was 44.8 per cent of total output. In village D, where most of the production is from cattle, added value is more than 60 per cent of output.

TABLE 25. *Gross Added Value: 1954–58*

	1954	*1955*	*1956*	*1957*	*1958*
Gross added value: 1954 IL	8,206	9,161	9,983	10,493	11,944
Index: 1954=100	100	112	122	128	146
Gross added value/output (per cent)	53	53	52	53	51

SOURCE: Tables B–10 and B–11.

The proportionate growth in added value is very similar to that of output. The reason for taking the gross rather than the net added value lies in the difficulty of calculating depreciation. Nevertheless, in order to obtain net income it is necessary to deduct depreciation, even if in doing so we make certain arbitrary assumptions. A calculation of this type was made for the first and last years assuming 8 per cent depreciation on structures and equipment. The values arrived at are IL 439 for 1954 and IL 870 for 1958. By deducting these figures from gross added value we find that net added value was IL 7,767 and IL 11,074 respectively. The proportionate increase was 43 per cent.

The net added value represents the income of the productive factors on the farm. If all work were done by the farmers themselves and all capital were their own, the added value would be the income of the farm owners. The significance of this statement is limited because of the way the figures were obtained. As stated, all values were calculated on the basis of 1954 prices. If the ratio of input prices to output prices in 1958 differs from that of 1954 the results will not give a true picture of real income. For this we must first calculate income at current prices and only then convert the results to a fixed price basis, if we so wish to present them.

TABLE 26. *Net Income per Farm: 1954–58*

	1954	*1955*	*1956*	*1957*	*1958*
1. Current prices: IL thousands	5.6	5.7	6.4	7.3	8.5
2. 1954 prices: IL thousands	5.6	5.4	5.7	6.1	6.9
Index: 1954=100	100	96	102	109	123

SOURCE: Line 1—Y. Lowe and Y. Remer (see footnote 2).
Line 2—Line 1 deflated by Consumers' Price Index.

Lowe and Remer calculated net income in their study analyzing the profitability of about the same sample of farms.[2] To arrive at net income at current prices expenditures on both raw materials and hired labor were subtracted from output, along with interest on loans and fixed costs such as village taxes etc. The results appear in Table 26.

It is clear from Table 26 that although there was a considerable increase in output and added value—measured in constant prices—net income

[2] Y. Lowe and Y. Remer, *Profitability of Established Moshavim in 1959 as Compared with Previous Years,* Ministry of Agriculture and Jewish Agency Extension Service, October 1960, p. 9 (Hebrew). It should be noted that the above analysis does not cover exactly the same farms dealt with in the present work, which includes only those farms which were present in the sample during the entire period. However, the differences are not serious. Thus we may accept Table 26 as reflecting the trend in the series with which we are dealing.

changed but slightly during the first three years but rose in the last two. The reason, as pointed out by Lowe and Remer, stems from the changes in the input-output price ratio. Since the majority of production comes from livestock (including poultry) some idea of price fluctuations may be obtained by comparing prices of output in these branches with those of concentrated feeds, which are the main item in production costs (Table 27).

TABLE 27. *Price Ratio of Output and Concentrates for Cattle and Poultry: 1954–58*

Price ratio	*1954*	*1955*	*1956*	*1957*	*1958*
Price of milk (IL per kiloliter) / Price of concentrates (IL per ton)	1.66	1.43	1.43	1.37	1.42
Price of eggs (IL per thousand eggs) / Price of chikenfeed (IL per ton)	0.41	0.38	0.38	0.39	0.34
Price of poultry meat (IL per ton) / Price of chickenfeed (IL per ton)	12.7	9.8	8.0	8.4	7.5

SOURCE: Y. Lowe, T. Gans, and Y. Remer; *op. cit.* Table 5 of the Appendix.

The dispersion of income among farms was large in each year. According to Lowe and Remer[3] the range of net income at current prices varied from less than IL 1,000 to close to IL 15,000 in 1954 and from less than IL 2,000 to close to IL 25,000 in 1958.

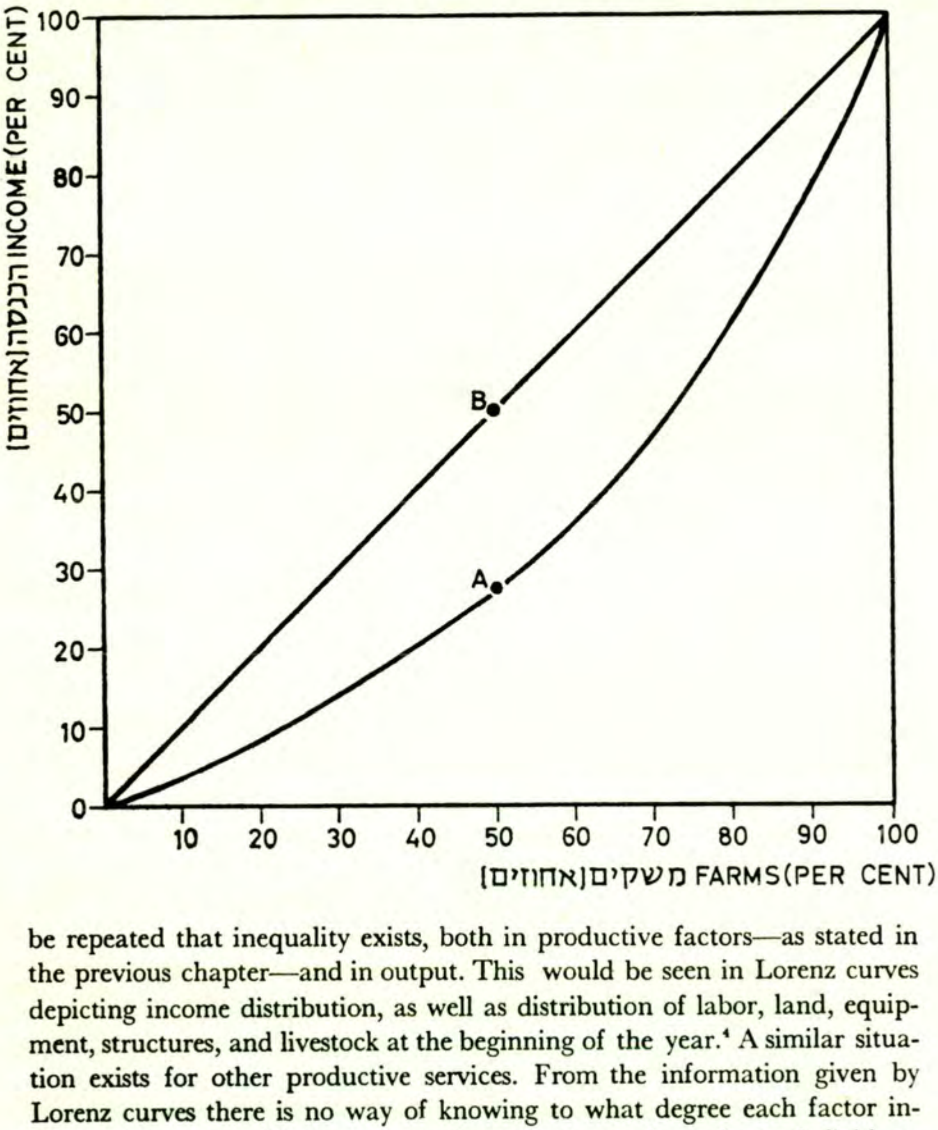
The dispersion may also be seen from the Lorenz curves in Figure 1. Point A on the curve shows that 50 per cent of the low income farms received about 27 per cent of the sample farms' total income. If income were equal in all farms, instead of point A we would get point B—meaning that 50 per cent of the farms receive 50 per cent of the income. The area formed between the curves and the straight line shows the degree of inequality existing in the distribution of income among farms.

The important questions then are: what are the factors influencing the size of income on the farm and causing income to vary among farms? What causes an increase in income through the years? At a point in time, when prices are fixed and equal for all producers, the size of income reflects the amount of the various inputs used and the efficiency of their utilization. At different points in time income distribution is also influenced by differences in prices and in productivity.

Before entering on a more detailed examination of this problem it should

[3] *Op. cit.*, p. 13, Diagram 1.

FIGURE 1. *Distribution of Income Among Farms in 1956*



be repeated that inequality exists, both in productive factors—as stated in the previous chapter—and in output. This would be seen in Lorenz curves depicting income distribution, as well as distribution of labor, land, equipment, structures, and livestock at the beginning of the year.[4] A similar situation exists for other productive services. From the information given by Lorenz curves there is no way of knowing to what degree each factor influenced output and how a change in the amount of any factor is liable to change production or net income. However, this is the important point to be examined in the following chapter.

[4] Since these curves are in general similar to that of income distribution, they are not presented here.

CHAPTER 4

THE PRODUCTION FUNCTION

1. *Introduction*

At the end of the previous chapter it was noted that there is considerable interfarm variation in net income, output, and use of production factors. This chapter will examine the extent to which variations in the use of factors explain differences in output by estimating the production function which expresses output as a function of inputs. Then, by comparing the value of the marginal product of each factor with the factor's market wage, we can see whether it would have been possible to raise the farmers' net income by increasing or decreasing the use of services. However, results of such a comparison would only relate to the entire sample and would not by themselves explain fully the differences in income existing among the farms. Differences in income are also the result of differences in farm efficiency. By this we mean that two farms might employ identical inputs and yet output and net income would vary. We shall call disparity in efficiency 'differences in the management factor'. Management is not given to direct measurement and we shall therefore have to use an indirect way of measuring it and of measuring its existing distribution among the farms. Differences in management influence net income in two ways: first, as stated, by achieving a larger output with the same amount of inputs; second, by different utilization of the various inputs. In other words, an increase in management causes a rise in the value of the marginal product of the other factors and thus increases their employment. In this way, managerial disparity may partially explain differences in use of inputs among individual farms.

Input differences exist not only among farms—but on the same farm over a period of time. This is caused by changes in price and in productivity from year to year. Response to prices will be treated separately in later chapters; here we shall deal only with the examination of productivity changes through time. An increase in productivity is defined as an increase in output obtained from a given quantity of inputs. We are interested here in annual changes in productivity shared by all farms, whereas, when discussing management, differences in productivity among farms for the same year are of importance. If productivity increases over a certain period and at the same time prices remain constant, the result will be a rise in income. This is a result of additional use of inputs, and because a larger output is achieved from the same input.

Knowledge of the production function is not limited to the considerations stated in the previous paragraphs. From economic theory we know that behavior of the firm—and in our discussion we regard the farms as firms—is dictated by the production function and market prices. Knowledge of the production function permits derivation of the product supply curve as well as of the input demand curves and thus enables us to find the farms' reactions to price changes. It is of interest to examine this point at the level of individual branches, and an attempt should therefore be made to separate the individual branch components from the aggregate production function.

2. *The Function*

The function to be estimated here is that known as the Cobb-Douglas, whose logarithmic form is:[1]

(1) $$Y = B_0 + B_t + A_1X_1 + \cdots + A_kX_k + A_mM + U,$$

where Y is the logarithm of output, X_1 to X_k are logarithmic values of the inputs, and M designates the logarithm of management in farm i. Although it is not possible to measure this latter variable directly we include it in order to complete the presentation of the production function. Later we shall check its significance and the methods for measuring it. U is a random variable indicating nonsystematic errors in the formulation of the equation or in measurement of output. The coefficients $A_1 \ldots A_m$ are production elasticities, i.e., A_1 represents the percentages change in Y when X_1 changes by one per cent. A similar explanation holds for the remaining A's—including A_m. B_o is the intercept. B_t indicate productivity for the year t. To illustrate the meaning of productivity differences we shall describe in the following diagram (Figure 2) two production functions for two different years. The slope of both functions is identical. They differ only in their intersection with the output axis. Output resulting from input X_D is D in the first year and E in the second. The difference between the two $(E–D)$, equals the difference between the respective productivity coefficients for the two years $(B_2–B_1)$.

When productivity changes, employment of productive factors also

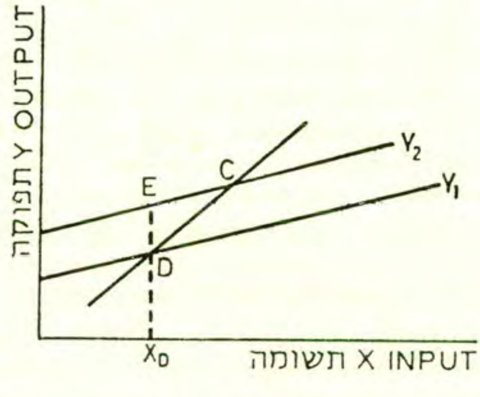
[1] For future reference this form is given here; the original form is:

$$y = b_0 b_t x_1^{A_1} x_2^{A_2} \cdots x_k^{A_k} m^{A_m} v,$$

where the lower case letters are the variables in the original units.

changes, and possibly in the second year the farms would not be at point E but rather at C. This causes certain statistical problems. If—as is usually done in research of this type—we ignore the fact that productivity changes from year to year, we would estimate the slope of CD instead of the slope

FIGURE 2. *Production Functions for Two Years*



of the lines Y_1 or Y_2. This would cause bias of the estimates. Thus dual importance attaches to correct formulation of the function: first, there is significance for annual productivity and its measurement is therefore important; and second, incorrect formulation results in biased coefficients.

A similar explanation can be proffered for the significance of including the managerial factor even though it cannot be measured directly. Let us revert to Figure 2 and assume that Y_1 and Y_2 represent output curves on two farms. The vertical difference between them represents the difference in productivity between them, that is, $E-D = A_m\ (M_2-M_1)$, when M_1 and M_2 signify management in farms 1 and 2 respectively. Here, too, it is plausible that the more efficient farm will employ more productive factors and will thus be at, say, point C. We may, therefore, repeat that here as well a double advantage exists in including the variable in our analysis—both because management is a significant factor and in order to avoid biasing the remaining coefficients.

To estimate the function as it appears in (1) we need a time series on a cross-section of farms, i.e. repeated observations of a sample of farms.[2]

[2] The statistical problems of such an estimation are discussed in Yair Mundlak: "Empirical Production Function Free of Management Bias", *Journal of Farm Economics*, Vol. 43, No. 1, February 1961, pp. 44–56, reissued as FP Research Paper 9, September 1961; and "Estimation of Production and Behavioral Functions From Combination of Cross-Section and Time-Series Data", in *Measurement and Economics:*

3. *The Variables*

From the point of view of the analysis it would be best to use physical units for all inputs and outputs, but since this is not possible a number of variables will be expressed in value terms. In this case, we chose to work with a series at constant prices, the reason being that we are analyzing data which cover a number of years and when relative prices change from year to year the annual figures will not lend themselves to comparison. The variables are output and inputs. *Output* is measured in Israel pounds at 1954 prices and the dependent variable is value of output at constant prices. Output of different branches is aggregated by multiplying prices by physical units. There is only one change from the definition of output presented in the previous chapter and that is that output here includes value of the poultry flock at the end of the year and not the change in inventory. An explanation is included in the section below dealing with expenditure on raw materials. In the definition of *inputs* an effort was made to limit the number of input items, which is desirable from the statistical point of view. When aggregating inputs into more general categories it is helpful to include in the same class factors which are complete substitutes or complements. In the event of partial substitution, weighting by prices, i.e. measuring the variable by its value, preserves the single value property of the production function as long as there are no changes in relative prices of the components of the aggregates.

When measuring dependence between output and inputs, it is the service rendered by the factors that is relevant. If factors are defined in terms of stock certain difficulties arise. It is possible that not all of the inputs owned by the farm are used. This is often difficult to measure and in this instance measuring input as the entire quantity of a factor at the disposal of the farm would be an exaggeration of the quantity actually used in production.

Distinction between the various capital items was made according to 'gross' annual returns on one pound spent on those items. With respect to raw materials the expenditure of a pound must bring in over the year a return of one pound with the addition of interest for the time interval between purchase and sale. In the item 'production assets' a one pound expenditure must bring in during the year a return equal to annual depreciation of the asset plus interest. This heading could be subdivided were we interested in examining the rate of return of capital spent on various items,

Studies in Mathematical Economics and Econometrics in Memory of Yehuda Grunfeld, Stanford University Press, 1963, reissued as FP Research Paper 13.

but as already stated, overclassifying causes trouble in the analysis and it is better to desist.

The actual inputs used in the analysis are:

Labor: Mandays employed on the farm by the operator and his family plus mandays of hired hands. The variable is measured in mandays per year. It is reasonable to assume that there are qualitative differences between the farmer's labor and that of a hired hand—but these were ignored, just as differences in labor efficiency between farms or among different workers in the same family were largely ignored.

Value of livestock structure capacity: In defining this item there is a difficulty in creating a single basis according to which it will be possible to measure the services given by the buildings. Appraisal according to either historical or renewal value may result in a different evaluation of buildings which render identical services although built at different times or constructed from different materials. To circumvent this difficulty a different approach was chosen, where it is assumed that the services of a structure are proportional to its capacity. Thus, capacity would best represent housing services. A description of capacity measurement was given in Chapter 2. The problem with using capacity is that not all structures and equipment are included—but only those directly used for housing livestock. This does not present a problem when a fixed ratio exists between structure capacity used for livestock and service structures such as hay barns, storerooms etc. This assumption was not tested but is presumably not too far from reality.

Cattle value at the beginning of the year: Calculated according to cattle records at the start of each year on each farm according to prices fixed for each type of cattle. Prices are fixed at the 1954 level except for bull calves, whose price was fixed at the 1955 level.

Land: This item represents both land area and water. Not all farms kept a record of water use so that it was impossible to present water as a separate variable. Instead, it was decided to present all land on an irrigation basis. This was done on the assumption that the average rate of substitution is four dunams unirrigated for each dunam of irrigated land.

Raw materials: These include expenditures on purchase of feed for livestock, fertilizers, pesticides and fungicides, and renting of equipment. They also include the value of the poultry flock at the start of the year, whereas output includes its value at year's end. The reason for this correction lies in the random nature of the size of the flock at the beginning of the year and the comparatively short life of poultry. Thus, in contrast to cattle, there is no sense in including live inventory value of poultry at a certain date as a specific productive factor differing in nature from the raw materials.

The number of farms included in the analysis is 66 and the period studied 1954–58.

4. *Estimates of Production Elasticities*

The estimation of production elasticities in equation (1) is made within the framework of covariance analysis.[3] We are mainly interested in the results of (1) according to its complete formulation, but in view of the fact that this approach has not been widely used in the literature it would be desirable to present here the results under alternative assumptions as to variations in productivity among farms and from year to year. Later on in the discussion the relationships between the different estimates will be explained. Results appear in Table 28.[4]

The first row gives the estimates assuming no changes in productivity among farms or over the years. From a statistical point of view it is helpful to describe it as not allowing for the effects of year or farm (on productivity).

In the second row we assume that variations in productivity are only from year to year; in the third row the assumption is that productivity differences occur only from farm to farm, and in the last row we find the most general case where both time and farm effects are allowed for.

The choice of the restriction is made empirically. The null hypothesis that there are no differences among years and farms is tested. In the case in question this was rejected and the conclusion is that there are variations

[3] Mundlak, *Empirical Production*, op. cit.

[4] Perhaps it should be emphasized that the production function, as expressed in (1), reflects the assumption that the production elasticities are constant over the period analyzed, whilst the marginal productivities vary directly with B_t. To get some idea of the empirical validity of this assumption the function was estimated for each year separately. In such an analysis it is impossible to allow for firm effect, as there is only one observation per firm. Therefore, the results of the annual analysis should be compared with the estimates which appear in the first line of Table 28. Two main variations in the results were detected. First, the elasticities of value of cattle at the beginning of the year showed unsystematic fluctuations. Second, the elasticities of labor were very low in the first two years and increased markedly for the remaining period. This result is noted in subsequent discussion in the text. Further comments on this point would require some technical discussion, avoided here since the main conclusion would remain unchanged.

in both directions. In the following discussion we shall therefore refer to the estimates in the last row of Table 28. The degree of differences in each direction will be discussed later.

TABLE 28. *Production Elasticity Estimates*[a]

Allowance for effect	*Restrictions on B_i and B_t*	*Labor* X_1	*Capacity of livestock structures* X_2	*Value of cattle* X_3	*Land* X_4	*Raw materials* X_5	Σa
None	$B_i = B_t = 0$	0.130	0.104	0.0043b	0.037	0.692	0.967
Year	$B_i = 0$	0.153	0.101	0.0042b	0.032	0.679	0.969
Farm	$B_t = 0$	0.083	0.156	0.0021c	0.002c	0.635	0.878
Farm and year		0.115	0.100	0.005c	−0.007c	0.582	0.795

[a] Unmarked coefficients are significant at the 5 per cent level; coefficients marked b are significant at the 20 per cent level; and those marked c are not significant at a plausible level. Farm effect $(B_i = M_i A_m)$ differs from zero at the 0.1 percent significance level, and year effect differs from zero at the 2.5 per cent level. The last column does not include elasticity of management.

The estimate of production elasticity with respect to labor of 0.115 means that a 1 per cent increase in labor was associated with a 0.115 per cent rise in output. A similar interpretation holds for the other estimates. Thus production elasticities indicate how output can be affected by an increase of one productive factor or another—and a connection between differences in output and differences in input has been established.

The sum of elasticities of all productive factors (Σa) shows the percentage increase in output associated with a 1 per cent increase in all productive factors. The value found is 0.795 (Table 28). This sum of course does not include the production elasticity of management. In this sense the function is not complete. However, if we add management we may assume that the function includes all important productive factors. If the condition of complete divisibility of productive factors is fulfilled, the sum of their elasticities should be unity. Thus an estimate of managerial elasticity can be made by calculating the difference between unity and the sum of the remaining elasticities, or as in our case between 1 and 0.795=0.205. This means that a 1 per cent increase of management caused a rise of 0.2 per cent in output.

Examination of the significance of the coefficients shows that land and cattle elasticities do not significantly differ from zero at any plausible significance level. As for cattle we shall eventually see that the correct elasticity should be very low and it is difficult to differentiate statistically between the unknown, correct value and zero. Thus, for the rest of the discussion we shall accept the estimate of 0.005 appearing in the table. A similar explanation might be proffered for land elasticity which received a negative value but does not differ significantly from zero. Such an explanation would require further discussion as there is no reason to assume *a priori* that elasticity is close to zero. We shall return to this point later. However, in the calculations below we shall assume that land elasticity is zero.

Additional meaning may be attached to the production elasticities. When the farms are in equilibrium under perfect competition, the value of the marginal product of each productive factor will equal the wages paid each factor. The production elasticity therefore shows the percentage of revenue that should be paid for each factor.[5]

With this in mind and assuming that the farms are not far from equilibrium, we note that most of the output is used as payments for capital and raw materials. By subtracting raw materials we can get an idea of the distribution of added value among the factors. To do this we assume that each IL of raw material expenditure bears 10 per cent interest; the interest should be calculated as a capital payment and separated from the expenditure on raw materials. Hence, we find that raw materials account for approximately 53 per cent ($58 \div 1.1$) of output.

Gross added value, which reaches 47 per cent, should then be distributed as follows: 24.5 per cent as labor payments, 33 per cent as capital payments, and 42.5 per cent as management return. Since land elasticity is nil, no return for this factor is included. It is important to remember that the above values relate to distribution of output when the farms are in equilibrium. Before we continue, it is worthwhile examining this point a little further.

5. *Value of the Marginal Product and Use of Production Factors*

Production elasticities answer the first question posed in the preface to this chapter: how will a change in the amount of one of the productive

[5] Production elasticity equals the ratio between marginal product and average product. Thus for a factor j we have:

$$A_j = \frac{MP_j}{AP_j}$$

Equilibrium conditions imply $MP_j = \frac{W_j}{P}$, where W_j is the wage of factor j and P is the price of the product.

Hence: $A_j = \frac{\text{Payments to factor } j}{\text{Total value of product}}$

services influence output? The next question demanding attention is: was it worthwhile to make such changes, and if so—in what direction and with which inputs? The following table presents a comparison of the value of marginal product of various factors with their market wages. The comparison is made at the geometric average of all variables—hence at the average level of productivity for the entire period and for all farms.

TABLE 29. *Value of Marginal Product*
(IL per factor unit)

Factor unit	*Mandays*	*IL 1 of capacity of livestock structures*	*IL 1 of cattle*	*Land (standard dunam)*	*IL 1 of raw materials*
VMP at 1954 prices	4.04	0.285	0.058	5.4	1.12
Factor wages	4.75	0.270	0.100	—	1.10

NOTES: Labor wages were those paid in 1954. Wages for other years (at 1954 prices—deflated by the Consumers' Price Index) were: 1955—5.95; 1956—5.75; 1957—6.00; 1958—5.97. These results were obtained from the sample. Interest of 10 per cent was assumed for all capital items.
Depreciation on structures and equipment was taken at 8 per cent per annum—hence annual expenditure on IL 1 in structures and equipment is 10 per cent interest plus 8 per cent depreciation, or a total of 18 per cent. But on every pound invested in building capacity there is extra equipment. We assume the ratio between value of building capacity and extra equipment on the farm to be one to one-half. Thus, for each IL in structures an extra IL 0.5 should be added—representing investments in other pertinent items. The price of capital in structures would then be $1.5 \times 0.18 = 0.27$.
Capital costs on livestock include interest alone and those on raw materials are IL 1.10, i.e, principal and interest.

The main conclusion from the above comparison is that the value of the marginal product is well adjusted to input wage rates. A slight difference exists in labor, where the value of the marginal product is lower than wages. In an annual analysis, the results of which are not presented here, it was found that the value of the marginal product of labor was especially low during the first two years; in later years it rose and even exceed labor wages. Since we are dealing with the period as a whole it is plausible that our result stems from low labor productivity at the beginning of the period. In Chapter 2 we pointed out that average labor input diminished over the years while at the same time the amount of capital increased. This helps exlpain the annual trend of marginal output of labor.

There is close agreement between the wage rates and the value of the marginal product of expenditure on raw materials on the one hand, and of value of structure capacity on the other. As for cattle, the value of marginal product equals 6 per cent interest. If 10 per cent has to be paid the existing gap calls for a reduction in herd size—but it should be remembered that the significance of cattle elasticity was low and care must be taken not to regard our results too literally.[6] We shall return to the above variable in the discussion on cattle.

The value of the marginal product of land will be discussed in the next section after examination of the technical problems connected with measuring land elasticity. As for the other factors we may sum up by saying that at the prices prevailing for that period it was not possible to make serious readjustments in their use and thus raise income. Where a gap for the labor factor may have existed the farms adjusted themselves by diminishing the amount of work and increasing the amount of capital. Finally, two remaining points need closer examination: (1) Why is the value of the marginal product of land of those farms so low? (2) What is the significance of the returns to management and this factor's influence on use of productive factors and size of farms?

6. *Use of Land*

Before examining the implications of zero marginal productivity of land it is desirable to try and see if no technical or conceptual errors have crept into our analysis. Land is measured in units of irrigated dunams. Dry-farmed areas were converted to irrigated dunams at a four to one ratio. It may very well be that this rate of substitution is incorrect. However, even without testing other ratios it can be assumed that noticeable changes will not take place. Only in two of the five villages studied were there large areas of dry farming. The same two villages are at the output extremes: E is the largest producer and C the smallest. Hence, if any bias exists in the analysis it would presumably be offset.

The best way to avoid problems of aggregation of land and water would be to deal with each factor separately. This was not done in the first place because water data were incomplete. But in view of the importance of this point it was desirable to use any data that were available and could shed further light on it. Consequently, analysis was carried out for those villages and years where water consumption records existed. The investigation was conducted in two groups: (a) villages D and E during the years 1954–58, and (b) all villages except A during the period 1955–57. This analysis gives the amounts of water consumed and the physical area at the disposal of the farms. Since the data here are not identical with those of the general analysis the production function was also

[6] Statistically, the difference between 6 and 10 per cent is not significant.

calculated with standard area for the partial data, so that comparison would be possible. Results appear in Table 30.

The upper half of Table 30 deals with villages D and E which are the largest users of inputs and also the largest producers. E has the largest land area, only partly irrigated, whilst most of the land in D is under irrigation. Hence, we have different combinations of physical area and water. In a comparison of farms (with no allowance for effects) land elasticity is significant at a low level of significance, whereas water elasticity is significant. With allowance for effects, however, water elasticity does not differ significantly from zero. A similar situation emerges from the analysis of the four villages.

The significant elasticity of water arrived at in the analysis of D and E, when no allowance is made for farm effect, may reflect either a positive correlation between water utilization and the farm effect (the managerial factor) or the fact that water elasticity is actually different from zero. If the latter possibility were correct, a similar result should have been obtained from the analysis allowing for the farm effect.[7] This means that variations in water utilization over time should have been reflected in output. It may be noted that allowance for year and farm effects results in insignificant elasticities of both water and land. Hence, there is no reason to conclude that elasticity is other than nil, and the first possibility—that a positive correlation existed between use of water and management—is acceptable. We may therefore conclude that the low elasticity calculated for area measured on the basis of irrigated land (standard area) does not reflect incorrect measurement of the two components land and water.

A second point revealed by the analysis is that the use of physical quantities of land and water instead of standard area (on the basis of irrigated dunams) did not drastically change the estimates of the elasticities of the other factors. This is especially true for equations in which farm and year effects were allowed for. This finding can be applied as well to the original analysis presented at the beginning of the chapter which covers the entire sample for the entire period.[8]

[7] Such a result requires that there be variations in water utilization after the allowance for farm and year is made. This was actually the case here.

[8] An additional point made clear from this analysis does not relate to land and water but aids in understanding the other results. Village D and E are the largest employers of production assets and other factors, but the relative difference in labor inputs between them and the other villages is smaller than that existing in utilization of the remaining factors or in output. As a result, a high labor elasticity and low elasticity with respect to capacity of structures are found for D and E, whereas in the general analysis or that of the four villages labor elasticity is lower while that of capacity is higher.

TABLE 30. *Production Elasticity Estimates for the Analysis, Including Land and Water*[a]

The equation: *Village*	*Period*	*Effects*	R^2	*Labor*	*Capacity of livestock structures*	*Value of Cattle*	*Raw materials*	*Land: standard dunams*[b]	*Land: physical area*	*Water*
D, E	1954–58	No allowance	0.939	0.240	–0.015c	0.059b	0.673	*	0.057b	0.105
			0.937	0.251	–0.050c	0.115	0.711	0.078b	*	*
		Year and farm[c]	*	0.273	0.026c	0.018c	0.515	*	0.088b	0.024c
			*	0.271	0.024c	0.028c	0.512	0.086c	*	*
B, C, D, E	1955–57	No allowance	0.926	0.139	0.075	0.006b	0.684	*	0.022b	0.023b
			0.930	0.141	0.073	0.009	0.684	0.043	*	*
		Year and farm[c]	*	0.14.3	0.106b	0.006c	0.569	*	0.010c	0.018c
			*	0.126	0.111b	0.005c	0.565	0.009c	*	*

[a] Coefficients with no marks are significant at the 5 per cent level; coefficients marked b are significant at the 20 per cent level; and those marked c are not significant at a plausible level. The symbol * means not included in equation, or not computed.

[b] See Table 8, note d.

[c] The values of R^2 for the 'year and farm effects' were computed. It is known from statistical theory that they cannot be smaller than the corresponding value obtained for regular regressions.

In the light of the above discussion the results appearing in Table 28 are acceptable for the remainder of our analysis. It is, however, desirable to observe the two estimates of production elasticity for standard area. The estimate obtained with the allowance for effects of year and farm is almost zero, whereas that obtained with allowance for year effect alone is 0.032. This estimate is likely to be biased upwards, due to omission of the managerial factor from the analysis, and hence can serve as an upper boundary. The 'true' value is probably less; but even 0.032 is not a high value and shows that only 3 per cent of value output can be attributed to land and water.

If we calculate the value of the marginal product of standard area according to an elasticity of 0.032, the result is IL 25. From this must be deducted water costs at 1954 prices for that area which was irrigated. The remainder will be the return to land including the permanent irrigation equipment belonging to it. In 1954 water consumption costs were approximately IL 15–16 per irrigated dunam. Irrigated land comprised 77 per cent of total standard area. Hence water costs per standard dunam were close to IL 12 and the value of the marginal product of an irrigated dunam is approximately IL 13. This value must be equated with the market price of a year's use of land. Rental fees paid to the Jewish National Fund cannot serve as a criterion since it is not possible to rent unlimited area at that price. The suitable price would be rental fees when rental takes place directly between farms. Leasing or letting of land by the sample farms was limited and data on rent are few and show extremely low prices. A superficial examination of other cases shows the price to be in the vicinity of IL 10–20 per dunam. These findings are consistent with our own presented above.

All this goes to prove that the value of the marginal product of land and water is low. From the point of view of economic significance it is unimportant whether the marginal product is nil or some positive value near zero. The important point is that it is usually accepted as a fact that moshav farms are small as far as land area is concerned and therefore intensive cultivation could be expected from them. This would create a relatively high marginal product of land. Why, then, was a low value of marginal product found?

A zero value of the marginal product means that adding an additional dunam to the farm, all other factors being constant, will have no effect on output value. The reason is that to cultivate the additional dunam other productive services are needed. Since we have held them constant for the entire farm they must be transferred from other branches. By so doing, output will be reduced in those branches. The value of the marginal product of the land would then be the difference between output value of the additional dunam and the decline in output value in the branches from which the production factors were taken. The productive services may be taken from the already cultivated area of the same branch but this would not change the analysis. This may be seen from the following equation, derived from Euler's theorem:[9]

$$(2) \qquad MP_1^A = \frac{Y_A}{X_1} - \frac{X_2^A}{X_1} MP_2^A - \cdots - \frac{X_k^A}{X_1} MP_k^A,$$

where MP_1^A represents the marginal product of land on the farm, land being utilized for production of product A. $\frac{X_j^A}{X_1}$ is the quantity of input j per dunam in branch A, and $\frac{Y_A}{X_1}$ is the output per dunam in the same branch. Production factors $X_2 \ldots . X_k$ can be used in other branches as well. The condition for optimum allocation of these factors is that the value marginal product of any factor be equal in all branches.

Assume two branches A and B. We then find:

$$VMP_j^A = VMP_j^B; \text{ hence } MP_j^A = MP_j^B \frac{P_B}{P_A} .$$

Substituting this condition in the above expression, we obtain:

$$(3) \qquad VMP_1^A = P_A MP_1^A = P_A \frac{Y_A}{X_1} - \frac{X_2^A}{X_1} MP_2^B P_B - \cdots - \frac{X_k^A}{X_1} MP_k^B \cdot P_B .$$

The value of the marginal product of land equals the difference between value output per dunam $(P_A \frac{Y_A}{X_1})$ and the alternative costs connected with the cultivation of that dunam. The costs depend on the price ratios between the alternative branches (represented by B above) and the branch which utilizes land (branch A). The more profitable the alternative branches become, the lower will be the value of the marginal product of land.

If the farms were in equilibrium in the use of all productive services then the value of the marginal product of each factor would equal its wages, and by substituting $W_j = \text{VMP}_j^B$ we arrive at:

$$(4) \qquad VMP_1^A = \frac{P_A Y_A}{X_1} - \frac{X_2^A}{X_1} W_2 - \cdots - \frac{X_k^A}{X_1} W_k .$$

[9] Euler's theorem: $MP_1 X_1 + \ldots + MP_k X_k = Y$. By isolating MP_1 we arrive at the formulation in equation (2). This analysis applies to a linear and homogenous function, which may serve as a good approximation to the 'true' situation.

Alternative costs here are the direct costs on the various production factors. From the above expression we find that the higher the factor wages—relative to the price of the product—the lower the value of the marginal product of land. From all of the above it is clear that the explanation of the low marginal product of land demands examination of market prices and their effect on the allocation of productive factors on the farm. It should be emphasized that a low marginal product of land does not mean that no output is produced by land or that yields are small. The phenomenon is economic and not physical. No matter what the output is the comparison is between the value of output and possible alternatives available to the farm.

To find the reason for a low value of the marginal product of land, let us suppose that farms react to price ratios by adjusting production to price changes. This assumption will be subject to a more detailed and direct examination and will be laid down in the following chapters. At this point, it enables some deductions to be made regarding profitability of various branches. Since the main expansion of production—both relative and absolute—took place in the livestock enterprises, we may infer that they were the most profitable. The productivity of inputs in these branches comprises the alternative costs of field crops, as expressed in (3) above, if we define livestock as B and field crops as A. Expansion of livestock branches was accompanied by contraction of vegetables and other cash crops. As for vegetables, it may be said that not only did prices fall at the beginning of the period discussed but that they were subject to large fluctuations—which caused uncertainty among producers. Uncertainty usually affects production similarly to price decline: the greater the uncertainty (without changing average price) the greater the inclination to decrease production. This is reflected in the comparatively low value of P_A: hence, the small difference between the returns to land and alternative costs.

The decrease in vegetable crop area was accompanied by a large increase in area under forage crops which occupied 90 per cent of the irrigated crop area in 1958. The question is: how did this affect the marginal product of land? Forage is an intermediate product—produced and consumed on the farm. Fodder produced on the farm is mainly roughage and is fed the cattle together with concentrates, usually purchased from external sources. Both types of feed (roughage and concentrates) can be given in various combinations. Thus, the value of fodder produced on the farm is fixed according to the rate of marginal substitution between the two feeds (S_{CA}) and also by the price of concentrates (P). The condition for producing a given output at lowest possible costs is:

$$S_{CA} = \frac{P_A}{P_C} = \frac{MP_A}{MP_C},$$

where MP_A represents the marginal product of roughage, and MP_C the marginal product of concentrates in milk production. Hence: $P_A = S_{CA} P_C$. If we substitute this expression for P_A in (3) we find that:

$$(5) \qquad VMP_1^A = \frac{Y_A}{X_1} S_{CA} P_C - \frac{X_2^A}{X_1} MP_2^B P_B - \cdots - \frac{X_k^A}{X_1} MP_k^B P_B .$$

If all other prices are held constant and the price of concentrates is reduced, the value of the marginal product of land will fall. With the reduction in its price, input of concentrates will be increased and substituted for roughage; factors of production engaged in roughage production will thus be freed and transferred to other branches where they will increase output. Although the rate of marginal substitution of concentrates (S_{CA}) rises with this process it does not rise at the same rate. A similar effect is achieved by a price increase for livestock products (P_B). In other words, this will cause expansion of the livestock branches because of increased profitability (a result of the rise in P_B). Such an expansion is made possible by absorption of productive factors utilized in fodder production—thus contracting fodder output and increasing concentrate consumption. The marginal product of land is also determined by the productivity of the various inputs as expressed by their marginal product, and by the productivity of forage crops as measured by average output per dunam ($\frac{Y_A}{X_1}$). This productivity is affected by relative amounts of the various inputs and by the general level of productivity. An increase in the marginal productivity of inputs engaged in livestock production will cause a fall in the value of the marginal productivity of land. From all this we may infer that at the existing prices, during that period, there was no advantage in more intensive cultivation of the land—a practice which would have been reflected in a positive marginal product of land.

7. *Management*

In the discussion on production elasticities reference was made to the elasticity of production with respect to management, which was calculated under the assumption of constant returns to scale. Management elasticity was given the same meaning as the other elasticities: when the farms are in equilibrium the elasticity shows that proportion of total value output which remains as a return to management. This part is the difference between the value of total output and all input costs or—simply—net income. This sum includes fixed costs to the farm covering all costs not pertaining to those inputs included in the analysis; however, from a functional point of view, it reflects management's contribution.[10]

This calculation of the share of management in total output or in added value was made under the assumption that the estimated elasticities are the correct elasticities and that the farms equated the value marginal product of the inputs with their market wages. However, since we have noted that certain discrepancies exist between the value of the marginal product and input wages it would be of interest to calculate the added value and the share of management in it, according to actual expenditures on the various factors. The computation was made at the point of the geometric averages of inputs and output. Wage rates are those appearing in Table 29. The results are: added value comprises 48 per cent of output, divided into 32 per cent to capital, 33 per cent to labor, and 34 per cent to management.[11] The difference between this and the previous estimate (see p. 64) reflects either sampling errors in the estimates or deviations from the point of equilibrium. In either case, management's share in total output is liable to range anywhere from 34 to 42.5 per cent.

The above calculations show that, on the average, returns to management were large in relative terms—it is difficult to judge whether they were large or small in absolute terms. Returns to management, *less* fixed costs, have to cover the alternative costs of the farm owners in other sectors of the economy, and these are difficult to ascertain.

The discussion of management up to this point has focused on the calculation of management elasticity and its significance. The next problem is to find a measure for management in individual farms. The point of departure is the very definition of management—the comparison between output of a certain farm and average output of all farms having the same input level. However, since the various farms employ varying quantities of the several inputs, a common denominator must be found for them all—this is the point of the averages of all inputs. That is, if a farm employs a greater amount of any input, its output will be greater because of this. However, if we deduct the influence of the difference of inputs

[10] In equilibrium $A_j = \frac{X_j W_j}{PY}$. Since $A_m = 1 - \Sigma A$, we get:

$$A_m = \frac{PY - \Sigma X_j W_j}{PY} .$$

[11] It should be mentioned that in Chapter 3 added value was calculated at the point of arithmetic averages—hence the difference in the percentage which added value occupies of total output. An additional reason for discrepancy is that in this chapter output includes poultry inventory at year's end and raw materials include the inventory at the beginning of the year, as described early in this chapter.

between the individual farm and the overall average it will be possible to compare its output with those of the other farms. The estimate thus arrived at is actually a least squares estimate and has the desirable statistical properties.[12] The estimate is in output units (in logarithms) and actually measures the product of management *times* its elasticity ($A_m\ M_i$). The estimate is:

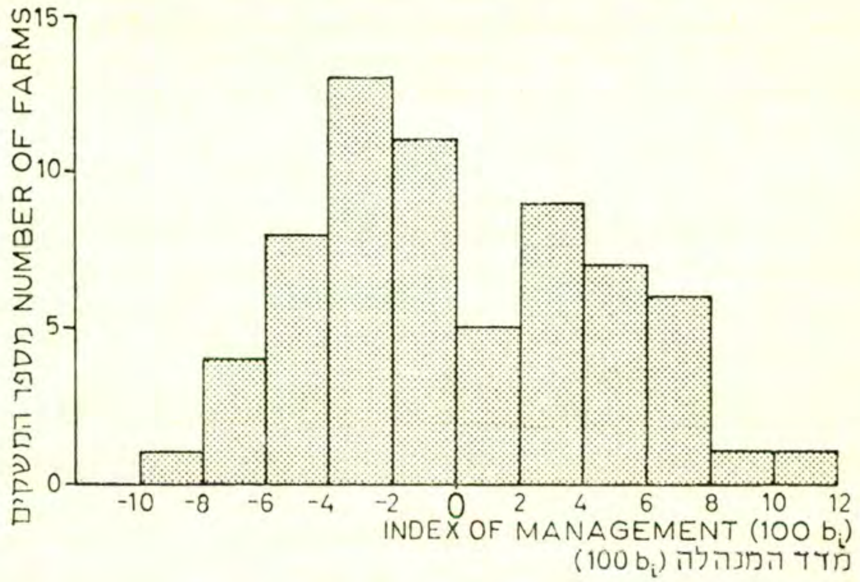
$$b_i = (Y_{i\cdot} - Y_{\cdot\cdot}) - a_1(X_{1i\cdot} - X_{1\cdot\cdot}) - \cdots - a_k(X_{ki\cdot} - X_{k\cdot\cdot}),$$

where $Y_{i\cdot}$ is the average of the logarithm of output in farm i for the entire period; X_{1i} is the average of the logarithm of X_1 in farm i for the entire period etc.; $Y_{\cdot\cdot}$ is the average of the logarithm of output for the entire period and the entire sample; $X_{1\cdot\cdot}$ is the average of the logarithm of X_1 for the entire period and the entire sample etc.; and $a_1 \ldots a_k$ are the estimates of the elasticities $A_1 \ldots A_k$. Hence, b_i may be said to express by how much output will increase in farm i over average output when the difference between the inputs of farm i and average inputs for the entire sample are taken into account. Since the calculation is made in logarithms, b_i is the estimate of $A_m \log m_i$. The distribution of the values computed appears in Figure 3. The value of b_i varies from –0.087 to 0.1157, or if we calculate the original values (not logarithms)—those of m_i rather than of $M_i = \log m_i$—we find the coefficient values running between 0.818 and 1.305. This means that for a given bundle of resources the least efficient farm produced 82 per cent and the most efficient farm 130 per cent of average output for the entire sample, or a difference of approximately 58 per cent. The difference in management itself is of course much greater. To isolate management the product must be divided by the managerial elasticity estimate (A_m). The estimate obtained for elasticity is $a_m = 0.2$. Accordingly, the range of the logarithm of management is from –0.435 to 0.5785 or, in original units, from 0.367 to 3.789. Thus, management in the most efficient farm is approximately ten times that of the least efficient.

The differences in management are reflected in two forms. First, as stated, the good managers achieve a larger output for a given amount of inputs. Second, an increase of management raises the productivity of other inputs, just as an increase in capital per laborer increases the productivity of labor. An increase in productivity of inputs raises the demand for them and at fixed prices the amount employed will be enlarged. Hence, the better managers will employ more productive factors.

[12] See Mundlak, ***Empirical Production*** op. cit.

FIGURE 3. *Distribution of Management Values*



We can now summarize the factors affecting output differences among farms as follows:

(1) Differences in inputs, the sources of which will be discussed later.

(2) Differences in management, which are partly reflected in variations in inputs and partly in fluctuations of output at given inputs.

(3) Random disturbances, which do not lend themselves to direct measurement.

The coefficient of determination (R^2) indicates the degree of fit of the production function and thus reflects the contribution of input variations to the explanation of output differences. The question now is what effect did the other factors mentioned have and, especially, what was management's contribution? To answer this we must calculate the variance of output for a given input basket (thus ignoring the problem of input fluctuations) and divide it into the following components:[13] (1) variance of the random factors; (2) variance of the contribution of total management to differences in output; and (3) variance of the contribution to output of

[13] The statistical problems connected with such calculations will not be discussed here, but we wish to note the difference between calculations to be made later and the range computed in these pages. The former will be for the extreme farms of the sample, whereas the calculations here give the estimates of the parameters for the population of all managers (of moshav farms).

that part of management not reflected by differences in inputs. Comparison of the variances presents a measure of the relative contribution of each one of the components. Values were computed in logarithms. The results are 0.002329, 0.002037, and 0.001041, respectively. The first figure shows what the variance of logarithm value of output would have been had there been no differences in management and if the only source for variation were the random disturbances. The second number points out what the variance of logarithm output would have been in the opposite case where there were no random disturbances and where only differences in management had any effect. The sum of the above two values gives us total variance, which is 0.004366; of this, management's share is 47 per cent. Hence a large portion of output variability is explained by differences in management.

It has already been indicated, however, that a portion of managerial influence is in the employment of more inputs. It would thus be interesting to separate this component from that reflected through the output achieved with given input. The variance of the latter is the third figure and it amounts to 52 per cent of the total managerial variance. Therefore, half the differences in management among the farms are reflected by larger inputs.

To substantiate the significance of our results we can construct production intervals so that 95 per cent of all farms (or any other proportion we choose) fall within them. The range of the interval is directly related to the variance. The limits are computed for a given input basket but the ratio (L_2/L_1) between the upper limit L_2 and the lower L_1—which denoted the relative dispersion—is independent of the size of the basket.[14]

The results are presented in Table 31.

The explanation given the intervals is as follows: were all factors affecting choice of inputs—excepting management—to be fixed, the actual

[14] The interval is computed as follows:

$$P\left\{\left|\frac{Y^* - Q^*}{\sigma y^*}\right| \leqq K_{\alpha/2}\right\} = 1 - \alpha,$$

where Q^* is the expected value of output Y^* given the input basket X^*. $K_{\alpha/2}$ is determined so that probability will be at a level of $1-\alpha$. σy^* the standard deviation of Y^*. To simplify the presentation we shall ignore sampling errors; hence the random variable $\frac{Y^* - Q^*}{\sigma y^*}$ has a normal distribution. After opening the brackets and converting from logarithms into the original values, we have:

$$P(L_1 \leqq Y^* \leqq L_2) = 1 - \alpha,$$

where $L_1 = 10^{Q^*}H^{-1}$ and $L_2 = 10^{Q^*}H$ for $H = 10^{\sigma_{y^*} k_{\alpha/2}}$ —i.e. we arrive at an interval within which log output will fall in $1-\alpha$ of the cases. In the above presentation we chose $1-\alpha = 95$ per cent.

choice of the input basket would reflect management alone. In this case the relative interval for output would have been between 1 and 1.5—assuming the nonexistence of random disturbances. In other words, the maximum output would have been 1.5 times the minimum output (first line of Table 31). By deducting the effects of managerial differences of input the relative interval would be reduced to 1.34 (second line). This can be compared with the interval set if there were no managerial differences and output fluctuations were to arise only as a result of random disturbances (the input basket given). The relative interval in this case would be 1.55 (third line). The combined effect of randomness in production and management results in a relative interval of 1.82 if total management is taken into account, and 1.69 without differences due to management.

TABLE 31. *Confidence Limits for Output Obtained from Fixed Basket of Inputs*

Source of variance	L_1	L_2	L_2/L_1
A. *Individual components*			
1. Total management	0.816	1.226	1.50
2. Management not reflected in inputs	0.864	1.157	1.34
3. Random disturbances	0.804	1.243	1.55
B. *Combined components*			
4. (1) with (3)	0.742	1.347	1.82
5. (2) with (3)	0.769	1.300	1.69

From the above it is obvious that dispersion of output and thus of income depends considerably on management. Increased output from a given input is identical with increased revenue at a fixed cost level. The relative increase in net income is clearly larger than the relative increase in output itself. This can be seen from the following relations; if we define net income as I, revenue as R and costs as C, we arrive at $I=R—C$. Let us assume that due to management output is enlarged by 35 per cent. We can then compute the ratio between net income in the two instances:

$$\frac{I_2}{I_1} = \frac{(1.35)R - C}{R - C} = 1 + \frac{0.35R}{I_1} = 1 + \frac{0.35}{A_m};$$

and assuming $A_m=0.2$ we find $I_2/I_1=2.75$; where I_1 is net income of the low output farm (revenue R) and I_2 is the net income of the high output farm (1.35 R). The effect on net income thus depends on the ratio of revenue to net income, or approximately the reciprocal of management elasticity. Since the estimate of management elasticity is 0.2, net income will increase five times as much as output. In the above example a 35 per cent increase in output will raise net income by 175 per cent. In other words, the ratio between net incomes of the high output and the low output is 2.75. All of this was carried out with a basket of fixed inputs. However, should inputs expand due to management, the ratio would become even greater. The upper limit would be fixed by taking a 50 per cent difference in output instead of 35 per cent (line 1 in Table 31 instead of line 2) and the resulting ratio between the top farm and the bottom farm would be 3.5. The actual ratio would be slightly lower since higher output is partly achieved by increasing inputs, and costs thus also rise.

Calculations of net income indicate that differences in net income among the farms are larger. In 1958 the ratio between the top and bottom farms in a range which corresponds to that taken here was approximately seven to one.[15] Such a gap may reflect three additional influences besides management: (1) that of random factors; (2) price differences among farms, and (3) differences in input utilization not associated with management. Since our assumption is that the random factors are independent of management they will always act to increase dispersion of output achieved with a given amount of inputs, thus increasing dispersion of net income. From line 5 in Table 31 we note that the combined effect of these two factors creates a ratio of approximately 1.7. According to the method used above such a ratio corresponds to a relative range of 4.5 to 1 in net income instead of that of 2.75 to 1 found earlier.

If price differences exist their influence is liable to be in two directions. If the more efficient farms receive higher prices for their produce or pay lower prices for inputs price effects would act to increase the net income gap. If the correlation between prices and management is inverse, the gap would be closed. Superficial examination showed that positive correlation existed in the sample. Price thus contributed to widening the gap.

The last factor is variations in input utilization. We shall enter into a detailed discussion of this at a later stage. However, we may note here that when the production function is of the Cobb-Doublas type, demand elasticity of inputs according to management is unity. Thus, all other factors influencing demand (prices, etc.) being given, the extent of inputs must be determined by management alone. In this case all farms would be operating at the same input ratio and the correlation between

[15] Calculated according to the distribution in Y. Lowe and Y. Remer, *Profitability of Established Moshavim in 1959 as Compared with Previous Years,* Ministry of Agriculture and Jewish Agency Extension Service, October 1960, p. 11, Figure 1 (Hebrew). To take 95 per cent of the farms we subtracted two farms from each side.

quantity of inputs and management (all in logarithms) would then have to be unity. Since we have an estimate of the management index we can calculate the correlation between it and inputs. The results are as follows: labor—0.602, raw material costs—0.617, value of livestock at the beginning of the year—0.135, building capacity—0.402, and land—0.492. Since correlation is not unity we can infer that additional factors are active, outside of management, and effect input differences among farms. It is interesting to note that high correlation was found for labor and costs which can be changed in a comparatively short time. Correlation between management and land does not have the same meaning as that for the remaining inputs since possibilities for varying land area are limited. The explanation which can be offered is that the better managers were found on farms with larger land units.

A closer examination of farm behavior is presented in the next chapter. Farm behavior depends first and foremost on the production function. To analyze farm behavior we shall have to restrict ourselves to a few branches —mainly poultry—both for lack of sufficient data to analyze behavior for the composite output and because of conceptual difficulties in analyses of this type. However, the production function found was for aggregate output. Thus, if we wish to use the estimates of the production function for explaining behavior we must first examine the relations between the aggregate function and the functions of the individual branches which comprise the aggregate. We shall deal with them after discussing the annual increase of productivity.

8. *Estimate of Productivity Increase*

In Figure 2 we demonstrated the meaning of an annual increase in productivity. At the time, it was noted that the analytical aspects of the effects were similar to those of management. The difference between the two is that whereas management effects were found by comparing different farms, productivity is tested by comparing the output of a certain year with average output for all years, after allowing for input variations in different years. As a result the comparison is made for a given input basket—the average basket for the entire period. The calculation, as in the case of management, is made in logarithmic values and, after translation to original values, an index expressing annual productivity is provided. The geometric average of the index is unity. The results obtained were: 1954—0.947; 1955—0.986; 1956—1.023; 1957—1.008; and 1958—1.038. Average of all farms' production in 1954 was approximately 94.7 per cent of average production for the entire period evaluated for the same input basket. A similar explanation holds for the other years. For the first two years the annual increase in productivity was at the rate of approximately 4 per cent per year. In 1957 poultry production dropped following a serious shortage of feeds. This drop had great influence on the productivity index since, in calculating it, allowance is made for all inputs including building capacity at the disposal of the farms. Part of the buildings stood idle and were therefore not reflected in output. Because of this a 4 per cent annual increase is possibly more characteristic of these farms than a 2.3 per cent rate found for the entire period. The above rise in productivity reflects the situation in the established moshavim alone and is not typical of the entire moshav movement. Even at present, a productivity gap exists between the established and the new farms. The gap will close as the new settlers gain the experience and knowledge possessed by the veteran farmers. It is therefore plausible to presume that the annual rate of increase in agricultural productivity in Israel in the near future will be larger than was found in our survey.

The rate of increase in output caused by rising productivity is greater than the rate of increase of productivity itself. This is because increased productivity raises the demand for productive factors. Hence increased output is the result of additional inputs as well as rising productivity. This is reflected in the data which show an overall productivity rise of 10 per cent whereas output for the same period grew by approximately 52 per cent.

9. *Breakdown of the Aggregate Production into Branches*

The dependent variable in the production function which we estimated was total value output of the farm. It included the value output in the individual branches. The explanatory variables were the farm inputs, with no differentiation as to allocation among branches. The production function is an expression of technological relations between inputs and outputs which change from enterprise to enterprise. The question, then, is what significance can be attached to aggregate function? In three cases a clear and definite meaning can be attributed to the aggregate function: (1) Fixed relations exist among branches; in such a case all characteristics of a single product production function apply to the aggregate function. (2) No constant relations exist among branches, but the individual functions of each branch are identical; in this case the aggregate function is identical with its component functions and so no special problems arise. The relative importance of both these cases is small since such conditions rarely exist. (3) The third case is the most important one. It deals with a situation where the relative prices of outputs comprising the aggregate and the various inputs remain constant. In this instance, and given some other conditions not to be specified here, a unique relationship exists between inputs and aggregate output. In these circumstances the aggregate function enables us to get meaningful solutions to the problems dealt with in the foregoing discussion. Specifically, these involve the examination of the effect of input changes, including management, on output; estimation of the annual increase in productivity and its effects on output; and finally examination of the influence of a change in the ratio between prices of inputs and the weighted price of aggregate output on employment of inputs and on aggregate production. When the period analyzed is short the assumption of stability of relative prices may, in fact, prove valid and the results achieved retain the meaning attributed them above. This very problem also exists in empirical research on Engel curves; strictly speaking the results are only applicable to situations where the appropriate price ratios remain fixed. When the price ratios change, the results of the analysis will change accordingly.

It can be shown that in the case under discussion the coefficients of the aggregate function are a combination of the coefficients of the component functions, the weights reflecting the relative importance of each branch. But the relative importance of the various branches depends on the price ratios. Consequently, the weights of the aggregate coefficients will depend on prices. This is somewhat disturbing. The production function should reflect purely technological relations and not the behavior of the producers. From the above it is clear that knowledge of the aggregate function alone is insufficient for determining the response to prices in individual branches.

The problem is recognized in agriculture, although not in its present formulation. In various places recommendations can be found which in essence expound the need to base production function analyses on samples taken according to farm types. The difficulty is that no precise definition of farm types exists. The ideal solution lies in single product farms. However, when more than one product is produced on the same farm there are diverse ways of defining farm types, according to the combinations of the products. Consequently, at best, farm types can be defined solely on an operative basis which, conceptually, does not solve the problems of aggregate analysis.

In spite of its limitations, the aggregate function is usually the one estimated in most empirical research, both in agriculture and in other fields. In this there is no parallelism between empirical analysis and discussions in economic literature dealing with a general implicit production function which ties together all inputs and outputs.[16] To empirically estimate a general production function of this type it must first be explicitly

[16] See J.R. Hicks, *Value and Capital*, Oxford, 1939, pp. 319–20.

formulated so that all the conditions required of such a function be fulfilled. Next a method of estimation must be found whereby the estimates will have optimum statistical properties.[17]

Two alternative approaches may be offered instead of the general one. The first is to estimate the functions for each branch. This is possible if data on outputs and inputs are available by branch. In our case such data do exist on the output and for some of the inputs. For this reason it was necessary to use external information to complete the analysis. The second approach turns the limitations of the aggregate analysis into an instrument for breaking the aggregate function down into its components. Here we utilize the fact that the coefficients of the aggregate function consist of combinations of the component elasticities with weights representing the relative importance of the branches. Since the weights are known it is possible to estimate the aggregate function for samples with different weights or in farms of varying types—and thence to receive the component estimates. The foregoing approach does not demand any arbitrary and yet inflexibile definition of the term 'farm types'. Only a division of the sample into groups with varying weights is needed. In this study we have used the second approach as a check on the plausibility of the estimates calculated by the first approach.

The analysis was conducted for the two main branches, cattle and poultry, and the results are presented in Table 32. A comparison of the estimates in the first two rows of the table points to the differences in input productivity in the two branches. Of the three inputs listed for both branches significant differences exist in the elasticities of labor and raw materials, whereas for structure capacity elasticities are more or less equal.

As indicated, the aggregate elasticities may be thought of as weighted averages of the corresponding elasticities of the individual branches. Hence, the value in the table can be accepted as limits between which aggregate elasticities will fluctuate. Since the limits are far apart the possible fluctuations in the estimates of the aggregate function will also be fairly large.

So far we have not given any details as to the weights according to which the component elasticities make up the aggregate elasticity. The weights vary with the assumptions made as to farm behavior. When the farms are in equilibrium (i.e. all inputs are employed in the branches to the point where their value of marginal product is equal in all branches and equal to market wages), the weights will equal each branch's share

[17] We deal with this problem elsewhere and suggest a formulation for a general function fulfilling the various conditions and with relatively few parameters. See Yair Mundlak, "Specification and Estimation of Multiproduct Production Functions", *Journal of Farm Economics,* May 1963.

of total revenue. This formulation allows us to construct the aggregate function from the elasticity estimates of poultry and cattle, since together they account for about 90 per cent of total revenue. The results of our calculation appear in the fifth line of Table 32. The estimates there were received under the assumption that labor and land elasticity in the branches which contribute the remaining 10 per cent to output are equal to

TABLE 32. *Production Elasticity Estimates in the Cattle and Poultry Branches: 1954–58*

	Weight	*Labor*	*Structure capacity*	*Value of cattle*	*Land*	*Raw materials*
1. Cattle	0.35	0.200	0.095	0.107	0.043	0.300
2. Poultry	0.54	0.060	0.09[a] / 0.13	—	—	0.780
3. Subtotal						0.590
4. Other branches[b]	0.11	0.200	—	—	0.043	0.590
5. Aggregate elasticities	1.00	0.124	0.082[a] / 0.103	0.037	0.020	0.590
6. Estimates of the aggregate[c]		0.115	0.100	0.005	−0.007	0.582

[a] Two alternative estimates were made for poultry structure capacity, and there are accordingly two estimates of aggregate elasticities.
[b] Obtained as the weighted average of the first two lines, except as explained in the text.
[c] From Table 28.

those of cattle. For raw materials the elasticity in the remaining branches was assumed to equal the aggregate elasticity arrived at by weighting the elasticities in the poultry and cattle branches alone. The weights for poultry and for cattle are 0.54 and 0.35 respectively. For beginning-of-year cattle value, the factor was multiplied by 0.35, since it is specific to cattle; similarly, for structure capacity, the factors were multiplied by the livestock weights, since buildings are specific to livestock.

The estimates found by combining the elasticities of individual branches should be compared to the directly found estimates of the aggregate function appearing in line 4 of Table 28 and are written again in Table 32. Comparison of the direct estimates for raw materials, labor, and capacity with the combined estimates shows them to be similar. Less similarity was found for the estimates of cattle value and land. The explanation lies in the relatively large standard error of the estimates for those two variables.

An additional examination was made for the individual villages. From the discussion in Chapters 2 and 3 we know that the composition of output differed from village to village. Thus, different weights were allotted to each village. The elasticities of the aggregate function were made up from the elasticity estimates for three villages, each representing a different type. They were compared with the direct estimates for the individual villages. There was a fair amount of similarity between them but not to the same degree found in the entire sample.

CHAPTER 5

SHORT-RUN SUPPLY OF POULTRY

1. *Introduction*

In this chapter we shall test the basic assumption that producers react to market prices. If confirmed, this will enable us to explain the development observed in the sample farms for the period surveyed and in particular to confirm our assumption that the value of the marginal product of land reflects a reaction to market prices.

This analysis has considerable significance in determining economic policy in agriculture. Over the years an approach has developed which supports widespread intervention in and direction of agricultural production, both as to the quantities produced in each branch and as to their allocation among farms. The means for imposing such a policy are diverse but prominent among them are extensive physical planning determining production quotas, and fixed prices maintained by various means. At this point we shall not examine the basic question—to what extent intervention is consistent with the objectives it has to fulfill, and whether the goals themselves are consistent with an efficient allocation of productive factors in the Israel economy in general and in agriculture in particular. However, we will point out that the success of any efforts dedicated to influencing production depends on the behavior of producers and especially on the degree to which they react to market prices. If production is determined according to market prices and if they are not identical with equilibrium prices there will be a strong tendency for surpluses (scarcities) to form when the price is higher (lower) than the equilibrium price. Production quotas are incapable of substituting for the market mechanism in regulating production. There is no way of forcing producers to produce their full quotas, but only to prevent them from overproducing. In practice even the latter is limited in many cases. If a tendency exists to produce more than the quota, producers find ways of marketing their goods through various channels. It is difficult to prevent such leakages and these may attain dimensions so large that the original purpose is defeated. An example may be found in the extent of nonorganized marketing of eggs in recent years.[1]

[1] This point is discussed in Eitan Hochman's work on the poultry industry (forthcoming).

Thus, it is presumably very important to study producer behavior, especially where intervention in market functions is practised. As stated, the main object of this chapter is to test the assumption that there exists a response to prices. At the same time we shall make a quantitative estimate of the reaction and its speed. This will only be for the sample surveyed. To be able to make generalizations for all producers additional factors must be considered. Generally studies of supply are based on time-series data on quantities and prices for the entire market. Supply analysis from farm data is not intended to replace such aggregate studies but rather to supplement them. The merit of such an approach lies in the possibility of measuring the response at the decision maker's level, i.e. the level of the individual farm. Statistically, the advantage is in the existence of a large dispersion of outputs and fixed factors. The statistical disadvantage is in the small dispersion of prices among farms.

In this chapter we shall deal solely with poultry. In the poultry industry the production process is short and there exist differences in prices which make it possible to analyze supply. The next chapter, which deals with the long-run aspect of the problem, will include a discussion of the cattle branch as well. The remaining branches are relatively unimportant in the sample farms, so there is little point in dealing with them, especially since the data do not allow any type of analysis. On the other hand, if we find that a price reaction exists in poultry, this would imply that such response exists for other branches as well; however, the force of the reaction is liable to be different.

The supply of an individual farm is derived from its production function. Hence if the production function is known, in addition to the various prices, it is possible to determine the farm's supply at the point of equilibrium. Thus, one way of deriving the supply curve is to start with the empirical production function. In the first parts of this chapter we will attempt to test this possibility and for this purpose will use the production elasticity estimates found in the preceding chapter. In the second part we shall attempt a direct estimate of supply.

In analyzing supply we have to distinguish between long-run and short-run supply. In the short run the intention is to estimate the effect of prices on the quantity supplied while a number of production factors remain constant. In the long run no production factor except management is constant. Thus, the transition from short to long run will be through explanation of the changes in constant factors—this will be done in the following chapter. The conclusion will be an attempt to combine both approaches into a single framework by summing up both sets of results and examining their implications.

2. *The Short-Run Supply Function*

From the discussion at the end of the preceding chapter it is clear that the main input factors in poultry production are concentrates, other raw materials, structures, labor, and live inventory. In the short run structures are a fixed factor and therefore the capacity of structures will appear in the supply equation. In other words, we shall deal with the supply derived from a given size of structure capacity.

For lack of data on the price of raw materials other than concentrates this variable will not be included in the analysis. Generally speaking, the real cost of the above item rose during the period and thus negatively affected supply. For example, a portion of the costs of other materials is for purchase of chicks. Lately, with the development of new lines of poultry, the price of chicks has risen.

As for labor, we may assume that in the short run wages do not affect supply since part of the work is done by the settler's family. For lack of a suitable measure of changes in labor in the poultry branch, this variable will be excluded from the analysis.

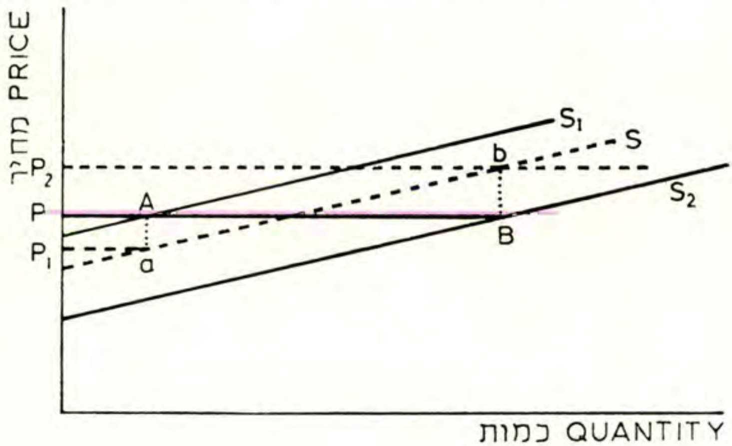
In Appendix D we show how the supply function is derived from the production function. The supply function derived includes, as independent variables, the various prices and the quantities of fixed factors. In the present case, with the assumption given above, we arrive at the short-run supply equation for poultry:

$$Y = (K, \frac{P}{W}), \qquad (1)$$

where Y is the quantity supplied, K is structure capacity, P the product price, and W the price of concentrated feed. The quantity supplied depends on structure capacity and the ratio between the prices of product and concentrates. In this formulation differences in supply between farms or on the same farm in different years are ignored.

Two important causes of interfarm differences may be noted. The first—as stated in the preceding chapter—is management. The more efficient a farm the more it will produce at a given price. The second cause is farm behavior in reaction to price fluctuations. Since prices are not known with complete certainty and since there is uncertainty as to size of yields, farms are liable to operate at a point which is not identical with the point of equilibrium. Cautious farmers might produce at a point where the value of the marginal product of inputs is above the real price, whereas optimists would probably place themselves in the opposite position. This does not necessarily exclude the possibility that on the average for the entire sample the value of the marginal product equals wages. In an analysis based on a comparison of farms such factors must be allowed for, otherwise the results will be distorted. The explanation of such possible distortion is similar to that given for the effect of individual farms in the analysis of the production function. This can be seen from Figure 4. S_1 and S_2 depict the supply curves of two farms. Both have equal slopes but are on different levels.

FIGURE 4. *Supply Curves of Two Farms with Different Production Functions*



First, we shall assume that the farms are identical in every respect except efficiency. Farm 2 is more efficient than farm 1, and hence at a given price will be willing to produce more. At a price P equilibrium for the two farms is at A and B. If we ignore the differences in efficiency and draw a supply curve according to observation A and B—we find a horizontal supply curve. This curve lacks all meaning since it cannot answer the query by how much (or by what percentage) the quantity offered will change, following a given change in price.

A similar explanation may be offered for farm behavior. We need only assume that the farms are alike in every respect except in their reaction to market prices. Accordingly, the common supply curve for both farms would be S. However, since a lag exists between the time of a production decision and the time of sale of the finished product, the farmer has no assurance that P will still be the price at a later date. If such is the case, the cautious manager of farm 1 will presume the price to be lower, say P_1. He would produce at a. The second farmer would behave as though the price would rise to P_2 and produce at b. In a supply estimate we wish to ascertain how, *ceteris paribus,* a price change would affect the quantity supplied by all producers. If we assume that producers' behavior is not dependent on price level, then a unit change in price would affect both producers similarly, since they are both on supply curves with identical slopes. Accordingly, the only difference between the two is the level of the curves. Thus we may assume that farm 1 is on S_1 and farm 2 on S_2.

Thus it is possible that both factors (efficiency and behavior) contribute to the spread in output among farms. As a consequence, if we wish to find the slope of S it is necessary to allow for the effects of factors connected with the individual farms themselves.

Similarly, it is possible to analyze the effect of differences in efficiency or productivity over time. In this case we refer to the same diagram where S_2 represents supply for a year with higher productivity than that depicted by S_1. At the same time there might be differences in the level of certainty as to prices from year to year. For certain years prices are government controlled and not given to fluctuation. Hence, there will be no uncertainty compared with other years when there is a great deal of fluctuation. Here again we can show that in a year when there is no uncertainty the farms will produce on a curve representing greater supply than in a year of much uncertainty. By adding the above factors to our supply equation we replace (1) with:

$$(2) \qquad Y = \left(K; \frac{P}{W}, m_i, R_i, B_t, G_t\right),$$

where m_i = management in farm i, R_i = behavior of farm i, B_t = productivity for year t, and G_t = certainty condition for year t.

In Appendix D we find the explicit form of this function under the assumption that the production function is of the Cobb-Douglas type. If we combine the effects associated with individual farms, calling them I and the two effects associated with the year, calling them T, we can write out the function for the case under discussion as follows:

$$(3) \qquad Y = C_0 I T \left(\frac{P}{W}\right)^{c_1} K^{c_2} U,$$

where U is a random disturbance, c_1 = supply elasticity with respect to the ratio between output and concentrate prices, c_2 = supply elasticity with respect to structure capacity, I = combined farm effects, and T = year effects. In accordance with Appendix D, c_1 equals the production elasticity of concentrate feed *divided by* one *minus* the sum of elasticities of the variable factors. If we accept the estimates of the production elasticities for poultry as presented in the previous chapter, we can examine the anticipated value of the supply elasticity. In our present calculation we shall regard concentrates and other expenditures as variable factors. The sum of their elasticities is 0.785 and 0.215 is therefore its complement to unity. The production elasticity of concentrates is 0.643. c_1 should therefore be approximately 3.0 $\left(\frac{0.643}{0.215}\right)$. c_2 can be calculated similarly. Two estimates exist for the production elasticity of structure capacity: (0.09 and 0.135). Short-run supply elasticity for structure capacity would then be either 0.42 ($\frac{0.09}{0.215}$) or 0.63. Effects of annual productivity on supply can also be found in this way. The value of supply elasticity according to annual productivity is 4.7, meaning that a rise of one per cent in yearly productivity should be reflected by a 4.7 per cent increase in supply.

The above findings are based on two assumptions: the first that the production function is of the Cobb-Douglas type; the second that changes in quantities supplied, which stem from a change in one of the variants which determine the quantities, are measured as the difference between two points of equilibrium, one before the change and one after the change. An additional limitation exists which we will not consider at present. During the entire discussion we deal with a single enterprise, ignoring the existence of other branches on the farm. Were we to extend our discussion to embrace all of the branches simultaneously we would have to include the price of inputs and outputs of other branches in the supply function of any one sector. Hence our analysis is incomplete in this sense. However, the direction of the expected effect of this deficiency can be evaluated. We shall return to this point at a later stage. Instead of accepting our findings as final we shall try yet another approach to the problem; we shall attempt to estimate the producers' actual response to prices as reflected in the sample. It will thus be possible to verify if and to what extent they do react to the above-mentioned factors.

3. *Direct Estimation of the Short-Run Supply Estimates*

Poultry output consists of several items: eggs, meat of laying birds sold because of selection, broilers, and change in inventory. Hence, the supply of the poultry branch on a given farm is that of an aggregate product. The production function of poultry, previously discussed, also applies to the aggregate product, so that to be able to compare the findings of the supply analysis with those of the previous chapter it is desirable to examine supply of the aggregate. Such an analysis is possible only under certain conditions which will become clear below. On the other hand, we can divide the analysis into two parts: eggs and poultry meat. However, here the problem of aggregation still exists since poultry meat includes three components (broilers, laying birds, and changes in livestock) but the data do not distinguish between them. The analysis was carried out once for poultry output as a whole and once for each of the two components separately.

In each case the dependent variable includes annual output and not the annual quantities sold. The difference between the two lies in the change in inventory during the year. The reason for using output to represent supply stems from the fact that a change in price is more quickly reflected in output than in sales. This is because of the period needed for production. In other words, there is a lag between the producers' decision to react to prices and the time that their decision is reflected in sales.

In production processes which demand a certain period for their completion the quantity produced at point of time t applies to the price which existed when the decision on scale of production was taken: say at $t-k$ where k denotes the time units needed to complete production. In poultry this period is a number of months. In an annual analysis there are therefore two alternatives: to relate supply to present prices or to those of the previous year. Since the production period is relatively short, the present year's prices are more relevant.

Till now we have assumed that producers do react to current prices. However, due to uncertainty as to prices which will prevail when produce is marketed, they may take past experience with prices into account; in accordance with this we can change the formulation of the problem.

The supply equation, as formulated in the preceding section, denotes the desirable supply—that quantity which the producer would wish to produce should prices remain at the same level for a long time. With a change in price we do not assume that the producer will react immediately but rather that he will act according to the adjustment equation:[2]

$$Y_t - Y_{t-1} = \gamma(Y_t^* - Y_{t-1}).$$

In other words he will adjust present supply (Y_t) in relation to previous supply (Y_{t-1}) in proportion to the gap created between the quantity desired at present (Y_t^*) and that produced previously. The coefficient γ is the adjustment coefficient—denoting the degree of adjustment for a single period. According to this approach there is a difference between supply response to price for one period and that which is realized after several periods have passed. We shall call the former a first period response and the latter an equilibrium response. The empirical equation in this case will include an extra variable—supply in the preceding period. We shall refer to this as lagged response analysis.

a. *Aggregate supply*

The dependent variable in this analysis is total poultry production at constant prices. Structure capacity was calculated for the beginning of the year, as described in Chapter 2. The main difficulty here is the definition of average price for the aggregate product. Since we are interested in the

[2] On this see Marc Nerlove, *Distributed Lags and Demand Analysis for Agricultural and Other Commodities*, Agriculture Handbook No. 141, U.S. Department of Agriculture, 1958.

price ratio between output and concentrates we may present this price as the ratio between total revenue from the poultry enterprise and total expenditure on concentrates. The fluctuations of the above ratio will reflect —in addition to price differences—variations in the level of average output. These latter stem from differences in the efficiency level or in the level of intensity, i.e. in combinations of inputs. As for efficiency differences, we have already shown that they affect supply. Thus, this formulation allows their explicit inclusion and that is its advantage. Differences in intensity of input use include mainly variations in the ratio between active capacity and concentrates. These are not large enough to cause any considerable distortion of the results. Adaptation to prices by producers is mainly through changes in the flock size and not through adjustments of input combinations.

The period of analysis is the four years 1955–58, and the results appear in Table 33. The estimates in the first line are for a regression where no allowance is made for either year or farm effects. The results of the covariance analysis appear in lines 2 to 4.

TABLE 33. *Short-Run Supply Elasticities for Aggregate Poultry Output*

Effects allowed for	*First year response*		*Equilibrium response*		
	Capacity	*Price*	*Adjustment coefficient*	*Capacity*	*Price*
1. None	0.348	0.853	0.610	0.57	1.40
2. Year	0.274	0.881	0.580	0.53	1.70
3. Farm	0.381	0.396	0.963	0.40	0.41
4. Year and farm	0.317	0.671	0.792	0.40	0.85

NOTE: All coefficients, as well as effects of year and of farm, are significant at a 1 per cent level.

The results show certain differences between the analysis with no allowance for effects and the one where allowance was made for both effects. A look at the results obtained for effect of farm alone and effect of year alone shows that the two acted in opposite directions. Hence, when both effects were allowed for the results did not change much. From here on we shall refer to the estimates found allowing for both effects, since both are statistically significant. Supply elasticity for capacity shows that a 1 per cent increase in capacity, other variables remaining constant, was associated with an increase of 0.317 per cent of quantity supplied that year—on the average for the entire sample. However, if all other factors had remained constant the final change in supply elasticity with respect to capacity would have reached 0.40 per cent. Price elasticities are interpreted similarly. A 1 per cent rise in relative price, other factors being equal, brought a 0.671 per cent increase in quantity supplied that year, and total response of 0.85 per cent when the farms reached their new point of equilibrium. The differences between the first year and the final response are not large, since the adjustment coefficient shows an average rate of approximately 80 per cent per annum in closing the gap between desired and actual supply.

b. *The supply of eggs and poultry meat*

Since the purpose of this chapter is to explain differences in supply with emphasis on the role of prices it would not be desirable to remain at the aggregate level in the hope that our assumptions are acceptable to the reader. Accordingly, we have chosen to conduct an analysis with a lesser degree of aggregation. This is done by estimating supply curves for eggs and meat separately. In this way there is no problem of which weight to use in aggregation of output, nor is there a need to obtain a price for such an output, and finally, it is possible to obtain cross-elasticities.

In principle the two analyses are similar. The main difference, of course, is in the new variables which will be defined below. In addition, we have included another year—1959—in the analysis. Data for 1959 were not previously available. An additional variable—value of inventory at the beginning of the year—has also been included. The new variables are:

E = Value of egg sales at constant prices (6.6 agorot per egg).

M = Meat sales in IL at constant prices (IL 2.050 per kg. poultry meat).

I_B = Value of laying birds' inventory at the beginning of the year (see Appendix B, note 2).

I_T = Value of entire live inventory at the beginning of the year.

$P_E = \frac{\text{Price of eggs}}{\text{Price of concentrates}}$ with the units $\frac{\text{Agorot per egg}}{\text{IL per kg. concentrates}}$.

$P_M = \frac{\text{Price of meat}}{\text{Price of concentrates}}$ with the units $\frac{\text{IL per kg. poultry meat}}{\text{IL per kg. concentrates}}$.

E_{-1} ; M_{-1} represent the previous year's value of the same variable.

The results were calculated with allowance for effects of year and farm. Apart from production of the previous year all coefficients are significant. With the present formulation we find that there is no delayed response and adjustment to prices is immediate—within a year.

Meat prices appear with a positive coefficient. This means that from the point of view of supply meat and eggs are complementary. This can be explained by the fact that layer meat and eggs are produced at a more or less

TABLE 34. *Estimates of Short-Run Egg Supply Elasticity*

	K	P_E	P_M	I_E	
(1)	0.347	0.700	1.100	*	*
(2)	0.246	0.564	1.059	0.149	—
(3)	0.316	0.682	1.102	*	0.047*a*

NOTES: Estimates were made allowing for effect of year and farm; unmarked coefficients are significant at a 1 per cent level; the coefficient marked *a* is not significant at an acceptable level; effect of farm and effect of year are significant at a 1 per cent level. Asterisks indicate the variables omitted.

fixed ratio. An increase in the price of meat increases the profitability of keeping laying birds in the same way as an increase in the price of eggs.

Live inventory at the beginning of the year is a significant variable with an elasticity of 0.149, meaning that *ceteris paribus,* a 1 per cent increase in the inventory value was followed by a 0.15 per cent average rise in production by the sample farms. The equations in Table 34 differ mainly in the variables included.

Estimates for meat supply are given in Table 35.

TABLE 35. *Estimates of Short-Run Poultry Meat Supply Elasticity*

	K	P_E	P_M	I_T	M_{-1}
(1)	0.433	0.335*a*	0.236*a*	*	*
(2)	0.286	0.208*a*	0.069*a*	0.401	*
(3)	0.409	0.286*a*	0.310*a*	*	0.071*a*

NOTES: Estimates were calculated allowing for effect of both farm and year; unmarked coefficients are significant at a 1 per cent level; those marked *a* are not significant at an acceptable level; effect of year is significant at 5 per cent but not at 1 per cent ($F_{4,196}=7.8$); effect of farm is significant at a 1 per cent level. Asterisks indicate the variables omitted.

The results show that the only variables explaining differences in meat production are initial capacity and initial inventory. The interesting point is that neither egg nor poultry prices are significant. In other words, they do not significantly differ from zero. There may be a number of reasons for this but we cannot verify them from the data at hand:

(a) A large proportion of the meat is from laying birds. The variations in this component reflect mainly variations in initial inventory and capacity, which are, relatively speaking, far larger than the price variations and thus lead to a large standard error in the estimates.

(b) We can strengthen the supposition in (a) with the knowledge that the coefficients for capacity, and especially for initial inventory, were relatively high. With initial inventory it is important to note that the life cycle of broilers is far shorter than that of laying birds Thus, initial inventory should have less effect in the meat equation if supply reflects mainly differences in broiler supply. On the other hand, if the meat is from laying birds inventory will have a much stronger effect. That is exactly what happened. We have no data on the ratio between the two types of meat, either for individual farms or for the sample as a whole. One way of testing the composition of meat output is by comparing meat sales with egg sales and finding the extent of differences. This was accomplished by dividing the geometric average of eggs by that of meat, thus arriving at the ratio between the values of the two components for the various years.

Ratio of Values: $\frac{\text{Egg Sales}}{\text{Meat Sales}}$

1955	*1956*	*1957*	*1958*	*1959*
1.13	0.88	1.20	1.15	1.28

With the exception of 1956 the ratio remained more or less constant—fluctuating between 1.13 and 1.28. This means that if there were variations in the amount of broiler meat produced they were not large enough to disrupt the relations between the two components. Accordingly, there is reason to believe that a considerable proportion of meat output was a by-product of egg production.

(c) To the extent that broilers are produced the reaction to prevailing prices occurs in less than a year. It is possible that the annual analysis distorts the actual relations. It is especially important to note that prices are those paid to producers and thus include only those periods in which the farmers sold their produce. For this reason it is desirable that future analyses of poultry meat supply be conducted for shorter periods.

(d) Possibly, to get to the root of the matter, it would be better to separate supply of laying birds' meat from that of broilers. The first equation would be similar to that for eggs. The second, for broilers, is liable to produce different results—depending on observations.

Finally, if we accept the results as they appear, ignoring the fact that the coefficients are not significant at a plausible level, we shall discover that they are consistent with those found for aggregate supply. If we wish to find the effect of a price change on the quantity supplied its effect both on eggs and on meat must be calculated. It can be shown that:

$$C_{y/P_1} = \gamma_1 C_{y_1/P_1} + \gamma_2 C_{y_2/P_1}$$
$$C_{y/P_2} = \gamma_1 C_{y_1/P_2} + \gamma_2 C_{y_2/P_2},$$

where $C_{y/Pj}$ = elasticity of y according to P_j,

y_1 = egg output,

y_2 = meat output, $y = y_1 + y_2$,

γ_1 = share of eggs in total production value $= \frac{y_1}{y_1+y_2}$, and

γ_2 = share of meat in total production value $= 1-\gamma_1$.

On the average for the period egg production totalled 53 per cent of total poultry output· Hence, production elasticity according to egg and meat prices, calculated from the first equation of Tables 34 and 35 are:[3]

$$C_{y/P1} = (0.53)(1.100) + (0.47)(0.326) = 0.74.$$
$$C_{y/P2} = (0.53)(0.700) + (0.47)(0.335) = 0.53$$

A 1 per cent change in the price of eggs changes the total quantity supplied of poultry products by 0.53 per cent and a 1 per cent change in the price of meat changes total quantity supplied by 0.74 per cent. In the previous analysis we found that a 1 per cent increase in average revenue per IL spent on feeds increased the quantity supplied by 0.67 per cent when the delay in price response is not allowed for and by 0.85 per cent in the long run—when delayed response is taken into account but the size of housing is given.

Until we are able to improve tne results we can perhaps conclude this discussion with the hypothesis that in the short run poultry supply elasticity according to prices is close to 0.7. When initial inventory is included elasticity drops to close to 0.6.

Supply elasticity according to capacity is quite similar for the various equations. In the former analysis the value found was 0.32 with no delay in response allowed for and 0.40 for the long run—allowing for a delayed reaction. Here we arrive at a value of 0.39 by weighting the elasticities for eggs and meat in the first equation. This value falls when initial inventory is included. Hence, in order to summarize the discussion perhaps a value of 0.4 can be proffered for capacity elasticity in the equation without initial inventory and 0.3 in that including initial inventory. Average effect of inventory is 0.27. The conclusion, therefore, is as shown in Table 36.

The results in Table 36 can be compared with those achieved by derivation of supply elasticities from the aggregate poultry production function. The elasticities found there were: 0.4–0.6 for capacity and 3.0 for price. It is clear, therefore, that for capacity there is a fair amount of com-

[3] The reason for using the first equation is to allow a comparison with the previous analysis, where initial inventory was not included.

patibility between the direct empirical analysis and the derived analysis. As for price, the elasticity resulting from the direct empirical analysis is much lower than that derived from the production function.

TABLE 36. *Short-Run Poultry Supply Elasticity*

	K	P	I_T
(1)	0.4	0.7	*
(2)	0.3	0.6	0.27

NOTE: The dependent variable is total poultry output. $\bar{P}$ is the average price of meat and eggs. The asterisk indicates the variable omitted.

A possible explanation for the difference between the price elasticity estimates as found by the two separate methods might be in the fact that the analysis was conducted as though poultry were the only branch on the farms. In reality there are other branches, including cattle. Expansion of the poultry industry went hand in hand with the contraction of land area for vegetables and production expansion of cattle. In a more comprehensive analysis prices of products and inputs in other branches would have to be included. It is possible that had the effects of other branches been included the gap between the two results might have been narrowed. Another reason might be the fact that not all poultry input prices were included, including the price of labor and materials other than concentrates. If the ratio between the price of the product and these input prices acted towards decreasing supply, it can be shown statistically that a downward bias of supply elasticity could be caused.

We may conclude this section by stating that farms react noticeably to prices. It is possible that by extending and refining the analysis an even stronger reaction might have been found. We might therefore be able to regard a price supply elasticity of 3 as an upper limit.

c. *Annual variations in supply*

The year effect on supply is intended to represent two influences: increased efficiency, and conditions connected with behavior, including uncertainty in production. The effect is reflected in the level of the supply as presented in the preceding chapter. Results are given in the form of an index, the geometric average of which is unity. The value for a given year expresses the ratio between that year's supply, with allowance for the effects of the price level and capacity, and average supply for the entire period—with allowance for the same effects.

A value of 0.789 for 1955 shows that egg production for that year would have been 79 per cent of the average production for the entire period had prices and capacity remained constant. The upward trend of short-run supply partly reflects an increase in efficiency. The low value for 1957 reflects the recession in poultry production for reasons mentioned earlier. However, it is apparent that increased productivity alone cannot explain the leap

TABLE 37. *Index of the Annual Level of Short-Run Supply of Poultry Meat and Eggs: 1955–59*

Equation		*1955*	*1956*	*1957*	*1958*	*1959*
Eggs	(1)	0.789	0.883	0.813	1.244	1.420
	(2)	0.797	0.881	0.829	1.260	1.363
Meat	(1)	0.949	1.178	0.795	1.118	1.007
	(2)	1.090	1.179	0.780	1.065	0.937

NOTE: Lines (1) and (2) were derived from the regressions marked (1) and (2) in Tables 34 and 35.

in the supply level of eggs over the last two years. The main cause is to be found in the poultry agreement signed in October 1957 between the government and the marketing agencies, by which the price of eggs was assured. The factor of uncertainty was thus removed as far as the price of eggs was concerned. As a result, the supply level index rose from 0.813 in 1957 to 1.244 in 1958 and to 1.420 in 1959. There is no similar tendency in poultry meat supply since that product is not included in the agreement; meat supply is subject to noticeable fluctuations. A possible explanation might be found in the fact that the year effect reflects two factors which do not always act in the same direction. While there is a constant increase in efficiency, the degree of uncertainty changes from year to year. During the last two years its effect was greater than that of efficiency. The explanation proffered for supply level differentiates between eggs and meat and attributes much importance to the factor of uncertainty regarding market prices. From the formulation in Appendix D it may be seen that uncertainty acts similarly to price in determining the quantity supplied. Greater uncertainty can be regarded as if the ratio between the product's price and prices of input were lower. Hence, certainty has a price. In other words, if the egg supply level rose from 0.829 in 1957 to 1.260 in 1958 (an increase of 52 per cent) it is possible to calculate the price which would have caused the same increase in supply without changing cost conditions. This imputed price is dependent on supply elasticity, but in all the alternatives which have been discussed above the change would have been considerable. Accordingly, the price fixing policy as carried out following the signing of the poultry agreement had an effect similar to an increase in egg prices—thus expanding production. The degree of supply increase to be attached to the agreement depends on the base taken for comparison. The agreement increased supply noticeably within a year, but perhaps an increase was forthcoming anyway with the end of the extraordinary conditions of 1957. Hence, the best base for comparison would probably be 1956. However, even then the relative increase in supply was prominent and reached 43 per cent in 1958 and 55 per cent in 1959.[4]

[4] Calculations were made according to equation (2).

CHAPTER 6

INVESTMENT IN PRODUCTION ASSETS

1. *Outline of the Analysis*

In this chapter we shall extend the analysis of farm behavior and try to explain disparities in production assets among different farms, and in the same farms over a given period. The assets discussed are durable factors which appeared in the short-run analysis as fixed inputs, such as structure capacity for poultry. Apparently, what we have here is a demand function for productive factors which, according to Appendix D, should have a form identical with that of the demand function for other factors, except as regards elasticities. In other words, the variables explaining capacity fluctuations are the various prices and factors connected with the individual farms and years. However, there is a basic difference between demand for long-term assets and that for variable inputs, namely the effect of the certainty factor. This was mentioned in the short-run supply analysis but there pertained to uncertainty regarding prices which were to come into effect shortly after the production decision had been made. When dealing with long-term assets uncertainty relates to the entire life expectancy of the factor—usually a period of several years. Hence, even if at a certain time prices justify a production increase, long-term assets will not be expanded immediately. Reaction to prices will be first and foremost through a change of variable inputs. This will lead to a change in the ratio of variable to fixed inputs. If before the change the farms were on the expansion path, i.e. they used that input combination which assured least-cost production, it is clear that after the change a less efficient combination will be employed. However, if the new conditions continue over a sufficiently long period the farms will finally return to production using an input combination assuring minimum costs. This will be accomplished by varying the 'fixed' factors. The questions which this analysis attempts to answer are: (a) How do output variations influence production asset capacity? (b) What period of time is necessary to adapt the quantity of production assets to changes in market conditions?

In formulating the problem we shall accept the model proffered by

Koyck[1] and assume that for each output Y_t, produced over the period t, a desirable asset capacity K^*_t exists. This capacity is determined according to the long-run cost curve and K_t therefore denotes the capacity with which Y^t will be produced at the lowest cost. The relation between output and capacity is:

$$(1) \qquad K_t^* = L_0 + L_1 Y_t ,$$

where L_0 and L_1 are coefficients. However the farm capacity for the beginning of the periods is K_{t-1}. If existing capacity is not equal to desirable capacity a gap exists which the farms wish to close eventually. When the rate at which the gap is closed is proportional to the size of the gap we can express the capacity adjustment as follows:

$$(2) \qquad K_t - K_{t-1} = \beta(K^*_t - K_{t-1}) \qquad 0 \leqq \beta \leqq 1,$$

where β is the adjustment coefficient which measures the percentage by which the gap is closed during a single period. The left side of (2) represents the addition to capacity during the period t or, in other words, the investment in capacity during that period. The formulation implies that the investment is proportionate to the gap.

The desired quantity K^* does not lend itself to direct measurement as it is impossible to measure investors' intentions directly. It is, however, possible to measure the existing amount K.

Accordingly, the empirical equation has to be formulated in terms of measurable variables. This is done by substituting (1) in (2).

$$(3) \qquad I_t = \beta L_0 + \beta L_1 Y_t - \beta K_{t-1} ,$$

where I_t represents investment during the period t.

Investment in capacity depends on two factors—output and existing capacity on the farm. As output increases, with initial stock constant, investment increases; whereas the greater the initial capacity, output remaining constant, the lower will be investment.

The dependent variable in (3) is investment. Although we are in fact interested in explaining changes in capacity and not in investment, explanation of the latter gives us an explanation of capacity differences at the

[1] L. M. Koyck, *Distributed Lags and Investment Analysis,* North Holland Publishing Company, Amsterdam, 1954. Koyck arrived at equation (3) below through the assumption that a quantity in existence at a point in time is a function with decreasing weights of past outputs. Nerlove has shown that equations (1) and (2) lead to the same result. In other words, a change in output not only influences investment in the same period but in future periods as well. (Marc Nerlove, *Distributed Lags and Demand Analysis for Agricultural and Other Commodities,* Agricultural Handbook No. 141, U.S. Department of Agriculture, 1958.)

same time—and vice-versa. This can be shown by isolating K in (3), so that: [2]

(4) $$K_t = \beta L_0 + \beta L_1 Y_t + (1 - \beta) K_{t-1}.$$

The coefficients which interest us are the adjustment elasticity and elasticity of capacity with respect to output. If the variables in (3) represent logarithms of the variables discussed the elasticities will be β and L_1 respectively. It is sometimes assumed that constant returns to scale exist and hence capacity elasticity should be unity.[3] In the appendix to this chapter (Appendix E) we show that if constant returns to scale exist and if a Cobb-Douglas type production function with managerial elasticity greater than zero is assumed, capacity elasticity will be greater than unity. It will equal $\frac{1}{1-A_m}$ where A_m is elasticity with respect to management.

Since long-run capacity elasticity of supply can be anticipated on the basis of the production function, the main emphasis in our analysis will be on measurement of the rate of adjustment. In the present formulation we explicity assume that this elasticity is a coefficient, i.e. a fixed value. However, it is important to bear in mind that the coefficient represents various effects, and hence its degree of stability in a population of farms over any length of time is subject to doubt. A number of factors influence the adjustment rate:

(a) The certainty which a producer attaches to changes in demand conditions.

(b) The alternative cost connected with keeping excess capacity of a production asset.

(c) The cost of intensive utilization of an asset.

(d) The possibility of financing purchases.

(e) The time needed to implement an investment.

(f) The divisibility of the asset into small units. When it is impossible to purchase small units of the asset an adjustment lag is liable to be created until a large enough gap forms to justify the purchase of an asset of a size found on the market.

By expanding (1) and (2) it can be shown that capacity in period t is actually a function with decreasing weights of outputs in preceding periods. In other words, the production of the last year has more weight in

[2] The advantage in estimating (3) instead of (4) stems from the strong serial correlation in durable assets between K_t and K_{t-1}; hence in a direct estimate of (4) the initial quantity would account for most of the variations in the final amount and there would be no way of testing the model. However, the correlation between initial capacity and investment is not especially strong, and thus (3) suits our analysis better.

[3] Koyck, *op. cit.*, p. 70.

influencing present capacity than that of two years earlier etc. An additional explanation of the above relationships is that a change of output for a certain year will affect the same year's capacity but will also influence future capacity.

In formulating the problem we ignored the rate of interest which may also be a factor in explaining investments. Presumably as with prices themselves, the interest rate does not change noticeably at a point in time. What may have an even greater effect than the rate of interest itself, in the event of an imperfection in the credit market, is the amount of liquid assets that can be used to finance investment in the durable assets. This was not tested here, under the assumption that it is at best a factor of secondary importance. When expectations justify expansion we may assume that the farmers will find the necessary resources for it. However, this may take time and we have therefore noted it as one of the reaction-delaying factors.

It must be explicitly stated that there were absolutely no means of hiring the services of an asset—the asset must be purchased. Had this not been the case, there would be no problem. The considerations involved in purchasing a service differ from those for purchasing a durable factor.

Until now we have mentioned the quantity of production assets without showing how it is measured. The very formulation of the model solves the problem of measurement. The question which can be asked is, what is the necessary condition for moving along the expansion path of a firm expanding production? The answer is that the services of the productive asset must be increased. If we assume that when the asset is fully employed the service rendered by it is proportional to the capacity volume of the productive factors, we may conclude that the capacity of the assets should be increased. Capacity can be changed in various ways by acquiring assets of varying quality or age. The basic assumption here is that the age of the asset has no serious effect on the service rendered by it and can thus be ignored. Hence we can simply measure the physical capacity of the assets.[4] The measurement of physical capacity is relatively simple and thus the complications of the evaluation of used assets are circumvented.

When stock is measured physically and does not involve market prices there may be a disagreement between investment and difference in physical capacity at two points in time. The difference between them depends on the homogeneity of the asset at a point in time when dealing with a cross-

[4] For discussion of some of the problems involved in measuring capacity the reader is referred to: L. R. Klein, "Some Theoretical Issues in Measurement of Capacity", *Econometrica,* Vol. 28, No. 2, April 1960, pp. 272–87.

section, and on technological improvements when studying time series. When all units of the asset are homogeneous, capacity changes indicate increased investment in that asset. When the units are dissimilar the analysis can explain only changes in physical capacity; it can explain investment only approximately.

2. *Poultry Structure Capacity*

Poultry output includes a number of components which can be aggregated in terms of money value as was done in the preceding chapter. On the other hand, the planned output would be better represented by the quantity of concentrate feed, and it was therefore decided to use concentrates for measuring output. In addition the data on feed are more reliable than those of output.

Capacity is measured in IL at constant prices to allow aggregation of broiler capacity with that of laying birds.[5] Data on capacity exist from 1954 on; hence the analysis is based on the period 1955–58. It was conducted at various levels of aggregation as will be explained below for each individual case.

a. *Annual analysis*

The unit of observation in this case is farm i for year t. The analysis was of the logarithmic values of the variables. Investment is measured through the ratio $\log \frac{K_t}{K_{t-1}}$. It was conducted with allowance for effects of village and year.[6]

The results are as follows: R^2 (coefficient of determination) = 0.35; short-run capacity elasticity = 0.137; adjustment elasticity = 0.356; long-run capacity elasticity of production = 0.384.

The village effect is not significant, whereas that of the year is significant at a 1 per cent level.

The explanation of the results is as follows: an adjustment value of 0.356 for elasticity means that on the average for the sample farms the annual relative increase in capacity was at a rate of 35.6 per cent of the relative gap which existed between desired capacity at the year's end and actual capacity at the beginning of the same year. In other words, on the average

[5] See Chapter 2, Section 6.

[6] The empirical equation is similar to (3):

$$\left\{\frac{K_t}{K_{t-1}}\right\}'_{it} = (a_0 + a_{0j} + a_{0t}) + a_1 Y'_{it} + a_2 K'_{i\,t-1}.$$

The indices are: i denotes farm i; t denotes the year, whereas the prime indicates logarithmic value, and the a's are coefficients.

for the sample farms a 1 per cent change in desired capacity was followed by a 0.356 per cent change in actual capacity for that year.

Capacity demand elasticity of 0.384 means that a 1 per cent rise in output was accompanied—on the average for the sample—by an increase of 0.384 per cent in desired capacity. If there is only a single change in output the final increase in capacity will be 0.384 per cent. The speed at which this is accomplished depends on the adjustment elasticity.

The short-run demand elasticity denotes the average rate of increase of demand for the first year, related to a 1 per cent increase in output.

The value found for the elasticity of capacity with respect to output is lower than might be expected. Nor is the coefficient of determination (R^2) high, since only 35 per cent of the variance in investments is explained by the equation. A possible explanation is that Y does not measure correctly what it was meant to measure—the market evaluation of the producers. In this case Y may be regarded as a variable which measures the correct variable with error. The regression coefficient of Y then has a downward bias. To obtain the long-run elasticity, the short-run elasticity is divided by the adjustment coefficient. When the value of the adjustment coefficient is close to one-third any error in the short-run elasticity is multiplied threefold in calculating the long-run value. Hence it is very likely that due to an error in Y a value lower than the true regression coefficient was found. To examine this assumption we can aggregate the equation over time to arrive at the following:

$$I_i = a_0 + a_1 \sum_t Y_{it} + a_2 \sum_t K_{it-1},$$

where all variables, as in the preceeding case, represent logarithms and I_i measures the relative capacity increase. If Y is affected by errors of measurement there is a possibility that these cancel each other out in aggregation, thus improving the results. The results of the four-year equation are:

Coefficient of determination (R^2)	= 0.442
Short-run elasticity (a_1)	= 0.193
Adjustment coefficient ($-a_2$)	= 0.278
Long-run elasticity	= 0.695.

Compared with the previous case the coefficient of determination rose slightly, while long-run elasticity rose considerably; however, it is still far from unity. Hence, the assumption that a measurement error was the sole factor in determining the results cannot be accepted.

An examination of the data shows that not every farm invested annually. This may be the result of a decision and thus is explained by the model but it is also partly related to lack of continuity in investment. Presumably it is possible to expand poultry capacity little by little according to needs, especially in the case of batteries. Actually investment is usually carried out in relatively large units.[7] A situation is possible where for a certain year a gap exists between desired and actual capacity and yet no investments will be made. Instead of closing the gap at a fixed annual rate the farmers may prefer investments in larger units at time intervals exceeding a year. After all, the choice of a year as the period for analysis is more a matter of habit and convenience than a result of economic reasoning. Even so it is not at all sure that the larger investments will be made in the first year immediately following the creation of the gap. They may be delayed—for various reasons—for two and even three years.

These possibilities bring us to the conclusion that capacity demand should perhaps be measured in the individual farm for periods exceeding one year. According to this assumption better results would be achieved from an analysis of data aggregated over a number of years for each individual farm. This has the same effect as aggregation of data of various items in a time series analysis where the problem does not exist.

Accordingly, data for four years were aggregated and a regression of the aggregate data was calculated for the entire period.[8]

b. *Aggregate analysis*

The three cases below differ from the one considered above in that their values refer to the four-year period 1955–58 and not to each year separately. The analysis was conducted in ordinary values in the first case (a) and in logarithms in the second and third ones (b, c). The variables are: initial capacity (K_{-1}), which is the capacity at the beginning of 1955; investment (I), the increase in capacity during the period from the beginning of 1955 to the end of 1958 (in the first case investment denotes the absolute increase, whereas in the second and third instances it represents the relative increase); and output (Y), here, as well, represented by concentrate feed consumption. When dealing with a four year period the problem arises of how to measure output. One way might be to take average annual production. This was done in the third case (c) where Y denotes the geometric average of annual food consumption. Another pos-

[7] It should be borne in mind that batteries are placed in sheds. Even if batteries can be purchased in varying numbers each year, the shed itself cannot be enlarged at the same rate.

[8] This hypothesis can also be tested by aggregating the data for shorter periods, say two or three years. The estimated coefficients would then have to fall between the values obtained in the analysis of four-year aggregation presented below. This, however, was not contemplated here.

sibility arises from the assumption that capacity demand is affected mainly by large outputs when fluctuations exist in annual production, and is less influenced by low outputs. Thus, we are justified in trying to present the maximum annual output achieved over the four-year period instead of average production. This was done in the first and second cases where $Y_t = \max_t Y_{tt}$. We may now sum up the three cases as follows:

	Equation	*Output*
a	Linear	Maximum
b	Logarithmic	Maximum
c	Logarithmic	Geometric average

The results appear in Table 38.

TABLE 38. *Estimates of Structure Capacity for Poultry*[a]

	a	*b*	*c*
Coefficient of determination (R^2)	0.674	0.859	0.810
a_1 = estimate of βL_1	100.5	0.776	0.680
a_2 = estimate of β	–0.620	–0.897	–0.931
Coefficient of adjustment	0.620	0.825	0.883
Elasticity of adjustment	0.810	0.897	0.931
Slope of long-run demand for capacity	162	120	139
Elasticity of long-run demand for capacity	0.914	0.865	0.730

[a] In the logarithmic equations (*b, c*) elasticities and regression coefficients are identical. The adjustment coefficient and the slope of long-run demand were calculated at the geometrical average. In the second equation the opposite is true: the coefficients were found from the empirical equation and elasticities were calculated at the point of arithmetic average.

In all three equations greater compatibility was found with the data than was found in the annual analysis. R^2 ranges between 0.67 and 0.86, i.e. the various equations explain between 67 and 86 per cent of the variations in investment. This shows that the general approach of examining investments in capacity for a period of four years was closer to reality as reflected in the data at our disposal. This point is extremely important since the difference between the annual and the four-year analysis is not conceptual but, in the main, empirical. In other words, the adjustment equation, as we see it, is not continuous enough to allow us to reduce the period analyzed to a single year.

The adjustment elasticity is approximately 0.9—much higher than the value found in the annual analysis. An elasticity of 0.9 shows that 90 per cent of the gap between actual capacity at the beginning of the period and desirable capacity at its end is closed during the period. The difference between the four-year and the annual values may be explained in two ways.

It can be assumed that the closing of the gap is usually executed in a single action. Were all the farmers to react simultaneously, approximately unit elasticity of adjustment would result. On the other hand, if some of them do not react at all during the period of analysis the value found will be lower. According to the above explanation a value of 0.9 means that most producers reacted fully during the period.

The alternative explanation is based on a gradual closing of the gap by a slight amount each year. In this case the four-year adjustment is the aggregate sum of annual adjustments. Thus the annual adjustment elasticity is lower. However, there is no unique correspondence between the annual and the four-year elasticities. This relation depends on the distribution of outputs during the four years and on the number of periods over which the adjustment is actually made.[9]

It is quite possible that the real situation is a combination of the two alternatives: there is gradual adjustment but not necessarily on an annual basis as assumed in the annual model. Hence in a given year not everyone reacts.

Whatever the correct explanation, it should be pointed out that the results show relatively quick adjustment, even if carried out over a four-year period. It is conceivable that such adjustment is made, at least in part, on an annual basis. Perhaps the results obtained from the annual analysis may serve as a lower limit of the annual elasticity. In other words annual adjustment elasticity is higher than 0.36 but lower than 0.9.

As explained in the appendix to this chapter (Appendix E) the elasticity of capacity with respect to output should be slightly higher than unity. A possible cause of bias is the omission of the managerial variable and the change in productivity over time.[10] At this point it would be interesting to examine the slopes of long-run demand. On the average one finds from

[9] Y. Mundlak, "Aggregation Over Time in Distributed Lag Models", *International Economic Review,* Vol. 2, No. 2, May 1961, reissued as FP Research Paper 10, October 1961.

[10] In view of the technical nature of the argument required to establish this statement we chose not to explore it here.

the various equations that a one ton increase in concentrates expands desirable capacity by between IL 120 and IL 165. From calculations on structure utilization (the concentrates capacity ratio) it appears that the ratio between structure capacity and quantity of concentrates for the various years runs between IL 114–150 per ton of concentrates. This means that the long-run slope is almost equal to average utilization of assets on the farms during the period analyzed.

3. *Cattle Stands*

The capacity of cattle structures may be measured by the number of stands; these designate the maximum number of head of cattle which can be housed in the barns according to normal cattle raising practices. The last qualification is very important since quite a few farms at times keep cattle in temporary quarters such as sheds, constructed at low cost from materials found on the farm; the capacity of such structures is difficult to determine. It is not our intention to discuss whether this system of cattle raising is preferable to housing in concrete or similar constructions which demand relatively large investments. The assumption is that the farms eventually revert to the more permanent housing conditions. This is mainly an empirical finding and can perhaps be explained by the fact that the temporary structures bridge the gap between the dates of expanding output, on the one hand, and capacity on the other. Hence in cattle, as opposed to poultry, the live inventory may be increased over and above the capacity of the permanent buildings. This is not accepted as a permanent solution by the farmers themselves, and when they see that the expansion of production is a permanent characteristic they increase building capacity. This phenomenon causes great dispersion among the farms with regard to utilization of cattle stands as expressed by the ratio between the number of stands and the number of head. However, on the average for all farms this coefficient was fairly stable. For the period 1955–58 the number of stands grew by 67 per cent while the number of head of cattle increased by 61 per cent.

For the purpose of the analysis we decided to measure capacity by the number of stands found in permanent quarters without differentiating between stands for calf-rearing or milking cows.

It was decided that the number of cattle on the farm and not output would represent the production level. Since one head only can be kept in each stand this variable is the pertinent one in determining capacity rather than output itself.

For the analysis only the 53 farms raising cattle in both 1954 and 1958 were used (the entire sample comprises 66 farms). The period analyzed is four years—from the beginning of 1955 (end of 1954) to the end of 1958. The analysis was for the period as a whole for the reasons stated above in the case of poultry. These reasons carry still greater weight in the present discussion since the investment in stands is even less continuous than in poultry—and is usually undertaken once every few years.

In the case of cattle there is more justification than in poultry to have output represented by maximum annual output rather than average production, because of the existence of temporary housing. Maximum numbers of head will be used here.

The analysis was conducted in ordinary and logarithmic values. In the first case investment denotes the absolute change in the number of stands between the beginning of 1955 and the end of 1958, in the second the relative change in the number of stands. Capacity is represented by the number of stands—both for milking cows and for calves. The number of head includes calves.

The variables are:

Investment (I): absolute or relative depending on whether the values are ordinary or logarithmic.

Initial capacity (K_0): the number of stands at the beginning of 1955.

Production level (Y): the maximum number of cattle during the period analyzed (i.e. for each farm the highest beginning-of-year figure was used).

The results are shown in Table 39.

TABLE 39. *Estimates of Demand for Cattle Structures*[a]

	Linear equation	*Logarithmic equation*
Coefficient of determination (R^2)	0.307	0.487
a_1 = estimate[b] of βL_1	0.892	0.912
a_2 = estimate[b] of $-\beta$	−0.853	−0.896
Coefficient of adjustment	0.853	0.832
Elasticity of adjustment	0.912	0.896
Slope of long-run demand for capacity	1.047	1.031
Elasticity of long-run demand for capacity	0.971	1.029

[a] The details of the calculation are explained in the footnote to Table 38.
[b] The coefficients are significant at a 1 per cent level.

The degree of fit of the equations is relatively unsatisfactory. The linear equation explains 31 per cent of the investment variance and the logarithmic equation 49 per cent of the variance of the relative investments. The possible explanations of the low correlation have already been mentioned: the raising of cattle in temporary structures and the uneven flow of investments which are made in fairly large units.

In spite of the low values of R^2 both coefficients are significant at a 1 per cent level, and thus the results have some meaning, as well as appearing logical. The coefficients and the elasticities are very similar in both cases and we shall therefore refer to the results of the logarithmic equation alone. The coefficient of adjustment is 0.83, while adjustment elasticity is close to 0.9. Hence, over a four-year period approximately 90 per cent of the relative gap in capacity was closed by investment. It should be noted that the gap is measured according to desirable capacity which itself is measured by the maximum number of head. In many farms the number of head increased towards the end of the period. The high coefficient is thus not merely a result of accumulated reactions to the gap already in existence at the beginning of the period but rather to a gap whose dimensions grew over the years. This is indicative of a quick response.

The coefficients of long-run demand for capacity are close to unity, as is the elasticity. Hence, on the average, a unit increase in the number of cattle caused a unit expansion in the desirable number of stands. With regard to the ratio between the number of head and the number of stands there are of course no grounds for talking of returns to scale other than constant. The results would therefore seem to be plausible.

The results of the cattle analysis are quite similar to those obtained for poultry housing. From this we may deduce that variations in output lead to corresponding changes in desirable building capacity—at approximately the same relative rate. Investments needed to bridge the gap between desirable and actual capacity are carried out fairly quickly; or, in other words, farmers in the sample responded quite promptly to changes in market conditions.

4. *Demand for Cattle Inventory*

Cattle production depends first and foremost on live inventory while structures only rate second in importance. Live inventory of cattle is a production asset conceptually different from structures in that it is liquid and the alternative costs of keeping it are relatively high since it can be sold at prices not far from the purchase price. The productive life expectancy of live inventory is shorter than that of buildings—usually between five and ten years. Because of its liquidity it is far more meaningful to analyze the demand for cattle directly rather than through investments as was the practice with structures.

For cattle the term physical capacity is not very meaningful. Instead it would be more appropriate to consider the value of livestock, thus aggregating cattle units of various ages. The herd value at the beginning of each year was calculated on the basis of cattle records for each farm according to price index for each type of cattle. Prices were fixed at the 1954 level, with the exception of bull calves for which the 1955 price was taken. Cattle output was also calculated at constant prices and includes milk sales and herd growth.[11]

The basic assumption in this analysis is that the demand for cattle as a production asset depends on the level of production. As it rises the farms will be interested in increasing the value of cattle owned by them and, vice-versa, as output falls the demand for cows will fall. Since cows can easily be sold we have here a symmetric problem from the point of view of investors' decisions. It is just as easy to expand live inventory as it is to decrease it. This was not the case with structures but this fact did not present a problem in this study since market conditions on the whole were favorable and no farm wanted to deplete its capacity.

TABLE 40. *Estimates of Demand for Cattle*[a]

	Linear equation	*Logarithmic equation*
Coefficient of determination (R^2)	0.891	0.874
a_1 = estimate[b] of βL_1	0.492	0.371
a_2 = estimate[b] of $1-\beta$	0.498	0.497
Coefficient of adjustment	0.502	0.451
Elasticity of adjustment	0.540	0.503
Slope of long-run demand for cattle	0.981	0.962
Elasticity of long-run demand for cattle	0.802	0.738

[a] See footnote to Table 38.
[b] Coefficients are significant at a 1 per cent level.

Here, too, we assume that the closing of the gap between desirable and actual capacity is not done instantaneously and there is an adjustment process. In this case adjustment is continuous and may be carried out in relatively small units. The expansion of live inventory is achieved by adding cattle units which can be of varying ages. Hence there is no problem of adding on large units as is the case with buildings. This allows us to conduct the analysis on an annual basis.

The empirical equation is (4), where the dependent variable is the value of cattle at the year end—and not the annual addition to value. The

[11] For particulars of the calculation see Appendix B.

analysis covers the five-year period between 1954 and 1958 and deals with 53 farms in each year. It is conducted both in ordinary values and in logarithms. The results are presented in Table 40.

The estimates of the two equations are not too dissimilar. There is fairly close agreement with the data since close to 90 per cent of the variations in cattle value are explained by the equation. Since the unit of observation is the farm-year it is reasonable to compare the present analysis to the annual one which was conducted in poultry on the same basis. The coefficient of determination (R^2) was there 0.348. It is logical to suppose that the disparity in the values of R^2 in the two cases to a large extent reflects the difference in continuity of adjusting actual capacity to desirable capacity. This is only a hypothesis which is not given to direct verification but is consistent with the rest of the results presented in this chapter.

The adjustment coefficient and its elasticity are both close to 0.5, showing that the gap between live inventory demand and existing inventory is closed at the rate of 50 per cent per annum. The adjustment rate does not necessarily have to be the same as that for buildings or equipment since the main investment comes in the form of natural increase of number and age of calves and hence their rate of growth affects the rate of adjustment. However, this influence is not exclusive, since both purchases and sales were carried out on a relatively large scale. At any rate we can conclude by stating that a 1 per cent increase in the desirable value of cattle resulted in a 0.5 per cent increase in value of cattle for the same year.

We now return to our basic assumption for the analysis—that desirable capacity at year end is determined by the annual output. It can be seen that the results for demand for livestock represent an empirical verification which is free of the limitations which exist in the case of structure capacity. It cannot be said that the value of livestock inventory at year end is physically determined by output during the year. The scale of output does not automatically determine the final inventory. The only explanation that can be suggested is that the farmer wants to maintain the level of output in future and hence must adjust his inventory. In other words, if the annual output on one farm is IL x and the desirable inventory at the end of the year is IL 1,000, while in another farm annual output is IL $2x$ and the desirable value of inventory at the end of the year is IL 2,000, we say that this value is double because the farmer wishes to produce twice as much and therefore must double the inventory; we do not say the opposite because the desirable inventory at the end of the year is not forced upon the farmer according to his level of output during the year. We emphasize this point regarding livestock inventory since stock here is liquid and can be sold at market prices without special difficulty.

5. *Conclusion*

In this chapter an attempt has been made to examine the connection between output and the desirable quantity of production assets, as well as the rates of adjustment of assets to the desirable level.

It has been suggested that methodologically it is advantageous to examine the relations between capacity and output rather than between capacity and prices, even though capacity elasticity can be anticipated in this formulation to be slightly higher than unit elasticity. The results achieved accord with the hypothesis, as in all three cases the estimates are reasonably close to this value. As for the degree of capacity adjustment we obtained various estimates depending on the analytical framework. For the annual analysis we found an adjustment elasticity of close to 0.4 for poultry structures and 0.5 for cattle. In the four-year analysis the adjustment elasticities were 0.8–0.9 for poultry. It is quite possible that an annual elasticity of 0.5 suits the results of the four-year analysis. If there were need to conclude this analysis with a single average we would proffer an adjustment elasticity of 0.5, on an annual basis.

6. *Synthesis of the Short-Run and Long-Run Analyses*

To examine the effect of changes in price or other factors, such as certainty, on supply, both the long-run and the short-run effects must be observed. As an illustration we shall again give the two equations used for the poultry branch:

Short-run supply (see Chapter 5):

$$Y_{ti} = C_0 I_t T_t \left(\frac{\mathrm{P}}{\mathrm{W}}\right)_{ti}^{c_1} K_{t-1}^{c_2},\, iUti$$

Capacity—output relationships: $K_{ti}^{*} = L_0 Y_{t_i}^{L_1}$

In accordance with the conclusions of the two chapters we shall assume the following values: $c_1 = 0.7$; $c_2 = 0.4$; and $L_1 = 0.9—1.1$.

Let us assume that the farms are in both short- and long-run equilibrium when a 1 per cent change in output (Y) suddenly occurs. As a result desirable capacity (K^{*}) will change by 1 per cent in the same direction (assuming $L_1 = 1$). After adjustment is made, actual capacity (K) will change by the same relative amount. This change in actual capacity will bring about a 0.4 per cent change in short-run supply which means that at the same price the quantity supplied will vary. This change will cause an additional variation in desirable capacity and later in actual capacity and still later in output and so on. As long as c_2 is less than unity the changes will become smaller and eventually converge to the point of equilibrium. A 1 per cent variation in output will cause a final change in output amounting to:

$$1+0.4+(0.4)^2+(0.4)^3+\ldots=\frac{1}{1-0.4}=1.67 \text{ per cent.}$$

If the initial change in output stems from a price change, for the output to vary by 1 per cent the price would have to change by $\frac{1}{c_1}$ or approximately by 1.4 per cent. Accordingly, a 1.4 per cent price change caused a 1.67 per cent change in output, i.e. long-run supply elasticity is $\frac{1.67}{1.4}=1.2$. This means that when prices rise by 1 per cent, short-run supply will increase by 0.7 per cent. This will bring about capacity changes and after the farms make the proper adaptation their supply will be 1.2 per cent greater than it was before the price change.

The change in long-run capacity will also be different and when $L_1=1$ it will equal the change in output. In other words a 1 per cent variation in output will cause a 1.67 per cent change in final capacity.

Output fluctuations may be caused by changes not only in price but also in other factors connected with the farm or with a certain year and shared by all farms. In the preceding chapter we observed that the Poultry Agreement brought about an increase of more than 50 per cent in supply level. This was explained by the removal of price uncertainty. If the conditions of the Poultry Agreement had been maintained for a long period, the 50 per cent increase in short-run output would have expanded capacity and long-run output by approximately 83 per cent. In other words, the early evaluation of the effect of the Poultry Agreement did not take into account future developments and its influence is actually much stronger. According to our results it will increase long-run supply by close to 83 per cent. Of this 50 per cent or more was already achieved in the short-run but the increase was not exhausted within the period analyzed.

The results depend on the values of c_2 and L_1. These two elasticities connect the short- and long-run equations. There are not many doubts as to L_1; its value should be slightly greater than unity although estimates slightly lower than unity were found in the analysis. If we take 1.1 for this elasticity we shall find a stronger reaction in the long-run. The same applies for c_2. In Chapter 5 it was stated that the value of c_2 falls between 0.4 and 0.6, and if we take the higher value we shall find that the reaction in the long-run will be two-and-a-half times greater than the short-run reaction instead of 1.67 times greater: i.e. the result found above. Hence, the previous calculations are fairly conservative and the reaction is possibly stronger. The conclusions as to the long-run response did not relate to any specific period of time in which it is possible to measure the effects.

If we wish to know how long it will take for the effects to materialize it is necessary to resort to the adjustment coefficients. Assuming a certain value for the adjustment elasticity it is possible to find the annual change. In this way we could wind up the analysis and add the time dimension to it.

APPENDIX A

SURVEY RESULTS BY VILLAGE[1]

TABLE A–1. *Physical Area*[a]*: 1954 and 1958*

(Dunams)

		All villages	*Village*				
			A	*B*[b]	*C*	*D*	*E*
1. Number of farms[c]		66	14	16	9	13	14
2. Total physical area:	1954	51.6	26.2	23.9	32.0	50.1	122.5
	1958	47.8	34.3	18.9	35.8	46.4	103.1
1958/1954 (per cent)		93	131	79	112	93	84
3. Irrigated area:	1954	23.6	24.4	21.0	4.4	37.3	25.4
	1958	26.6	29.1	17.9	6.2	41.8	33.1
1958/1954 (per cent)		113	119	85	141	112	130
4. Unirrigated area:	1954	28.0	1.9	2.9	27.6	12.8	97.1
	1958	21.1	5.2	1.1	29.7	4.5	70.0
1958/1954 (per cent)		76	274	37	108	35	72
5. Irrigated orchards:	1954	1.7	5.0	0.4	—	1.0	1.4
	1958	3.5	9.9	1.3	—	0.8	4.1
1958/1954 (per cent)		205	198	292	—	80	289
6. Irrigated area other than orchards:	1954	21.9	19.4	20.5	4.4	36.3	24.0
	1958	23.1	19.3	16.2	6.2	41.0	28.9
1958/1954 (per cent)		105	99	79	141	113	120

[a] *Physical area* is defined as total area of farm *less* area let *plus* area leased during the year.
Irrigated area is physical area which is equipped for irrigation.
Unirrigated area is total physical area *less* irrigated area.

[b] Six of the 16 village B farms did not cultivate their land in 1958.

[c] Unless otherwise specified, the number of farms shown here applies to all tables in this appendix.

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[1] (1) Throughout, B represents farms from two villages (12 in one and 4 in the other) situated in the same district.

(2) Unless otherwise stated, all figures are per farm averages.

(3) All ratio, percentages and indexes were calculated from the unrounded figures underlying the tables.

TABLE A–2. *Composition of Irrigated Crop Area: 1954 and 1958*

	All villages	*Village*				
		A	*B*	*C*	*D*	*E*
1. *Greenfodder*						
a. Dunams 1954	19.4	22.0	6.3	5.0	37.7	23.9
1958	28.8	30.0	18.1	11.4	51.1	29.8
b. 1958/1954 (per cent)	150	138	287	228	136	124
c. Ratio of greenfodder area to irrigated physical area other than orchards						
1954	0.88	1.13	0.31	1.14	1.04	1.00
1958	1.25	1.58	1.12	1.84	1.25	1.03
2. *Field crops for sale (other than greenfodder)*						
a. Dunams 1954	10.1	4.1	21.0	1.4	8.3	10.8
1958	2.9	0.5	3.2	0.2	3.7	6.2
b. 1958/1954 (per cent)	29	12	15	14	45	57
c. Ratio of field crop area to irrigated physical area other than orchards:						
1954	0.46	0.21	1.02	0.32	0.23	0.45
1958	0.12	0.03	0.20	0.03	0.09	0.21
3. *Coefficient of utilization of irrigated area*						
1954	1.34	1.34	1.33	1.46	1.27	1.45
1958	1.37	1.61	1.32	1.87	1.34	1.24

NOTES:

LINE 1a. Comprises cultivated area of all irrigated green fodder crops.

LINE 1c. and 2c. Obtained by dividing the figures of 1a and 2a respectively by the appropriate values of panel 6 of Table A–1.

LINE 2a. Comprises vegetables, industrial corps and irrigated gains.

LINE 3. 1c. *plus* 2c.

TABLE A-3. *Distribution of Irrigated Area: 1954 and 1958*

(Number of farms with less than stated number of dunams)

	Irrigated area (dunams) less than								
	5	10	15	20	25	30	35	40	60
1954	9	11	15	25	38	48	56	61	66
1958	8	15	17	20	27	36	47	55	66

TABLE A-4. *Unirrigated Fodder[a]: 1954 and 1958*

(Dunams)

	All villages	Village				
		A	B	C	D	E
1954	14.3	1.9	0.2	15.8	2.3	52.9
1958	13.6	3.0	—	19.4	4.5	44.4

[a] Roughage only.

TABLE A-5. *Water Utilization: 1954–58*

	Villages B–E[a]	Village			
		B[a]	C	D	E
1. *Average per farm (thousands of m³)*					
1954	14.2	12.6	4.2[b]	21.9	15.0
1955	16.7	11.4	4.2	28.4	18.4
1956	17.8	10.7	4.8	30.6	20.3
1957	18.2	10.4	6.3	29.7	21.4
1958	19.4	11.5	5.1	30.9	24.8
2. *Average per irrigated dunam (m³)*					
1954	610	600	954[bc]	587	590
1958	729	643	823[c]	739	749

[a] Only 12 village B farms are included, owing to the lack of 1954 and 1958 data for the other 4.
[b] There were no 1954 figures for village C, and 1955 data were used instead.
[c] Village C figures are high compared to the others because a considerable part of the water used was for auxiliary irrigation of 'unirrigated' orchards.

Table A–6. *Value of Structure and Equipment: Beginning of 1954*
(1954 IL)

All villages	*Village*				
	A	*B*	*C*	*D*	*E*
5,490	3,515	5,436	3,848	5,658	8,424

Table A–7. *Gross Investment: 1954–58*
(1954 IL)

	All villages	*Village*				
		A	*B*	*C*	*D*	*E*
1. *Total (2. + 3. + 4.)*	**10,632**	**7,889**	**8,926**	**9,640**	**12,719**	**14,025**
2. *Structures and equipment*	*5,391*	*3,266*	*4,814*	*3,935*	*6,371*	*8,199*
a. Cattle	1,454	869	641	1,145	2,605	2,097
b. Poultry	2,736	1,433	3,456	1,257	1,968	4,880
c. Irrigation	398	293	164	174	688	644
d. Machinery etc.	803	671	553	1,359	1,110	578
3. *Livestock*	*4,614*	*2,733*	*3,875*	*5,137*	*6,348*	*5,395*
a. Cattle	3,003	1,878	1,497	4,521	5,218	2,819
b. Poultry	1,611	855	2,378	616	1,130	2,576
4. *Orchards*	*627*	*1,890*	*237*	*568*	—	*431*
5. *Direct investment in livestock branches (2a+2b.+3.)*	*8,804*	*5,035*	*7,972*	*7,539*	*10,921*	*12,372*

Notes:

Line 2. Gross investment at purchase price was deflated by the price index for gross agricultural investment given A. L. Gaathon, "The Estimate of Depreciation in Israel's National Accounts," *Bank of Israel Bulletin 11,* January 1960. Draught animals are included in 'machinery and equipment' (in 2d.) and not in livestock.

Line 3. The livestock figures are for the change in inventory bewteen the beginning of 1954 and the end of 1958, and therefore represent net investment. The are at 1954 prices, except for calves for fattening, which are at 1955 prices.

Line 4. Gross investment in orchards calculated by applying 1954 prices to the physical data.

TABLE A–8. *Composition of Investment: 1954–58*
(Per cent)

	All villages	Village A	B	C	D	E
1. *Total investment*	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
a. Structures and equipment[a]	50.7	41.4	53.9	40.8	50.1	58.5
b. Livestock	43.4	34.6	43.4	53.3	49.9	38.5
c. Orchards	5.9	24.0	2.7	5.9	—	3.0
2. *Total structures and equipment*[a]	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
a. Cattle	27.0	26.6	13.3	29.1	40.9	25.6
b. Poultry	50.8	43.9	71.8	31.9	30.9	59.5
c. Irrigation	7.4	9.0	3.4	4.4	10.8	7.9
d. Machinery, draught animals, etc.	14.8	20.5	11.5	34.6	17.4	7.0
3. Direct investment in livestock as per cent of total investment[b]	82.8	63.8	89.3	78.2	85.9	88.2

[a] Including draught animals.
[b] Line 5 of Table A–7 as per cent of Total.
SOURCE: Table A–7.

TABLE A–9. *Laying Capacity*[a]*: 1954–58*

End of year	All villages	Village A	B	C	D	E
1. *Places*						
1954	647	641	676	358	273	1,152
1955	802	707	850	451	425	1,419
1956	914	712	948	640	578	1,563
1957	993	712	1,082	620	593	1,783
1958	1,131	811	1,266	674	728	1,966
2. *Index: 1954=100*						
1954	100	100	100	100	100	100
1955	124	110	126	126	155	124
1956	141	111	140	179	212	136
1957	154	111	160	173	217	155
1958	174	127	187	188	267	171

[a] Calculated on the basis of 1 squaremeter floorspace=5 laying birds
1 battery-cage =5 laying birds.

TABLE A–10. *Broiler Capacity*[a]*: 1954–58*

End of year	*All villages*	*Village*				
		A	*B*	*C*	*D*	*E*
1. *Places*						
1954	104	47	203	34	—	191
1955	168	109	313	88	—	271
1956	268	135	509	88	39	453
1957	299	135	547	88	55	544
1958	341	173	638	134	55	567
2. *Index: 1954=100*						
1954	100	100	100	100	*,[b]	100
1955	162	235	154	255	*	141
1956	258	290	250	255	100	237
1957	287	290	269	255	139	284
1958	328	371	314	394	139	296

[a] Calculated according to size and type of structures in use.
[b] 1956=100.

TABLE A–11. *Value of Poultry Structure Capacity: 1954–58*

End of year	*All villages*	*Village*				
		A	*B*	*C*	*D*	*E*
1. *Fixed prices (IL)*						
1954	2,869	2,686	3,254	1,524	1,092	5,124
1955	3,662	3,118	4,246	2,041	1,698	6,408
1956	4,380	3,214	5,168	2,798	2,417	7,475
1957	4,779	3,214	5,807	2,718	2,520	8,601
1958	5,445	3,709	6,786	3,060	3,059	9,395
2. *Index: 1954=100*						
1954	100	100	100	100	100	100
1955	128	116	130	134	155	125
1956	153	120	159	184	221	146
1957	167	120	178	178	231	168
1958	190	138	209	201	280	183

TABLE A-12. *Consumption of Concentrates in the Poultry Branch: 1954–58*

Year	All villages	Village A	B	C	D	E
1. *Tons*						
1954	25	22	31	10	8	44
1955	29	29	35	13	8	52
1956	33	28	36	20	19	54
1957	31	20	42	15	17	51
1958	40	27	52	19	24	67
2. *Index: 1954=100*						
1954	100	100	100	100	100	100
1955	116	130	113	134	96	118
1956	132	127	117	200	241	123
1957	124	91	134	155	222	115
1958	160	123	166	191	303	152

TABLE A-13. *Utilization of Poultry Structures*[a]*: 1954–58*

	Village A	B	C	D	E	All Villages	Index: 1954=100
	Kg/IL						
1954	8.3	9.6	6.6	7.2	8.6	*8.7*	100
1955	10.0	9.5	7.5	5.7	8.9	*8.8*	102
1956	8.8	7.8	8.5	9.2	7.8	*8.2*	94
1957	6.2	7.6	5.4	7.1	6.3	*6.7*	78
1958	7.9	8.3	6.6	8.6	7.4	*7.8*	90
All years (arithmetic mean)	*8.24*	*8.56*	*7.00*	*7.50*	*7.80*		

[a] Kilograms of concentrates per IL of annual average capacity, except for 1954, where end-year figure was used.

SOURCE: Calculated from Tables A-11 and A-12.

TABLE A–14. *Cattle Structure Capacity*[a]*: 1955 and 1959*

(Number of stands)

Beginning of year	All villages	Village A	Village B	Village C	Village D	Village E
1. *Cows and heifers*						
1954	9.3	8.1	9.6	7.8	9.5	11.1
1959	10.7	9.3	7.4	8.2	12.1	14.1
1959/1955[b] (per cent)	119	106	123	106	127	127
2. *Total constructed stands*						
1955	10.0	8.4	11.0	8.5	9.8	12.2
1959	16.1	12.8	11.1	11.8	19.9	21.1
1959/1955[b] (per cent)	167	140	162	138	204	173

[a] Calculated on the basis of farms with cattle. In village A, 13 farms had cattle in 1954, and 12 in 1958; the corresponding figures for village B were 5 and 8, while for the other villages the number of farms was as shown in Table A–1 for both years. The average was accordingly calculated for 54 farms in 1954 and 56 in 1958.

[b] Since the number of farms was different in the two years, the percentages were cal-calculated from the total and not from the per farm number of stands. The figures therefore reflect changes in both the number of cattle-keeping farms and in the average number of stands per farm.

TABLE A–15. *Composition of Cattle Inventory*[a]*: 1954 and 1959*

(Number of head)

Beginning of year	Total head	Cows[b]	Heifers[c]	Calves: Heifer	Calves: Bull[d]
1954	10.0	5.6	1.3	2.7	0.4
1959	15.6	6.7	2.4	3.8	2.8
1959/1954[e] (per cent)	161	123	189	144	816

[a] See note a to Table A–14.

[b] Cows having calved at least once by the beginning of the stated year.

[c] Due to calve for the first time during the year. However, for 1959 no check was made to determine whether the heifers had in fact calved during the year, and the category was defined to include any heifer aged 18 months or more.

[d] Kept for fattening.

[e] Se note b to Table A–14.

TABLE A–16. *Value of Cattle Inventory*[a]*: 1954 and 1959*

(1954 IL)

Beginning of year	All villages	Village A	B	C	D	E
1954	7,758	7,659	6,556	4,968	9,280	8,659
1959	11,021	10,488	7,091	9,490	14,498	11,478
1959/1954[b] (per cent)	142	137	108	191	156	133

[a] See note a to Table A–14.

[b] The percentages were calculated from the first two lines of the table, and not as in Tables A–14 and A–15; they thus reflect the change in average cattle-value per cattle-raising farm.

TABLE A–17. *Expenditure on Raw Materials: 1954–58*

(Current IL)

Year	All villages	Village A	B	C	D	E
1954	7,319	6,883	7,835	4,040	4,794	11,615
1955	9,466	9,224	10,079	5,355	5,886	14,972
1956	11,941	9,719	11,076	7,389	9,524	20,324
1957	13,239	9,641	14,058	8,230	11,345	20,879
1958	17,535	12,417	18,498	10,569	14,639	28,719

TABLE A–18. *Feed Purchases: 1954 and 1958*

(Current IL)

	All villages	Village A	B	C	D	E
1954: Total	5,652	5,732	5,649	3,312	3,684	8,904
For cattle	3,981	3,592	5,072	1,602	1,279	7,160
For poultry	1,671	2,140	577	1,710	2,405	1,744
1958: Total	13,326	9,746	14,353	8,457	11,451	20,604
For cattle	3,569	3,064	1,677	3,807	5,621	4,176
For poultry	9,757	6,682	12,676	4,650	5,830	16,428

Table A–19. *The Share of Purchased Feeds in Total Raw Materials[a]: 1954 and 1958*

(Per cent)

	All villages	Village A	Village B	Village C	Village D	Village E
1954: Total	**77**	**83**	**72**	**82**	**77**	**77**
For cattle	23	31	7	42	50	15
For poultry	54	52	65	40	27	62
1958: Total	**76**	**79**	**78**	**80**	**78**	**72**
For cattle	20	25	9	36	38	15
For poultry	56	54	69	44	40	57

[a] Calculated from Tables A–17 and A–18.

Table A–20. *Expenditure on Raw Materials: 1954–1958*

(1954 prices)

	All villages	Village A	Village B	Village C	Village D	Village E
1. *1954 IL*						
1954	7,319	6,883	7,835	4,040	4,794	11,615
1955	8,231	8,021	8,764	4,657	5,118	13,019
1956	9,115	7,419	8,455	5,640	7,270	15,514
1957	9,130	6,649	9,695	5,676	7,824	14,399
1958	11,613	8,223	12,250	6,999	9,695	19,019
2. *Index: 1954=100*						
1954	100	100	100	100	100	100
1955	112	117	112	115	107	112
1956	125	108	108	140	152	134
1957	125	97	124	141	163	124
1958	159	119	156	173	202	164

Source: Current price figures from Table A–17. For the deflator used see text, p. 46.

TABLE A–21. *Labour Input: 1954–58*

	All villages	Village				
		A	B	C	D	E
1. *Mandays*						
1954	627	553	692	345	604	829
1955	602	547	637	324	616	781
1956	562	533	513	331	582	778
1957	549	522	470	338	619	737
1958	569	557	462	356	643	773
2. *Index: 1954=100*						
1954	100	100	100	100	100	100
1955	96	99	92	94	102	94
1956	90	96	74	96	96	94
1957	88	94	68	98	102	89
1958	91	101	67	103	106	93

APPENDIX B

APPENDIX TO CHAPTER 3

1. *Calculation of Output at Fixed Prices*

Output sources on the farms in the sample consist of poultry, cattle, fruit, vegetables and other field crops, and appreciation of orchards. Calculations at fixed prices were made in order to find real changes in output and to isolate them from fluctuations in the price level. The base year taken was 1954, with a few exceptions which will be indicated below.

a. *Poultry*

Poultry output comprises sales of eggs and meat, and changes in the size of flocks which will be called 'change in live inventory'. The value of egg sales was found as the product of the number of eggs and the price—6.6 agorot per egg.[1] The value of meat sales is the quantity multiplied by IL 2.050 per kilogram. The data did not allow differentiation of broiler sales from those of layers sold in the course of selection. Flock value was calculated according to a price key which evaluated the birds on the basis of age.[2] The difference in flock value at the beginning and end of the year served to measure the difference in the size of the flock.

b. *Cattle*

Cattle output consists of milk sales and herd growth. Milk sales were found by multiplying the quantities of milk marketed by a price of 23.3 agorot per liter.[3] With regard to herd growth some of the calves were marketed during the year while the remainder were used to replenish the herd. These two components are not given to direct measurement. Although we have data on cattle sales on the farms, these sales are not identical

[1] Price sources: Y. Lowe, T. Gans, and Y. Remer, *Report on the Economic Situation of Established Family Farms for the Years 1952/53 to 1957/58,* December 1958, mimeograph, (Hebrew).

[2] Prices used to calculate flock value:
Layers — IL 4 per unit
Pullets — IL 2 per unit
Chicks — purchase price.

[3] Lowe, Gans, and Remer, *op. cit.*

with the component mentioned above—since some of the sales might be from the inventory already in existence at the beginning of the year and not necessarily from output produced during the year. At the same time there are no specific data on the replenishment. The difference in inventory between the beginning and end of the year can be measured—but this difference in inventory is no proof of natural growth in the herd since it may be the result of cattle purchases during the year. On the other hand, the decrease of inventory does not necessarily indicate negative growth since the extent of sales may have been greater than that of growth. The growth of the herd may be expressed as follows: Annual herd growth= end of year value *less* beginning of year value *plus* sales *less* purchases. Thus, growth is measured excluding ownership transfers which occurred during the year, i.e. there is no differentiation as to whether cattle were sold or remained on the farm. In both cases what interests us is the scale of growth of the herd.

The calculation itself was made on the basis of the physical census of the herds at the beginning and end of each year. Cattle listed were divided into four categories: dairy cows, heifers, heifer calves, and bull calves. Herd value is the sum of the products of the number of heads in each category multiplied by a suitable price. The base year for prices was 1954, with the exception of bull calves, whose value was calculated at 1955 prices.

The prices per head are: dairy cows—IL 1,000; heifers—IL 800; the price of calves is IL 150 plus an additional IL 30 for each month of age. Hence the price of a calf at the age of x months is IL $150+30x$. These prices refer to heifer calf prices in 1954 and bull calf prices in 1955.

Sales and purchases were calculated slightly differently. Instead of multiplying cattle bought or sold by 1954 prices, the sales and purchases were classified according to the above-mentioned categories and their value arrived at by deflation of the purchase price by the price index for cattle of the class to which they belonged. The index itself was fixed according to average annual prices, thus reflecting the conditions under which farms worked. The indexes used are:

	1954	*1955*	*1956*	*1957*	*1958*
Bull and heifer calves	0.67	1.00	1.33	1.67	2.00
Cows and heifers	1.00	1.19	1.41	1.47	1.89

The year 1955 was taken as the base for the calf price-index because the price ratio between mature cattle and calves for that year appeared more characteristic of the entire period, whereas 1954 prices for calves were exceptionally low and the number of sales was also small.

c. *Fruit, vegetables, and field crops*

Sales of fruit, vegetables, hay, and grains were calculated at current prices without the use of deflators, since the weight of these items is very low and their price level changed only slightly. Appreciation of the orchards was calculated according to production costs which are more suitable to the end of the period. But these costs do not include managerial costs and interest and are therefore lower than actual costs at the end of the period and almost certainly not very far from those of the beginning of the period. In any event orchard area is small and even if there are deviations their influence on the results is almost nil.

SURVEY RESULTS BY VILLAGE[4]

TABLE B–1. *Total Output: 1954–58*
(1954 prices)

	All villages	*Village*				
		A	*B*	*C*	*D*	*E*
1. *1954 IL*						
1954	15,525	14,264	14,097	9,202	12,626	25,170
1955	17,392	15,604	15,501	10,327	13,280	29,703
1956	19,098	15,265	16,353	12,206	18,966	30,623
1957	19,665	14,916	17,571	12,282	19,493	31,711
1958	23,557	17,427	21,859	13,816	23,547	37,897
2. *Index: 1954=100*						
1954	100	100	100	100	100	100
1955	112	109	110	112	105	118
1956	123	107	116	133	150	122
1957	127	105	125	133	154	126
1958	152	122	155	150	186	151

[4] 1. Unless otherwise specified, the number of farms shown in Appendix A, Table A–1, line 1, applies to all tables in this appendix.
2. Throughout, B represents farms from two villages (12 in one and 4 in the other) situated in the same district.
3. Unless otherwise stated, all figures are per farm averages.
4. All ratios, percentages, and indexes were calculated from unrounded figures underlying the tables.

TABLE B–2. *Output/Raw Materials Ratio*[a]*: 1955–58*

(Index: 1954=1)

	All villages	Village A	B	C	D	E
1955	1.00	0.93	0.98	0.97	0.98	1.05
1956	0.98	0.99	1.07	0.95	0.99	0.91
1957	1.02	1.08	1.01	0.94	0.94	1.02
1958	0.96	1.03	1.00	0.87	0.92	0.92
Arithmetic four-year mean	0.99	1.01	1.02	0.93	0.96	0.97

[a] Calculated from Tables B–1 and A–20 as the output index *divided by* the raw materials index.

TABLE B–3. *Output of Livestock Branches: 1954–58*

(Per cent of total output)

	All villages	Village A	B	C	D	E
1. *Total livestock*						
1954	85	88	78	86	88	86
1955	90	91	86	93	93	89
1956	92	91	89	95	91	94
1957	89	83	94	92	86	90
1958	91	86	95	94	90	90
2. *Cattle*						
1954	36	39	11	56	70	30
1955	35	38	12	45	70	30
1956	35	39	15	45	55	30
1957	38	46	15	51	63	33
1958	36	41	14	56	59	28
3. *Poultry*						
1954	49	49	67	30	18	56
1955	55	53	74	48	23	59
1956	57	52	74	50	36	64
1957	51	37	79	41	23	57
1958	55	45	81	38	31	62

SOURCE: Tables B–1, B–4, and B–7.

TABLE B–4. *Cattle Output: 1954–58*
(1954 prices) [a]

	All villages	Village				
		A	B	C	D	E
1. *1954 IL*						
1954	5,612	5,601	1,547	5,158	8,822	7,577
1955	6,046	5,852	1,908	4,633	9,272	8,884
1956	6,630	5,940	2,396	5,492	10,493	9,295
1957	7,525	6,864	2,571	6,254	12,243	10,283
1958	8,382	7,193	3,174	7,748	13,905	10,800
2. *Index: 1954=100*						
1954	100	100	100	100	100	100
1955	108	104	123	90	105	117
1956	118	106	155	106	119	123
1957	134	123	166	121	139	136
1958	149	128	205	150	158	143

[a] Except for calves, which were evaluated at 1955 prices.

TABLE B–5. *Disposal of Live Cattle Inventory: 1954–58*
(All villages)

	1954	1955	1956	1957	1958	Entire period	
	1954 IL						Per cent
Cattle sales	1,595	2,197	2,063	2,333	2,241	10,429	85
Herd replenishment	229	–84	299	585	882	1,911	15
Total cattle production	**1,824**	**2,113**	**2,362**	**2,918**	**3,123**	**12,340**	**100**

TABLE B–6. *Change in Cattle Inventory and Its Sources: 1954–58*
(All villages)

	1954	1955	1956	1957	1958	Entire period	
	1954 IL						Per cent
Herd replenishment	229	84	299	585	882	1,911	62
Purchases	164	318	299	238	142	1,161	38
Total change in inventory	**393**	**234**	**598**	**823**	**1,024**	**3,072** [a]	**100**

[a] This figure differs from that shown in Table A–7 owing to the different methods of deflation used (see p. 129).

TABLE B–7. *Poultry Output: 1954–58*
(1954 prices)

	All villages	Village A	B	C	D	E
1. *1954 IL*						
1954	7,576	6,981	9,434	2,790	2,332	13,995
1955	9,576	8,310	11,494	5,007	3,015	17,681
1956	10,946	7,923	12,147	6,086	6,856	19,518
1957	9,959	5,458	13,883	5,017	4,512	18,209
1958	13,091	7,846	17,664	5,297	7,345	23,454
2. *Index: 1954=100*						
1954	100	100	100	100	100	100
1955	126	119	122	179	129	126
1956	144	113	129	218	294	139
1957	131	78	147	180	193	130
1958	173	112	187	190	315	168

TABLE B–8. *Share of Eggs in Total Poultry Output: 1954–58*
(Per cent)

Year	All villages	Village A	B	C	D	E
1954	51	48	55	56	42	51
1955	51	53	58	38	51	48
1956	44	47	49	49	40	39
1957	54	59	55	46	69	50
1958	52	48	53	56	48	54
All years (arithmetic mean)		51	54	49	50	48

TABLE B–9. *Other Output:*[a] *1954–58*
(1954 IL)

	All villages	Village A	B	C	D	E
1954	2,337	1,682	3,116	1,254	1,472	3,606
1955	1,770	1,442	2,099	687	993	3,138
1956	1,522	1,403	1,810	628	1,617	1,810
1957	2,181	2,594	1,117	1,011	2,739	3,219
1958	2,084	2,388	1,021	771	2,297	3,643

[a] Output other than that of livestock branches. See p. 130, section c.

TABLE B–10. *Gross Added Value: 1954–58*
(1954 prices)

	All villages	Village A	Village B	Village C	Village D	Village E
1. *1954 IL*						
1954	8,206	7,381	6,262	5,162	7,832	13,563
1955	9,161	7,583	6,737	5,670	8,162	16,684
1956	9,983	7,846	7,898	6,566	11,696	15,109
1957	10,493	8,267	7,876	6,606	11,669	17,312
1958	11,944	9,204	9,609	6,817	13,852	18,878
2. *Index: 1954=100*						
1954	100	100	100	100	100	100
1955	112	103	108	110	104	123
1956	122	106	126	127	149	111
1957	128	112	126	128	149	128
1958	146	125	153	132	177	139

TABLE B–11. *Gross Added Value as Per Cent of Output: 1954–58*

	All villages	Village A	Village B	Village C	Village D	Village E
1954	53	52	44	56	62	54
1955	53	49	43	55	61	56
1956	52	51	48	54	62	49
1957	53	55	45	54	60	55
1958	51	53	44	49	59	50
All years (arithmetic mean)	52.4	52.0	44.8	53.6	60.8	52.8

SOURCES: Tables B–1 and B–10.

APPENDIX C

Appendix to Chapters 2 and 3

Comparison of the Sample with Other Data on Established Moshavim

In this section a comparison is made with the results of a survey conducted in moshav farms in November 1957.[1] This survey covered 589 farms in 32 villages out of a population of 97 villages containing 7,100 farms. Every third village was included in the sample and within each village every fourth farm was chosen. The data of this survey are not as detailed as those compiled for the present project. The comparison will therefore be made only for those subjects included in the survey and which are of interest in our discussion.

The survey results are presented in three groups: established farms, non-established farms, and small farms. The first and second groups differ in age, the non-established group comprising farms which still receive long-term loans from the Settlement Department of the Jewish Agency. The group of small farms includes undeveloped farms where labor input calculated according to norms does not exceed 150 mandays per farm per year. For comparison we have included the results of the sample for which the detailed analysis in this project was carried out.

The table shows that the sample farms possessed far more productive factors than the overall moshav average and even more than the established farm group. The sample farms had greater area, both irrigated and unirrigated, and more livestock, although their orchards were smaller. Moreover, more capital was invested in structures and equipment in the sample farms, a fact not appearing in the table. Thus, we may conclude that the sample farms are at a more advanced stage of development, i.e. their output is higher than the average of the moshav population as a whole, or of the 'established farm' category. It may therefore be assumed that farmers' income in the entire population is lower than of the sample.

Increasing production with the purpose of correcting the situation might come from extending the use of the various factors. However, there are institutional limitations on land and water, and any increase is subject to

[1] Y. Lowe, T. Gans, and Y. Remer, *Results of a Farm Survey Conducted in November 1957 on 600 Family Farms,* The Hebrew University, Faculty of Agriculture, June 1958, (Hebrew).

TABLE C–1. *Comparison of Sample Results in the Farm Survey*[a]

	Sample farms[b]	Family Farm Survey November 1957			
		All farms	Established farms	Non-established farms	Small farms
Number of farms	66	589	349	151	89
Irrigated area (dunams)	26.6	19.0	21.7	16.5	12.7
Total area (standard dunams[c])	31.9	21.8	25.6	17.6	14.6
Irrigated crop area (dunams)	35.2	23.6	27.7	22.4	9.4
Grains, hay and fodder	*28.8*[d]	*16.0*	*18.4*	*16.4*	*6.3*
Vegetables, potatoes and industrial crops	*2.9*	*2.9*	*3.1*	*4.1*	*0.4*
Orchards	*3.5*	*4.6*	*6.2*	*1.9*	*2.7*
Dairy cows	9.1	2.5	2.9	3.0	0.3
Calves	6.5	3.5	4.5	2.9	0.6
Laying hens[e]	. .	378	572	115	67
Mandays[f]	566[g]	383	482	330	82

[a] All figures are per farm averages.
[b] Area figures—1958; livestock—end of 1958; labor—1957.
[c] Standard dunams calculated as: irrigated area *plus* ¼ × (unirrigated area).
[d] Does not include grains.
[e] The number of laying birds was not calculated for the sample, but is higher than the Survey's established-farm average. However, as the Survey was carried out at the peak of the poultry-industry crisis, the number of birds in the farms surveyed is probably below normal. For example, the average structure capacity in small farms was 185 birds, only 36 per cent of this capacity being utilized.
[f] Calculated according to norms.
[g] Lowe, Gans, Remer, *op. cit.* Actual labor average was 549 mandays.

a decision by the settlement authorities and not by the settlers themselves; the settlers can only increase production within the given framework of the two fixed factors by developing the livestock branches or by more intensive use of the water and land at their disposal. The development pattern depends both on market conditions and the farmers' reaction to them. The latter is here examined for the sample farms in order to generalize the results. Our comparison clearly suggests that a marked increase of output is to be expected in the moshav sector, especially in poultry and cattle. This will take place as the output of other farms approaches the level of the sample, even without considering a further increase in the output of the sample farms themselves.

APPENDIX D

APPENDIX TO CHAPTER 5

Derivation of a Behavior Function from a Cobb-Douglas Production Function [1]

The following production function function is assumed:

$$Y = B_0\, B_t\, X_1^{A_1}\, X_2^{A_2}\, X_3^{A_3}\, M^{A_4} \quad (1)$$

The symbols are: Y=output, X_j=input j, M=management, A_j=production elasticities, and B_t =the coefficient which represents the level of productivity in year t. Assume that inputs 1 and 2 vary during the period discussed while X_3 represents a fixed input.

The necessary conditions for equilibrium of the firm are:

$$MP_h = \frac{W_h}{P} \text{ and } h = 1,2 \quad (2)$$

where W_h is the wage of input h and P the price of the product.

By derivation:

$$MP_h = A_h \frac{Y}{X_h} .$$

Hence:

$$X_h = A_h Y \frac{P}{W_h} . \quad (3)$$

Various entrepreneurs are liable to react differently to prices. This depends on their evaluation of market conditions as well as their readiness and ability to take a risk. Accordingly an additional variable (R_h) is introduced which discriminates between entrepreneurs according to their behavior.

Hence:

$$X_h = A_h \frac{YP}{W_h} R_h . \quad (4)$$

[1] For a more complete discussion and evaluation of the implications of the specification the reader is referred to Y. Mundlak: "Estimation of Production and Behavioral Functions from a Combination of Cross-Section and Time Series Data", in *Measurement in Economics: Studies in Mathematical Economics and Econometrics in Memory of Yehuda Grunfeld,* Stanford University Press, 1963, (this essay has been reissued as FP Research Paper 13).

In a similar manner another variable can be added describing certainty conditions for a given year, say G_h, thus giving us:

$$(4)' \qquad X_h = A_h \, Y \frac{P}{W_h} \, R_h G_h.$$

This variable is liable to vary from one input to another, and so bears the subscript h. Substituting (4)' in (1) and carrying out certain algebraic simplifications we arrive at:

$$(5) \qquad Y = C_0 B_t^{1/D} \left(\frac{P}{W_1}\right)^{C_1} \left(\frac{P}{W_2}\right)^{C_2} X_3^{C_3} M^{C_4} RG,$$

where:

$$C_0 = (B_0 \quad A_1^{A_1} \, A_2^{A_2})^{1/D}$$

$$D = 1 - A_1 - A_2$$

$$C_j = \frac{A_j}{D} \qquad j = 1, \cdots 4.$$

$$R = R_1^{C_1} R_2^{C_2}$$

$$G = G_1^{C_1} G_2^{C_2}.$$

Substituting (5) in (4)' we obtain

$$(6\text{–}1) \qquad X_1 = A_1 \, C_0 \, B_t^{1/D} \left(\frac{P}{W_1}\right)^{C_1+1} \left(\frac{P}{W_2}\right)^{C_2} X_3^{C_3} M^{C_4} R_1^{C_1+1} R_2^{C_2} G$$

and a similar expression for X_2 (which we shall call 6–2).

Equations (5) and (6) are the equations of the reduced form of the firm. They express the variables which the firm decides on during the period analyzed (endogenous) as functions of all the variables over which the firm has no control or which are fixed: prices, the general efficiency level, fixed inputs, management and behavior in reaction to price (exogenous). In other words, when we fix the values of the exogenous variables we derive from the reduced form equations the equilibrium production and inputs for the firm. Equation (5) is the supply function, whereas the equations in (6) are input demand equations. In the long run X_3 will also be a variable input. Thus, in a long-run model there is need for a behavior equation for X_3 as well.

The important points reflected in the above formulation are:

(a) If the firms are under perfect competition and prices are equal for all, not all firms will necessarily be of the same size. The behavior functions denote that size depends on the firms' management as well as on price behavior and willingness to take risks.

(b) At times the criticism of the Cobb-Douglas function is voiced that were all firms in equilibrium the input ratios would be identical among them. The formulation presented shows that equilibrium is possible without input ratios being identical for all firms. For instance, by dividing (6–1) by (6–2) we find:

$$\frac{X_{1i}}{X_{2i}} = \frac{A_1}{A_2}\,\frac{W_2}{W_1}\,\frac{R_{1i}}{R_{2i}} \,,$$

where i denotes the firm. Thus the ratios may vary from one firm to another.

(c) Supply elesticity according to product price ($E_{Y/P}$) equals the sum of production elasticities of the variable inputs divided by their complement to unity, or:

$$E_{Y/P} = \frac{1 - D}{D} \,.$$

(d) If the production function is homogeneous of the first degree, the difference between the sum of the production elasticities and unity equals management elasticity in the long run. Thus supply elasticity equals:

$$\frac{1 - A_4}{A_4} \,.$$

This result gives special meaning to an unbiased estimate of production elasticities, including those of the individual branches.

(e) Supply elasticity according to the price of one of the inputs, say W_1, denotes the per cent change in supply stemming from a one per cent change in W_1. The value arrived at is:

$$E_{Y/W_1} = -\frac{A_1}{D} \,.$$

Its size depends on the production elasticity of the factor and on D.

(f) Supply elasticity according to the quantity of the fixed factor denotes by what per cent supply will vary when the particular fixed input is allowed to increase by 1 per cent:

$$E_{Y/X_3} = \frac{A_3}{D} \,.$$

This value will always be less than unity. Its size depends on the number of fixed factors and their elasticities (including management).

(g) Supply elasticity according to annual level of productivity denotes the percentage change of supply following a one per cent productivity increase. The value is:

$$E_{Y/B_t} = \frac{1}{D} .$$

It will always exceed unity and increases with time as more and more fixed inputs turn variable—reducing the value of D.

(h) Management supply elasticity shows the percentage difference in supply between two firms where the only difference is that in the second management is one per cent larger than in the first. Its value is:

$$E_{Y/M} = \frac{A_4}{D} .$$

If all factors are variable it will equal unity. However, if fixed factors exist it will exceed unity. Hence if the behavior of all firms is identical (R_n equals unity for all firms and inputs) in the long run dispersion of firm size will reflect dispersion of management.

(i) Quantity supplied depends on the firm's behaviour as represented by R_1 and R_2. If the firms reach equilibrium both these variables will equal unity and will not affect the quantity supplied. With firms which do not wish to run risks or are conservative in their behavior the above values will be less than unity, thus negatively influencing supply. Values greater than unity may reflect an optimistic evaluation of price conditions or of productivity, as well as willingness to take risk.

(j) Similar explanations can be given for the input demand elasticities.

APPENDIX E

APPENDIX TO CHAPTER 6

The Relation between Capacity and Output

As in Appendix D we shall assume the following production function:

$$Y = B_0 B_t X_1^{A_1} X_2^{A_2} X_3{}^{3} M^{A_4}. \tag{1}$$

The conditions for production at minimum costs are:

$$\frac{MP_1}{W_1} = \frac{MP_2}{W_2} = \frac{MP_3}{W_3}. \tag{2}$$

By derivation: $$MP_h = A_h \frac{Y}{X_h},$$

hence:

$$\frac{A_1}{X_1 W_1} = \frac{A_2}{X_2 W_2} = \frac{A_3}{X_3 W_3}. \tag{3}$$

(3) contains two independent equations. Solving for X_2 and X_1 in terms of X_3 and substituting in (1) we find:

$$Y = B_0' B_t X_3^H M^{A_4} \tag{4}$$

where: $H = A_1 + A_2 + A_3$ and, assuming constant returns to scale, $H = 1 - A_4$, and

$$B_0' = B_0 \left(\frac{W_3}{A_3}\right)^{A_1 + A_2} \left(\frac{A_1}{W_1}\right)^{A_1} \left(\frac{A_2}{W_2}\right)^{A_2}.$$

Equation (4) expresses the relation between output and desirable long-run capacity. To bring (4) to the form in which the relations in Chapter 6 were expressed we shall present capacity as a dependent variable:

$$X_3 = [B_0'^{-1} B_t^{-1} M^{-A_4}] Y^{1/H} \tag{5}$$

In this form we find that capacity elasticity according to production in the long run is:

$$E_{3/Y} = \frac{1}{H} = \frac{1}{\sum\limits_h A_h}$$

and with constant returns to scale:

$$E_{3/Y} = \frac{1}{1 - A_4}.$$

Hence this elasticity must be greater than unity despite the existence of constant returns to scale. Elasticity will be unity only when managerial elasticity is zero, i.e. when management does not constitute a productive factor or when A_4 is not zero, but increasing returns to scale exist, so that H is unity.

APPENDIX F

Economic Analysis of Established Family Farms in Cooperative Villages

by GERSHON KADDAR

1. *Project Formulation and Organization*

It was realized from the beginning that the study would be of value to national institutions concerned with agricultural and settlement policy. Together with these functions the project was so formulated as to be of service also to the participating farmers, thus creating the nucleus of an economic extension service in agriculture. The direct aims of the study were to investigate the input-output relationship of the various types of farms.

The working staff of the project was organized as follows:

Project leader—Mr. G. Kaddar (replaced by Dr. Y. Lowe in 1956)

Statistician	— Mr. M. Noam, until 1956
Field man	— Mr. T. Gans, until 1960
Field man	— Mr. E. Heiman, until 1957
Field man	— Mr. Y. Remer, until 1961
Field man	— Mr. M. Zohar, from 1957 to 1961
Data processing	— Mr. M. DeVries, until 1956
Data processing and analyses of village-cooperatives	— Mr. E. Sternberg, until 1961.

The work of the project was aided by an advisory committee consisting of:

Dr. Y. Lowe (Chairman)—Hebrew University
Dr. L. Samuel—Economic Advisor to the Ministry of Agriculture
Dr. A. G. Black—then the Chief of the F.A.O. Mission in Israel
Dr. M. Clawson—Economic Advisory Staff, Prime Minister's Office
Dr. A. Posner—Lecturer in Statistics in the Faculty of Agriculture, Hebrew University
Dr. J. Bach—General Manager's Office, Department of Agricultural Credits, Bank Leumi Le'Israel
Dr. Y. L. Oppenheimer—Agricultural Research Institute, Rehovot
Mr. G. Kaddar (project leader)—Bank Leumi Le'Israel.

2. *Sampling Procedure*

In the original planning of the field work it was proposed to take a random sample from the established villages and a random selection of the farms within the village. After a pre-test of a pilot sample it was realized that there were considerable differences between the villages and still greater differences between farms in the same village as regards scale and composition of production as well as production efficiency. In order to secure similar variability in the sample it was decided to base the sampling of villages on the size of their average farm; this was calculated in two ways:

(a) the acreage measured in 'standard dunams' (one standard dunam equalling one irrigated dunam or its yield equivalent in unirrigated land),[1] and (b) the normal yearly labor requirement of the farm as obtained by multiplying its crops, livestock, etc. by a set of assumed 'standard labor days'. All the cooperative villages in Israel were first grouped according to standard dunams, and within the group in diminishing order of standard workdays. Following this ranking, every fifth village among all existing cooperative villages of family farms founded prior to 1948 was counted out starting with a random number.

These 15 villages constituted the statistical sample of the survey. Within the villages the farms were selected at random—approximately every fifth farm as appearing on an alphabetical list provided by the village cooperative. In order to eliminate part-time farmers from the sample, farms with standard labor requirements under 250 workdays per year were excluded.

Data for the complete sample of 150 farms in 15 villages were completed only for 1953/54. In 1952/53 and after 1953/54 data could, for technical reasons, be completed only for 67–74 farms in 6 villages. The averages of these groups differed considerably from those of the sample of 15 villages.

3. *Field Work Procedure*

After the village sample had been decided on, the cooperative records pertaining to these farms were collected and copied on summary sheets. The yearly summaries were then transferred item by item onto the specially prepared questionnaires covering one agricultural year (see example in Section 6). Equipped with the questionnaire containing the figures of the cooperative records, the field men interviewed the farmer and filled in the missing answers at the farm itself. The farm visits also utilized a series of cross-checks to check the material received in the cooperatives. The production indices obtained as the study progressed served as an additional

[1] Dr. Y. L. Oppenheimer, in *Israel's Agriculture,* Government Printer, 1954.

check on the figures. It was felt that from year to year the statistical material became more and more reliable. (In only very few farms was a complete bookkeeping system found; most of the farmers rely on their cooperative which keeps a rather detailed system of records.) In later years the participating farmers themselves kept some semblance of records for those data not available in the books of the cooperatives. The farmers' records were returned to them in the form of a *Report to the Farmer* (Section 7) wherein profitability was analyzed by farm branches. The farm visits grew more and more into farm management instruction sessions, from which both the farmer and the field worker profited.

After the farm visits, the questionnaires were taken back to the central office for summarizing, and after being re-checked by a second person, data were summarized in village listing sheets. These village sheets were summarized and averages and ranges were calculated for the different items. In later years, the farms were tabulated on the village sheets in the decreasing order of their net income. Averages were calculated for 25 per cent of all farms in the highest net income group, the 50 per cent medium net income group, and the 25 per cent lowest net income group. Finally, these were also calculated for the sample as a whole. Altogether there were 950 items in the questionnaire, and 280 items on the listing sheet.

A code system prevented disclosure of the identity of farmers and villages at all stages of the study, i.e. data-listing, analysis, and publication.

4. *Farm Types*

Many of the initial discussions in the advisory council were concerned with the minimum size of farms to be included, and with the farm types based on the combination of the various farm branches. The data of the pre-test showed that the old conception of one farm type prevailing in the whole village was incorrect. There were at least seven farm types in the sample and up to five of these in any one village. The farm types were defined by Dr. Y.L. Oppenheimer on the basis of the farm branches, the size of the latter being measured by 'standard workdays'. The following were the main types: Poultry-Dairy, Dairy-Poultry, Poultry, Mixed Farms (consisting of at least three branches of more or less equal weights), Orchard Farms, Poultry-Orchards, and Vegetable Farms. It first plan was to summarize the data according to farm types and the statistical material pertaining to this was published in 1956 in the form of tables of arithmetic averages for each type for the year 1953/54 (*Cost and Income of Established Family Farms—Master Tables,* FP, August 1956). However, subsequent analysis showed that there was no homogeneity even in the production structure within the types. As a result this plan was abandoned.

Section 5 lists the publications describing the statistical findings of the survey. Sections 6 and 7 present examples of the *Questionnaire for Determining Farm Rentability* and of the *Report to the Farmer.*

5. *Publications on the Family Farm Study*

(1) G. Kaddar, *Interim Report for 1955,* FP, Jerusalem, 1955.

(2) *Family Farms in Israel's Cooperative Villages,* (FAO study group on settlement policies), May 1956.

(3) G. Kaddar and Others, *Costs and Income of Established Family Farms—Master Tables,* FP and Hebrew University, 1956.

(4) Y. Lowe, *The Method Used in Investigating the Economic Profitability of Family Farms,* Tel-Aviv, 1956, (Hebrew).

(5) Y. Lowe and Others, *Output, Input and Economic Profitability in Family Farms in Israel in the Years 1952/53, 1953/54 and* 1954/55, Ministry of Agriculture, 1957, (Hebrew).

(6) Y. Lowe and T. Gans, *The Influence of Business Activity on the Economic Profitability of Family Farms,* Ministry of Agriculture, (Hebrew).

(7) Y. Lowe, T. Gans, and Y. Remer, *Report on the Economic Situation of Established Family Farms in thc Years 1952/53 to 1957/58,* Ministry of Agriculture, 1958, (Hebrew and English).

(8) Y. Lowe and Y. Remer, *The Profitability of Established Moshavim in 1958/59 Compared to Former Years,* Ministry of Agriculture, Tel-Aviv, (Hebrew). .

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6. *Questionnaire for Determining Farm Rentability*

QUESTIONNAIRE FOR DETERMINING FARM RENTABILITY

FARM NUMBER 1 | VILLAGE NUMBER XIX | Year under study 1957/58

a. Family Labour | 1. Labour Force | Date of visit

Member of Family	Age	Experience in agr. years	Nr. of estimated working days during year	Imputed Expenses IL. per day	Imputed Expenses IL. per year	Work outside the Farm during the year: Working days	IL.	Kind of work
Farmer								Partial outside work
Farmer's wife								
Son								
Son's wife								Full outside work
Son								
Daughter								Army service
Total								

b. Hired Labour

Branch or kind of work	Nr. of working days during year	Salary paid - IL. Cash pay	Imputed value of farm produce or services	Total
Total				

c. Summary of Labour Input - in Standard working days

Crops	Dunam	Nr. of Standard workdays	Livestock	Units	Nr. of Standard Workdays
Grains & Hay - unirrigated			Cows		
Other unirrigated crops			Young stock		
Green Fodder - irrigated			Layers		
Vegetables - irrigated			Other Poultry		
Orchards, fruit bearing-irrig.			Total Livestock		
" " " unirrig.					
Young orchards					
Misc. (Investments etc.)			Total standard workdays		
			Total farm labour days		
Total Crops			Percent of Labour efficiency		

2. Land

Physical Area - Dunam	
Irrigated Land	
Unirrigated Land	
Total cultivated Land	
Buildings and Yards	
Uncultivated Land	
Miscellaneous	
Total Farm Area	

Rent	Total Dunam	IL.
Long term lease		
Short " "		
Total		

Crop Rotation by Fields

Field crops, irrig./unirrig.

Name or Nr. of field	Physic. Dunam	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	August	Sept.
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													
21													
22													
23													
24													
25	unirrig.												
26													
27													
28													
29													
30													
31													
32													
33													
34													
Total irrigated field crops													
Irrigated Orchards													
Total unirrigated area													

Utilization of irrigated area in Dunam/Month

1) Total irrigated area (without orchard)
2) Total irrigated crop dunams (without orchard)
3) Index of irrigated land utilization

$$\left(\frac{2}{1} \times 100\right)$$

CULTIVATED AREA AND CROP DESIGNATION

Crop	Dunam			Output in tons: Gross Product		Output in tons: Farm use		Output in tons: Sales		Home use	Inventory	Output in IL.: Gross Production	Output in IL.: Farm use		Output in IL.: Sales		Home Use	Inventory	Gross Output	Cash Sales	Unit Price	Remarks
	Irrig.	unirrig.	Total	Per dunam	Total	Fodder	Seeds	Co-op	Private				Fodder	Seeds	Co-op	Private						
Wheat																						
Sorgum																						
Barley																						
Total Grains																						
Irrig. Pasture																						
Egyptian Clover																						
Corn																						
Alfalfa																						
Stavion																						
Mangold																						
Setaria																						
Cattle beans																						
Total green fodder																						
Hay crops																						
Potatoes																						
Tomatoes																						
Total Vegetables																						
Lemons																						
Oranges																						
Valencia																						
Clementines																						
Total fruit bearing orchards																						
Clementines																						
Total young Orchards																						
Total Orchards																						
Miscellaneous																						
Total Crops																						

Dairy Hérd

Name	Date of last Calving	Age at beginning of the year or at date of purchase	Date of purchase or birth	Date of sale or death	IL. *)Value at begin. of year	IL. Value at end of year	IL. **) Purchases Co-op. Priv.	IL. **)Sales Co-op. Pr.	Reason for sale, home use etc.	Number of months in the herd
Total cows										
Heifers										
H. Calves born before Oct. 1st										
Heifer calves born during year under study										
Total bull calves										
Total cattle										

*) Imputed prices Home use in kg.
**) Actual prices received or paid " " " IL.

DAIRY HERD

Balance of stock inventory
- in Nr. of heads

Entering	Nr.	Leaving	Nr.
Beginning of year		End of year	
Purchases		Sales	
Birth		Death and home use	
Total		Total	

Output in change of inventory and cattle trade (IL.)

Inventory change	
Output in cattle trade - total	
Co-op sales	
Private sales	
Home use	

Average head of cattle during year

	Kind	Nr.	Cattle units
Cows			
Heifers			
H. Calves			
B. Calves for rearing			
B. Calves for meat			
Total			

Manure

	Gross product	Farm use	Sales Co-op	Sales Private	Invnt. + -	Gross Output
Cubic m.						
IL.						

Remarks:

Summary of dairy herd production

	Item	Gross production	Farm use	Sales Co-op	Sales Private	Home use	Changes in Inv. + -	Gross Output	Cash Sales
Equivalent of kg milk	Fresh Milk								
	Total Milk								
IL.	Milk								
	Milk products								
	Inventory change								
	Cattle trade								
	Manure								
	Total								

Analysis

kg. milk per cow

Price per liter of milk - IL.

Dunam fodder per CATTLE UNIT

APPENDIX F

DAIRY HERD

Cattle Fodder	Farm produced							Purchased		Feed Units	
	No. of Dunam	Tons per dunam Norm	Tons per dunam Actual	Prod. in Tons	Value in IL	Feed Units Per Ton	Feed Units Total	Ton	Value in IL	Feed Units	Total	Per Cattle Unit
Alfalfa												
Egypt. Clover												
Mangold												
Stavion												
Corn												
Pansilaria												
Sateria												
Cattle peas												
Cultivated peas												
Cattle beans												
Sunflowers												
Total green fodder												
" irrig past.												
" natural "												
" silage "												
" hay & straw												
" concentrates												
Total fodder												

Concentrated feed units in percent of total supply
Purchased feed units in percent of total supply

Feed needs of the Dairy herd — Group	No. of heads	Feed units p. head	Total feed units
Cows			
H. Calves up to 3 months			
" " 3-11 "			
" " 12-24 "			
B. Calves up to 3 months			
" " 3-12 "			
Bulls			
Milk in kg.			
Total			

Feed Balance	
Surplus	F.V.
Deficit	F.V.
Price of feed unit	
Farm produced	I.L.
Purchased	I.L.
Total	I.L.

*) Cabbage leaves

The Poultry Flock

Summary of poultry production in IL.

Item	Gross production	Farm use	Sales Co-op	Sales Private	Home Use	Inventory changes + / -	Gross output	Cash Sales
Eggs								
Inventory changes								
Poultry sales & home use								
Manure								
Total								

Eggs	Gross production	For Farm Incubation	Co-op sales Brood Eggs	Co-op sales Table Eggs	Private sales Brood Eggs	Private sales Table eggs	Home use	Total Output
Units								
IL								

Manure	Gross production	Farm use	Sales Co-op	Sales Private	Inventory changes + / -	Total Output
Tin measure						
IL.						

Egg prices	IL.
Co-op. Brood eggs	
Table eggs	
Total private sales	
All sales	

Analyses

Nr. of Tons of Feed
Nr. of eggs per Tons of Feed
kg. of meat per Tons of Feed
kg. of meat per Tons of Feed
Total Number of Standard Eggs per Ton of Feed

Fodder

Total concentrated feed	ton	IL.
Total concentrated feed per average layer	Kg.	IL.

Price per kg. concentrated feed IL.

APPENDIX F

Inventory and Poultry Movements

Entry	At beginning of year			Purchases				Total Nr. of birds	Remarks
				Co-op.		Private			
	Nr.	kg.	IL.	Nr.	IL.	Nr.	IL.		
Purchased Eggs									
Chicks									
Pullets									
Broilers									
Layers									
Breeding Cocks									
Total									
Farm incubation									Total purchased in IL.
Total entry of birds									

Exit	At end of year			Co-op sales			Private Sales			Home use		Total Nr. of birds
	Nr.	kg.	IL.	Nr.	kg.	IL.	Nr.	kg.	IL.	Nr.	IL.	
Purchased Eggs												
Chicks												
Pullets												
Broilers												
Layers												
Breeding Cocks												
Total												
Deaths in number of chickens												
Total exit of birds												

Changes in inventory value IL. Remarks:

Meat production in weight	kg.
Co-op sales	
Private sales	
Inventory changes	
Home rise	
Total	

Meat price per kg.: IL.

CURRENT EXPENSES

Feed stuff

Item	Tons	IL. Co-op	IL. Private	IL. Total	Price per ton	Designation	Feed Unit
Cattle							
Milk meal							
TOTAL CATTLE FEED							
Poultry							
Layers							
Batteries							
Chicks							
Pullets							
Grain							
Miscellaneous							
TOTAL POULTRY FEED							
Work Animals							
Total concentrated feed							
Cabbage leaves							
Orange Peels							
Silage							
Green fodder & pasture							
Hay							
Straw							
Miscellaneous							
Total feed purchased							
Total for cattle use							

APPENDIX F

CURRENT EXPENSES

Item	Unit and quantities	IL. Co-op	Private	Total	Price per Unit	Designation	Remarks
Petroleum						Home use	IL.
Electricity						" ."	IL.
Fuel and power							
Seed for fodder crops							
Seeds and plants							
Water							
Immunizat. of calves							
" " chicks							
Spraying Orchard							
Veterinary Supply							
Expenses for pest control							
Orchard							
Deep Ploughing							
Rent for machinery							
Interim Summary						Water per physical Dunam	Cub. m. IL.

Price of tractor hours in IL.	
Track	
Wheel	

CURRENT EXPENSES

Item	Unit and quantities	IL. Co-op	IL. Private	IL. Total	Price per Unit	Designation	Remarks
Lime							
Fertilizers							
Fertilizers and Manure							
Artf. Insemination							
Herd book							
Security							
Cattle miscell.							
Poultry "							
Transportation & Marketing costs							
Co-op Taxes							
Total Taxes							
Cattle Insurance							
Security "							
Insurance							
Cattle							
Misc.							
Miscellaneous							
Interim Summary							

Summary of expenses in IL.
Total page
" "
" "
Total other cash expenses

Summary
IL.

Expenses	Cash	Imputed	Total
Other cash expenses			
Salary for workers			
Rent			
Purchase of chicks & pullets			
Interest			
Depreciation			
Total farm expenses			

CAPITAL

Item	Cubic Meter	Full description	Full (* replacement value IL.	Age at beginning of year	Yearly depreciation		Value in IL.		Remarks
					%	IL.	At beginning of year	At end of year	
Living quarters									
Cow shed									
Hay barn									
Open shed									
Manure pit									
Fences									
Total buildings for dairy herd									
Poultry houses									
Rearing house									
Nr. of Batteries									
Store									
Total poultry buildings									
Total other buildings									
Total farm buildings									

*) Purchases and sales according to actual prices

CAPITAL

Item	Full description	Full (*) replacement value-IL.	Age at beginning of year	Yearly depreciation %	Yearly depreciation IL.	Value in IL. At beginning of year	Value in IL. At end of year	Designation of depreciation: Branch	Designation of depreciation: IL.
Brought forward									
Tractors								Fodder	
Sprayers								Grains	
Ploughs								Vegetables	
Cultivators								Orchards	
Drills									
Rakes									
Carts									
Choppers									
Harrows									
Platform									
Total tools & machines									
Pipes 1 Inches								Fodder	
" 2 "								Grains	
" "								Vegetables	
								Orchards	
Water meter									
Total irrigation equipment								Per physical dunam in IL.	
Interim summary - bring forward to page									

*) Purchases and sales according to actual prices

CAPITAL

Item	Full description	Full (* replacem. value - IL.	Age at beginning of year	Yearly depreciation		Value in IL.		Designation of depreciation	
				%	IL.	At beginning of year	At end of Year		
Brought forward								Branch	IL.
								Fodder	
								Grains	
								Vegetables	
								Orchards	
Draught animals									
	Lemons)								
	Oranges) 2 dunams								
	Valencia)								
	New plantation								
	Clementina 4.6 dunams								
Total orchards									
Total stores									
Total farm capital								Capital per standard dunam	

*) Purchases and sales according to actual prices

SUMMARY OF CAPITAL

Assets	At beginning of year			At end of year		
	Farm	Co-op	Total	Farm	Co-op	Total
Living quarters						
Buildings for dairy herd						
Poultry buildings						
Machines						
Irrigation equipment						
Drought animals						
Orchards						
Stores						
Cattle						
Poultry						
Other livestock						
Loans to others						
Credit in the Co-op.						
Total in assets						

Gross new investments during year

Liabilities (including current accounts)	The Lender	Year loan rec'd	How many years	% Interest	Debts in IL. At beginning of year	Debts in IL. At end of year	Yearly cash payments Principal	Yearly cash payments Interest	Yearly cash payments Total
Total exceeding a year									
Private debt									
Debt at current acc.									
Total less than a year									
Total									

Imputed interest - IL. Total interest - IL.

Summary of capital at end of year - IL.	Farm	Co-op.	Total
Living quarters			
Farm capital			
Short term debts			
Long term debts			
Equity			

APPENDIX F

ALLOCATION OF EXPENSES TO FARM BRANCHES

	orchard	poultry	dairy	green fodder
Concentr. feed				
Green fodder				
Hay				
Straw				
PURCH. FODDER				
Pest control				
Seeds				
Water				
Tractor				
Fertilizers				
Rent				
Depr. of Machinery				
" " Irrig. Equip.				
" " Orchard				
TOTAL EXPENSES FOR FIELD WORK				
Paid Work Days				
Chicks				
Pest Control Livst.				
Fuel				
Production Expenses				
Taxes				
Insurances				
Misc.				
TOTAL MISC. EXPENSES				
Depr. of Buildings				
TOTAL EXPENSES				

TOTAL EXP. for GREEN FODDER PRODUCED ON THE FARM

Work Days

Prutot per feed unit.

PURCHASES FROM THE CO-OP. SUPPLY STORE

Date of Purchase	Cattle Feed						Poultry Feed												Grains for work animals		Sacks		Total
	Conc. Fodder for Cows		Conc. Fodder for calves		Milk Powder		For Layers		For Pullets		For Chicks		For Batteries		Grains		Miscell.				+	-	
	Quant.	I.P.	Quant.	I.P.	Q.	I.P.	Q.	I.P.	Q.	I.P.	Q.	I.P.	Q.	I.P.	Q.	I.P.	Q.	I.P.	Q.	I.P.	Q.	I.P.	I.P.
X																							
XI																							
XII																							
I																							
II																							
III																							
IV																							
V																							
VI																							
VII																							
VIII																							
IX																							

SUMMARY ACCOUNT FOR THE ANALYSIS OF FAMILY FARMS

Farm number I XIX
Year 1957/58 **Family Farm Project**

Income	Total Income		October		November		December		January		February		March		April		May		June		July		August		September	
	I.P.	Qty.	I.P.	Qty.	I.P.	Qty.	I.P.	Qty.	I.P.	Qty.	I.P.	Qty.	I.P.	Qty.	I.P.	Qty.	I.P.	Qty.	I.P.	Qty.	I.P.	Qty.	I.P.	Qty.	I.P.	Qty.
Dairy herd																										
Milk (kg)																										
Bull calves																										
Cow sales																										
Poultry																										
Brood Eggs (units)																										
Table Eggs (units)																										
Geese																										
Breeding cocks																										
Meat from layers (units)																										
Broilers (units)																										
Citrus Fruit (kg.)																										
Clementines																										
Shamuti																										
Valencia																										
Lemons																										
Hay and grains																										
retur ued empty sacks																										
residual payments																										
Work for the Co-op.																										
Interest																										
Sale of seeds																										
TOTAL INCOME																										

Farm Number I XIX
Year 1957/58

Expenses	Total Expenses		October		November		December		January		February		March		April		May		June		July		August		September	
	I.L.	Qty.	I.L.	Qty.	I.L.	Qty.	I.L.	Qty.	I.L.	Qty.	I.L.	Qty.	I.L.	Qty.	I.L.	Qty.	I.L.	Qty.	I.L.	Qty.	I.L.	Qty.	I.L.	Qty.	I.L.	Qty.
Purchases in the Co-op. Store																										
Concentrated feed																										
Hay, straw																										
Silage																										
Seeds for fodder crops																										
Fertilisers																										
Expenses for the Dairy Herd																										
Artificial insemination																										
Cattle insurance and veterinary																										
Herd book																										
Expenses for the poultry flock																										
Purchase of chicks																										
Pest control																										
Miscellaneous																										
Concentrated feed																										
Expenses for field crops																										
Machinery rent																										
Land rent																										
Water																										
Pest control in the orchards																										
General Expences																										
Hired Labour																										
Interest																										
Miscellaneous																										
Petrol and electricity																										
New Investments																										
Dairy herd																										
Poultry flock																										
Living quarters																										
Equipment																										
Taxes																										
Co-op Taxes																										
Income tax																										
Pension fund																										
National insurance																										
Cooperative shares																										
Private Expenses																										
Co-op. Store																										
Cash drawn from the coop.																										
Total Expenses																										

APPENDIX F

SUMMARY

Production and Output in IL.	Gross Production	Farm use	Sales Co-op	Sales Private	Home use	Changes in inventory + -	Gross Output	Cash sales
Fodder and grains								
Vegetables and potatoes								
Orchards								
Miscellaneous crops								
Total crops								
Dairy herd								
Laying flock								
Other poultry								
Other livestock								
Investments which do not appear in inventory								
Miscellaneous								
Total								

Measure of profitability	IL.
Gross production	
Gross output	
Total cash expenses + depreciation	
Net income	
Imputed labour expenses	
Net profit	
Nr. of family labour days	
Income per family labour day	

7. *Report to the Farmer: Economic Analysis of the Farm Operation for the Year*

7. *Report to the Farmer: Economic Analysis of the Farm Operation for the Year*

Area

At your disposal are ... cultivatable irrigated dunams
... " unirrigated "
Total ______

you utilized the irrigated land ... Months/Dunam in the surveyed year
... " " " " previous "

Crops dunam	Survey year irrigated	Survey year unirrigated	Previous years irrigated	Previous years unirrigated
Grains				
Green fodder				
Hay				
Vegetables and potatoes				
Other crops				
Orchards				
Total				

Labour Force

According to norms you should have invested ... working days as follows:

Hay, grains and green fodder	
Orchards	
Vegetables and potatoes	
Dairy herd	
Poultry flock	
Miscellaneous	
Total	

Actually you invested during the year ... working days
of these you and your family worked ... " "
" " paid labourers ... " "

The number of invested working days amounted therefore to ... %
of the norms in the surveyed year as against ... %
in the previous year.

Farm Capital

The value of your farm capital at the beginning of the year amounted to .... I. P.

The value of your farm capital at the end of the year amount to ________ I. P.

The value therefore increased/decreased by ====== I. P.

Items	At the beginning of year	At the end of year
Farm buildings		
Irrigation and other equipment		
Orchards		
Dairy herd		
Poultry flock		
Drought animal		
Credit in the Cooperative		
Miscellaneous		

Vegetables

	Surveyed year	Previous year
Utilized area-dunam	....	....
Yield - ton	....	....
Gross output - I. P.	....	....

	Surveyed year	Previous year
Yield per dunam-ton	....	....
Price per ton - I. P.	....	....
Gross output per dunam - I. P.	....	....

Expenses during surv. year - I. P.	
Paid work days	
Seeds and plants	
Water	
Nachinary	....
Expenses of Drought Animal	....
Fertilizers	....
Rent	....
Depreciation of equipment	....
Pest control	....
Taxes and miscellaneous	________
Total	============

Measure of profitability	Surveyed year	Previous year
Gross output - I. P.		
Current expenses - I. P.	....	....
Net income - I. P.	========	=========
Net income per dunam - I. P.	========	=========

ORCHARDS

Fruit bearing orchards	- dunam	Yield per dunam	- ton
Young orchards	- dunam	Price per ton	- I. P.
Yield	- ton	Gross output per dunam	- I. P.
Gross output	- I. P.		

Expenses

Hired workers	
Cultivation expenses	
Depreciation	
Taxes and miscellaneous	
Total	

Measure of profitability

Gross output	I. P.
Expenses	I. P.
Net income	I. P.

DAIRY HERD

Annual average number of cattle	Surveyed year	Previous year
Cows		
Heifers		
Calves		
Bull calves		

Balance of stock inventory in number of herds

Stock at beg. of year	Stock at end of year
Purchases	Sales
Birth	Deaths

	Surveyed year	Previous year
Total milk production - liter		
Average milk yield per cow - liter		
Price of milk - prutot per liter		
Price of purchased feed - unit - prutot		
Price of farm produced feed - unit - prutot		
Concentrated feed units in percent of total suply		
Purchased feed units in percent of total supply		

Income	Surveyed year	Previous year
Milk		
Inventory charges		
Sales of cattle		
Manure		
Total gross output		

Expences	Surveyed year	Previous year
Concentrated fodder		
Purchased hay, straw		
Exp. of farm produced fodder		
Hired labour		
Taxes and miscellaneous		
Depr. of buildings and equipment		
Total		

Measure of profitability	Surveyed year	Previous year
Gross output - I. P.		
Expenses - I. P.		
Net Income - I. P.		

Net income per cow - I. P.

POULTRY FLOCK

Utilisation of poultry fodder (Number of Standard eggs per ton of feed)

Total consumption of feed - ton	Per ton of feed	% Physical proportion	% Monetary proportion
Total eggs			
Total kg. of meat			
Total Standard eggs			

	Inventory of poultry - units At beginning of year	At end of year
Chicks		
Pullets		
Drollers		
Layer		
Bread cocks		

Purchased chicks

Purchased pullets -

Income	Surv. year	Previous year	Expenses	Surv. year	Previous year
Eggs			Purchased feed		
Inventory changes			Exp. of grain production		
Poultry sales and home use			Hired labour		
Manure			Purchased chicks		
Total gross output			Pest contorl		
			Fuel		
			Taxes and misc.		
			Depr. of buildings and equipment		
			Total		

Measure of profitability	Surveyed year	Previous year
Gross output		
Expenses		
Net Income		
Net income per ton of feed		

Sumary of profitability in survyeyd year - I.P.

	Gross output	Gross input	Net income
Vegetables and potatoes			
Orchards			
Dairy herd			
Poultry Flock			
Miscellaneous *			
Total			
Previous year - Total			
Miscellaneous			
Previous year - total			

Miscellaneous * Sales of fodder seeds

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The Falk Project for Economic Research in Israel, established in 1954, is an independent, private, non-profit organization, set up under grant from the Maurice and Laura Falk Foundation, Pittsburgh, Pennsylvania, to foster economic research and training.

ABOUT THE AUTHOR

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